

SPACE TUG  
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# SPACE TUG

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## 1

TO THE WORLD at large it was, of course, just another day. A different sort entirely at different places on the great, round, rolling Earth, but nothing out of the ordinary. It was Tuesday on one side of the date line and Monday on the other. It was so-and-so's wedding anniversary and so-and-so's birthday and another so-and-so would get out of jail today. It was warm, it was cool, it was fair, it was cloudy. One looked to the future with confidence, with hope, with uneasiness or with terror according to one's temperament and geographical location and past history. But to most of the human race it was nothing remarkable. It was just another day.

To Joe Kenmore, though, it was a most particular day indeed. Where he was, it was the gray hour just before sunrise, and already there were hints of reddish colorings in the sky. It was chilly, and somehow the world seemed still and breathless. To Joe, the feeling of tenseness marked this morning off from all the other mornings of his experience.

He got up and began to dress, in Major Holt's quarters back of that giant steel half-globe called the Shed, near the town of Bootstrap. He felt queer because he felt much as usual. By all the rules he should have experienced a splendid, noble sensation of high resolve and fiery exaltation. Perhaps he should have felt a praiseworthy sense of humility and unworthiness to accomplish what would presently be expected of him. And as a matter of fact he did feel suitable emotions very far deep down inside him. But it happened that he couldn't spare the time for appropriate reactions today.

He was definitely aware that he wanted coffee, and that he hoped everything would go all right. He looked out a window at empty, dreary desert under the dawn sky. Today was the day he'd be leaving on a rather important journey. He hoped Haney and the chief and Mike weren't nervous. He also hoped that nobody had gotten at the fuel for the pushpots, and that the sHderule wielders had calculated everything correctly. He was also bothered about the steering rocket fuel, and he was uncomfortable about breaking clear of the launching cage. There was cause for worry in the takeoff rockets. If the tube linings had shrunk the consequences would be gruesome. And there could always be last minute orders from Washington to postpone or even cancel everything.

In short, his mind was full of strictly practical details. He didn't have time for suitably heroic sensations or sensations of high destiny. He had a very tricky and exacting job ahead of him.

The sky was growing lighter outside. Stars faded in a paling blue and the desert showed faint colorings. He tied his necktie. A deep-toned keening set up to the southward. It was a faraway noise, something like the lament of a mountain-sized calf bleating for its mother. Joe took a deep breath. He searched for the source of the sound, but saw nothing. The noise, though, told him that at least there'd been no cancellation of orders so far. He mentally uncrossed two fingers. But he couldn't have enough fingers crossed against all foreseeable disasters. There weren't enough fingers. Or toes. But it was good that so far the schedule held.

He went downstairs. Major Holt was pacing up and down the living room of his quarters. Electric lights burned, but already the windows were brightening. Joe straightened up and tried to look casual. Strictly speaking, Major Holt was a friend of his family who also happened to be security officer here, in charge of what went on in the great construction shed. He'd had a bad enough time before today, and his troubles might keep on into the future. He was also the ranking officer here and consequently the boss of Joe's enterprise. Today's program was still very doubtful. The whole thing was controversial and uncertain and might spoil the careers of everybody connected with it if it should happen to fail. Nobody with eagles or stars on their shoulders wanted the responsibility. So Major Holt was in charge. If everything went well, somebody outranking him would step forward for the credit. Meanwhile—

He looked sharply at Joe.

"Morning."

"Good morning, sir," said Joe. Major Holt's daughter Sally had a sort of understanding with Joe, but the major hadn't the knack of cordiality. Nobody ever felt too much at ease with him. Besides, Joe was wearing a uniform this morning. It was the first time, and there were only eight such uniforms in the world, so far. Joe's was black whipcord, with an Eisenhower jacket, narrow silver braid on the collar and cuffs, and a silver rocket on the spot where a plane pilot wears wings. It was strictly practical. Against accidental catchings in machinery the trouser legs were narrow and tucked into ten-inch soft-leather boots, and the wide leather belt had flat loops for the attachment of special equipment. Its width was a brace against violent acceleration. Sally'd had something to do with its design.

But it still hadn't been decided by the Pentagon whether the Space Exploration Project would be taken over by the Army or Navy or Air Force sections of the now-combined armed forces, so Joe wore no insignia of rank. Technically he was still a civilian.

The deep-toned noise to the south became a howling uproar, sweeping closer and trailed by other howlings. The major said, "The pushpots are on the way over, as you can hear. You're feeling all right?"

"If you want the truth, sir," Joe admitted, "I'd feel better if I'd had a few years of experience. But we've had all the experience to be had aground. I think we'll manage."

"You're saying you'll do your best," said the major curtly.

"We may have to do better than that," Joe answered. "We'll try."

"Hm—ah—," said the major. He said somehow formidably, "You're well enough aware that there are—ah— people who don't like the idea of the United States having a manned artificial satellite aloft."

"I should know it," agreed Joe.

The Earth's second inhabitable moon had been out in space just six weeks, today. It no longer seemed a bitterly contested achievement. One tended to take it for granted. From Earth it was only a tiny speck of light in the sky, identifiable only because it moved swiftly and serenely from the sunset toward the east, or from night's darkness into the dawnlight. But it had been fought savagely before it was launched. It was first proposed to the United Nations, but was vetoed before it reached the Council. So the United States had built it alone. Yet the nations who'd opposed it as an international project liked it even less as a national one, and they'd done what they could to wreck it.

The building of the great globe out in emptiness had been fought more bitterly, by more ruthless and highly trained saboteurs, than any other enterprise in history. There'd been two attempts to blast it with atomic bombs. But now it was high aloft, rolling grandly around the Earth. And today Joe would try to get a supply ship up to it. The crew of the Space Platform needed food and air and water, and especially means of self-defense. Today's takeoff would be the first attempt at the carrying of a cargo out to space.

"The—ah—opponents of the Platform haven't given up," said the major. "They used spectroscopes on the Platform's rocket fumes when it went up. It seems likely they've duplicated the fuel."

Joe nodded. The major continued restlessly: "For more than a month Military Intelligence has been aware that very special rockets were being rushed into production abroad. Behind the Iron Curtain, that is. There are plenty of satellites in orbit, and the trick of getting them there is no secret. It shouldn't be too difficult to get one into collision orbit with the Platform. With an atomic missile head—it's unpleasant. So you'll take up some interceptor rockets to be used against anything of the sort. Of course you know all this!"

"It would seem to me," said Joe carefully, "that an attack on the Platform would be an act of war."

"Once upon a time, yes," said the major with irony, "but now it will be—ah—anonymous. Everybody will wonder aloud who would be so unkind as to blast the Platform. Especially the people who do it. But we're building for peace. To start a war because somebody interrupted it wouldn't be consistent. So—the Platform has to defend itself, for the moment. You have a very worthwhile mission. I suggest that you have breakfast and get over to the Shed. I'm leaving for there now."

"Yes, sir."

The major started for the door, then stopped.<sup>1</sup> He said abruptly, "I'm quite aware, Joe, that if you're killed by sabotage or carelessness, it's my fault."

"I'm sure, sir, that anybody can do—"

"Anything anybody can do to destroy you will be tried," said the major. He was grim. "I'll have done my best. Try to believe it."

Before Joe could answer, the major went out. Joe frowned for a moment. It occurred to him that it can't be very pleasant to feel responsible for the things that other men's lives depend on, especially when you don't share their danger. But just then the smell of coffee reached his nostrils. He trailed the scent. There was a coffee pot steaming on the table in the dining room. There was a note on a plate;

*"Good luck! I'll see you in the Shed. Sally."*

Joe was relieved. Major Holt's daughter had been somewhere around underfoot all his life. He liked Sally, but he was glad he didn't have to talk to her just now.

He poured coffee and looked at his watch. He went to the window, because the monstrous howling noises were much nearer and dawn had definitely arrived. Patches of yucca and mesquite and sage stretched away to a far-off horizon. They were now visibly different from the red-yellow earth between them. They cast long, streaky shadows. The cause of the howling was still undiscoverable.

Joe stared skyward, searching. He saw the Platform.

It was a small bright sliver of sunlight high aloft. It moved slowly toward the east, showing the unmistakable glint of sunshine upon polished steel. It was the huge steel hull which had been built in the gigantic Shed from whose shadow Joe now looked up. The Space Platform was the size of an ocean liner, and six weeks since some hundreds of pushpots, all straining at once, had gotten it out of the Shed. They'd panted toward the sky with it. They'd gotten twelve miles high and speeding eastward at the topmost rate they could manage. Then they'd fired jatos, all at once, and so pushed their and the Platform's speed up to the preposterous. And then they'd dropped away and the giant steel object had fired its own rockets—which made flames a mile long—and swept on out to space. It circled the Earth above the equator for strategic reasons. Most of the inhabited parts of the earth passed under it within clear view. And it would continue its circling forever, needing no fuel and never descending. It was a second moon for the planet Earth.

But it could be destroyed.

Joe watched it hungrily as it went on to meet the sun. Smoothly, unhurriedly, serenely, the remote and twinkling speck floated on out of sight. And then Joe went back to the table and ate his breakfast quickly. He wolfed it. He had an appointment to meet that glittering speck some thousands of miles out in emptiness. His appointment was for a very few hours hence.

He'd been training for just this appointment since before the Platform's launching. There was a great box swinging in twenty-foot gymbal rings over hi the Shed. There were motors and projectors and thousands of transistors. It was a space flight simulator—a descendent of the Link trainer which once taught pilots how to fly. But this offered all the problems and all the sensations but one to be experienced in the takeoff of a rocketship for space. The one missing sensation was heavy acceleration. The similitude of flight, though, was utterly convincing. In six weeks they'd learned how to handle a spaceship so far as it could be learned aground. They'd learned to face emergencies and calamities staged in horrifying detail. More than once they'd come out of that training apparatus drenched with sweat and the feeling that they were lucky to be alive.

Joe realized how fully they had to depend on that training as he left Major Holt's quarters and headed for the Shed's nearest entrance. The Shed was gigantic. There were hills to the westward, but only flat and

arid plain to the east and south and north. There was but one town in hundreds of miles, and that was Bootstrap, built to house the workmen who'd built the Platform and the still invisible, ferociously howling pushpots and now the small supply ships for it, of which the first was to thrust out to meet the Platform today.

The Shed seemed very near because of its monstrous size. When he was actually at the base of its wall, it seemed to fill half the firmament and more than half the horizon. He went *in*, and felt self-conscious when the guard's eyes fell on his uniform. There was a tiny vestibule, then he was in the Shed itself, and it was gigantic.

There were acres of wood-block flooring. There was a vast, steel-girdered arching roof which was fifty storeys high. All this had been needed when the Space Platform was built. Men on the far side were merely specks, and the rows of windows to admit light usually did no more than make a gray twilight inside. But there was light enough today. To the east the Shed's wall was split from top to bottom. A colossal triangular gore had been loosened and thrust out and rolled aside, and a doorway a hundred and fifty feet wide let in the sunshine. Through it, Joe could see the fiery red ball which was the sun just leaving the world's edge.

But there was something more urgent for him to look at. The small supply ship had been moved into its launching cage. Only Joe, perhaps, would really have recognized it. Actually it was a streamlined hull of steel, eighty feet long by twenty in diameter. There were stubby metal fins—useless in space and even on takeoff, but essential for the planned method of landing on its return. There were thick quartz ports in the bow section. But its form was completely concealed now by the attached, exterior takeoff rockets. It had been shifted into a huge cradle of steel beams from which it was to rise to space. Men swarmed about it and over it, checking and re-checking every possible thing that could make or mar its ascent to emptiness. The other three crew members were ready—Haney and Chief Bender and Mike Scandia. They were especially entitled to be the crew of this first supply ship. When the Platform was being built, its pilot gyros had been built by a precision tool firm owned by Joe's father. He'd accompanied the infinitely precious device to Bootstrap, by plane. He was to deliver and install the gyros in the Platform. And the plane was sabotaged and the gyros ruined. They'd required four months to make, and four months more for balancing to absolute no-tolerance accuracy. The Platform couldn't wait so long for duplicates. So Joe had improvised a process for repair. And with Haney to devise special machine tool setups, and the chief to use fanatically fine workmanship, and Mike and Joe aiding according to their gifts, they'd rebuilt the apparatus in an impossibly short time. The idea was Joe's, but he couldn't have done the job without the others.

And there had been other, incidental triumphs. They were not the only ones who worked feverishly for the glory of having helped to build the Earth's first actually inhabitable artificial moon. But they had accomplished more than most. Joe had even been appointed to be an alternate member of the Platform's crew. But the man he was to have substituted for recovered from an illness, and Joe was left behind at the Platform's launching. But all four of them had demonstrated special qualities, and as a team they were very special indeed. So, as a team, they were chosen to serve in the small ships that would supply the Platform.

Now they were ready to begin. The chief grinned exuberantly as Joe ducked through the bars of the launching cage and approached the ship. He was a Mohawk Indian—one of that tribe which for two generations has supplied steelworkers to every bridge and dam and skyscraper job on the continent. He was brown and bulky and explosive. Haney looked tense and strained. He was tall and lean and a good man in any sort of trouble. Mike blazed excitement. He was forty-one inches high and he was full-grown. He had worked on the Platform, bucking rivets and making welds and inspections in places too small for a normal-sized man to reach. He frantically resented any concession to his size, and in fact he was all man, only the small economy size.

"Hi Joe!" boomed the chief. "Had breakfast?"

Joe nodded. He began to ask anxious questions. About steering rocket fuel and the launching cage release and the takeoff rockets and the reduction valve from the air tanks—he'd thought of that on the way over—and the shortwave and loran and radar. Haney nodded to some questions. Mike said briskly, "I checked" to

others.

The chief grunted amiably. "Look, Joe! We checked everything last night. We checked again this morning. I even caught Mike polishing the ejection seats, because there wasn't anything else to be fixed!" Joe managed a smile. The ejection seats were surely the most unlikely of devices to be useful today. They were supposedly life-saving gadgets. If the ship came a cropper on takeoff, the four members of its crew were supposed to use ejection seats like those in jet planes. They'd be thrown clear of the ship, and ribbon parachutes might open and might check their fall and might let them land alive. But it wasn't likely. Out in space, of course, they'd be worse than useless. If a feather were dropped from six hundred miles up, by the time it hit air it would be going so fast it would flame and burn from mere air friction. It wasn't likely any of them would get out if things went wrong.

Somebody marched stiffly toward the four of them. Joe's expression grew rueful. The Space Project was neither Army nor Navy nor Air Force, but something that so far was its own individual self. But the man marching toward Joe was Lieutenant-Commander Brown, strictly Navy, assigned to the Shed as an observer. And there were times when he baffled Joe. As now.

He halted, and looked as if he expected Joe to salute. Joe didn't. The lieutenant-commander said formally, "I would like to offer my best wishes for your trip, Mr. Ken-more."

"Thanks," said Joe.

The lieutenant-commander said with careful cordiality, "You understand, of course, that I consider piloting essentially a naval function, and it does seem to me that anything that can be called a ship should have Navy personnel. But I assuredly wish you good fortune."

"Thanks," said Joe, again.

Brown shook hands, opened his mouth as if to speak again, didn't, and went away.

Haney rumbled in his throat. "How come he doesn't wish all of us good luck, but only you?"

"He does," said Joe. "But he's been trained not to mention it. I'd like to make a bet we'll have him as a passenger out to the Platform some day."

"Heaven forbid!" growled Haney.

There was an outrageous tumult outside the gap in the Shed's wall plating. Something went shrieking past the doorway. It looked like a magnified half loaf of bread, painted gray and equipped with an air scoop hi front and a plastic bubble for a pilot. It howled like a lost baby dragon, and its flat underside tilted up and up until it was almost vertical. It had no wings, but a blue-white flame sputtered out of its rear, wobbling from side to side for reasons best known to itself. It was a pushpot, which could not possibly be called a jet plane because it could not possibly fly. Only it did. It settled down on its flame-spouting tail, and the sparse vegetation burst into smoky flame and shriveled, and the thing—still shrieking like a foghorn in a tunnel—flopped flat forward with a resounding *clunk!* It was abruptly silent.

But the total noise did not lessen. Another pushpot came soaring wildly into view, making hysterical outcries. It touched and banged violently to Earth. Others appeared in the air beyond the construction shed. One flopped so hard on landing that its tail rose in the air and it attempted a somersault. It made ten times more noise than before—the flame from its tail making strange gyrations—and flopped back again with a crash. Two others rolled over on their sides after touching ground. One ended up on its back like a tumblebug, wriggling.

They seemed to land by hundreds, but their number was actually in scores. It was not until the last one was down that Joe could make himself heard. The pushpots were jet motors in frames and metal skins, with built-in jato tubes beside their engines. On the ground they were quite helpless. In the air they were unbelievably clumsy. They were actually balanced and steered by vanes in the blasts of their jets, and they combined the absolute maximum of sheer thrust with the irreducible minimum of flyability.

Crane trucks went out to pick them up. Joe said anxiously, "We'd better go over our flight plan again. We have to know it absolutely!"

He headed across the floor to the flight data board. He passed the hull of another ship like his own, which was near completion. There were the bare skeletons of two others which still needed a lot of work. They'd been begun at distant plants and hauled here on gigantic trailers for completion. The wooden mockup of

the design for all of them lay neglected by the Shed wall, though it had been useful for trying every possible arrangement of the control cabin part of the ship.

The four stood before the data board. It listed the readings every instrument should show during every second of the flight. The readings had been calculated with infinite care, and Joe and the others needed to know them rather better than they knew their multiplication tables. Once they started off, they wouldn't have time to wonder if everything were right for the time and place. They'd need to know.

They stood there, soaking up the information the board contained, forming mental pictures of it, making as sure as surety that any one of them would spot anything wrong the instant it happened, and would instantly know what to do about it.

A crane truck came in, dangling a pushpot. It rolled over to the launching cage *in* which the supply ship lay. It set the pushpot against that cage. There was a clanking as the pushpot caught hold by magnetic grapples. The crane went out again, passing another crane on the way in with another pushpot. The second beetlelike thing was presented to the cage. That crane went out for another.

Major Holt approached. It took him a long time to reach the data board. When he got there he looked about impatiently. His daughter Sally came out of nowhere and blew her nose as if she'd been crying. He spoke to her with some sternness.

The cranes brought in more pushpots and set them up against the steel cage. The ship had been nearly hidden before by the rocket tubes fastened outside its hull. It was completely blanked out by the clumsy objects that now began to wall it in.

The major looked at his watch. Joe and the others left the data board. Joe saw the major and went to him.

"I've brought you," said the major in an official voice, "the invoice of your cargo. You'll deliver it and bring back proper receipts." "I hope," said Joe.

"*We* hope!" said Sally in a strained voice. "Good luck, Joe!"

"Thanks."

"There isn't much to add," said the major, without visible emotion. "The next crew will start training immediately, but it may be a month before another ship is ready for them. It's extremely necessary for you to reach the Platform."

"Yes, sir," said Joe. "I've even a personal motive to use my best efforts. If I don't, I break my neck."

The major ignored the comment. He shook hands formally and marched away. Sally smiled up at Joe, but her eyes were suddenly full of tears.

"I—do hope everything goes all right, Joe," she said unsteadily. "I'll—I'll be praying for you."

"I can use some of that, too," admitted Joe.

She looked at her hand. Joe's ring was on her finger. Then she looked up again, and was crying unashamedly.

"I—will," she repeated. Then she said fiercely, "I don't care if somebody's looking, Joe. It's time for you to go in the ship."

He kissed her quickly and went to the peculiar mass of clustered pushpots which touched and almost overlapped each other.

He ducked under and looked back. Sally waved. He waved in return. Then he climbed up the ladder into the little supply ship's cabin. Somebody removed the ladder.

The others were in their places. Joe closed the door from the cabin to the outer world. There was suddenly a cushioned silence all about him. Out the quartz glass ports he could see beyond the end of the cage and through the monstrous door to the desert beyond. Overhead he could see the dark, girder-lined roof of the Shed. At either side, though, he could see only the scratched, dented, flat undersides of the pushpots ready to lift the ship upward.

"You can start the pushpot motors, Haney," he said curtly.

He moved to his own, the pilot's seat. Haney pushed a button. Through the fabric of the ship came the muted uproar of a pushpot engine starting. Haney pressed another button. Another. Another. More engines bellowed. The tumult in the Shed would be past endurance, now.

Joe strapped himself *in* his seat. He made sure that the chief at the steering rocket controls was fastened properly, and Mike at the radio panel was firmly belted past the chance of injury.

Haney said with a tremendous calm: "All pushpot motors running, Joe."

"Steering rockets ready," the chief reported.

"Radio operating," came from Mike. "Communications all set."

Joe reached to the maneuver controls. He should have been sweating. His hands, perhaps, should have quivered with tension. But he was too much worried about too many things. Nobody can strike an attitude or go into a blue funk while they are worrying about things to be done. Joe heard the small gyro motors as their speed went up. A hum and a whine and then a shrill whistle which went up in pitch until it wasn't anything at all. He frowned and said to Haney, "I'm taking over the pushpots."

Haney nodded. Joe took the overall control. The roar of engines outside grew loud on the right-hand side and then died down. It grew thunderous to the left, and dwindled.

Joe nodded and wetted his lips. "Here we go!"

There was no more ceremony than that. The noise of the jet engines rose to a thunderous volume. Then it grew louder, and louder still. Joe stirred the controls by ever so tiny a movement.

Suddenly the ship did not feel solidly placed. It shifted position. Joe held his breath and cracked the overall control of the pushpots' speed a tiny trace further. The ship wobbled a little. Out the ports, the great Shed door seemed to descend. In reality, the clustered pushpots and the launching cage rose some thirty feet from the Shed floor and hovered there uncertainly. Joe shifted the lever that governed the vanes in the jet motor flames. Ship and cage and pushpots, all together, wavered toward the doorway. They passed out of it, rocking a little and pitching a little and wallowing a little more. As a flying device, the combination was a howling tumult and a disgrace. It was an aviation designer's nightmare. It was a bad dream.

But it wasn't intended as a way to fly from one place to another on Earth. It was the first booster stage of a three-stage rocket system, aimed at outer space. It looked like—Well, if a swarm of bees clung fiercely to a wire gauze cage in which lay a silver minnow wrapped in match-sticks; and if the bees buzzed furiously and lifted it in a straining, clumsy, and altogether unreasonable manner, and if the appearance and the noise together were multiplied a good many thousand times, it would present some likeness to this takeoff. Nothing like this could be graceful or neatly controllable or even very fast in the thick air near the ground. Higher, it would be another matter.

It was another matter. Once clear of the Shed, Joe threw on full power to the pushpot power plants. The clumsy aggregation of grotesque objects began to climb. Ungainly it was, and clumsy it was, but the assembly of strange objects went upward at a rate a jet fighter plane might envy. It wobbled, and it swayed, and it tipped crazily. But it climbed!

The ground dropped so swiftly that even the Shed seemed to shrivel like a pricked balloon. The horizon retreated as if a carpet were being hastily and magically unrolled. The barometer needles moved.

"Communications says," reported Mike, "our rate of climb is four thousand feet a minute and still going up ... We're at seventeen thousand feet... Eighteen ... Everything's go. Our height is now twenty-one thousand feet..."

There was no change in the feel of things inside the ship. Sealed as they were against the vacuum of space, barometric changes took place only in the instruments.

At twenty-five thousand feet the chief said suddenly, "We're pointed right, Joe. Freeze it?"

"Right," said Joe. "Freeze it."

The chief threw a lever. The gyros were running at full operating speed. By engaging them the chief had all their stored up kinetic energy to resist any change of direction the pushpots might create by minor variations in their thrusts. Haney brooded over the individual engines outside. He made minute adjustments to keep them balanced. Mike uttered curt comments into the communicator from time to time. At thirty-five thousand feet there was a momentary sensation as if the ship had tilted sharply. It hadn't.

"Jet stream. We just hit it," Joe said.

There was no need to say any more. The upward-climbing mass of ungainly objects had simply risen into that rushing wind, like an invisible river, which flows sometimes five hundred miles an hour—and even more—from west to east many miles above the Earth's surface on certain continents.

"We're picking up speed," said Mike briskly. "It was five-ten eastward. Now it's five-forty. Fifty. Sixty. ..."

Joe changed nothing. He didn't need to, to gain the maximum possible bit of extra speed from the jet

stream. Mike's cracked voice reported increased speeds—the speeds the pushpots could give to the ship and the launching cage, plus the speed the jet stream added.

At forty thousand feet they were moving eastward at the better part of a thousand miles an hour ground speed. A jet motor cannot be directly rated, but there was almost a quarter of a million horsepower applied to get the small space ship as high as possible with as great as possible an eastward velocity. It couldn't be kept up indefinitely. The pushpots didn't carry enough fuel.

But they reached fifty-five thousand feet, which is where space begins for humankind. A man exposed to emptiness at that height will die just as quickly—fifteen seconds, plus or minus two—as anywhere between the stars. But it still wasn't quite empty space for the push-pots. There was still a very little air.

"The ground says get set to fire the jatos, Joe," Mike said.

"Right," said Joe. "Set yourselves."

Mike threw a switch and a voice began to chatter behind Joe's head. It was the voice from the communications room atop the Shed, now far below and far behind. Mike settled himself in his special acceleration chair. The chief squirmed to comfort in his seat. Haney took his hands from the equalizing adjustments he had to make so that Joe's use of the controls would be exact, regardless of differences in the thrust of the diverse pushpots.

"We've got a yaw right," said the chief sharply. "Hold it, Joe!" Joe waited for small quivering needles to return to their proper registrations.

"Back and steady," said the chief a moment later.

"Okay!"

The tinny voice behind Joe now spoke precisely. Mike had listened to it while the work of takeoff could be divided. Now Joe had to control everything at once.

The roar of the pushpots outside the ship had long since lost the timbre and volume of normal atmosphere. Not much sound could be transmitted by the near vacuum outside. But there was sound enough by solid conduction from the pushpots. The walls and hull of the space ship picked up a crawling, quivering pulsation and turned it into a sound. Standing waves set up and dissolved and moved erratically in the air of the cabin. Joe's eardrums were strangely affected. Now one ear seemed muted by a temporary difference of air pressure where a standing wave lingered for a second or two. Then the other eardrum itched. There were creepy sensations as of things touching one and quickly moving away.

Joe swung a microphone before his mouth. "All set," he said evenly, "brief me."

The tinny voice said, *"You're at sixty-five thousand feet. Your rate-of-climb curve is flattening out. Your air speed relative to ground is seven hundred eighty. You should fire jatos in twelve seconds."*

Joe tried to settle himself. He swallowed. Then he said, "Ten . . . nine . . . eight... seven . . . six... five . . . four... three . . . two . . . one ..."

He stabbed the master jato switch. Monstrous jato rockets, built into each and every one of the pushpots outside, flared chemical fumes in a simultaneous thrust. Even a small jato for jet-assisted takeoff will weigh a hundred and forty pounds and deliver a thrust of a thousand pounds for so many seconds. In jatos to be used at such an altitude that their poisonous effects could do no harm, fluorine-beryllium rockets could far surpass that thrust and duration, and a jato is a disposable rocket. When all the pushpots fired all their jatos at once ...

Joe felt himself slammed back into his seat with irresistible, overwhelming force. The vibration from the jets had been bad. He'd hardly noticed it. Now he could feel nothing but the horrible sensations of seven-gravity acceleration.

It was not exactly pain. It was a feeling as if a completely unbearable pressure pushed at him. Not only on the outside, like a blow, but inside too, like nothing else imaginable. Not only his chest pressed upon his lungs, but his lungs strained toward his backbone. And not only the flesh of his thighs tugged to flatten against his acceleration chair, but the blood in his veins tried to flow exclusively away from the front part of his body—and his brain.

This acceleration seemed to endure for centuries. Actually, it lasted under a full minute. In that time it increased the speed of the ship by rather more than a mile per second. Which, of course, was not nearly enough, not much more than four thousand miles per hour. The supply ship would need very, very much



more than that to get out to the Platform's orbit. But it did arrive at that speed without expending an ounce of the fuel in its own rockets, and it had gotten all the way up through the belt of thick atmosphere which offered resistance to its traveling.

The jato thrust ended with wild variations of the ship's straining as the separate jatos burned out unevenly. Joe gasped, but he could allow himself only a shake of the head to try to clear his brain. The irregular, violent thump-ings as the jatos burned out almost exactly cancelled each other out. He jammed down the ship's own takeoff rocket control. There was a monstrous noise and a mighty surging.

"Clear of cage," Haney panted.

And then they were pressed fiercely against their acceleration chairs again. The ship was no longer in its launching cage. It was no longer held up by pushpots. It was free, with its takeoff rockets naming. It plunged on up and out. But the acceleration was less. Nobody can stand too much gravity too long. But by comparison with the jato boost, the three-gravity acceleration of the ship's own rockets was mild.

Joe's body resisted movement with a weight of four hundred fifty pounds instead of a third as much, aground. His heart had to pump against three times the normal "head" of liquid. His chest felt as if he had a leaden weight on it. His tongue still tried to crowd itself back into his throat and strangle him. But the sensation was only nightmarish. It was possible to move and possible to see. One could breathe, with difficulty, and by titanic effort one could speak. But it was still far from pleasant.

Joe managed to keep his eyes focused. The dials of the instruments said that everything was all right. The tinny voice behind his head, its timber changed by the weight of its diaphragm, said, "*All readings check! Good work.*"

Joe moved his eyes to a quartz view port. The sky was black. But there were stars. At the same instant he saw white disks of sunshine entering through the ports. Stars and sunshine together. And the sunshine was that of space. Even with the polarizers cutting down the glare it was unbearably bright and hot beyond conception. He smelled overheated paint where the sunlight smote on a metal bulkhead. Stars and superhot sunshine together....

It was necessary to pant for breath, and his heart pounded horribly and his eyes tried to go out of focus, but Joe strained in his acceleration chair and managed to laugh a little.

"We did it!" he panted. "In case you didn't notice, we're out of atmosphere. We're out in space."

## 2

THE PRESSURE of three gravities acceleration continued, and Joe had work to do in spite of it. The takeoff rockets were solid fuel jobs, like those which launched the Platform. That meant that they had some very desirable qualities, but there were some drawbacks. One was that a ship accelerating with multiple solid-fuel propelling rockets needed to be manually controlled. A robot couldn't take care of the situation. But the advantages were enough to overbalance that difficulty.

The little ship's rockets were wire-wound steel tubes lined with a very special refractory, with unstable beryllium and fluorine compounds to burn. The solid fuel burned at so many inches per second. The refractory crumbled away and was hurled astern at a corresponding rate—save for one small point. Some parts of it crumbled at a carefully arranged different rate, leaving a pattern of baffles which acted like a maxim silencer on a rifle, or like an automobile muffler. The baffles set up eddies in the gas stream and produced exactly the effect of a rocket motor's throat. And as the fuel burned away, those baffles did likewise and fresh ones came into operation, so that the gas-throated rocket motors were as efficient as liquid fuel ones, with the great advantage that every bit of refractory became reaction mass to be thrown astern. Even the steel tubes melted and were hurled away with a gain in acceleration for the ship. Every fraction of every ounce of rocket mass was used for drive. No tanks or pumps or burners rode deadhead after they ceased to be useful.

But solid fuel rockets simply can't be made to burn with absolute evenness as a team. Minute differences in burning rates do tend to average out. But now and then they reinforce each other. Gyros tend to precess

under

such conditions, so Joe had to watch his instruments and listen to the tinny voice behind his head and use his steering rockets—which were *not* solid fuel ones—to guide the ship as Earth fell away behind him. He did have the feel of the ship from six weeks of practise with a space flight simulator. It was a knack no apparatus could acquire. So he made fine adjustments with hands that weighed many pounds, and worried about all the innumerable things he'd been teamed to handle in that same instruction device. He was kept busy.

Later, he would feel a mild surprise that he hadn't worried at all about other rocket-lifted bodies in orbit around the Earth. There were more than two hundred of them ... There were telestars and weather observation satellites, some functioning but many more burnt out. There were second and third-stage booster units, tumbling uselessly above the curving world. If he'd encountered them, it would be so suddenly that evasion would be next to impossible. Nearly all of these artificial small satellites merely skimmed the top of the atmosphere. From time to time one of them hit and burned, but their number remained practically the same. There were always new ones being added.

The most important ones beside the Platform, of course, were the robot relay stations seeming to hang motionless above chosen cities and nations. But they were higher even than the Platform. They had periods of exactly twenty-four hours and remained seemingly fixed in place. But even the lower ones—the smallest ones—were not an actual danger. Each of them had some tens of millions of cubic miles of emptiness in which to float alone. It was statistically unlikely in the extreme that the tiny supply ship would pass within tens of leagues of any one of them.

But Joe could have worried about them. Still, he had enough to worry about without them.

It seemed eons before the voice in the speaker said crisply: *"Everything's set. You can release in ten seconds. Shall I count?"*

"Count!" Joe panted.

The voice said, *"... seven ... six ... five... four ... three .. two... one... Cut!"*

Joe pressed the rocket release. The small unburnt stubs of the takeoff rockets went hurtling away, consuming themselves as they went. They had to be released, because it was the only way to stop acceleration by a solid-fuel rocket. They couldn't be cut off. They had to be freed.

From exhausting heaviness, there was abruptly no weight at all in the ship. Joe's laboring heart beat twice with the violence the weight had called for, though weight had ended. It seemed to him that his skull would crack open during those two heartbeats. Then he lay limply in his chair, resting.

Nobody spoke. The four of them panted. Haney was better off than Joe, but the chief was harder hit.

Mike's small body had taken the strain best of all, and he would use the fact later in bitter argumentation that midgets were designed by nature to be the explorers of space for their bulkier and less spaceworthy kindred.

The ending of acceleration was good, but the new feeling was hardly pleasant. From almost intolerable heaviness, they now had no weight at all. They felt that they were falling down an abyss which must have a bottom. Actually, they were falling up. But they felt a physical, cringing apprehension.

They'd expected it, but it was not the better for being understood. Joe flexed and unflexed his fingers. He stirred, —and swallowed hastily. The space flight simulator hadn't prepared them for this. It couldn't.

Joe unstrapped himself from his seat. He stood up, and floated to the ceiling. He fended himself off and caught at a handline placed for this exact situation. But he hadn't anticipated what his heels would do. He suddenly noticed that his companions were upside down and staring at him with dazed, wooden expressions.

He tried to laugh, and gulped instead. He pulled over to the quartz glass ports. He didn't put his hand into the sunshine, but shifted the glare-shutters over those ports which admitted direct sunshine. Through one of the remaining ports he saw the Earth seemingly at arms'-length somewhere off. Not up. Not down. Simply out from where he was. It filled all the space the view-port showed. It was a gigantic surface of white, fleecy flecks and specks which

would be clouds, and there were vagrant patches of green which would be solid ground, and areas—between the white spaces—of a dark greenish color which would be ocean. Yet it seemed to slide very,

very slowly past the port.

He recognized an outline between the cloud masses. He knew what it was.

"We've just about crossed the Atlantic," he said blankly. He felt as if the ship had been aloft a very long time. "We're still rising."

He looked again, and drew himself over to an opposite porthole. He saw the blackness of space, which was not blackness because it was a carpet of jewels. The stars were infinite in number and variations in brightness, and somehow of many more colorings than one noticed from Earth.

He heard the chief grunt. Haney made an indefinite noise. Joe was suddenly aware that his legs were floating rather absurdly in mid-air. He saw the chief rise cautiously, holding on to the arms of his seat.

"Better not look at the sun," said Joe, "not even through the glare shields."

The chief nodded. The shields would keep out most of the heat and a great deal of the ultraviolet the sun gave off. But even so, to look at the sun directly might result in a retinal sunburn which could result in blindness.

The loudspeaker behind Joe's chair chattered. It had seemed muted because of the weight of its diaphragm. Now it blasted unintelligibly until Mike adjusted it. He took the message.

"Communications reports radar says we're right on course, Joe," he repeated nonchalantly, "and our speed's okay. We'll spiral out to maximum altitude in two hours thirty-six minutes. We ought to be right with the Platform there and then."

"Good!" said Joe abstractedly.

He strained his eyes at the Earth. They were moving at an extraordinary speed and angle, climbing steeply. The height they aimed for had been reached by just four human beings before them. More than that number had orbited, to be sure, in space capsules which could only go up and come down with a greater or lesser delay between those

happenings. But all of them were in low orbits. The men in the Platform, and now those in this ship, had to pass through the Van Alien belts of radiation and cosmic particles which in theory should be lethal. A man named San-ford had designed the protection on which Joe and his companions counted. He was up in the Platform now, having bet his own life on the principle he'd worked out. But still this was only the second time men had passed through the heaviest and worst of the Van Alien radiation.

"I'll take communications," Joe told Mike.

A moment later he was reporting. Instrument readings, of course, had been transmitted by the ship's telemetering equipment as fast as the instruments reacted. But Joe reported with precision on exactly what sensations they'd had. He reported their body temperature at the moment he began his narrative, with the other three giving him their readings. He gave it again at the end. He gave the ionization reading of the ship's air. There were biological specimens—half a dozen different grades of small living creatures whose metabolic rate could be read off. They were all, of course, water dwellers so that the change of weight would not exhaust them and itself change the rate at which they used oxygen. Joe and his human companions would be repairing the fatigue caused by massive weight, and the excitement of takeoff would further change their bodily reactions. But it should be possible to make certain that the radiation protection they carried had worked to protect them, or that it hadn't.

If it hadn't, there wasn't much that could be done about it.

The facts Joe reported, though, ruled out any likelihood of radiation burns. It was a verification of that simple answer to an apparently hopeless problem which made so many people insist that space travel was impossible. The protection against Van Alien Belt radiation was adequate against even the storms of radiation resulting from solar flares. The last trace of skepticism about the future of humanity in space was erased.

Then time passed. Again the four of them might have been expected to experience splendid emotions.

Triumph. Perhaps exaggerated elation, and the assurance that they

would be famous for all time . . . But another matter was more insistently clamorous for their attention.

They had cramps.

The feel of unending fall continued. They knew what it was, but they had to remind themselves of it or they tended to feel sudden irrational panics because of the feel of falling. Astronauts in the past had used

medication to avoid it. But Joe and his fellows were to be in space for longer than any kind of medication was desirable. Anyhow the crew of the Platform reported—now in space for more weeks than Joe had been quarter hours—that one got partly used to it. When awake, at any rate. Sleeping was still difficult. The Earth as seen through the ports was still a monstrous bulk, speckled with clouds above vast mottlings which were its seas and continents. There was no point in looking for cities. They'd be mere patches of gray crosshatchings, even via telescope. Their task was simply to wait. The Platform was coming up behind them as the supply ship climbed. Their speed in miles per minute was now greater than that of the Platform, but they were still rising and losing speed as they rose. When their path intersected that of the Platform, the two velocities should be exactly equal.

Major Holt's voice came on the communicator.

*"Joe," he said harshly, "I have very bad news. A message came from Central Intelligence within minutes of your takeoff. I—ah—with Sally I had been following your progress. I did not decode the message until now. But Central Intelligence has definite information that more than ten days ago—ah—enemies of our Space Exploration project—"* Even on a tight beam to the supply ship, the major did not name the nation or nations everybody knew to be determined to smash space exploration by anybody else— *"completed at least one rocket capable of reaching the Platform's orbit with a payload that could be an atomic bomb. It is believed that more than one rocket was completed. All were shipped to an unknown destination."*

"Not so good," said Mike.

He'd left his post when Joe took over. Now he made a swooping dart through the air of the cabin. The midget

showed no signs of the uncertainty the others displayed. He'd been a member of a midget acrobatic team before he went to work at the Shed. He brought himself nonchalantly to a stop and looked at the others.

Major Holt spoke again. *"The worst of it is that radar may have told those people that you're on the way up, and what your cargo is. In that case they may try to blast the Platform before you reach it."*

"I don't like that idea," said Joe dourly. "Is there anything we can do?"

*"What is there?"* demanded the major bitterly. *"Don't you realize that if you can't unload your cargo you can't get back to Earth?"*

"Yes," said Joe. "I do realize it. We'll have to try to think of something."

But he hadn't the ghost of an idea. It was true that the supply ship couldn't return to Earth unless it landed at the Platform. The pushpots and the takeoff rockets—and the jatos—had been fired to give the supply ship a speed at which it would rise to meet the Platform and stay there. It would need no power to stay there, but it would take power to get down. It had expended so much power to get up with its cargo. It would need less to get down, empty. The landing rockets had been designed to land an empty ship, not a full one. But there was no way to jettison cargo. None at all. The more the ship and cargo weighed, the more power it had needed to get out to space. And the more it needed to get down. If Joe and his companions couldn't get rid of their cargo—and they could only unload in the shiplock of the Platform—they'd stay on in emptiness.

The major said bitterly, *"This is all most irregular, but —here's Sally."*

Then Sally's voice came out of the communicator.

*"I'm not going to waste your time talking to you. You've got to figure out something. I don't know what it will be, but you can do it. Try, won't you?"*

"I'm afraid we're going to have to trust to luck," admitted Joe. "We weren't equipped for anything like this."

*"// I were with you,"* Sally said fiercely, *"you wouldn't trust to luck! You'd do something! Do it!"*

"Then I'd feel responsible," admitted Joe. "But just the same—"

*"You're responsible now!"* said Sally, as fiercely as before. *"// the Platform's smashed, war's possible as soon as some crazy dictator gets the power to start it. But if you can reach the Platform and arm it, there won't be any war! Half the world would be praying for you if it knew! I can't do anything else, so I'm starting that right now. But you try, Joe! You hear me?"* "I'll try," said Joe. "Thanks, Sally."

He heard a sound like a sob, and the communicator was silent. Joe swallowed very carefully. It can be alarming to find oneself the intended victim of a murder, but it can also be very thrilling. One can play up

splendidly to a dramatic picture of doom. It is possible to be one's own audience and admire one's own fine disregard of danger. But when other lives depend on what's done, there's an irritating obligation to do something practical.

"Mike, how long before we reach the Platform?"

"Forty minutes, fifty seconds." Mike said promptly. "Nasty business. Something occurs to me. They won't smash the Platform before we get to it. Public opinion would feel for us, marooned in orbit. So they'll try to smash the Platform just as we arrive or within seconds after. Hm... Where'll we be?"

"Straight overhead over the Indian Ocean," said Joe. "Over the Bay of Bengal. But we'll be moving fast. The tricky part is that it'll take time to get our missiles unloaded and into launching tubes on the Platform. One bomb could meet us over the Bay of Bengal as we make contact with the Platform. But we couldn't have a rocket tube loaded on the Platform before we're somewhere over the Philippines."

"And hi between times we're sitting ducks!" the chief said sourly.

"We'll check with the Platform," said Joe. "See if you can raise them, Mike."

Then something occurred to him. Mike scrambled to the communication board. He began feverishly to work the computer that could tell him where the Platform

should be and how to aim a tight beam at it. He threw a switch and said sharply, "Calling Space Platform! Calling Space Platform! Supply Ship One calling Space Platform ..." He paused. "Calling Space Platform..."

Joe had a sliderule going. He looked up, his expression peculiar.

"A solid fuel rocket can start off at ten gravities acceleration," he said slowly. "As its fuel burns away the acceleration goes up beyond that. If it isn't launched yet, it might be too late, just the same."

Mike snapped into the communicator.

"Right!" To Joe he said, "Space Platform on the wire."

Joe slipped on headphones. "I've just had word from the Shed," he explained carefully, "that there may be some missiles coming up from Earth to smash us as we meet. You're still higher than we are and they ought to be starting. Can you pick up anything with your radar?"

The voice from the Platform said acidly, *"We have picked something up. There are four rockets headed out from near the sunset line in the Bay of Bengal. Assuming they're solid fuel rockets, they are on a collision course with us."*

"Are you doing anything about them?" asked Joe absurdly.

The voice said caustically, *"Unfortunately, there's nothing to do anything with."* It paused. *"Of course you can use your landing rockets. If you fire them immediately, you'll pass our scheduled meeting place some hundreds of miles ahead of us—and the rockets from below. You'll go on out to space, setting up an orbit to wait for rescue."*

"We've air for ten days." Joe said briefly. "That's no good. It'll be a month before the next supply ship is finished and can takeoff. There are four rockets coming up?"

"Yes." The voice changed. It spoke away from the microphone. *"What's that?"* Then it returned to Joe.

*"They went up at the same instant from four separate launching sites, which were probably submarines at the corners of a hundred mile square. They'll converge as they rise."*

"I think," said Joe, "that we need some luck."

*"I think,"* said the caustic voice, *"that we've run out of it."*

Joe repeated the news to his companions and added irrelevantly, "It was Sanford talking. He found out how to beat the Van Alien belts, but he has no ideas for now."

The chief rumbled. Haney clamped his jaws. Mike's expression became one of blazing hatred. Joe's mind went rather absurdly to the major's peculiar and almost despairing talk in his quarters early that mom-ing. There was hatred for the Platform. But those who hated it most were trying to destroy their own best hopes. For freedom, certainly, whether or not they could imagine being free. But the Platform and the space exploration project in general represented the first fumbling attempt to end the one disaster all quarters seemed to think unavoidable. Not atomic war, as such. There would be some survivors in any case. But the human race was increasing in number at an astonishing rate. Presently

one world would not be large enough for its inhabitants. They would have to allow wars or presilences to keep their number down, unless—

Unless the actual final object of the conquest of space was attained. The ultimate goal of the entire program of space development was the millions and millions and hundreds of millions of other planets now circling un-visited suns and ready for mankind to come and live on them. The prospect of the hundreds of millions of Earth-type worlds of an entire galaxy thrown open to colonization ... that prospect should make anyone enthusiastic. But there was something or someone who fought against every upward step of the human race. It was in evidence now.

Joe swallowed. It would have been comforting to take refuge in fine gestures just now. They could send back an eloquent, defiant message to Earth that they did not regret their journey into space, though they were doomed to be killed by the enemies of their country. It could have been a very pretty gesture. But Joe happened to have a job to do. Pretty gestures were no part of it. He had no idea how to do it. Instead he spoke with a sick feeling.

"Sanford said we could fire our landing rockets as additional takeoff rockets and get out of the way. Of course we've got missiles in our cargo space, but there's no way to launch them. Absolutely the only thing we can do or not do is fire our landing rockets. I'm open to suggestions."

There was silence. Joe's reasoning was sound. When a man can't do what he wants, he surveys the things he can do to twist them into utility. It didn't look too promising, here. They could fire the rockets now or later, or— Then an idea came into Joe's head. Not dramatically. Not with any trace of excitement. He simply found himself thinking about it, almost casually.

"Those bomb-carrying rockets will have proximity fuses."

Mike's eyes flamed. The chief nodded profoundly.

Haney said with some skepticism, "It's all we've got. Anyhow we can try!"

"I need some calculations. Spread. Time of firing. That sort of thing. But I'm worried about calling in the clear. A beam to the Platform will bounce and might be picked up ...»

The chief said exuberantly, "I've got a trick for that! There are tribesmen of mine in the Shed. Get one of them—Get Charley Red Fox to the phone, and we'll talk private!"

The small spaceship floated upward. It pointed steadfastly in the direction of its motion. The glaring sunshine which at its takeoff shone squarely in its bow ports now poured down slantingly from behind. The steel plates of the ship gleamed brightly. Below it lay the sunlit Earth

—with a shadow beginning at the eastern horizon. Above and about it on every hand was a multitude of stars. Even the moon was visible as the thinnest of crescents against the night of space.

The ship floated upward. It was meeting the Platform after only half a circuit of Earth, while the Platform had climbed upward for three full revolutions. Earth still appeared as the most gigantic of possible objects. It curved away and away to mistiness at its horizons, of which one was now partly vanished past the shadowline. Invisible microwaves flung themselves through emptiness. They traveled thousands upon thousands of miles,

and struck the strange shape of the Platform. From there they were relayed to the Shed. In the ship Chief Bender, Mohawk and steelman extraordinary, talked to the Shed and to one Charley Red Fox. They talked in Mohawk, which is an Algonquin Indian language, agglutinative, complicated, and not to be learned in ten easy lessons. It was not a language which eavesdroppers were likely to know as a matter of course. But it was a language in which computations could be asked for and conveyed, so that a very forlorn hope could be attempted with the best possible chance of success.

None of this appeared in the look of things. The supply ship and the Platform moved toward their rendezvous. The ship still moved a little faster, because it was climbing. The speeds would match exactly when they met. The small, torpedo-shaped ship and the bulging metal satellite floated with vast deliberation in emptiness. Time passed. The Platform appeared to gain upon the supply ship. It did. Presently they were only two hundred miles apart. One hundred. Fifty.

By that time the twilight band of Earth was nearly at the center of the planet, and night filled more than a quarter of its disk.

By that time, too, even to the naked eye the enemy rockets had become visible. They were a thin skein of

threads of white vapor, which seemed to unravel from a mathematical point of nothing at all. The vapor curled and expanded prodigiously. It could be seen to be jetting into existence from four separate sources, two of them a trifle ahead of the others.

They came up in a straight line aimed accurately ahead of the larger, floating objects, the supply ship and the Platform. The rockets came ravening to destroy them at the instant of their joining.

The tiny spaceship turned slowly. Its rounded bow had pointed longingly at the stars. Now it tilted away from that position. The direction of its flight did not change, of course. In the absence of air it could tumble indefinitely without achieving anything else. It was still in a trajectory instead of an orbit, though presently its motion

would be strictly orbital. But now it pointed its nose downward.

The great steel hull and the supply ship were only twenty miles apart. An infinitesimal radar bowl moved in the ship. Tight beam waves flickered invisibly between the two craft. The rockets raged toward them. The ship and Platform were only ten miles apart. The rockets were now glinting missiles leaping ahead of the fumes that propelled them.

The two floating things were two miles apart. The rockets rushed upward... There were minute corrections in their courses. They converged.

Flames leaped from the supply ship. Its landing rockets spouted white-hot flame and fumes more thick and coiling than even the smoke of the bomb carriers. The supply ship surged momentarily ahead ... And then. The rockets which were supposed to land the supply ship on Earth flew free a good many thousands of miles from it. They flew unburdened at the rockets carrying atomic warheads.

The landing rockets plunged downward at forty gravities acceleration or better. They were a group of fiery sparks which seemed to group more closely as they dwindled. They charged the attacking robots. They were unguided, of necessity, but the murder robots had to depend on robot, proximity fuses to explode. No remote control could be accurate enough for such a range. The war rockets had to be devised to explode when near anything that reflected their probing microwaves. They had to be designed to be triggered by anything in space. The loosened landing rockets plunged among them. They did not detonate all at once. That was mathematically impossible. But no human eye could detect the delay. Four close-packed flares of pure atomic fire sprang into being between the Platform and the Earth. Each was brighter than the sun. For the fraction of an instant there was no darkness where night had fallen on the Earth. For thousands of miles the Earth glowed brightly

Then there was a twisting, coiling tumult of incandescent gases, which were snatched away by nothingness and ceased to be.

Then there were just two things remaining in the void. One was the great, clumsy, shining Platform, gigantic in size when seen close by. The other was the small spaceship which climbed to it and fought for it and defended it against bombs from Earth.

The little ship had now a slight motion away from the Platform, due to the instant's tugging by its rockets before they were released.

It turned about in emptiness. Its steering rockets spouted steam. It began to cancel out its velocity away from the Platform and to swim slowly and very carefully toward it.

### 3

MAKING ACTUAL contact with the Platform was not a matter for instruments and calculations. It had to be done by hand—practically by ear. Joe watched out the ports and played the controls of the steering jets with a nerve-wracked precision. His task was not easy.

Before he could get back to the Platform, the blinding sunshine on that ungainly object took on a tinge of red. It was the twilight zone of the satellite's orbit, when for a time the sunlight that reached it was light that had passed through Earth's atmosphere and had been bent and colored by the dust. It glowed a fiery red, and the color deepened, and then there was darkness.

They were in Earth's shadow. There were stars to be seen, but no sun. The moon was hidden, too. And Earth was a monstrous, incredible, abysmal blackness which at this first experience of it produced an almost superstitious fear. Formerly it had seemed a distant but sunlit world, flecked with white clouds and with sprawling differentiations of color beneath them.

Now it did not look like a solid thing at all. It looked like a hole in creation. One could see ten thousand million stars of every imaginable tint and shade. But where the Earth should be there was—Nothingness. It looked like an opening to annihilation. It looked like that Pit of Darkness which is the greatest horror men have imagined. And since there was no weight, it seemed that Joe and the chief and Haney and Mike were falling into it.

Joe knew better, of course. So did the others. But that was the look of things, and that was the feeling. One did not feel in danger of death, but of extinction—which is very much worse.

Then lights glowed on the outside of the Platform to guide the supply ship to it. There were red and green and blue and harsh blue-white electric bulbs. They were bright and distinct, but the feeling of loneliness above that seeming awful chasm was appalling. No small child alone at night had ever so desolate a sensation of isolation as the four in the little supply ship.

But Joe painstakingly played the buttons of the steering rocket control board. The ship surged, and turned, and surged forward again.

At the communicator Mike said, "They say'slow up, Joe."

Joe obeyed, but he was tense. Haney and the chief were at other ports, looking out.

The chief said heavily, "I've got to admit it. I never felt so lonely before in all my life!"

"I'm glad somebody's with me," Haney admitted.

"The job's almost done," said Joe.

The supply ship's own hull, outside the ports, flowed suddenly in a light beam from the Platform. The small, brief surges of acceleration produced enormous emotional effects. When the Platform was only a mile away, Haney switched on their searchbeams. They stabbed through emptiness with no sign of their existence until they touched the steel hull of the satellite.

Mike said sharply, "Slow up some more, Joe."

Again he obeyed. It would not be a good idea to ram the Platform after they'd come so far to reach it. They drifted slowly, slowly, slowly toward it. The Pit of Darkness which was the night side of Earth seemed about to engulf the Platform. They happened to be higher than the big globe, and the blackness was behind it. They were a quarter mile away. The distance diminished.

A thin straight line seemed to grow toward them in the searchbeam's light. There was a small, bulblike object at its end. It reached out farther than was at all plausible. Nothing so slender should reach so far without bending of its own weight. But there was no weight. It was a plastic noble hose with air pressure in it. It groped for the supply ship. The four in that ship held their breaths. There was a loud, metallic, *clank!* Then it was possible to feel the ship being pulled toward the Platform by the magnetic grapple. It was a landing line, the means by which the ship would be docked in the great lock designed to receive it.

As they drew near they saw the joints of the plating of the Platform. They saw rivet heads. There was the huge, thirty-foot doorway with its valves swung wide. Their searchlight beam glared into it. They saw the metal floor and the bulging plastic sidewalls, restrained by nets. They saw the inner lock door. It seemed that men should be there to welcome them. There were none.

The airlock swallowed them. They touched against something solid. There were more clankings. They seemed to crunch against the floor. That was the magnetic grapples. Then, in solid contact with the Platform's substance, they heard the sound of the outer doors swinging shut. They were inside the artificial inhabited satellite of Earth. It was brightly lighted in the lock, and Joe stared out at the quilted sides. Then a hissing of air, and he saw mist, and then the bulges of the sidewall sagged. The air pressure gauge went spiraling up toward normal Earth sea level pressure.



Joe threw the ready lever of the steering rockets to  
*off.*

"We're landed," he said, as if surprised.

There was silence. He looked about him. The other three wore queer expressions. They should have rejoiced at their arrival. But it didn't seem that they had arrived anywhere.

Joe said, "It seems like we ought to weigh something here, but we don't. So we feel that nothing's happened. Shoes, Mike?"

Mike peeled the magnetic-soled slippers from their place on the cabin wall. He handed them out and opened the door. A biting chill came in. Joe slipped on the shoe soles with their elastic holding bands. He stepped out of the door.

He didn't land. He floated until he reached the side-wall. Then he pulled himself down by the netting.

Once he touched the floor he had a new sensation. His shoes seemed to be tricky. The net and the plastic sidewalls were, of course, the means by which a really big lock

was made practical. When this ship was about to take off again, pumps would not have to labor for hours to pump the air out. The sidewalls would inflate and closely enclose the ship's hull, and so force the air in the lock back into the ship. Then the pumps would work on the air behind the walls—with nets to help draw the wall stuff back to let the ship go free. The lock could be used with only fifteen minutes of pumping instead of four hours.

The door to the rest of the ship opened. Joe tried to walk toward it. He discovered Ms astounding circumstances. When he lifted one foot and tried to swing the other forward, his body tried to pivot. When he lifted his right foot, he had to turn his left foot inward. His arms tried to float absurdly upward. When he was in motion and essayed to pause, his whole body tended to continue forward with a sedate toppling motion that would land him flat on his face. He had to put a foot forward to check himself. When he stood still—his stomach queasy—he found himself tilling forward or back or with equal unpredictability sidewise. He would have to learn an entirely new knack of walking.

A man came into the lock. Joe recognized him. It was Sanford, the senior scientist of the crew, who had worked out the answer to radiation danger in the Van Alien belts and from solar flares. More than any other one man, he'd made the Platform possible. But now he looked nerve-wracked, though his eyes were bright and his expression sardonic.

"My compliments," he said, his voice tight with irony, "for a splendidly futile job well done! You've got your cargo invoice?"

Joe nodded. Sanford held out his hand. Joe fumbled in his pocket and brought out the yellow sheet.

"I'd like to introduce my crew," said Joe. "This is Haney, and this is Chief Bender, and Mike Scandia." He waved his hand and his whole body wobbled unexpectedly.

"We'll know each other!" said Sanford, as sardonically as before. "Our first job is more futility—you get the missiles you've brought into the launching tubes. A lot of good they'll do!"

A large plate in the roof of the lock—but it was not up or down nor in any particular direction—withdraw itself. A man floated through the opening and landed on the ship's hull. Another man followed him.

"Chief," said Joe, "and Haney, will you open the cargo doors?"

The two figures moved with extreme clumsiness to obey.

Sanford called sharply, "Don't touch the hull without gloves? If it isn't nearly red-hot from sunshine, it'll be below zero from shadow!"

Joe realized, then, the temperature effects on the skin of his face. A part of the supply ship gave off heat like a panel heating installation. Another part imparted a chill.

Sanford said unpleasantly, "You want to report your heroism, eh? Come along!"

He clanked to the doorway through which he'd come. Joe and Mike followed in single file.

They went out of the lock. Sanford suddenly peeled off his metal-soled slippers, put them in his pocket, and dived casually into a four-foot metal tube. He drifted swiftly away along the lighted bore, not touching the side-walls. He moved in the manner of a dream, when one floats with infinite ease and precision in any direction one chooses.

Joe and Mike did not share his talent. Joe launched himself, but in twenty or thirty feet his shoulder

rubbed against the tube wall and he came to a stop, Mike thudded into him.

"I haven't got the hang of this yet," said Joe apologetically.

He untangled himself and went on. Mike followed him, his expression one of pure bliss. He was a tiny man, but he had the longings and the ambitions of half a dozen full-sized men in his small body. And he'd known frustration. He could prove by mathematics that space exploration could be carried on by midgets at a fraction of the risk and cost of the same job done by normal-sized men. He was, of course, quite right. The cabins and air and food for a space-ship's crew of midgets would cost and weigh only a fraction of what similar equipment for six-footers would require. But people simply weren't interested in sending midgets out to space.

But Mike had gotten here. He was in the Space Platform. There were full-sized men who would gladly have changed places with him, forty-one-inch height and all. He was blissfully happy.

The tube ended and he bounced off the wall that faced its end. Sanford was waiting. He grinned with more than a hint of spite.

"Here's our communications room," he said. "Now you can talk to Earth. It'll be relayed, at just this moment, but in half an hour you can talk to the Shed direct."

Joe made his way awkwardly into the indicated compartment. There was another crew member on duty there. He sat before a group of screens, with thigh grips across his legs to hold him in his chair. He turned his head and nodded cheerfully enough.

"Here!" snapped Sanford.

Joe pulled himself to the indicated seat. He worked himself down into it. Suddenly he was oriented. He'd seen this room before—before the Platform was launched. True, the man at the communication equipment was upside down with reference to himself, and Sanford had hooked a knee negligently around the arm of a firmly anchored chair, but at least Joe knew where he was and what he was to do.

"Go ahead and report," said Sanford with biting irony. "Tell them you heroically destroyed the rockets that attacked us, and your crew behaved splendidly, and you've landed here and the situation is well in hand. It isn't, but it'll make nice headlines!"

"Our arrival's been reported?" Joe asked evenly.

"No," said Sanford, grinning. "Obviously the radar down on Earth—shipboard ones on this hemisphere, of course—have reported that the Platform's still here. But we haven't communicated since the bombs went off. They probably think we had so many punctures that we lost all our air and are all wiped out. They'll be glad to hear from you that we aren't."

Joe threw a switch, frowning. This wasn't right. Sanford was one of the top scientists of the world. He'd solved the one seemingly insuperable obstacle to space flight when he found the answer to lethal radiation belts around the Earth, with equal protection against solar flares. His whole career had been a series of brilliant coups. True, he was a laboratory man, and the Platform was an alien environment for him, and the sort of problems it presented were unlike those he'd dealt with before. But his manner was distinctly unpleasant. Something was wrong.

The communicator hummed. A flat voice sounded. It swelled to loudness. *"Calling Space Platform! Calling Space Platform! CALLING SPACE PLATFORM!"*

Joe turned down the volume, and said into the microphone, "Space Platform calling. Joe Kenmore reporting. We have made contact with the Platform and completed our landing. Our cargo is now being unloaded. Our landing rockets had to be expended and we are now unable to return to Earth. The ship and Platform are unharmed. I am now awaiting orders. Report ends."

"Go on! Tell them what a hero you are!" Sanford said sharply.

"I'm going to help unload my ship," said Joe shortly. "You report what you please."

"Get back at that transmitter!" shouted Sanford furiously. "Tell them you're a hero! Tell them you're wonderful! Then I'll tell them how useless it is!"

Joe saw the other man in the room, the man at the screens, shake his head warningly. He got up and fumbled his way to the door. Sanford shouted at him again.

Joe went out. He found the four-foot tube and floated, not down but along it back to the unloading lock. Mike followed him. Wordlessly, Joe set to work to get the cargo out of the supply ship's hold.

Handling objects, which on earth would weigh tons, was a very special art in weightlessness. Two men could move almost anything. One man could start a massive case in motion, simply by pushing it in the exact line it was to follow. To thrust hard for a short time produced exactly the same effect as to push gently for a longer period. Anything floated tranquilly along the line it was aimed. The man who was to stop it, though, needed to use exactly as much energy as the man who started the floating motion. He had to check the floating object in exactly the proper line. Miscalculation there could create confusion and cause dismay.

The chief had gone off to help maneuver two-ton missiles into launching tubes. One crew member remained with Haney, unloading objects that would have required cranes on Earth. A crate floated from the ship to the crewman. Standing head downward, he stopped its original movement, braced himself, and sent it floating to Joe. He braced himself, stopped its flight, and very slowly—to move fast would pull his feet from the floor—placed it on a stack of similar objects which would presently be fastened down. Everything had to be done in slow motion, or one would lose his footing. Joe worked painstakingly. He gradually began to understand the process. But the muscles of his stomach ached from the almost-continuous cramp due to the sensation of unending fall.

Presently Joe said uncomfortably, "It looks to me as if something's wrong with Sanford."

"All empty here! We're unloaded!" Haney called from the cargo hold.

There were sounds as he closed the cargo doors. Haney came into view, floating as Mike had done, but less skilfully. He touched the wall on his hands and knees and bounced away and tried helplessly to swim to a handhold. It might have been amusing except that Joe was in no mood for humor.

Mike whipped off his belt and flipped the end of it to Haney. He caught it and Mike hauled him to the wall. Haney's shoes clicked on the metal floor.

"I need wings!" Haney said. "You reported, Joe?"

Joe turned to Brent, the crew member who'd been unloading. He knew Brent, too, from back in the Shed before the Platform went up.

"What's the matter with Sanford?" he demanded. "When he met me in the lock, here, he said our coming was useless. He talked about the futility of everything while I reported. He sounds like he sneers at everything as futile. What's the matter?"

"Maybe it is futile," said Brent mildly. "Here, anyhow. It does look as if we're going to be knocked off. But Sanford's taking it badly. The rest of us have let him act as he pleased because it didn't seem to matter. It probably doesn't, except that he's annoying."

Mike said truculently, "We're not going to be knocked off! We've got missiles of our own, now! We can fight back if there's another attack!"

Brent shrugged. His face was young enough, but deeply lined. He said as mildly as before: "Your landing rockets set off four bombs on the way from Earth. You brought us six rocket missiles. How many bombs can we knock down with them?"

Joe saw. It was a shock. But there are special facts of life in an artificial satellite. If it could be reached by bombs from Earth, the bombs could be reached by missiles from the satellite. But it would take one missile to knock down one bomb, with luck.

"I see," he said slowly. "You mean, we can handle just six more bombs aimed at us from Earth."

"Six in the next month," agreed Brent. "It'll be not less than a month before we get more. Somebody sent up four bombs today. Suppose they send eight next time? Or simply one a day for a week?"

Mike made an angry noise.

"That means the seventh bomb could knock us out. We're sitting ducks here, too!"

Brent nodded. "We have to have at least one missile for every bomb they throw at us. It can't be done.

That's  
that!"

"And," said Joe distastefully, "Sanford's cracked up because he knows he's going to be killed!"

Brent said earnestly, "Oh, no! He's a terrifically brilliant physicist. His whole career has been one triumph after another. He's always had a brilliant mind, and he's done brilliant things with it. Poor devil, he's never failed at anything he ever attempted, until now. Now he has failed! We're going to be killed and he can't

solve the problem of preventing it. He's been so brilliant that his brains became the only thing he's ever believed in. And now they're no good. He can't accept the idea that he's stupid, so he has to believe that everything else is. Haven't you known people who had to think everybody else was stupid to keep from knowing that they were, too?"

Joe nodded.

Brent said, shrugging, "That's an extreme form of rationalizing. It's not a matter of intelligence, but of personality. Sanford has to feel that he's superior to everybody else. He's frustrated. He's not used to it. So he acts like—well—like a child. He'll be just as scornful when he's killed." He looked at his watch. "I'm the crew psychologist. 'Close study of the effect of a totally alien environment on men hi it, including myself. But in five minutes we're due to come out of the Earth's shadow into sunshine again. I'd suggest that you come to watch. It's good to look at."

He didn't wait for an answer. He led the way. The others followed in a strange procession. Somehow, automatically they fell into a single file, and they moved on their magnetic-soled shoes toward a passageway. Their slipper soles clanked and clicked hi an erratic rhythm. Brent walked with the mincing steps needed for movement in the absence of weight. The others imitated him. Their hands no longer hung naturally at their sides, but tended to make extravagant gestures with the slightest muscular impulse. They swayed extraordinarily as they walked. Brent was a slender figure, and Joe was more thickset, and Haney was taller, and lean. The burly chief appeared suddenly and fell in line and Mike the midget followed after him. They made a queer procession indeed.

Minutes later they were in a blister on the skin of the Platform. There were quartz glass ports in the sidewall. Outside the glass there were metal shutters. Brent served out dense goggles, almost black, and touched the button that opened the steel coverings.

They looked into space. The dimmer stars were extinguished by the goggles they wore. The brighter ones seemed faint and widely separated. Beneath their feet as they held on to handholds lay the featureless darkness which was Earth. But before them and very far away there was a vast, dim arch of deepest red. It was sunlight filtered through the thickest layers of Earth's air. It barely outlined the curve of that gigantic globe. As they stared, it grew brighter. To those on the Platform, obviously, Earth would go through all its phases each time the Platform went around it. They saw now the thinnest possible crescent of the new Earth. But in minutes—almost in seconds—the deep red sunshine lightened to gold. The hair-thin line of light widened to a narrow ribbon which described an eight thousand mile half-circle. It brightened markedly at the middle. It remained nearly red at its ends, but in the very center it glowed with splendid flame. Then a golden ball appeared and swam up and detached itself from the Earth, and the onlookers saw the breathtaking spectacle of all of Earth's surface seemingly born of the night.

As if new-created before their eyes, seas and lands unfolded in the sunlight. They watched bits of cloud and the long shadows of mountains and the strangely different colorings of its forests and fields. As Brent had told them, it was good to watch. It was half an hour later that they gathered in the kitchen of the Platform. The man who had been loading launching tubes now briskly worked to prepare a meal on the extremely unusual cooking devices of a human outpost in interplanetary space.

The food smelled good, but Joe noticed that he could also smell growing things. Green stuff. It was absurd, until he remembered that there was a hypdroponic garden here. Plants grew in it under sun lamps which were turned on for a certain number of hours everyday. The plants purified the Platform's air and provided some fresh and nourishing foodstuff for the crew.

They ate. The food was served in plastic bowls, with elastic thread covers through which they could see and choose the particular morsels they fancied next. The threads stretched to let through the forks they ate with. But Brent used a rather more practical pair of tongs in a businesslike manner.

They drank coffee from cups which looked very much like ordinary ones on Earth. Joe remembered suddenly that Sally had had something to do with the design of domestic arrangements here. He regarded his cup with interest. It stayed in its saucer because of magnets in both plastic articles. The saucer stayed on the table because that was magnetic, too. And the coffee did not float in mid-air as a hot round brownish ball because the cup had a transparent cover. When one put his lips to the proper edge, a part of the cup yielded to pressure and coffee came to one's lips without the

spilling of a drop.

At that moment Joe thought of Sally for the first time in a good two hours. She'd tried to arrange that living in the Platform should be as normal and Earthlike as possible. The total absence of weight would be bad enough. She believed that it needed to be countered, as a way of staying sane, by the effect of normal-seeming chairs and normal-seeming food, and not too exotic systems for eating. She'd argued this viewpoint with high authorities who came to consult her father. Other and more official designers had the credit for her contributions, but Joe knew how many items had originated with her.

He mentioned the cups, and Brent said, "Oh, yes! We might have gone off the deep end if there weren't some familiar things about. To have to drink from a cup one squeezes is tolerable. But we'd have felt hysterical at times if we had to drink only from the equivalent of nursing bottles."

"Sally Holt thought of that," said Joe. "I've known her all my life."

"She has all the brains any woman should be trusted with," said Brent. "Sound psychology!" Then he grinned. "She fell down on one point, though. Everybody did. Nobody happened to think of a garbage disposal system."

It was reasonable enough, for such an item to be forgotten. But people thought of voyaging in space as journey-ings with beginnings and endings. Yet the Platform wasn't at all the same thing as a ship. A ship could jettison refuse and leave it behind, or store it during a voyage and dump it at the end. But the Space Platform would never land. It should roll on forever. And if it heaved out its garbage from airlocks—the stuff would still have the Platform's orbital speed and would follow it tirelessly around Earth until the end of time.

"We dry and store it now," said Brent. "If we weren't going to be killed we'd have to figure out some way to turn it into fertilizer for the plants in the air room. But even then the problem of tin cans could be difficult."

The chief wiped his mouth deliberately. He had helped load four missiles into launching tubes, and he had been brought up to date on the state of things in the Platform.

"We brought up two-ton missiles," said the chief dourly. "We'll have warning of other bombs coming up. We can send out these missiles to intercept them. Six of 'em. They can get close enough to set off bombs' proximity fuses, anyhow. But we've got the problem of what we'll do if they fling seven bombs up at us. Six, we can handle. What'll we do with the one left over?"

"Have you any ideas?" asked Joe.

The chief shook his head.

Brent said mildly, "We've considered that problem, too, I assure you. And as Sanford puts it quite soundly, the only thing we can really do is throw our empty tin cans at them."

Joe nodded. Then he tensed. Brent had meant it as a rather mirthless joke. But Joe was astonished at what his own mind made of it. He thought it over carefully. Then he said, "Why not? It ought to be a good trick."

Brent looked at him incredulously. Haney looked solemnly at him. The chief regarded Joe out of the corner of his eye. Then Mike shouted gleefully. The chief barked, and a moment later grunted wrathful, unintelligible syllables in Mohawk. He essayed to pound Joe on the back. But where there was no weight it wasn't exactly practical.

Haney said disgustedly, "There are times when a guy wants to murder you, Joe! Why didn't I think of that?"

But Brent was looking at the four of them with a very lively curiosity. "Will you characters let me in on this?"

They told him. Joe began to explain it carefully, but the Chief broke in with a barked and impatient description, and then Mike interrupted to snap a correction. But by that time Brent's expression had changed with astonishing suddenness.

"I see! I see!" he protested. "All right! Have you got

spacesuits in your ship? We have them. So we'll go out and pelt the stars with garbage. I think we'd better get at it right away, too! In less than a lot of hours we'll be very fine target for more bombs, and we should start our job now!"

Mike made an exuberent gesture and went floating out of the kitchen to get spacesuits out of the supply ship. The grin on his small face threatened to cut his throat. Joe said tentatively;

"But Sanford's in command here. How'll he like this idea?"

Brent hesitated. "I'm afraid," he said regretfully, "that he won't like it. As a psychologist, that's my opinion. He's suffering from a very bad case of frustration, to which he's made an almost typically neurotic reaction. If you solve a problem he's had to give up, it will shatter that reaction. I think, though, that he'll allow it to be tried while he swears at us for fools. He's most likely to react that way if you suggest it."

"Then," said Joe. "I suggest it. Chief—"

The chief raised a large brown hand. "I get the program," he said. "We'll all get set."

Joe went uncomfortably to the control room. He heard Sanford's voice, sardonic and mocking, as he reached the communications room doorway.

"What do you expect?" Sanford was saying derisively. "We're clay pigeons. We're a setup target. We've just so much ammunition. You say you can send up so much more in three weeks instead of a month. I admire your persistence, but it's really of no use! This is a very stupid business—"

He felt Joe's presence. He turned, then sharply struck the communicator switch with the heel of his hand. The image on the television screen faded. The voice cut off. He said blandly, "Wen?"

"I want to take a garbage disposal party out on the outside of the Platform. I came to ask for authority."

Sanford's mocking expression did not change. "It seems quite as intelligent," he said brightly, "as anything else the human race has ever done. But why does it appeal to you as a desirable project? I don't object. I'm only curious!"

"I think," said Joe, "that we can make a defense against bombs from Earth with our empty tin cans."

Sanford raised his eyebrows. "If you should happen to have a four leaf clover with you," he said in fine irony, "I'm told they're good, too."

His eyes were scornful. His manner was derisive. Joe would have done well to have let it go at that. But he was nettled.

"We set off the last bombs," he said doggedly, "by shooting our landing rockets at them. They didn't collide with the bombs. They simply touched off the bombs' proximity fuses. If we surround the Platform with a screen of tin cans and such things, they may do the same thing. Things we throw away won't drop to Earth. Ultimately they'll actually circle us, as satellites of this satellite. But if we can get enough of them between us and Earth, any bombs that come up will have their proximity fuses detonated by the floating trash we throw out.

Sanford's expression changed. For an instant he looked! blankly astonished. But then he showed anger—but only momentarily. Then he went back to his former air of mockery.

"We might," added Joe, "we might ask for aluminum foil ribbon to be sent up in the next supply ship. We could have masses of that or maybe metallic dust floating around us."

"I much prefer used tin cans," said Sanford. The phrasing was irony, but the tone was something else.

"Very well! I'll take the watch and let everybody go out with you. By all means we must defend ourselves. Forward with the garbage! Go ahead!"

His eyes were almost hysterically scornful as he waited for Joe to leave. Joe didn't like it at all, but there was nothing to do but get out.

He found the chief with a bag filled with empty tin cans. Haney had another. There were still others for the three other members of the Platform's crew. They were getting into spacesuits when Joe came upon them. Mike was grotesque in the cutdown outfit built for him. Actually, he carried the same size air tanks as the rest—only they didn't hold air, but oxygen—and only the size of the suit was smaller than the rest. The weight of one's equipment didn't matter when there was no weight.

Joe got into his own suit. It was no such self-contained spacecraft as the fantastic storytellers dream of. It was actually a plane altitude suit aluminized to withstand the blazing heat of sunshine and the utter frigidity of shadows, and of course with magnetic soled boots. In theory, there simply was no temperature in space. In practise, a solid object in unshielded sunshine goes up to dull red heat on its sunward side, and may drop very close to minus two hundred fifty degrees Centigrade on the side that happens to be in

shadow. But space boots could be insulated. There was some trouble with larger areas.

A crewman named Corey moved into an airlock with one of the bags of empty tin cans. Brent watched in routine fashion through a glass pane in the inner lock door. The pumps began to exhaust the air from the airlock. Corey's suit visibly inflated from the difference of pressure within and without. Presently the pump stopped. Corey opened the outside door. He went out, playing out plastic rope behind him. An instant later he reappeared and removed the rope. He was fast to the line and the line was now fast to a hand hold outside. He closed the outer lock door. Air rushed into it and Haney crowded within. Again the pumping. Then Haney went out, and was anchored to the Platform not only by his magnetic boots, but by a rope fastened to a hand hold too. Brent went out. Mike. Joe came next. The chief.

They stood on the hull of the Space Platform, waiting in the incredible harsh sunshine of emptiness. The bright steel plates swelled and curved away on every hand. There were myriads of stars and the vast round bulk of Earth seemed farther away to a man in a spacesuit than to a man looking out a port. Were shadows cut across the Platform's irregular surface, there was utter blackness. Elsewhere it was blindingly bright. The men were specks of humanity standing on a shining metal hull, and all about them there was the desolation of nothingness. But Joe felt strangely proud. He took part in the pre-cautionary checkover of ropes. They were roped to each other and also to the Platform's surface. They were a straggling line of figures with—most of them—impossibly elongated shadows. They were at once oddly like and totally unlike a party of weirdly costumed mountain climbers on a glacier of gleaming silver.

But no mountain climbers ever had a background of ten thousand million stars, peering up from below them as well as from overhead. Nor did any ever have a mottled greenish planet rolling thousands of miles beneath them, nor a blazing sun with writhing prominences flaring furiously in the sky.

In particular, perhaps, no other explorers ever set out upon an expedition whose purpose was to pelt the cosmos with tin cans and garbage and coffee grounds.

They set to work. The spacesuits were clumsy, of course. It was not easy to throw with only magnetic-shoed soles for foundation. The most practical throw was straight overhead. But even that would send the refuse particles an enormous distance, in time. There was no weight to stop them nor air to slow them. The tin cans twinkled. They left the Platform at probably ten to twenty miles an hour. They floated away in every imaginable direction. They would never reach Earth, of course. They shared the Platform's orbital speed, and they would circle the Earth with it forever. But when they were thrown away, their orbits were displaced a little. Each can thrown downward just now, for example, would always be between the Platform and the Earth on this side of the Platform's orbit. But on the other side of Earth it would be above the Platform. That shining steel object, in fact, had become the center of a swarm—a cloud of infinitesimal objects which would always accompany it and always be in motion with regard to it. Together, they should make up a screen no proximity-fused bomb could pierce without exploding.

Joe heard clankings, transmitted through his shoe soles.

"What's that?" he demanded sharply. "It sounded like the airlock!"

Voices mingled in his ears. The suit-talkies allowed

everybody to speak at once. Most of them did. Then Joe heard someone laugh. It was Sanford's voice.

Sanford's aluminized, space-suited figure came clanking around the curve of this small metal world. The antenna of his suit-talkie glittered above his head. He seemed to swagger against the background of many-colored stars.

Brent spoke quickly, before anyone else could question Sanford. His tone was mild and matter-of-fact, but Joe somehow knew the tension behind it.

"Hello, Sanford! You came out? Was it wise? Shouldn't there be someone inside the Platform?"

Sanford laughed again.

"It was wise! It was very wise! It was perhaps the wisest thing anybody ever did! We're going to be killed, as you know perfectly well. It's futile to try to avoid it. So very sensibly I've decided to spare myself the nuisance of waiting for it. So I came out."

There was silence in the earphones of Joe's helmet. He heard his own heart beating loudly and steadily in the absolute stillness.

"Incidentally," said Sanford with almost hysterical amusement, "I fixed it so none of us can get back in. It would be useless. Everything's futile. So I've put an end to all our troubles for good. I've locked us all out."

He laughed yet again. And Joe knew that in Sanford's state of mind it was perfectly possible for him to have done exactly what he said.

There were eight human beings on the Platform. All were now outside it, on its skin. They wore spacesuits with from half an hour to an hour's oxygen supply. They were locked out—but it was not a matter of a key. There was no way to get back in. They had no tools with which to force an entrance. And no help could possibly reach them in less than three weeks.

If they didn't get back inside the Platform, Sanford, laughing proudly, had killed them all.

## 4

THERE WAS a babble of strained and tense and angry voices. Joe's headphones rang with them. Then the chief roared for silence. Joe found himself thinking that Sanford very probably wasn't actually insane, except as any man may be who believes in nothing but his own brilliance. Sooner or later it is bound to fail him. On Earth, Sanford's pride in his own intelligence had been useful. He'd accepted every problem and every difficulty as a challenge. But here on the Platform he'd been faced with a problem his brilliance had failed to solve. It was in effect a mockery of everything Sanford had lived by. It was like the slamming of a door in scornful derision of the source and the motivation of all his achievements, to face any evidence of his own incapacity. When the cosmos showed him up as a fool, he couldn't take it. He defied the demonstration by denying its importance and trying to scorn and deride it. He'd developed a raging contempt—a wholly false one—for the world that frustrated him. It was a childish reaction—but not everyone grows up.

When Joe solved the problem of the rising bombs, after Sanford gave it up, he took it as mockery. He couldn't accept that! So he had to do something to reassert his superiority.

And he'd done it, and when quiet succeeded the angry turmoil in Joe's headphones, Sanford chuckled to himself.

"This crazy fool's tried to commit suicide for all of us," rasped the chief. "How about it? Why can't we get back in? How many locks—"

Joe knew the situation. He could be angry later, but now was no time for such self-indulgence. They had thirty to forty minutes of breathing. No tools. A steel

hull. The locks were naturally arranged so that both inner and outer lock doors couldn't be open at the same time. That was essential to the working of an airlock. But it could be the answer, too, to the situation of the moment.

Joe spoke sharply: "Hold it! Somebody watch Sanford. All we've got to do is find which lock he came out of. He couldn't get out until it was pumped empty, and that should unlock the outer door!"

But Sanford laughed once more. He sounded like someone in the highest of high good humor.

"Heroic again, eh? But I took a compressed air bottle in the lock with me. When the outer door was open, I opened the stopcock and shut the door. The air bottle filled the lock behind me. Naturally I'd fasten the door after I came out! One must be intelligent!"

Joe heard Brent muttering, "Yes, he'd do that!"

"Somebody check it!" snapped Joe. "Make sure! It might amuse him to watch us die while he knew we could get back in if we were as smart as he is!"

There were clankings on the hull. Men moved, unfastening the lines which held them to the hull to get freedom of movement, but not breaking the links which bound them to each other. Joe saw Haney go grimly back to the task of throwing away the stuff they'd brought out for the purpose.



Then Mike's voice came, brittle and cagey, "Haney! Quit it!"

Sanford's voice rose again, horribly amused: "By all means! Don't throw away the garbage! We may need it!"

A voice snapped, "This lock's fastened..." Another voice; "And this . . ." Other voices, with increasing desperation, verified that every airlock door was implacably sealed fast by the presence of pressure inside the airlock itself.

Time was passing. Joe had never noticed before the minute noises of the air pressure apparatus strapped to his back. His exhaled breath went to a tiny pump that forced it through a hygroscopic filter which at once extracted excess moisture and carbon dioxide. The same pump carefully replaced the absorbed CO<sub>2</sub> with an equal measure of oxygen. The pump made very small sounds indeed, and the valves were almost noiseless, but Joe could hear their clickings.

Something burned him. He had been standing perfectly still while concentrating on a way out of this tragic predicament. Sunshine had beaten upon one side of his spacesuit for as long as five minutes. Despite the insulation, that was too long. He turned to expose another part of himself to the sunlight. He knew abstractedly that the metal underfoot would sear bare flesh that touched it. A few yards away in the shadow, the metal of the hull would be cold enough to turn air liquid and then to ice. But here it was fiercely hot. It would melt solder. It might—

Mike was fumbling tin cans out of the bag from which Haney had been throwing them away. He was a singular small figure, standing on shining steel, looking at one tin can after another and impatiently putting them aside.

He found one that suited him. It was a large can. He knelt, pressing a part of it to the hot metal of the satellite's hull. A moment later he was ripping it apart. The solder had softened. He unrolled a sort of cylinder, using the curved inner surface to concentrate the intolerable sunshine.

Joe caught his breath at the implications. Concentrated sunshine can be incredibly hot. Staring with unshielded, empty-space sunlight, practically any temperature is possible with a large enough mirror. Mike didn't have a concave spherical mirror. He had only a cylindrical one. He couldn't reflect light to a point, but only to a line. Mike couldn't hope to multiply the heat more than so many times, but considering what he wore on his back—

Joe made his way to the spot where Mike now gesticulated to Haney, trying to convey his meaning by gestures since Sanford would overhear any spoken word.

"I get it, Mike," said Joe. "I'll help!" Then he added, "Chief, you watch Sanford! The rest of you try to flatten out some cans or try to find some with round flat ends!"

He joined Mike, bent over the plating. His hand moved to cast a shadow where the light had played. It was dull red.

"I need more reflectors," said Mike brusquely, "but we can do it!"

Joe beckoned. Men came clanking to see, to understand, and to join in the enterprise.

The Platform rolled on through space. Where it was bright it was very, very bright, and where it was dark it was blackness. Off in emptiness the many-colored Earth shone hugely, rolling past. Innumerable incurious stars looked on. The sun flamed malevolently. The moon floated abstractedly far away.

Mike was bent above a small round airlock door. He had a distorted half-cylinder of sheet tin between his space-gloved hands. It reflected a line of intensified sunlight to the edge of the airlock seal.

Haney ripped fiercely at other tin cans. Joe held a strip of polished metal. It focused crudely—very crudely—on top of Mike's line of intensified sunshine. Someone else held the end of a round can to reflect more sunshine. Someone else had a larger reflector still.

They stood carefully still. It looked completely foolish. There were six men in frozen attitudes, trying to reflect sunshine down to a single blindingly bright spot on an airlock door. They seemed breathlessly tense. They ignored the glories of the firmament. They were absorbed in trying to make a spot of unbearable brightness glow more brightly still.

Mike cast a shadow. The steel was more than red-hot for the space of an inch or more. It would not melt, of course. It could not. And they had no tools to bend or pierce the presumably softened metal. But Mike

said fiercely, "Keep it hot!"

He squirmed. His spacesuit was fabric, like the rest, but it was bulkier on him than the suits of the others. He shifted his shoulder pack. The brass valve nipple by which the oxygen tank was filled up to pressure... He bent over, and a jet of high pressure oxygen, jetted out upon the white-hot area. A blazing storm of scintillating, streaking sparks leaped away from that special spot. A hollow in the plate appeared. The metal disintegrated in gushing flecks of light... White-hot iron hi pure oxygen happens to be highly inflammable. Steel is not incombustible at all. Powdered steel ground finely enough will burn if simply exposed to air. Really fine steel wool will make an excellent blaze if a match is touched to it. White-hot iron explodes to streaming sparks when a jet of oxygen plays upon it. Technically, Mike used the perfectly well known trick of an oxygen lance to pierce the airlock door, let the air out of the lock, and so allow the outer door to be opened.

There was a rush of vapor. The door was drilled through. Haney picked Mike up bodily, Joe heaved the door open, and Haney climbed in, practically carrying Mike by the scruff of the neck.

Joe panted, "Plug the hole from the inside! Sit on it if you have to!"

He slammed the door shut. They waited. Sanford's voice came in their earphones. It was higher in pitch than it had been before.

"You fools!" he raged. "It's useless! It's stupid to do useless things! It's stupid to do anything at all—"

There were sudden scufflings and clankings. Joe swung about. The chief and Sanford were struggling. Sanford flailed his arms about, trying to break the Chief's faceplate while he screamed furious things about futility.

The chief got exactly the hold he wanted. He lifted Sanford from the metal deck. He could have thrown him away to emptiness, but he did not. He set Sanford in mid-space as if upon a shelf. The raging man hung in the void an exact man-height above the Platform's surface. The chief drew back and left him there. Sanford could writhe there for a century before the Platform's infinitesimal gravity brought him down.

"Huh!" said the chief wrathfully. "How're Haney and Mike making out?"

Almost on the instant, twenty yards away, a tiny airlock door thrust out from the surface and a helmet and antenna appeared.

"You guys can come in now," said Haney's voice. "It's all okay. Mike's pumping out all the other locks, too, so you can come in at any of 'em."

The spacesuited figures clumped loudly to air lock doors. There were a dozen small locks hi various parts of the

hull, besides the great door to admit supply ships. The chief growled and moved toward Sanford, now raging like a madman in his helplessness.

"No, Chief," said Joe shortly. "He'd fight again. Go inside. That's an order, Chief!"

The chief grunted, and obeyed. Joe went to a nearby airlock and entered the great steel hull.

Sanford floated in emptiness, two yards from the Space Platform he'd have turned into a derelect. He did not move farther away. He did not fall toward it. There was nobody to listen to him. He cried out in blood-curdling fury because other men were smarter than he was. Other men solved problems he could not solve. Other men were superior to him. He screamed his rage.

Presently the Platform revolved slowly beneath him. It was turned, of course, by the giant gyros which in turn were controlled by the pilot gyros Joe and Haney and the Chief and Mike had repaired when saboteurs smashed them.

The Platform turned sedately. A great gap appeared in it. The door of the shiplock moved until Sanford, floating helplessly, was opposite its mouth.

A rod with a rounded object on its end appeared past the docked supply ship. It reached out and touched Sanford's helmet. It was the magnetic grapple which drew the supply ship into the shiplock. It drew Sanford, squirming and screaming, into the lock. The outer doors closed. Before air was readmitted to the inside, Sanford was suddenly still.

When they took him out of his suit he was apparently unconscious. He could not be roused. Freed, he drew his knees up to his chin in the position in which primitive peoples bury their dead. He seemed to

sleep. Brent examined him carefully.

"Catatonia," he said distastefully. "He spent his life thinking and proving that he was smarter than anybody else—probably smarter than the universe. He believed it. He couldn't face the fact that he was wrong. He couldn't stay conscious and not know it. So he's blacked out. He refuses to be anything if he can't be smartest. He's trying to be nothing." He shrugged. "We'll have to do artificial feeding and such things until we can get him down to Earth in a hospital."

"We'll have to report it to Earth," said Joe. "But I think we'd better not describe our screen of tin cans on radio. Not even on microwaves. It might leak. And we want to see if it works."

Just forty-two hours later they found out. A single rocket came climbing furiously out from Earth. It came from the night side and they couldn't see where it was launched, though they could make excellent guesses. They got a single guided missile ready to crash it if necessary.

It wasn't. The bomb from Earth detonated three hundred miles below the Platform. Its proximity fuse, sending out small radar-type waves, had them reflected back by an empty sardine can flung away from the Platform by Mike Scandia forty-some hours before. The sardine can had floated a long way from its starting point. Eventually it would very nearly return to it. But meanwhile it reflected urgent, squealing, proximity fuse waves to the climbing, bomb-carrying rocket. The rocket's fuse couldn't tell the difference between a sardine can and the Space Platform. So it exploded with a blast of pure brightness like that of the sun.

The Platform went on its monotonous round about the planet from which it had risen only weeks before. San-ford was strapped in a bunk and fed through a tube, and on occasion intravenously. He was kept alive. The men on the Platform worked. They made telephoto maps of Earth. This had been done before, by astronauts in space capsules, and weather satellites and the like. But the Space Platform photographs were superior. There was much such work to be done. For example, the Platform could take long exposure photographs of Mars with no atmosphere to hinder. Previously, the best information had come from fly-by satellites which sent television pictures back. Then there were really detailed studies of the solar constant. Radar brought back much more precise information about the frequency and size—and courses—of meteoric bodies than had ever been had before. And there were some bits of apparatus that needed really good vacua. They were made. There was plenty to do!

But sometimes Joe managed to talk to Sally.

It was very satisfactory to have personal conversations. Their talk couldn't be really private, of course. There was always the chance of something being picked up. But she told him she was well, and wanted to read him newspaper clippings about the reports Brent had sent down. Brent was now in command of the Platform since San-ford lay in resolute coma. But Joe discouraged the newspaper articles.

"How's the food?" asked Sally. "Are you people getting any food from the hydroponic garden?"

They were, and he told her so. The huge chamber in which sunlamps glowed for a measured number of hours and minutes in each twenty-four hours produced an incredibly luxuriant vegetation. It kept the air breathable. It even changed the smell of it from time to time, so there was no feeling of staleness. \

"And the cooking's really practical?" she wanted to know. She was partly responsible for that too. "And how about the bunks?"

"I sleep now," Joe told her.

That had been difficult, at first. It was possible to get used to weightlessness while awake. One might slip, sometimes, and find himself suddenly tense and panicky because he'd notice that he was falling. But the bunks were designed to help in this difficulty. Each bunk had an inflatable top blanket. One crawled in and settled down, and then turned the petcock that inflated the blanket. Then the air pressure held one quite gently yet firmly enough to be reassuring. With a little care about what one thought of before going to sleep, one could get a refreshing eight hours' rest. The bunks were luxury.

Sally said, "The date and time's a secret, of course, because it might be overheard, but there'll be another ship up before too long. It's bringing landing rockets for you to come back with."

"That's good." It would feel good to set foot on solid Earth again. Joe continued, "We've got a date the evening I get back?"

"We've got a date," she said.

But it couldn't be a specific date. There were people with ideas that ran counter to plans of that sort. The Space Platform was not uniformly admired by all the nations of Earth. The United States had built it because the United Nations wouldn't, and one of the attractions of the idea had been that once it got out to space and was armed, peace must reign upon Earth because anybody who started a war could be slapped down.

But so far it wasn't armed well enough. Six missiles couldn't defend it indefinitely. It looked helpless, and its enemies didn't intend for it to be helped. They'd try to smash it first.

A week after Joe reached it with six missiles, three rockets attacked from Earth. They went up from somewhere in the middle of the Pacific. One blew up two hundred ninety miles away. For safety's sake the third was crashed—at the cost of a missile—when it had come within fifty miles.

The screen of tin cans worked, but it wasn't thick enough. The occupants of the Platform went about hunting for sheet metal that could be spared. They pulled out minor partitions here and there, and went out on the surface and threw away thousands of scraps of metal in all directions.

Two weeks later, there was another attack. It could be calculated that Joe couldn't have carried up but so many missiles. There might be as few as two of them left. So eight rockets came up together—and the first of them went off four hundred miles from the Platform. Only one got as close as two hundred miles. No missiles were used in this defense.

The Platform's enemies tried once more. This time the bomb-carrying rockets arched up above the Platform's orbit and dived on the artificial moon from above. They went off at a hundred eighty and two hundred seventy miles from their target. Joe's trash screen wouldn't work on Earth, but in space it was an adequate defense against anything equipped with proximity fuses. It could be assumed that in a full-scale space war nuts, bolts, rusty nails and beer bottle caps would become essential military equipment. Three days after this last attack, a second supply ship took off from Earth. Lieutenant-Commander Brown was a passenger. Its start was just like the one Joe's ship had made. Pushpots lifted it, jatos hurled it to space, and its own furious, flaming takeoff rockets drove it valiantly out toward the stars.

Joe's ship was hauled out of the lock and moored against the outside of the Platform. The second ship made contact in no longer a time than Joe had required. It arrived with landing rockets for its own return safely on board, and landing rockets for Joe's ship to get down to ground on. But those landing rockets and Lieutenant-Commander Brown were practically all its payload. It couldn't bring up anything else.

Lieutenant-Commander Brown called a very formal meeting in the huge living space at the Platform's center. He stood up grandly in full uniform—and had to hook his feet around a chair leg to keep from floating away. He ignored the slight mischance and in a very official voice he read two documents. The first detached Lieutenant-Commander Brown from his regular naval duties and assigned him to work temporarily with the Space Exploration Project. The second was an order directing him to take command and assume direction of the Space Platform.

Having read his orders, he cleared his throat and said cordially, "I'm honored to serve here with you. Frankly, I expect to learn much from you and to have very few orders to give. I expect merely to issue such directions as experience at sea has taught me is necessary for a happy ship. I trust this will be one."

He beamed. No one was impressed. It was perfectly obvious that he'd simply been sent up to acquire experience in space for later use, and that he'd been placed in command because it was unthinkable that he'd serve under anyone without official rank. And he quite honestly believed that his coming, with experience in command, was a blessing to the Platform. In fact, there was no danger that this commander of the Platform would crack up under stress as Sanford had done.

But it was too bad he hadn't brought some missiles with him.

Joe's ship had brought up twenty tons of cargo and twenty tons of landing rockets for its own use. But it used them up detonating the first rocket-carried bombs aimed at the Platform. The second supply ship brought twenty tons of landing rockets for Joe's ship, and twenty tons of landing rockets for itself. That was all. This second trip to the Platform was a rescue mission and nothing else. Arithmetic wouldn't let it be anything else. Also, there were only two supply ships so far ready for service. They were needed to carry supplies.

So only thirty-six hours after the arrival of the second supply ship at the Platform, the two of them took off together to return to Earth. Joe's ship left the airlock first. Sanford was loaded in the cabin of the other. He was cargo only. Lieutenant-Commander Brown stayed out at the Platform to replace him.

Obviously, in order to get down to Earth they headed up and away from it. They pointed their noses at the Milky Way.

The upward course was an application of the principle that made the screen of tin cans and oddments remain about the Platform. Each of those small objects had had the Platform's speed and therefore its orbit, and that was the reason it had no weight. But when it was thrown away from the platform, it lost little or none of its orbital speed. But the center of its orbit was displaced. The center was originally the center of the Earth. The new center might be as much as two or three hundred miles away.

The returning supply ships also started out with the orbit and speed of the platform. But they wanted to arrive at Earth with an orbit that was very far removed from a circle. The idea was to approach on an elliptical course, barely touch atmosphere, lose some speed to it, bounce out to space and cool off and then slip down to touch air again and once more to lose speed to it until finally they'd stay down, the stubby fins would give them some sort of controls in air, and they'd land with their landing rockets expended and—that would be that.

But to get that elliptical course they headed away from Earth. The Platform dwindled behind them. Night flowed below until the Platform shone brightly against a background of pure darkness. Then it glowed redly, glowed crimson, glowed the deepest possible color that could be seen, and winked out. The two supply ships climbed on.

Nothing happened. They stayed near each other for companionship, perhaps. They were fifty and then sixty miles apart. One glowed red and vanished in the Earth's shadow. The other was extinguished in just the same way. They went hurtling through the blackness which was night above Earth. Microwaves from the ground played upon them—radar used by friend and foe alike—and the friendly radar guided tight beam communicators to assure them that their separate courses and heights were just about the calculated optimum. But they could not be seen at all.

When they came out into sunshine again they were no farther from each other than before. They were descending. The centers of their orbits had been very, very far displaced.

Going out, naturally, the ships had lost angular speed as they gained in height. Descending, they gained in angular velocity as they lost in height. They were hardly thirty miles apart as they seemed to dive toward their home planet and rushed toward the edge of the world's disk. When they were two thousand miles high, the Earth's surface moved under them much faster than it had on the way up. When they were a thousand miles high, the seas and continents seemed to flow past like a rushing river. At five hundred miles, mountains and plains were just distinguishable as they raced past underneath. At two hundred miles there was merely a churning, hurtling motion on which one could not focus one's eyes.

They missed the surface by just—just—barely under two hundred miles. They hit air—air almost as thick as the air inside the almost-complete vacuum in an electric light bulb. They were traveling at a completely impossible speed. The energy of their position in orbit had been transformed into kinetic energy of motion past the Earth's surface. And at that speed even the almost-vacuum of two hundred miles height had a violent effect.

A thin humming sound began. It grew louder. The substance of the ship was responding to the impact of thin air upon it. The sound rose to a roar, to a bellow, to a thunderous tumult. The ship quivered and trembled. It shook. Vibrations set up and increased in amplitude. The whole ship shook with a dreadful persistence, each vibration more monstrous, more straining, more ominous than before.

The four in the supply ship felt weight returned in the form of deceleration.

They endured. Nothing at all could be done. At so many miles per second no possible human action could change any happening. Intolerable weight oppressed them. The ground below was merely a blur. There was a black sky overhead, which did not seem to stir. But cloud masses rushed at express train speeds below him, and a body weighed a considerable fraction of a ton, and the ship made the sound of innumerable thunders, and it shook, and shook ...

Then, when it seemed that it must fly utterly to pieces, the thunder diminished to a bellow, to a roar. And the unthinkable weight disappeared. The ship was in clear space once more.

The Earth's surface was farther away and moving farther still. They were two hundred fifty miles high. Three hundred. Four.

There was no longer any sound at all except their gasp-ings for breath. Their muscles had refused to lift their chest during the most brutal of the deceleration period.

Presently Joe croaked a question. He looked at the hull temperature indicators. They read very, very high. He found that he was bruised where he had strapped himself in. The places where the straps had held him against the ship's vibrations were deeply black and blue.

The chief said thickly, "Joe, I don't think this is going to work. When do we hit again?"

"Three hours plus or minus something," said Joe, dry-throated. "We'll hear from the ground."

Mike said in a cracked voice, "Radar reports we went a little bit too low. They think we weren't tilted up enough. We didn't bounce as soon as we should've."

Joe unstrapped himself. "How about the other ship?" "It did better than we did," said Mike. "A couple of hundred miles ahead of us now. Down at the Shed they're recalculating for us. We'll have to land with six grazes instead of eight like we figured. We lost too much speed."

Joe went staggering, again weightless, to look out a port for the other supply ship. He should have known better. One does not spot a ship eighty feet long when it is two hundred miles away. Not with the naked eye, anyhow.

But he saw something, though for seconds he didn't know what it was.

His own ship was now probably four hundred miles high and still rising. Joe was dazed and battered by the shaking of the ship in the air graze just past. The sister ship hadn't lost so much speed. It was higher, though he couldn't see it.

What he did see was a thread of white vapor rising out of the mists at the horizon. It rose straight up, and it was a hundred miles tall, and its base expanded enormously before it grew thin and ceased to be. It was a rocket trail. The violence of its writhings told of the fury with which the rocket climbed.

It was on its way to meet the other supply ship.

It did. Joe saw the thread of vapor grow straight up until it was higher than he was. He never saw the other ship. It was too small. But he saw the burst of sun-bright flame which was the explosion of a proximity fuse bomb. He knew, then, that nothing but incandescent radioactive gas remained of the other ship and its crew.

Then he saw the trail of the second rocket. It was rising to meet him.

## 5

THE FOUR of them watched through the ports as the thread of vapor rose upward. They hated this rocket and the people who'd built it. The chief muttered in Mohawk. The words sounded as if they should have blue fire at their edges and smell of sulphur. Mike said crackling things in his small and brittle voice. Haney stared, his eyes burning. The supply ship was a little over four hundred miles high—two hundred miles above atmosphere of sensible effect at this velocity. The rocket reached a height of two hundred miles. Ship and bomb-carrier, they approached each other at a right angle, the rocket going up to meet the

ship where it could not but rendezvous. And the people aground had had unfortunate experiences with proximity fuses. At a range like this they'd have the rocket under absolute control and they'd explode its bomb by observation. It would not need to strike the ship. An atomic warhead blast in space would vaporize any substance that could exist, within many, many miles. And of course the ship could not turn back. Even the expenditure of all its landing rockets could not bring it to a halt, and if they did it would drop practically like a stone. The supply ships were designed to lose velocity by grazing, bouncing, repeated contacts with the atmosphere, and then to use landing rockets to get down to ground. In this present situation they could increase the supply ship's speed so it would pass the calculated meeting place ahead of the bomb-carrier. But that would simply turn, under control, and follow in a stern chase. In any case the supply ship could not stop.

But neither could the rocket.

Joe never knew how he saw the significance of that fact. On land or sea, of course, an automobile or a ship moves strictly in the direction in which it is pointed.

Change its aim and you change its course. But an object in space moves on a course which is always the sum of its previous speeds and courses. Joe's ship was moving eastward at so many miles per unit of time. If he drove north—at a right angle to his present course—the ship wouldn't cease to move to the east. It would simply move northward in addition to moving east—northeast. If the rocket from Earth turned north or east it would continue to rise and merely add the other motion to its vertical rise.

Joe stared at the uncoiling thread of vapor. He hated it so fiercely that he wanted to defeat it at any cost, including destruction. At one moment he was hardly aware of anything but his own fury and his frantic desire to frustrate the rocket at any cost. The next instant his mind was too busy for anger. Because it had somehow turned up the fact that the war rocket could no more turn back than he could, and he saw the meaning of that fact.

"Mike!" he snapped. "Get set! Report what we do! Everybody get set for acceleration. Steering rockets ready, Chief! Get set to help, Haney! I don't know whether we'll get out of this alive, but—we get into spacesuits, and fast!"

Then he literally dived back to his acceleration chair and strapped himself down in feverish haste. The ship was then a quarter of the way to the meeting place and the rocket had farther to travel. But it was rising fast. Joe found himself panting, "The rocket's—rising faster than we are; It's been gaining altitude *and* speed of climb! And it can't stop going up! We duck under it!"

He made no calculations. There wasn't time. The enemy rocket was racing skyward at a continually faster rate as it burned its rocket fuel and became lighter. If the supply ship dived under it, it simply couldn't stop. So the supply ship's gyros whined and its steering rockets growled. It spun in emptiness. Its nose pointed to the Earth.

"Haney!" panted Joe. "Watch out a port to see if we'll make it! And hold fast!"

Haney moved forward. Joe had forgotten the radar, because he could see with his own eyes. Mike spoke curtly into the microphone broadcasting to ground. He was reporting each action and order as it took place and as

Joe spoke. There was no time for explanations. The chief watched the radar screen while he worked the steering rockets of the ship. He reached over and made a dot on the screen with a grease pencil. The blip which was the murder rocket moved. He made another dot. The blip continued to move. He made other dots.

They formed a curving line which moved inexorably toward the center of the radar screen. The curve would cut the screen's exact center. That meant collision.

Mike said brittly, "Too close, Joe! We're getting too close!"

"We'll see!" said Joe very grimly. "Landing rockets firing, three—two—one!"

The bellow of landing rockets smote their ears. Weight seized them—three gravities of acceleration toward the rushing flood of clouds and solidity which was the Earth. The ship plunged downward. It was intolerable, after what they'd been through before, and after so long in weightlessness at the Platform.

Mike took acceleration better than the others, but his voice was thin when he said triumphantly, "It looks—like this does it, Joe!" Seconds later he panted. "Right! We're under it! The rocket's above us and still going away!" The gyros whined again. The ship plunged into vapor which was the trail of the enemy's fumes. For an instant the flowing confusion which was Earth was blotted out. Then it was visible again. The ship plunged downward, but still eastward, and its angular momentum was un-diminished so its speed with relation to the earth's surface went up and up and up....

"Mike—" panted Joe. "Get the news out—what we did and why! I'm going to turn the ship's head back on its course. We—can't slow enough but I'd rather—crash than have them—blast us—"

The ship turned again. It pointed westward, while its velocity was enormous toward the east. The landing rockets that had dodged the war rocket now tried to cut down the landing ship's speed. The first of them burned out. Joe hammered down the firing button of the second set. It was like a blow all over his body when the rockets thrust again.

Now it felt, of course, as if the ship had turned in its course and reversed its direction. But the clouds and colors below them flowed away ahead. The ship hurtled backward while its rockets burned and burned.

The ground looked like the wake of an impossibly fast ship, going away ahead. It fled from them.

"This is—crazy," said Joe with difficulty. "If the ship were lighter—or if we had more rockets—we could land, all right. Now we won't, but—"

Haney turned his head from where he clung near the bow ports. His features changed as he spoke, because of acceleration-driven blood engorging his lips and bloating his cheeks. After one instant he shut his eyes. They felt as if about to pop out of his head. He gasped, "Joe... Get into air... Not a good chance, but with the ejection seats we might—make it."

**He** began to let himself back toward his acceleration chair. He could not possibly have climbed against the pressure of the landing rockets. It was a horrible task to let himself down with many times his normal weight pulling at him. Once he almost slipped.

The landing rockets roared and roared, and Joe tilted the ship's bow down a little farther so that the streaming clouds came nearer.

Haney got to the acceleration chair. He lay in it, his eyes closed.

Mike barked, "What're the chances, Haney?" "Rocket flames, he managed to say. "Just probably—pushed back—wind—splash on hull—may melt—lighten weight—thousand to one against—"

The odds were worse than that. The ship couldn't land because its momentum was too great for the landing rockets to cancel out. If it had weighed five tons instead of twenty, its rockets might have landed it. But Haney was saying that if the ship were to be lowered into air while rushing irresistibly stern first, that the rocket flames might be driven back by the wind. Instead of streaking astern in a lancelike fashion, they might—just barely conceivably—they might be reformed into a mushroom shape like that of a rocket flame at the instant of takeoff, when the ground splashes it sidewise. Only, here the flames might be spread until the ship's now empty cargo space melted. And three-fourths or more of the hull might be torn loose from the cabin section. So much was so near statistical impossibility that nobody would have attempted it in cold blood.

But there was more and worse. They were already decelerating at so many gravities that if part of the ship burned or melted or was torn away, *if* the landing rockets didn't go with the broken-away section, the landing rockets could push the ship into such acceleration that its four occupants would die of sheer artificial weight.

Nevertheless, there was nothing else to do. They were due to be killed anyhow. So Joe tried it. He dived into atmosphere. At two hundred miles a thin wailing seemed to begin. At one hundred there was a shrieking which made one's ears hurt. At fifty there was as horrible a vibration and as deadly a deceleration as during the air graze now a halfout past. Here the second set of landing rockets burned out and for seconds there was a little—a very little relief from that part of their anguish which was due to the rockets. But Joe fired the third pair.

And now the inevitable happened. The hull temperature indicators showed the forepart of the hull at dull red heat. Astern—as the ship now traveled—air could not move away from the ship because it



was traveling faster than the speed of sound. It compressed to white heat at the entering surface,— exactly as air is compressed before a falling meteor—and the metal plating there went to bright red. But there were the rocket flames. They were confined by the pressure of air behind them. They bathed the tail area of the ship in intolerable incandescence. Hull plates, braces, and beams flared— And the tip of the tail caved in. The ship's empty cargo space was instantly filled with air at intolerable pressures and temperatures.

The hull exploded outward. There was a moonstrous, incredible moment—and the ports were filled with light, and then the rest of the fuel in the last pair of landing rockets went off.

Joe lost consciousness as instantly and peacefully as if he had been hit on the jaw.

An unknown but brief time later he found himself alive. Radar observation is authority for the statement that the cabin part of the ship remained intact long enough for its vastly diminished weight to let it slow below mach one. It began a long, curving fall to the ground. It reached terminal velocity. Four small objects were ejected from it. They were left behind as the cabin portion of the ship continued to descend.

It was then, of course, far below orbital speed. It was light enough for wind-resistance to have effect on it. Even so, it traveled forty-seven miles to the eastward between the point of its explosion and the impact of what was left. It hit a hillside and dug a very large crater where it arrived.

But there was nobody inside it. A little over a month before, it had seemed to Joe that ejection seats were the least useful of all possible pieces of equipment to have in a space ship. He'd been mistaken.

An ejection seat can let a jet pilot bail out well above mach one and live to tell about it. Four ejection seats had done the same thing for the four crewmen of the supply ship. They'd flung them out to emptiness when the amputated cabin section of the ship was down to no more than twenty-five miles above the ground. The ribbon parachutes did not split or burst. The men were in their spacesuits, so they did not suffocate on the way down to a breathable destiny of air. The ribbon chutes did, in landing, nearly break the necks of the supply ship's crew, but they got them down in one piece each. It was quite preposterous. Mike, the lightest and first ejected, was latest to come to ground. The chief and Joe landed almost together. After a long time, Joe exhaustedly got out of his spacesuit and tried to help the chief, and they held each other up as they stumbled off together in search of Haney.

When they found him he was sleeping heavily in a cane brake. He'd opened his face plate, but he hadn't bothered to disengage his parachute or take off his suit.

## 6

A GOOD DEAL of that landing remained confused in Joe's mind. While it was going on, he was much too busy to absorb impressions. When he landed, he was completely wrim out. It was only during the next day that he even tried to sort out his recollections.

Twenty hours, altogether, remained more or less vague at the beginning. Then he woke up suddenly with a peculiar roaring noise all about him. He blinked his eyes and listened. Presently he realized what the noise was, and wondered that he hadn't known before. It was the roaring of the motors of a multi-engined jet plane. He knew without remembering the details for the moment, that he and the other three were on a plane bound across the Pacific for America. He was in a bunk, and he felt extraordinarily heavy. He tried to move, and it was an enormous effort even to stir. He struggled to turn over, and found straps holding his body down.

He fumbled at them. They had readily releasable clasps, and he loosened them easily. After a while he struggled to sit upright. He was either horribly heavy or horribly weak—he couldn't tell which.

Twinges of pain accompanied every movement. He sat up, swaying a little with the slow movements of the plane, and gradually everything came back.

The landing in the ribbon chute. They'd come down somewhere on the west coast of India, not too far from the sea. He remembered crashing into the edge of a thin jungle and stumbling to open ground. He'd found the chief, and the two of them searched for Haney and blundered upon him. Then they laid out a signal for searchers from the air, and went into worn-out slumber. They'd known, even then, that Mike would undoubtedly

have landed some distance away because of his lesser weight.

There'd been a patrol of destroyers under the landing path of the supply ship, and their radar reported the destruction of one supply ship and the frantic diving of the other, its division into at least two major parts, and then the ejection of tiny objects from the smaller cabin section, which had descended as only ejection seat parachutes could have done. Two destroyers steamed under those drifting specks, to pick them up when they should land. But other destroyers took other action.

The trailing vessels reached Goa harbor within hours of the parachutes' descent. A helicopter found the first three of them within hours after that. They were twenty miles inland and twenty south of Goa. Mike wasn't located until the next morning. He traveled a very considerable distance beyond the others.

But things—satisfying things—had happened in the interval. Sitting *dizzily* on the bunk in the big jet, Joe remembered the gleeful, unofficial news passed around on the destroyers. They waited for Mike to arrive. But they rejoiced in the meanwhile.

The report was authentic, but it never reached the newspapers. Nobody would ever admit it, but the rockets aimed at the returning supply ships had been spotted as they went up from the Arabian Sea. And the ships of the radar patrol couldn't do anything about the rockets, but they could and did converge savagely upon the places from which they'd been launched. And—

Somewhere there was a navy department that could write off two atomic-powered submarines with rocket-launching wells, from which it had last heard when they were west of India. United States navy men would profess bland ignorance of any such event, but there were acres of dead fish floating on the ocean at a certain spot. Depth bombs had hunted down and killed two shapes much too big to be fish, which didn't float when they were killed, and which would never report back how they'd shot down two space-craft on the way down to land. There'd be seagulls feasting in that area and there'd be vague tales about it all the way from Goa to the bazaars of Hadramut.

But nobody would ever admit knowing anything for certain.

But Joe knew. He got to his feet, wobbling. He ached everywhere. His muscles protested the strain of holding him erect. He held fast, summoning strength. Where his safety belt had held him he was one wide bruise. That was from the killing acceleration and the jolts on the way to ground. Haney and the chief would be in as bad shape or worse. Mike would have had it easier, but the others felt rather as if they'd been rolled down Mount Everest in a barrel. All of them had slept for fourteen hours straight before they even woke up for food. Even now Joe didn't remember boarding this plane or getting into the bunk. He'd probably been carried in.

He began to dress. It was astonishing how many sore places he found. It was startling how heavy his arms and legs felt, and how much of an effort even sitting erect was. But he began to remember Mike's adventure, and managed to grin feebly. It was the only item worth a smile in all the things that had happened.

Mike's landing was quite different from the rest. Joe and the chief had landed close to the edge of a jungle. Haney'd landed in a cane brake. But Mike came floating down from the sky, magnificently attired and swaying splendidly, into the status of a minor godline.

He was relatively unharmed by the shaking-up he'd had. The strength of muscles depends on their cross-section, but their weight depends on their volume. The strength of a man varies as the square of his size, but his weight as the cube. So Mike had taken the deceleration and the murderous vibration almost in his stride. He'd floated longer and landed more gently than the rest.

Joe grinned to himself. Mike had arrived on the destroyer in Goa harbor in a towering, explosive fury.

When his ribbon parachute let him down out of the sky, it deposited him gently on ploughed fields not far

from a small and primitive Hindu village. He'd been seen to descend from the heavens. He was a midget, not as other men, and he was dressed in a glittering aluminum space-suit. The Hindu villagers greeted him with rapture.

When searchers found Mike, they were just in time to prevent a massacre—by Mike. Adoring villagers had sized upon him, conveyed him in high state to a red mud temple, seemingly tried to suffocate him with proofs of their pride and joy at his arrival, and dark-skinned maidens tried hopefully to win his approval of their dancing. But the rescue party found him with a club in his hand and blood in his eye, setting out furiously to change the tone of his reception.

Joe still didn't know all the details, but he' tried to concentrate on what he did know as he put his uniform on again. He didn't want to think how little that uniform meant, now. The silver rocket badge didn't mean a thing. There weren't any more rocket ships. The Platform wasn't a ship, but a satellite. There'd never been more than two ships. Now there were none.

Joe went painfully forward in the huge and roaring plane. The jet motors thundered. It was not easy to walk. He held on to hand holds as he moved. But he progressed past the bunk space, and there was Mike, sitting at a table and stuffing himself with good honest food. Joe caught glimpses of illimitable distances through a port beside him. There were clouds and sky and sea.

Mike nodded. He didn't offer to help Joe walk. That wouldn't have been practical. He waited until Joe sank into a seat opposite.

"Good sleep?" asked Mike.

"I guess so," said Joe. He added ruefully, "It hurts to nod, and it'd be worse to shake my head. What's the matter with me, Mike? I didn't get banged up too badly in the landing."

"You got messed up before we started down," said Mike. "Worse than a banging-up! You spent better than six weeks out of gravity, where in an average day you took less exercise than a guy in bed with two broken legs."

Joe eased himself to a more comfortable position. He felt about six hundred years old. Somebody poked a head into view and withdrew it. Joe lifted his arm and regarded it. "Heavy! I guess you're right, Mike."

"I know I'm right," said Mike. "If you spent six weeks in bed you'd expect to feel feeble when you got up. On the Platform you didn't even exert yourself to stand! We didn't realize it, but we were living like invalids. Worse! We'll get our strength back, but next time we've got to take measures. Huh! Take a trip to Mars in free fall, and by the time a guy got there his muscles'd be so flabby he couldn't stand up in half-gravity! Something's got to be done about that, Joe!"

Joe said somberly, "Something's got to be done about space ships before that comes up again!"

Someone appeared with a tray. There was food on it, smoking-hot food. Joe looked at it and knew that Ms appetite, at any rate, was back to Earth normal.

"Thanks!" he mumbled appreciatively. He attacked the food.

Mike drank his coffee. Then he said, "Joe, do you know anything about powder metallurgy?"

Joe shrugged. "Powder metallurgy? Yes. I've seen it used, at my father's plant. They made small parts with it. No machining. Why?"

"Do you know if anybody ever made a weld with it?" asked Mike.

"I think so. At the plant they did it. They had trouble getting the surfaces clean enough for welding. But they managed it. Why?"

"One more question," said Mike somehow tensely. "How much Portland cement is used to make a cubic yard of concrete?"

"I wouldn't know," said Joe. "Why? What's this all about?"

"Haney and the chief," said Mike bitterly, "those two big apes have been kidding me—so long as they could stay awake—for what happened to me when I landed. Those infernal savages!" Mike seethed. "They

got my clothes off and they had me smeared all over with butter and flower necklaces around my neck and flowers in my hair! They thought I was some kind of heathen god. Hanuman, somebody told me. The Hindu monkey god!" He raged. "And those two apes think it's funny? Joe, I never thought I knew all the words for the cussing I

gave those heathen before our fellas found me! And Haney and the chief will drive me crazy if I can't slap 'em down! Powder metallurgy will do the trick, from what you tell me. That's okay, then."

He stood up and stalked toward the front of the plane. Joe roused himself with an effort. He turned to look about him. Haney lay slumped in a reclining chair, his eyes closed. The chief lay in another chair. He smiled faintly at Joe, but he didn't try to talk. He • was too tired. The return to normal gravity bothered him as it did Joe.

Joe looked out the window. In neat, geometric spacing on either side of the jet transport, there were fighter jets. There were other flights above and further away. Joe saw, suddenly, a peeling-off of planes from the farthest formation. They dived down through the clouds. He never knew what they went to look for or what they found. He went groggily back to his bunk in a strange and embarrassing weakness.

He woke again when the plane landed. He didn't know where it might be. Looking out, he could see that it was an island. He could see the wide sun-baked white of the runways. He could see seabirds in clouds over at the edge. The plane trungled and lurched slowly to a stop. A service truck came growling up and somebody led cables from it up to the engines. Somebody watched dials and waved a hand.

There was silence. There was stillness. Joe heard voices and footsteps. Presently he heard the dull booming of surf. He wondered vaguely why this ship had landed here, instead of refueling in flight if that proved necessary.

The plane seemed to wait for a very long time. Then there came a faint and distant rumbling and presently a plane appeared in the east. It was first a dot and then a vague shape and then an infinitely graceful thing which swooped down and landed at the other end of the white strip. It came taxiing up alongside the transport. It stopped.

An officer in uniform climbed out and waved his hand. He walked over to the ship in which Joe watched. He climbed aboard. The pilot and copilot followed him. They took their places. The door closed. One by one, the jets roared into life.

The officer came to where Joe struggled to feel normal. Mike regarded ban suspiciously. The plane stirred.

The new arrival said pleasantly, "I'm sent out here, Kenmore, to be briefed on what you know and to do a little briefing hi return."

This explained the landing and the wait, here. The transport began to roll down the runway. It jolted and bumped, and then abruptly surged forward and was airborne. Joe could see that the island was nearly all airfield. There were a few small buildings and distance-dwarfed hangars. Beyond the field proper there was a ring of white surf. That was all. The rest was ocean.

"I haven't much to tell," said Joe. "But what I can—  
of course—"

The other man brought papers out of a briefcase. There seemed to be hundreds of pages. They were filled with questions. Joe'd be called on to find answers for most of them, and to admit he didn't know the rest. When he was through with this, every possible useful fact he knew would be on record for future reference. And now he realized that this was part payment for the efficiency and speed with which the Navy had trailed them on their landing and for the use of a big plane to carry them back to the United States.

"I'll tell you what I can," repeated Joe, "but what am I to be briefed about?"

"That you're not back on Earth yet," said the officer curtly, pulling out the first sheaf of questions.

"Officially, you haven't left the Platform. Ostensibly, you haven't \ even started back.;" Joe blinked at him.

"If your return were known," the lieutenant explained, "the public would want to make heroes of you. First real space travelers, and so on. They'd want you on television telling about your adventures and

return. What happened to your ship would come out. And if the public knew you'd been waylaid and more or less shot down, they'd demand violent action. It'd be something like the tumult over the sinking of the *Maine*, or the *Lusitania*, or maybe Pearl Harbor. It's much better for your return to be a secret for now."

Joe said wryly, "I don't think any of us want to be smothered in tickertape. That part's fine! I'm sure the others will agree."

"Good! One more difficulty. We had two spaceships. Now we have none. Our most likely enemies haven't only been building rockets. They've got a space fleet coming along. Intelligence just found out their prototypes are about ready for trial trips. They've been yelling to high heaven that we were building a space fleet to conquer the world. We weren't. They were. And it looks very much as if they may be getting ahead."

He set out the mass of papers in order, to call for every conscious or unconscious observation Joe might have made in space. It was the equivalent of the debriefing interviews extracted from fliers after a bombing raid. It was necessary, but Joe was still very tired. He began to answer the questions as they were put to him. Presently he seemed to hear his own voice giving replies, but all he really wanted to do was doze.

They arrived in Bootstrap some twenty-eight hours after the crashing of their ship. Joe, at least, had slept more than half the time since he'd been back in gravity. He was still wobbly on his feet, and would be for days yet, but his disposition was much improved.

There was nobody waiting at the airfield by the town of Bootstrap when they landed, but as they rolled toward the control tower a black car pulled out and ran alongside until they stopped. Joe got out and got hi the car. Sally Holt was there. She took both his hands and cried, and he was horribly embarrassed when the chief came blundering in after him.

But the chief growled, "If he didn't kiss you, Sally, I'm going to kick his pants for him."

"He—he did," said Sally, gulping. "And I'm glad you're back, Chief. And Haney. And Mike."

Mike grinned as he climbed in the car. Haney climbed in after him. The car started away. It swerved across the field and onto the ribbon of highway that led out of Bootstrap and to the Shed. It sped out and away, and the

desert was abruptly all around them. Far ahead, the great round dome of the Shed looked like a cherry pit on the horizon.

"It's good to be back," said the chief. "I feel like I weigh a ton, but it's good to be back! Mike's the only one who was happy out there. He figures he belongs out yonder. I've got a story to tell you, Sally—"

"Chief!" said Mike fiercely, "Shut up!"

"Won't," said the chief amiably. "Sally, this guy Mike—"

Mike went pale. "Maybe you're too big for me to kill," he said bitterly, "but I'll try it!"

The chief grunted at him. "Quit being modest! Sally—"

Mike flung himself at the chief, literally snarling. His small fist hit the chiefs face—and Mike was small but he was not weak. The *clack!* of the impact was loud in the car. Haney grabbed. There was a moment's frenzied struggling. Then Mike was helplessly wrapped in Haney's arms, incoherent with fury and shame.

"Crazy fool!" said the chief, feeling his jaw. "What's the matter with you? Don't you feel good?" He was angry, but he was more concerned. Mike was dead-white and raging.

"You tell that—" Mike panted shrilly, "and so help me—"

"What's got into you?" demanded Haney anxiously. "I'd be bragging if I'd got a brainstorm like you did! That guy Sanford would've killed us all—"

The chief said angrily, between unease and puzzlement: "I never knew you to go off your nut like this before! What's got into you, anyway?"

Mike gulped suddenly. Haney still held him fast, but both Haney and the chief were looking at him with

worried eyes.

"You were going to tell Sally—"

The chief snorted. "Huh! You fool little runt! No! I was going to tell her about you opening up that airlock when Sanford locked us out! Sure I kidded you about what you're talking about! Sure! I'm going to do it again! But that's amongst us! I don't tell that outside!"

Haney made an inarticulate exclamation. He understood, and was relieved. But he looked disgusted. Abruptly he released Mike, rumbling to himself. He stared out the window. Mike stood straight, an absurd small figure. His face worked a little.

"Okay," said Mike, with some difficulty. "I was dumb. Only, Chief, you owe me a sock on the jaw when you feel like it. I'll take it."

He swallowed. Sally watched, wide-eyed.

"Sally," said Mike bitterly, "I'm more of a fool than I look. I thought the Chief was going to tell you what happened when I landed. I—I floated down in a village over there in India, and those crazy savages had never seen a parachute, and they began to yell and make gestures, and first thing I knew they had a litter and were piling me hi it and throwing flowers all over me, and there was a procession—"

Sally listened blankly. Mike told the tale of his shame with the very quintessence of bitter resentment. When he got to his installation in a red-painted mud temple, and the reverent and forcible removal of his clothes so he could be greased with butter, Sally's lips began to twitch. At the picture of Mike in a loin cloth, squirming furiously while brown-skinned admirers sang his praises; howling his rage while they celebrated some sort of pious festival in honor of his arrival, Sally broke down and laughed helplessly. Mike stared at her, aghast. He'd felt that he hated the chief when he believed the chief about to tell this story. He'd told it on himself as a sort of penance for the blow he'd given the chief. To Mike it was still tragedy. It was still an outrage to his dignity. But Sally was laughing. She rocked back and forth next to Joe, helpless with mirth.

"Oh, Mike!" she gasped. "It's beautiful! They must have been saying such lovely respectful things while you were calling them names and wanting to kill them! They'd have bragged to each other about how good you were, visiting them because they'd been such good people—and—and this was a reward for their well-spent lives, and you—you—"

She leaned against Joe and shook. The car went on. The chief chuckled. Joe watched Mike as this new aspect of his

disgrace dawned upon him. It hadn't occurred to Mike that anybody but himself had been made ridiculous. It hadn't occurred to him that the chief and Haney would ride him mercilessly among themselves, but wouldn't dream of letting anybody outside the gang do so.

Presently Mike managed to grin a little. It was a twisty grin, and not altogether mirthful.

"Yeah," he said wryly. "I see it. They were crazy too. I should've had more sense than to get mad." Then his grin grew a trifle twistier. "I didn't tell you that the thing that made me maddest was when they wanted to put earrings on me. I grabbed a club then and—uh—persuaded them I didn't like the idea."

Sally chortled. The picture of a small and truculent Mike in frenzied revolt with a club against the idea of being decked with jewelry ... Mike turned to the two big men and shoved at them imperiously.

"Move over!" he growled. "If you two big lummoxes had dropped in on those crazy gooks instead of me, they'd've thought you were elephants and set you to work hauling logs!"

He squirmed to a seat between them. He still looked ashamed, but it was shame of a different sort. Now he looked as if he wished he hadn't mistrusted his friends even for a moment. And now he included Sally.

"Anyhow," he said suddenly, in a different tone, "maybe it did do some good for me to get all worked up. I got sort of frantic. I figured somebody'd made a fool of me. And I was going to put something over to pay back." "Mike!" said Sally reproachfully. "Not you," said Mike. "I made up my mind I'd beat these lummoxes at their own game. I asked Joe about my brainstorm in the plane. He didn't know what I was driving at, but he said what I was hoping was so. So I'm spouting it to your father, and if—" His tone grew fierce. "If it's any good everybody gets credit for it, because all four of us—even two big apes who try kidding—are responsible!" He glared at them and Joe asked, "What is it, Mike?" "I think," said Mike, "I

*think* I've got a trick to make space ships quicker than anybody ever dreamed of!" Then he closed his lips tightly.

The black car braked by the entrance to the security offices outside the Shed. Everything looked deserted. There was only a skeleton force here since the Platform had been launched three months before. There was almost nobody to be seen, but Mike pressed his lips pugnaciously together as they got out of the car and went inside.

The four of them, then, with Sally, went along the empty corridors to the major's office. He was waiting for them. He shook hands all around. But it was not possible for Major Holt to give an impression of cordiality.

"I'm very glad to see you all back," he said curtly. "It didn't look like you'd make it. Joe, you will be able to reach your father by long distance telephone as soon as you finish here. I—ah—thought it would not be indiscreet to tell him you'd landed safely, but I did ask him to keep the fact to himself."

"Thank you, sir," said Joe.

"You answered most of the questions we could ask, on the plane," added the major grimly. "Now you may want to ask some. You know our—ah—our rivals have copied our rocket fuel. You know they've fired rockets with it. You've met them! And Intelligence says they're building a fleet, now, to smash the Platform and get set for an ultimatum for us to back water or be bombarded from space."

Mike said crisply, "How long before they can do it?" Major Holt turned uncordial eyes upon him. "That's anybody's guess. Why?"

"We've been working something out," said Mike, firmly but in part untruthfully. He stood sturdily before the major's desk, which he barely topped. "The four of us have been working it out. Joe says they've done powder metallurgy welds, back at his father's plant. Joe and Haney and the chief and me, we've been working out the idea."

Major Holt waited. Joe looked at Mike. Haney and the chief regarded him warily. The chief cocked his head to one side.

"It'll take a minute to get it across," said Mike. "You have to think of concrete first. When you want to make a cubic yard of concrete, you take a cubic yard of gravel. Then you add some sand, just enough to fill in the cracks

between the gravel. Then you put in some cement. It goes in the cracks between the grains of sand. A little bit of cement makes a lot of concrete. See?"

Major Holt frowned. But he knew these four. "I see, but I don't understand."

"You can weld metals together with powder metallurgy at less than red heat. You can take steel filings for sand and steel turnings for gravel and powdered steel for cement—"

Joe jolted erect. He looked startledly at Haney and the chief. Haney's mouth was dropping open. A great, dreamy light seemed to be bursting upon him. The chief regarded Mike with very bright eyes.

And Mike sturdily, forcefully, coldly, made a sort of speech in his small and brittle voice.

Things could be made of solid steel, he said sharply, without rolling or milling or die-casting, and without riveting or welding the parts together. The trick was powder metallurgy. Very finely powdered metal, packed tightly and heated to a relatively low temperature— "sintered" was the word—becomes a solid mass. The process had been used only for small objects, but—there was the analogy to concrete. A very little powder could "weld" much metal in the form of turnings and smaller bits. And the result would be solid steel.

Then Mike grew impassioned. There was a wooden mockup of a supply ship in the Shed, he said. It was an absolutely accurate replica, hi wood, of the ships that had been destroyed. But one could take castings of it, and use them for molds, and heat them not even red-hot when filled with powder and filings and turnings, and there would be steel hulls in one piece. Solid steel; one-piece steel hulls! Needing no riveting or anything else—and one could do it fast! While one hull was fitting out a second could be molded—

The chief roared, "You fool little runt!" he bellowed. "Trying to give us credit for that! You got more sense than any of us! You worked that out in your own head."

Haney rubbed his hands together. He said softly, "I like that! I do like that!"

Major Holt turned his eyes to Joe. "What's your opinion?"

"I think," said Joe carefully, "that it's the sort of thing a professional engineer would say was a good idea but not practical. He'd mean that it'd be a lot of trouble to get working. But I'd like to ask my father about it. They have done powder-metallurgy welding at the plant back home."

Major Holt nodded. "Call him. If it looks promising, I'll pull what wires I can."

Joe went out with the others. Mike was sweating. All unconsciously, he twisted his hands the one within the other. He'd had many humiliations because he was small, but lately he'd humiliated himself by not believing in his friends. Now he needed desperately to do something that would reflect credit on them as well as himself.

Joe made the phone call. As he closed the door of the booth he heard the chief kidding Mike blandly.

"Hey, Einstein, how about putting that brain of yours to work on a faster-than-light drive?"

But then Joe began to struggle with the long distance operator. It took minutes to get the plant, and then it took time to get to the point of his call, because his father insisted on asking anxiously how he was and if he was hurt in any way. Personal stuff. But Joe finally managed to explain that this call also dealt with the desperate need to do something about a space fleet.

His father said grimly, "Yes. The situation doesn't look good right now, Joe!"

"Try this one on for size, sir," said Joe. He outlined Mike's scheme. His father interrupted only to ask crisp questions about the mockup of the supply ship, already his existence though made of wood. Then he said, "Go on, son."

Joe finished. He heard his father speaking to someone away from the phone. Questions and answers and then orders. His father spoke to him direct.

"It looks promising, Joe. Right here at the plant we've got the gang that can do it if anybody can. I'm getting a plane and coming out there, fast. Get Major Holt to clear things for me. This is no time for red tape! If he has trouble, I'll pull some wires of my own!" "Then I can tell him it's good stuff?" "It's not good stuff," said his father. "There are about forty-seven things wrong with it as first glance, and more will turn up as we go along! But I know how to take care of one or two, and we'll work out the others somehow. You tell your friend Mike I want to shake hands with him. I hope to do so tonight."

He hung up, and Joe went out of the booth. Mike looked at him with yearning eyes, Joe lied a little, because Mike deserved it.

"My father's on the way to help make it work," he told Mike. Then he added untruthfully; "He said he thought he knew all the good men in his line, and where've you been that he hasn't heard of you before?"

He hurried away as the chief whooped with glee. He left Haney and the chief zestfully manhandling Mike in celebration of his genius.

The Major held up his hand as Joe entered his office. He was using the desk phone. Joe waited. When the major hung up, Joe reported. The major seemed unsurprised.

"Yes. I had Washington on the wire," he said de-tachedly. "I talked to a personal friend who's a three star general. There will be action in the Pentagon. When you came in I was arranging with the largest producers of powder metallurgy products to send their best men here by plane. They'll start at once. Now I have to get in touch with some other people."

Joe stared. The major moved impatiently, waiting for him to leave.

Joe said uneasily. "Excuse me, sir, but—my father didn't say it was certain. He just thinks it can be made to work. He's not sure."

"Something," said the Major with asperity, "has to turn up to take care of this situation! It has to! This particular scheme may not be the answer, but if it isn't, something else will be. The main thing is to work at it! You should look at the twenty-five cent piece occasionally, Joe!"

He stirred still more impatiently, and Joe went out. In the corridor outside Sally was smiling as the chief and Haney celebrated Mike's brainstorm with salutary indignity, because if they didn't make a joke of it he



might cry with joy.

"Things look better?" asked Sally.

"They do," said Joe. "And if it only works . . ."

Then he hunted in his pocket. He found a quarter and examined it curiously. On one side he found nothing the major could have referred to. On the other side, though, just by George Washington's chin— He put the quarter away and took Sally's arm.

"It'll be all right," he said firmly.

But there were times when it seemed in doubt. Joe's father arrived by plane at sunset of that same day, and he and three men from the Kenmore Precision Tool plant instantly closeted themselves with Mike in Major Holt's quarters. The powder metallurgy men turned up an hour later, and a three-star general flew in from Washington not long after that. They joined the highly technical discussion.

Joe waited around outside, feeling left out of things. He sat on the major's porch with Sally while the moon rose over the desert and the stars shone down. Inside, matters of high importance were being battled over with the informality and heat with which practical men get things settled. But Joe wasn't in on it.

"You'd think my father'd have something to say to me in all this mess!" Joe said with annoyance. "After all, I have been—well, I have been places! But all he said was, 'How are you, son? Where's this Mike you talk about?'"

Sally said calmly, "I know how you feel. You've made me feel that way." She looked up at the moon. "I thought about you all the time you were gone, and I prayed for you, Joe. And now you're back and not even busy! But you don't— It would be nice for you to think about me for awhile!"

"I am thinking about you!" said Joe indignantly. "Now what," asked Sally interestedly, "what in the world could you be thinking about me?" He wanted to scowl at her. But he grinned instead.

## 7

TIME PASSED. Hours, and then days went by. Things began to happen. Trucks appeared at the Shed, loaded down with sacks of white powder. The powder was very messily mixed with water and smeared lavishly over the now waterproofed wooden mockup of a space supply ship. It came off again in sections of white plaster, which were numbered and set to dry in warm chambers that were constructed with almost magical speed. More trucks arrived, bearing such diverse objects as loads of steel turnings, a regenerative helium cooling plant from a gas well—it could cool metal down to the point where it crumbled to impalpable powder at a blow—and assorted fuel tanks, dynamos, and electronic machinery.

Ten days after Mike's first proposal of concreted steel as a material for spaceship construction, the parts of the first casting from the mockup were assembled. They were a mold for the hull of a spaceship. There were more plaster sections for a second mold ready to be dried out now, but meanwhile vehicles like concrete mixers mixed turnings and filings and powder in vast quantities and poured the dry mass here and there in the first completed mold. Then men began to wrap the gigantic object with iron wire.

Presently that iron wire glowed slightly, and the whole huge mold grew hotter and hotter and hotter. And after a tune it was allowed to cool.

But that did not mean a ceasing of activity. The plaster casts had been made while the concreting process was worked out. That process—including the heating—was in action while fittings were being flown to the Shed. But other hulls were being formed by metal concrete formation even before the first mold was taken down.

When the plaster sections came off, there was a long gleaming, frosty-sheened metal hull waiting for its fittings. It was a replacement of one of the two shot-down spacecraft, ready for fitting out some six weeks ahead of schedule. Next day there was a second metal hull, still too hot to touch. The day after that there was another.

Then they began to be turned out at the rate of two a day, and all the vast expanse of the Shed resounded with the work on them. Drills drilled and torches burned and hammers hammered. Small diesels rumbled.

Disk saws cut metal like butter by the seemingly unpractical method of spinning at twenty thousand revolutions per minute. Convoys of motor buses rolled out from Bootstrap at change-shift tune, and there were again Security men at every doorway and moving continually about.

But it still didn't look too good. There is apparently no way to beat arithmetic, and a definitely nagging problem still remained. Ten days after the beginning of the new construction program, Joe and Sally looked down from a gallery high up in the outward-curving wall of the Shed. Acres of dark flooring lay beneath them. There was a spiral ramp that wound round and round between the two skins of the fifty-storey-high dome. It led finally to the Communications Room at the very top of the Shed itself. When Joe and Sally looked down, the floor was three hundred feet below. Welding arcs glittered. Rivet guns chattered. Trucks came in the doorways with materials, and there was already a gleaming row of eighty-foot hulls. There were eleven of them already uncovered, and small trucks ran up to their sides to feed the fitting-out crews such items as tanks and gyro assemblies and steering rocket piping and motors, and shortwave communicators and control boards. Exit doors were being fitted. The last two hulls to be uncovered were being inspected with portable X-ray outfits, in search of flaws. And there were still other ungainly white molds which were other hulls in process of formation—the metal still pouring into the molds in powder form, or being tamped down, or being sintered to solidity.

Joe leaned on the gallery railing and said unhappily, "I can't help worrying, even though the Platform hasn't been shot at since we landed."

That wasn't an expression of what he was thinking, though. He was thinking about matters the enemies of the Platform would have liked to know about. Sally knew those matters, too. But top secret information isn't talked about by the people who have it, unless they are actively using it in work. At all other times one pretends he doesn't know it. That is the only possible way to avoid leaks.

The top secret information was simply that it was still impossible to supply the Platform adequately. Ships could be made faster than had ever been dreamed before, but so long as any ship that went up could be destroyed on the way down, the supply of the Platform was impractical. But ships were being built regardless, against the time when a way to get them down again was thought of. It hadn't been thought of yet.

But building the ships anyhow was unconscious genius, because only Americans could imagine anything so foolish. The enemies of the Platform and the United States knew that full-scale production of ships by some fantastic new method was in progress. That fact couldn't be hidden. But nobody in a country chronically short of materials could conceive of building ships before a way to use them was known. So the Platform's enemies were convinced that the United States had something wholly new and very remarkable, and they threatened their spies with unspeakable fates if they didn't find out what it was. They didn't. And the rulers of the enemy nations knew, of course, that if something really spectacular had been invented—something, say, like a new space drive—they would very soon have to change their tune. So there were no more attacks on the Platform. It floated serenely overhead, sending down astronomical observations and solar constant measurements and weather maps, while about it floated a screen of garbage and discarded tin cans.

But Joe and Sally looked down where the ships were being built while the problem of how to use them was debated.

"It's a tough nut to crack," said Joe dourly.

The problem haunted him. Ships going up had to have crews. Crews had to come down again because they had

to leave supplies at the Platform, not consume them there. Getting a ship up to orbit was easier than getting it down again.

"The Navy's been working on lightweight missiles," said Sally.

"Not good enough," said Joe.

It wasn't. He'd been asked for suggestions. Could a spaceship crew control missiles and fight its way back to ground with them? The answer was that it could be done. But missiles used to fight one's way down would have to be carried up first. And they would weigh as much as all the cargo a supply ship could carry. A ship that carried fighting missiles couldn't carry cargo. Cargo at the Platform was the thing

desired.

"All that's needed," said Sally, watching Joe's face, "is a slight touch of genius. There've been breakthroughs before now. Burning your cabin free with landing rocket flames—"

"Haney's idea," said Joe despiritedly.

"And making ships in a hurry with metal concrete—"

"Mike thought of that," Joe said ruefully.

"But you made the garbage screen for the Platform," insisted Sally.

"Sanford had made a wisecrack," said Joe. "And it just happened that it made sense that he didn't realize."

He grimaced. "I'll be much obliged if you'll say something like that, Sally!"

Sally looked at him with soft eyes. It wasn't really his job, this worrying. The top-level brains of the armed forces were struggling with it. They were trying everything from redesigned rocket motors to really radical notions. But there wasn't anything promising yet.

"What's really needed," said Sally regretfully, "is a way for ships to go up to the Platform and not have to come back."

"Sure!" said Joe ironically. Then he said, "Let's go back."

They started down the long curving ramp which led between the two skins of the Shed's wall. It was quite empty, this long, descending corridor, and remarkably private. In a place like the Shed, with frantic activity

going on all around, and even at Major Holt's quarters where Sally lived and Joe was a guest, there wasn't often a chance for them to talk in any sort of actual privacy.

But Joe went on, scowling. Sally went with him. If she seemed to hang back a little, at first, he didn't notice. Presently she shrugged her shoulders and ceased to try to make him notice that there was nobody else around. They made a complete circuit of the Shed within its wall, Joe staring ahead without words. Then he stopped abruptly. His expression was unbelieving. Sally almost bumped into him. "What's the matter?"

"You did it, Sally!" he said amazedly. "You did it! You said it."

"What?"

"The touch of genius!" He almost babbled. "Ships that can go up to the platform and not have to come back! Sally! You did it! You got it!"

She regarded him helplessly. He took her by the shoulders as if to shake her into comprehension. But he kissed her instead.

"Come on!" he said exuberantly. "I've got to tell the gang!"

He grabbed her hand and set off at a run for the bottom of the ramp. And Sally, with remarkably mingled emotions showing on her face, was dragged in his wake.

He was still pulling her after him when he found the chief and Haney and Mike in the room at Security where they were practically serf-confined, lest their return to Earth become too publicly known. Mike was stalking up and down with his hands clasped behind him, glum as a miniature Napoleon and talking bitterly. The chief was sprawled in a chair. Haney sat upright, contemplating his knuckles with a thoughtful air.

Joe stepped inside the door.

Mike went on, not pausing, "I tell you, if they'd only use little guys like me, the cabin and supplies and crew can be cut down by tons! Even the instruments can be smaller and weigh less! Four of us in a smaller cabin, less grub and air and water, we'll save tons! Why can't you big lummoxes see it?"

"We see it, Mike," Haney said mildly. "You're right. But people won't do it. It's not fair, but they won't."

Joe said, beaming, "Besides, it'd bust up our gang. And Sally's just gotten the real answer! The answer is for ships to go up to the Platform and not come back!"

He grinned at them. The chief raised his eyebrows. Haney turned his head to stare.

Joe said exuberantly, "They talked about carrying controllable, guided missiles to fight with. Too much weight, of course. But—if we could handle guided missiles, why can't we handle drones?"

The three of them gaped at him.

Sally said, startled, "But Joe, I didn't—"

"We've got plenty of hulls!" said Joe. Somehow he still looked astonished at what he'd made of Sally's perfectly obvious comment. "Mike's arranged for that! Make —say—six of 'em into drones, space barges. Remote-controlled ships! Control them with one manned ship,— the tug! We'll ride that! Take 'em up to the Platform exactly like a tug tows barges. The towlines will be radio beams. We'll have a space tow up, and not bother to bring the barges back! There won't be any landing rockets. They'll carry double cargo! That's the answer! A space tug hauling a tow to the Platform!"

"But Joe," insisted Sally. "I didn't think of—"

Haney's voice cut through what Sally was about to say. He said drily, "Sally, if Joe hadn't kissed you for that, maybe I would. Makes me feel mighty dumb!"

Mike swallowed. Then he said loyally, "Yeah. Me too. Fd have made a two-ton cargo possible, maybe. But this adds up! What does the major say?"

"I—haven't talked to him. I'd better, right away." Joe grinned. "I wanted to talk to you first."

The Chief grunted. "Good idea. But hold everything." He fumbled in his pocket. "The arithmetic is easy enough, Joe. Cut off the crew and air and you save something." He felt in another pocket. "Leave off the landing rockets, and you save plenty more. Count in the cargo you could take anyhow—providing you didn't take missiles along to fight your way home with—" He searched another pocket still. "And you get forty-two tons of cargo per space barge, de-

livered at the Platform. Six drones, that's two hundred and fifty tons of cargo in one tow. Here!" He'd found what he wanted. It was a handkerchief. He thrust it upon Joe. "Wipe that lipstick off, Joe, before you go talk to the major. He's Sally's father and he might not like it."

Joe wiped abashedly at his face. Sally, her eyes shining, took the handkerchief from him and finished the job. She displayed that remarkable insensitivity of females in situations that include both pride and embarrassment. But when a girl or woman is proud, she is never embarrassed.

She and Joe went to her father's office. In fifteen minutes technical men began to arrive for a conference, summoned by telephone. Within forty-five minutes, messengers carried orders out to the Shed to stop the installation of certain types of fittings in all but one of seven hulls. In an hour and a half, top technical designers were doing the work of foremen and getting things done without blueprints. The proposal was beautifully simple to put into practice. Missile control systems were already in mass production. They could simply be modified to take care of drones.

Within twelve hours there were truckloads of new sorts of supplies arriving at the Shed. Some were Air Force supplies and some were Ordnance, and some were strictly Quartermaster. These were not component parts for spaceships. They were freight for the Platform—two hundred fifty-odd tons of it. And just seventy-two hours after Joe and Sally had looked dispiritedly down upon the floor of the Shed, there were seven gleaming hulls hi swiftly built launching cages, and there was an unholy din of landing pushpots outside the Shed. They came with hysterical cries from their airfield to the South, and they flopped flat with extravagant crashings on the desert outside the eastern door.

By the tune the pushpots had been hauled in, one by one, and attached to the launching cages, Joe and Haney and the chief and Mike had climbed into the cabin of the ship which was not a drone. There were now seven cages in all to be hoisted toward the sky. A great double triangular gore had been jacked out and rolled aside to make an exit hi the side of the Shed. Nearly as many pushpots, it seemed, were involved in this launching as in the takeoff of the Platform itself.

The routine tests before takeoff set the pushpot motors to roaring inside the Shed. The noise was the most sustained and ghastly tumult that had been heard on Earth since the Platform's departure.

But this launching was not so impressive. It was definitely untidy, imprecise, and unmilitary. There were seven eighty-foot hulls surrounded by clustering, bellowing, preposterous groups of howling objects like oversized black beetles. One of the seven hulls had eyes. The others were blind, but they were equipped with radio antennae. The Ship with eyes had several small basket-type radar bowls projecting from its cabin plating.

The seven objects rose one by one and went bellowing and blundering out to the open air. At forty and fifty feet above the ground they jockeyed themselves into some sort of formation. It required much wallowing and pitching and clumsy maneuvering.

Then, without preliminaries, they started up. They rose swiftly. The noise of their going diminished from a bellow to a howl, and from a howl to a moaning noise, and then to a faint, faint, ever-dwindling hum. Presently that faded out, too.

## 8

ALL THE SENSATIONS were familiar. The small fleet of improbable objects rose and rose. Of all flying objects ever imagined by man, the loaded launching cages supported by pushpots were most irrational. The squadron, though, went bumbling upward. In the manned ship, Joe was more tense than on his former takeoff—if such a thing were possible. His task was increased on this trip. Before, he'd had Mike at communications and the chief at the steering rockets while Haney kept the pushpots balanced for thrust. Now Joe flew the manned ship alone. Headphones and a microphone gave him communication with the Shed direct, and the pushpots were balanced in groups, which cost efficiency but helped his control. He would, moreover, have to handle his own steering rockets during acceleration and when he could—and dared—he should supervise the others. Because each of the other three had two drone ships to guide. True, they had only to keep their drones in formation, but Joe had to navigate for all. The four of them had been assigned to this flight because of its importance. They happened to be the only crew alive who had ever flown a spacecraft designed for maneuvering, and their experience consisted of a single journey. But nobody else had even that much.

The jet stream was higher this time than on that other journey. They blundered into it at thirty-six thousand feet. Joe's headphones buzzed tinnily. Radar from the ground told him his rate of rise, his ground speed, his orbital speed, and added comments on the handling of the drones.

The last was not a precision job. Only once on the way up did Joe protest:

"Somebody's ship—number four—is lagging. Snap it up!"

"Got it, Joe. Coming up!" Mike said crisply.

Later, Joe said, "The Shed says formations are getting ragged. And we need due east pointing. Check it."

The Chief muttered, "Something whacky here. Come around, you! Okay, Joe."

Joe had no time for reflection. He was in charge of the clumsiest operation ever designed for a precise result. The squadron went wallowing toward the sky. The noise was horrible.

A tinny voice appeared in the headphones: *"You are at sixty-five thousand feet. Your rate of climb curve is flattening. You should fire your jatos when practical. You have some leeway in rocket fuel."*

Joe spoke into the extraordinary maze of noise waves and pressure systems in the air of the cabin.

"We should blast now. I'm throwing in the series circuit for jatos. Try to line up. We want the drones above us and with a spread, remember? Go to it!"

He watched his compass card and the small graphic indicators telling of the bearings of the drones. The sky outside the ports was a dark purple. The launching cage responded sluggishly. Its open end came around to the east. It reached the due east point. Joe pressed the firing button. Nothing happened.

He hadn't expected it. The seven ships had to keep formation. They had to start off on one course—with a slight spread as a safety measure—and at one time. So the firing circuits were keyed in series. Only when all seven firing buttons were down at the same time would any of the jatos fire. Then ah<sup>1</sup> would blast together.

The pilots in the cockpit bubbles of the pushpots had an extraordinary view of the scene. At something over twelve miles of height, seven aggregations of clumsy black things clung to frameworks of steel, pushing valorously. Far below there were clouds and there was Earth. There was a horizon, which wavered and tilted. The pushpots struggled with seemingly opposed purposes. One of the seven clusters seemed to drop below all the others. They

pointed vaguely this way and that. All of them. Gradually they arrived at an uncertain unanimity.

Joe pushed the firing button again as his own ship touched the due east mark. Again nothing happened.

Out of the corner of his eye he saw Haney pressing down the firing buttons of both drones under his

control. The chief lifted one finger. Mike pushed down one button and held off the other. Roarings and bowlings of pushpots. Wobblings and heartbreaking clumsinesses of the drone ships. They hung in the sky while the pushpots used up their fuel.

"We've got to make it," said Joe shortly. "We've got forty seconds. Else we have to go down and try again."

There was a clock dial with a red sweep hand which moved steadily and ominously toward a deadline tune for jato firing. Up to that deadline, the pushpots could let the supply ships down back to Earth without crashing them. After it, they'd not have enough fuel.

The deadline came closer and closer.

"Take a degree leeway." Joe snapped. "We've got ten seconds."

He held the manned ship nearly steady. His firing button stayed down. Haney pushed both hands down, raised one, pushed again. The chief had one finger down. Mike had both firing buttons depressed.... The chief pushed down his second button.

There was a monstrous impact. Every jato in every pushpot about every launching cage fired at once. Joe felt himself flung back into his acceleration chair. Six gravities. He began the horrible fight to stay alive, while the blood tried to drain from the consciou\$ forepart of his brain and while every button of his garments pressed noticeably against bun, and objects in his pockets pushed. The sides of his mouth dragged back, and his cheeks sagged, and his tongue strove to sink back into his throat and strangle him. It was very bad. It seemed to last for centuries.

Then the jatos burned out. There was the ghastly feeling of lunging forward to weightlessness. One instant Joe's body weighed nearly half a ton. The next instant it weighed less than a dust grain. His head throbbed twice as

if his skull were about to split open and let his brains run out. But these things he'd experienced before.

There were pantings in the cabin about him. The ship fell. It happened to be falling up, but the sensation and the fact was free fall. Joe had been through this before, too. He gasped for breath and croaked,

"Drones?"

"Right," said Haney.

Mike said anxiously, "Four's off course. I'll fix it."

The chief grunted guttural Mohawk. His hands stirred on the panel for remote control of the drones he had to handle.

"Okay, Mike?"

A half-second's pause.

"Okay!"

Joe pressed the firing button for the ships' own takeoff rockets. And he was slammed back in his acceleration chair again. But this was three gravities only. Pressed heavily against the acceleration cushions he could still perform the navigation for the fleet. He did. The mother ship had to steer a straight course, regardless of the vagaries of its rockets. The drones had simply to be kept in formation with it. The second task was simpler. But Joe was relieved, this time, of any need to report on the efficiency of the Van Alien belt equipment. That was proved.

The takeoff rockets blasted and blasted and blasted. The mere business of staying alive grew tedious. The ordeal seemed to last for centuries. Actually it could be measured only in minutes. But it seemed millennia before the headphones sounded, staccato fashion:

*"You are on course and will reach speed in fourteen seconds. I will count for you."*

"Relays for rocket release," panted Joe. "Throw 'em over!"

Three hands moved to obey. Joe could release the drive rockets on all seven ships at will.

The voice counted;

*"Ten ... nine ... eight ... seven ... six ... five ... four ... three ... two ... one ... cut!"*

Joe pressed the master key. The remnants of the solid

fuel rockets let go. They flashed off into nothingness at unbelievable speed, consuming themselves as they went.

There was again no weight.

This time there was no resting. No eager gazing out the cabin ports. They had work to do, and they'd been in space before.

Mike and Haney and the chief worked doggedly at their control boards. The radar bowls outside the ship shifted and moved and quivered. The six drone ships showed on the screens. They had only steering jets, now, for all navigational purposes. These were jets of high pressure steam, obtained by pumping 70 percent hydrogen peroxide into a spray of manganese permanganate solution. Both solutions burst instantly into steam, which could be released to change the direction of a ship in emptiness, or actually to increase or decrease its speed by a minute amount. Radar faithfully represented the distribution of the drones. Telemetering apparatus reported all cogent facts to ground as well as for Joe's inspection.

Presently Joe cast a glance out a view port and saw that the dark line of sunset was almost below. The takeoff had been timed to get the ships into Earth's shadow above the area from which war rockets were most likely to rise. It wouldn't prevent bombing, of course. But there was a gadget...

Joe spoke into the microphone. "Reporting everything okay so far. But you know it."

The voice from solid ground said, "*Report acknowledged.*"

The ships went on and on and on. The chief muttered to himself and made small adjustments of the movement of one of his drones. Mike fussed with his. Haney regarded the controls of his drones with a profound calm.

Nothing happened, except that they seemed to be falling into a bottomless pit and their stomach muscles knotted and cramped his purely reflex response to the situation. Even that grew wearisome.

The voice from the headphones said, "*You enter Earth's shadow in three minutes. Prepare for combat.*"

Joe said drily, "We're to prepare for combat."

The chief growled, "I'd like to do just that!"

The phrasing, of course, was intentional—in case enemy ears were listening. Actually the small fleet was to use a variant on the tin can shield which protected the Platform. It would be most effective if visual observation was impossible. The fleet consisted of seven ships in very ragged formation. Most remarkably, they were still within a fifty mile globe of space after the long three gravity acceleration. Number four loitered behind, but was being brought up by judicious bursts of steering rocket—steam, rocket—fire. Number two was some distance ahead. The others were simply scattered. They went floating on like a group of meteors. Two of them were visible to the naked eye. The others might be picked out, but it wouldn't be easy.

Drone two, far ahead and clearly visible, turned from a shining steel speck to a reddish pinpoint of light. The red color deepened. It winked out. The sunlight in the ports of the mother ship turned red. It blacked out.

"Shoot the ghosts," said Joe.

The three drone-handlers pushed their appropriate buttons, but nothing happened that anybody could see. Actually, a small gadget somewhere amidships began to cough rhythmically. Similar devices on the drones coughed, too. They were small, smooth bore, multiple-barreled guns. Rifle shells fired two-pound missiles at random targets in emptiness. They wouldn't damage anything they hit. They'd go varying distances, explode and shoot small lead shot ahead to check their missile velocity, and then emit dense passes of aluminum foil. There was no air resistance. The shredded foil would continue to move through emptiness at the same rate as the convoy fleet. The seven ships fired a total of eighty-four such shells away into the blackness of Earth's shadow. There were, then, seven ships and eighty-four masses of aluminum foil moving through pure blackness. They could not be told apart by radar, and telescopes couldn't see them at all.

If enemy radar probed upward, they reported ninety-one spacecraft in ragged but coherent formation, soaring through nothingness toward the Platform. And a fleet like that was too strong to attack. Of course radar operators had been prepared to forward details of the speed and course of a single ship. Rocket-launching submarines half-

way around the world waited for that information, despite what had happened to the last two subs which knocked down two supply ships. But ninety-one ships were too much!

So the fleet swam peacefully through the blackness that was Earth's shadow, and no attempt at attack was

made. They came out into sunshine again to look down at the western coast of America. With seven ships to get on an exact course, at an exact speed, at an exact moment, deliberation and care was required. So the fleet made almost a complete circuit of the Earth before it reached the height of the Platform's orbit. They joined it. A single man in a spacesuit, anchored to its outer plates, directed a plastic hose which stretched out impossibly far and clamped to one drone with a magnetic grapple. He maneuvered it to the Platform's hull and made it secure. He captured a second, which was worked delicately within reach by coy puffs of steering rocket steam. He fished for the others. One by one, they were made fast. Then the manned ship went in the lock and the great outer doors closed and the plastic fabric walls collapsed behind their nets, and air came in.

Lieutenant-Commander Brown was the one to come into the lock to greet them. He shook hands all around, and it again seemed strange to the four from Earth to find themselves with their feet more or less firmly planted on a solid floor, but with their bodies wavering erratically to right and left and before and back, because there was no up or down.

"We just had reports from Earth," Brown told Joe comfortably. "The news of your takeoff was released to prevent panic in Europe. But everybody who doesn't like us is yelling blue murder. Somebody—and you c\*an guess who—is announcing that a fleet of ninety-one war rockets took off from the United States and now hangs pointed in space while the decadent warmongering Americans prepare an ultimatum for all the world. Everybody's frightened."

"If they'll only stay scared until we get unloaded," said Joe in some satisfaction, "the government back home can

tell them how many we were and what we came up for. But we'll probably make out all right, anyhow."

"My crew will unload," said Brown in conscious thoughtfulness. "You must have gotten pretty well exhausted by that acceleration."

Joe shook his head. "I think we can handle the freight faster. We found out a few things by going back to Earth."

A section of plate at the top of the lock—at least it had been the top when the Platform was built on Earth—opened up as on the first journey here. A face grinned down. But from this point on, the procedure was changed. Haney and Joe went into the cargo section of the rocket-ship and heaved its contents smoothly through weightlessness to the storage chambers above. The chief and Mike stowed it there. The speed and precision of their work was out of all reason. Brown stared incredulously.

The fact was simply that on their first trip to the Platform, Joe and his crew didn't know how to use their strength where there was no weight. By the time they'd learned, their muscles had lost all tone. Now they were fresh from Earth, with Earth-strength muscles, and they knew how to use them.

"When we got back," Joe told Brown, "we were practically invalids. No exercise up here. This time we've brought some harnesses to wear, and we've some very special exercises we intend to use regularly. Shifting cargo's a good exercise, thought, all by itself."

Presently they moved out of the airlock and the ship was maneuvered to a mooring outside and a drone took its place. Again Brown blinked at the unloading of the drone.

"Navy style work, that!" Brown said.

"I'm afraid," said Joe gently, "that it isn't Navy. It's just fresh muscles, and we've got to try to find out how to keep them fresh, or presently somebody'll have to stay in the Platform because he couldn't live through a landing."

Brown frowned.

"Hm. I—ah—I shall ask for instructions on the matter." He stood erect. He didn't waver on his feet as the others

did. Joe guessed with private amusement that Brown must practise to maintain a dignified stance in weightlessness.

"Mr. Kenmore," said Brown suddenly. "Have you been assigned a definite rank as yet?"

"Not that I know of," said Joe without interest. "I skipper the ship I just brought up. That's official. The rest is pretty vague."

"I'll ask for clarification of your status," said Brown worriedly. "It shouldn't have been left unclear. I'd



better attend to it at once."

He went away. Brent, the Platform's psychologist, joined Joe. He nodded hi friendly fashion.

"Quite a change, eh?" he said drily. "Sanford turned out to be a crackpot with notions of grandeur. I'm not sure that Brown's notions of discipline aren't worse."

Joe told him, rather abruptly, about the newly discovered physical effects of long stays where there was no gravity. The doctors now predicted not only complete loss of muscle tone, but bone damage, and even a deterioration of heart action. One's heart would adjust to the absence of any need to pump blood against gravity.

"Which," said Joe, "means that you're going to have to be relieved before too long. But we brought up some gravity simulator harnesses that may help. And there are some exercises that look promising." Brent said regretfully, "And I was so pleased! We all had trouble with insomnia, at first, but lately we've all been sleeping well. Now I see why. It wasn't psychological adjustment. But after our muscles got weak enough we slept because we were tired out anyhow. Maybe by breathing!"

The unloading of the drones went on. But the last of them wasn't only unloaded. Its steering rocket fuel tanks were refilled and Haney rather enjoyably handled it from the Platform. With no cargo, and no weight, the steam rockets would take care of everything. It leaped out of the opened ship lock like a frightened horse.

"An amiably nasty trick," Joe told Brent, who watched. "It's heading back, so it'll settle down to a lower orbit. We can retrieve it if we want to, but it's a very gentle reminder that we could get tough if we wanted to. Our friends the enemy will really hate it! It's a radio relay, like the telestar satellites. It will pick up shortwave stuff beamed at it and repeat it down to Earth. And they can try to jam that!"

It was a mildly malicious trick to play. Behind the Iron Curtain broadcasts from the rest of the world couldn't be heard. There were stations expressly built to emit mere noise on broadcast frequencies, to jam out and obliterate signals with meaning. But those jamming stations were around the national borders of the nations whose populations were thus protected from foreign ideas. But if radio programs came down from straight overhead, jamming wouldn't work at least in the center of the jammed-off area! Populations would hear news and ideas their governments violently opposed.

But that was a minor matter. With spaceship hulls coming into being by dozens, and with one convoy of more than two hundred tons of supplies and equipment gotten aloft, the whole picture of supply for the Platform had changed.

Part of the new picture was certain devices that Haney and the chief were assembling. They were mostly metal backbone and a series of tanks, with rocket motors mounted on ball-and-socket joints. They looked like huge red insects, but they were officially "rocket recovery vehicles," and Joe's crew referred to them as space wagons. They had no cabin, so they could be used only by a man wearing a spacesuit, strapped into something like a saddle. Before the saddle there was a control board complete with radar screens. And there were racks to which solid fuel rockets of various sizes could be attached. They were literally short-range tow craft for travel in space. They had the stripped, barren look of farm machinery. So the name "space wagon" fitted. There were two of them.

"They look kind of peculiar," the chief told Joe. "I'm not sure I like 'em."

"They're temporary," said Joe. "There's a bigger and better one being built with a regular cabin and cargo *space*. But some experience with these will help."

"I'll see how they feel," observed the chief.

"No," said Joe doggedly. "I'm responsible. I take the first chance. They'll work all right, but when this one's tried out you can stand by with the other, just in case."

The chief went back to the assembly process.

Joe got out the gravity simulator harnesses. He showed Brent how they worked. Brown hadn't official instructions to order their use, but Brent was shocked to discover how far he'd deteriorated physically.

The simulators couldn't imitate actual gravity, of course, but only the effects of gravity on one's muscles, and not all of these. There were springs and elastic webbing pulling at one's shoulders and feet together, so that it was just about as much effort to stand with one's legs extended as to stand upright on Earth. Joe felt

better with a pull on his body.

Brent was upset when he found that to him more than a tenth of normal gravity effect was exhausting. But if he increased the pull a little every day, at least his muscles should regain some strength. There were other items. One's diaphragm normally resisted gravity. Here there was none to resist. But there could be exercises ...

Brown saw them demonstrated. He must privately have tried to do them himself. He found himself affected by life in no gravity. He came secretively to Joe and asked for instructions in the official exercises designed to prevent loss of physical fitness by the inevitable conditions of space travel.

A second drone broadcast relay went down to a lower orbit. The articulated red frameworks called space wagons took shape. Presently they were complete. They looked more than ever like farm machinery, save that their bulging tanks made them seem insectile, too. They were probably something in between small towboats and crash-wagons. A man in a spacesuit could climb into the saddle of one of these creations, plug in the airline of his suit to the space wagon's tanks, and travel in space by means of its rockets. There were powerful magnetic grapples. They had banks of solid fuel rockets of diverse powers and lengths of burning. And they even mounted small missiles which could be controlled and used to destroy what could not be recovered. They were intended to

handle unmanned rocket shipments of supplies to the Platform, when they came up individually or if a convoy were scattered when it arrived.

When they were ready for testing they seemed very small in the great space lock. Joe and the chief very carefully checked on an extremely long list of things that had to work right *if* anything was to work at all. That part of the job wasn't thrilling, but Joe no longer looked for thrills. Unintentionally but validly, he'd discovered the superior attraction of achievements. He did the things that produced results, and one result was much more satisfaction than mere excitement.

They got into spacesuits. They were in an odd position on the Platform. Lieutenant-commander Brown had avoided Joe as much as possible since his arrival. So far he'd carefully avoided giving him direct orders, because Joe was not certainly and officially his subordinate. Lacking exact information, the only thing a conscientious and rank-conscious naval officer could do was exercise the maximum of tact and insistently ask Authority for a ruling on Joe's place in the hierarchy of rank.

Joe flung a leg over his eccentric, red-painted mount. He clipped his safety belt, plugged in his suit air supply to the space wagon's tank, and spoke into his helmet transmitter.

"Okay to open the lock. Chief, you keep watch. If I make out all right, you can join me. If I get in serious trouble, come after me hi the ship we came in. But only if it's practical! Not otherwise!"

The chief said something in Mohawk. He sounded indignant.

The plastic walls of the airlock swelled inward, burying and overwhelming them. Pumps pounded briefly, removing what air was left. Then the walls drew back, straining against their nets. Joe waited for the door to open to empty space.

Instead, there came a sharp voice hi his helmet phones. It was Brown.

*"Radar says there's a rocket on the way up. It's around the edge of the world from here. Three gravities only. Better not go out!"*

Joe hesitated. Brown still issued no order. But defense against a single rocket would be a matter of using a guided rocket missile if the tin can screen didn't handle it. And that would be Brown's affair. Joe would have no part in it. He wouldn't be needed. He couldn't help. And there'd be all the elaborate business of checking to go through again.

"It'll be a long time getting here, and three gravities is slow!" Joe said uncomfortably. "Maybe it isn't working right. There could be something wrong. Anyhow it won't take long to try this wagon. They're anxious to send up a robot ship from the Shed, and these have to be tested first. Give me ten minutes."

He heard the chief grumbling to himself. But one tested space wagon would be better than none.

The airlock doors opened. Huge, half-circular valves swung wide. Bright, remote, swarming stars filled the opening. Joe cracked the control of his forward liquid fuel rockets. The lock filled instantly with swirling fumes. And instantly the tiny space wagon moved. Once the magnetic clamps were released it was free of the floor. But it did have mass. One brief push of the rockets sent it floating out of the lock. It

was in space. It kept on.

Joe felt a peculiar twinge of panic. Nobody who is accustomed only to Earth can quite anticipate the conditions of handling vehicles in space. Joe had given the wagon some forward speed. Then he cut off the power. But the space wagon did not stop. It kept on, and for an instant Joe felt that helpless astonishment of a man in an automobile who suddenly discovers that he has no brakes.

But he did have brakes. He cracked a braking rocket. He stopped. He hung seemingly motionless in emptiness. The Platform was a good half-mile away.

He tried the gyros, and the space wagon went into swift spinning. He reversed them and straightened out, almost. All of the vast creation seemed to revolve slowly about him. The monstrous globe which was Earth moved sedately from over his head to under his feet and continued the slow revolution. The Platform rotated in a clockwise direction. He was drifting very slowly away.

"Chief," he said ruefully, "you can't do worse than I'm doing, and we're rushed for time. You might come out. But listen! On Earth you keep a motor running because when it stops, you do. But out here you have to use your motor to stop, but not to keep on going. Understand? When you do come out, don't burn your maneuver rocket more than a second at a time."

The chief's voice came booming, *"Right, Joel Here I come!"*

There was a billowing of frantically writhing fumes, which darted madly in every direction until they ceased to be. The chief in his insectlike contraption came bolting out of the hole which was the airlock. The rocket fumes ceased. He kept on going. Joe heard him swear. He felt the same panicky uncertainty Joe had experienced. But a moment later the braking rockets did flare briefly, but still too long. The chief was not only stopped, but drifting backward toward the Platform. He evidently tried to turn, and he spun as dizzily as Joe had done. But after a moment he stopped, almost. There were, then, two red-painted things in space, floating forlornly, something like giant red water spiders in an eddy. They seemed very remote from the great, bright Platform and that gigantic ball which was the Earth.

"Suppose you head toward me, Chief," said Joe absorbedly. "Aim to pass, and remember that what you have to estimate isn't where I am, but where you have to brake to stop close by me. That's where you use your braking rockets."

The chief tried it. He came to a stop a quarter-mile past Joe.

*"I'm heavy-handed,"* he said disgustedly.

"I'll try to join you," said Joe.

He did try. He stopped a little short. The two weird objects drifted almost together. The chief was upside down with regard to Joe. Presently he was sidewise on.

"This takes thinking!" said Joe ruefully.

A voice spoke sharply in his helmet phones. It was Brown, in the Platform.

*"That rocket from Earth is still accelerating. Still at three gravities. It might be carrying a man. Hadn't you better come in?"*

The chief growled, *"We won't be any safer there! I want to get the hang of this!"* Then his voice changed. *"Joe! D'you get that?"*

Joe heard his own voice, very cold. "I didn't, but I do now. Brown, I suggest a missile at that rocket coming up. If there's a man in it, he's coming up to take control of some guided missile rockets that'll overtake him. He could try to smash the Platform by rockets under direct control, since proximity fuses don't seem to work. I'd smash him as far away as possible."

Brown's voice was very curt. *"Right."*

There was an eruption of rocket fumes from the side of the Platform. Something went foaming away toward Earth. It dwindled with incredible rapidity.

Then Joe said, "Chief, I think we'd better go down and meet that thing. We'll learn to handle the wagons on the way. I think we'll have a fight on our hands. Whoever's in that rocket isn't coming up to shake hands with us!"

He steadied the small red vehicle and pointed it for Earth. He added, "I'm firing a six-two solid fuel job, Chief. Counting three. Three, two, one!"

His mount vanished in rocket fumes. He was using rockets intended for use in towing something toward

the Platform. But it was desirable for whatever might happen to take place as far as possible from the Platform. After six seconds at two gravities thrust the rocket burned out. The chief had fired a matching tube. They were then miles apart, but speeding Earthward on very nearly identical courses. The Platform was smaller. That was their only proof of motion.

A very, very long time passed. The chief used steering rockets to get closer to Joe. He was not especially successful. Joe made calculations in his head. He worried. He and the chief were plunging Earthward—away from the Platform—at better than four miles a minute. The presumably manned rocket was still accelerating. And if the Platform's enemies had sent a manned rocket up to destroy the Platform, the man in it would have ways of defending himself. He'd expect guided missiles, but he would hardly anticipate attack by space wagons.

Joe said suddenly, "Chief, I'm going to burn a twelve-two. We've got to match velocities with him eventually, but—join me? Three—two—one"

He fired a twelve-two. Twelve seconds burning; two gravities acceleration. The gravity rating of such a rocket had to be arbitrary, but it was a measure of some sort. This firing built up Joe's velocity away from the Platform to a figure which would have been appalling on Earth. Here there was no sensation of motion, and the distances were enormous. Things which happen in space happen with insensate violence and extreme swiftness. But long, long intervals elapse between events. The twelve-two rocket burned out. The chief had matched that also.

Brown's voice in the headphones said, *"The rockets cut acceleration. I'm floating up, now. It should reach our orbit fifty miles behind us. But our missile should hit it in forty seconds."*

"I wouldn't bet on that," said Joe coldly. "Figure interception data for the chief and me. Make it fast!" He spotted the chief, a dozen miles away and burning his steering rockets too close again. The fumes located him. The chief had the hang of it now.

But nothing happened that Joe saw. And nothing happened. And nothing happened. The two space wagons were ninety miles from the Platform, which was now merely a glittering pinhead of light.

Brown's voice in the headphones: *"Our missile went off two hundred miles short. He had an interceptor out to set it off!"*

"Then he's dangerous," said Joe. "There'll be war rockets coming up any second now for him to handle - d detonate when and where he pleases. They've found ui proximities don't work, so he's going to do some infighting. Give us our course and data, quick! The chief i «nd I have to smash things!"

The two space wagons—like insects in form, absurdly Tainted a brilliant red—seemed inordinately lonely. It »as hardly possible to pick out the Platform with the naked eye. The Earth was still thousands of miles below. Joe and the chief, in spacesuits, rode tiny metal frameworks in emptiness more vast, more lonely, more terrible than either of them could have imagined. Then the war rockets started up. There were eight of them. They came out to do murder at ten gravities acceleration.

## 9

BUT EVEN at ten gravities' acceleration it would take time to get up level with the Platform. At three, and coasting much of the way, it would take longer. The Platform circled Earth. Anything intending interception and rising straight up would have needed to start skyward before the Platform was anywhere near overhead. A three-gravity rocket would have needed to start before the Platform rose above the horizon.

So there was time. Coasting, the rising manned rocket would be losing speed. If it planned to go no higher than the Platform's orbit, its upward velocity would be zero at that height. So it would already be slowing, and if it were intercepted five hundred miles down its rate of climb would be relatively low and Joe and the chief could check their downward dive and match its rising rate.

This they did. But what they couldn't do was match its orbital velocity, which was zero, too. They had the Platform's eastward speed to start with, very many hundreds of miles per minute. They couldn't lose all that and maneuver around the upward floating object. They were bound to flash past it in fractions of a second. To fire their small demolition missiles on ahead would be almost to assure that they would miss, Also, the enemy rocket was manned. It could fight back.

But Joe had been on the receiving end of one attack  
| ID space. It wasn't much experience, but it was more than  
| anybody but he and his crew possessed.

"Chief," he said softly into his helmet microphone, as  
**if** by speaking softly he could keep from being over-  
•eard, "Chief, get close enough to see what I do, and  
do it too. I can't tell you more. Whoever's running this show might know English."

There was a small flaring of vapor in space. The chief was using steering rockets to come closer. Joe spun his little space wagon about, so that it pointed back in the direction from which he had come. He had four strictly demolition guided missiles of very small size. Very deliberately, he fired the four of them away from the rising, coasting rocket. They were low speed units, *intended* to blow up a robot ship if it couldn't be hooked onto because it was traveling too fast or too slowly to be towed to the Platform. The missiles went away, low speed missiles. Then Joe faced about in the direction of his prospective target. The chief fumed—Joe heard him—but he duplicated Joe's maneuver. He faced his own vehicle in the direction of its line of flight.

Then his fuming suddenly ceased. Joe's headphones brought his explosive grunt when he suddenly saw the idea.

*"Joe, I wish you could talk Mohawk! This is pretty!"*

Brown's voice interrupted anxiously: *"I'm going to let that manned missile have a couple more shots."*

"Let us get by first," said Joe. "Then maybe you can use them on the bombs coming up."

He could see the vapor trails of the war rockets on the way out from Earth. They were infinitesimal threads of white. They were the thinnest possible filaments of gossamer. But they enlarged as they drew nearer. They increased their speed by three hundred feet per second every second.

But the arena in which this conflict took place was so vast that everything seemed to happen in slow motion. There was time to reason out not only the method of attack from Earth, but the reason for it. If the Platform could be destroyed, no matter how, its enemies would announce vociferously that it had been destroyed by its own atom bombs, exploding spontaneously. Even in the teeth of absolute proof, enemy nations would insist that bombs intended for the enslavement of humanity—in the Platform—had providentially detonated and removed that instrument of warmongering imperialists from the sky.

There might be somebody, somewhere, who would believe it.

Joe and the chief were now steadied on a line nearly to intercept thtrmanned rocket. They had already fired their missiles, which trailed them. They went into battle, not prepared to shoot but with their ammunition expended. For which there was excellent reason.

Something came smoking toward them from the manned missile. It seemed utterly deadly.

"Now we dodge," said Joe cheerfully. "It may be proximity, but it's not atomic!"

He shot up. The missile tried to follow, and failed. Which could have been predicted. When the space wagons sped toward the assassins' rocket, and missiles sped toward them from that rocket, the two speeds added together. If the space wagons dodged, the rocket's missile would be past them before it could change its course appreciably. And they might well be past the rocket before a second missile could be fired. On the other hand, the space wagons might flash past.

And they were really maneuverable! As the first missile approached, Joe shot away from Earth on steering rocket thrust, and then fired a four-three solid fuel tube toward Earth's North Pole, and halfway along that rush he flipped his craft in a somersault and the result was almost a right-hand turn. When the four-three burned out he set off a twelve-two, and halfway through that he set off a three-two with it. Relative to the rising rocket, he shot erratically in all directions in succession, with different accelerations every time.

With long practise a man might learn marksmanship in space. But shots aimed at targets ten miles away,

and twenty, and five, and fifteen... they call for prophecy if a hit is to be made. Joe and the chief kept whatever marksmanship the rising rocket might contain, very, very busy trying to shoot at them. They had already shot at it. Their projectiles were now coming toward their enemy from his rear. They could control them, steer them, and swerve them without any concern about anything but their aiming. They didn't need to dodge. All they needed was a hit.

They made a hit.

Two of the eight little missiles flashed luridly, almost together, where the radar screens of the space wagons said the rocket should be. Then there were two parts to the rocket. They separated. Another demolition missile hit the larger section. Still another exploded as that was going to pieces. The smaller fragment ceased to be important. The explosions were not atomic bombs, of course. But the space wagons' missiles had exploded the warheads of the missiles still aboard the rocket.

Brown's voice came in the headphones, still tense.

*"You got it! How about the others?"*

Joe felt a remarkable exhilaration. Later he might think about the poor devil—there could have been only one—who had been destroyed some thousands of miles above the surface of Earth. He might come to think of that man as a victim of hatred rather than as a hater. He might become extremely uncomfortable about it. But it would be later. Right now he only felt that he and the chief had won a good fight.

"I think," said Joe to the Naval officer back at the Platform. "I think we can treat them with silent contempt. They probably won't have proximity fuses, because they've been found not to work. Unless one of them's on a collision course—and I do mean a collision course—I don't think we need do anything at all."

The chief muttered to himself in Mohawk, twenty miles away.

"Chief," Joe said, "how about getting back to the Platform?"

The Chief growled, "My great-great-grandfather would disown me! Winning a fight and no scalp to show! Not even counting coup! He'd disown me!"

But Joe saw his rockets flare, away off against the stars.

The war rockets were very near, now. They still emitted monstrous masses of thick white smoke. They climbed with incredible speed. One went by Joe at a distance of little more than a mile, and its fumes eddied out to half that before they thinned to nothingness. They went on and on and on...

They burned out somewhere. It would be a long time before they'd fall back to Earth. Then they'd be meteors. They'd vaporize before they touched solidity. They wouldn't even explode.

But Joe and the chief rode back to the Platform. It was surprising how hard it was to match speed with it again, and to make a good entrance into the giant lock. They barely made it before its plunge into that horrible blackness which was the Earth's shadow. And Joe was very glad they did make it. He wouldn't have liked to be merely astride a skinny framework in that ghastly darkness with *the* monstrous seeming of the Pit below.

Haney met them in the airlock. He grinned.

"Nice job, Joe! Nice job, Chief!" he said warmly. "Uh —Joe, the lieutenant-commander wants you to report to him right away."

Joe cocked an eyebrow at him. "What for?"

Haney spread out his hands. He didn't know.

The chief grunted, "That guy bothers me! I'll bet he's going to explain that you shouldn't have gone out when he didn't want you to! Me, I'm keeping away from him!"

The chief shed his spacesuit and swaggered away, as well as anyone could swagger while walking on what happened—from Joe's viewpoint—to be the ceiling. But Joe put his space gear in its proper place. He went to the small cubbyhole Brown had designated as the office of the Platform commander. Joe went in, naturally without saluting.

Brown sat in a fastened-down chair with thigh grips holding him in place. He was writing. On Joe's entry he carefully put the pen down on a magnetized place that would hold it until he wanted it again.

Otherwise, it could have floated anywhere about the room.

"Mr. Kenmore," said Brown cordially, "you did a very nice piece of work! It's too bad you're not Navy."

"It worked out pretty fortunately," said Joe. "It's lucky that the chief and I were out practising with the space wagons. Now, though, we can take off any time a rocket's reported."

Brown cleared his throat. "I've a problem," he said vexedly. "I can thank you personally, and I do. But—really! How can I report this affair? I can't suggest a commendation, or a promotion or anything! I don't even know how to refer to you! I'm going to ask you, Mr. Kenmore, to put through a request that your status be clarified. An assimilated rank of some sort. I'd imagine your status would be—would be—" He looked estimating-ly at Joe. "Something probably equivalent to a lieutenant junior grade in the Navy. I've—ah—prepared a draft, asking for clarification, that you might find helpful. I consider it important." "Sorry," said Joe. "This important thing to me is getting ready to load up the Platform with supplies from Earth. Excuse me."

He went out of the office. He made his way to the quarters assigned to himself and his crew. Mike greeted him with reproachful eyes, but Joe waved his hand.

"Don't say it, Mike! First, it was an accident. Second, yes. See that the tanks are refilled and new rockets put in place. Then you and Haney can go out and practise. But no farther than ten miles from the Platform. Understand?"

"No," said Mike enviously. "It was a dirty trick!"

"Which," Joe assured him, "you'll even up presently. There's a robot ship coming out from Bootstrap shortly. We'll need to go out and pick it up and tow it here."

Later, he went to the communications room to see if he could get a vision connection to Earth.

He got the beam, and he got Sally on the screen. A report of the attack on the Platform had evidently already gone down to Earth. Sally's expression was drawn, almost haunted. But she tried to talk lightly.

"Derring-do and stuff, Joe?" she asked. "How does it feel to be a victorious warrior?"

"It feels rotten," he told her. "There was somebody in that rocket we had to smash."

"Maybe you didn't do it," suggested Sally. "Maybe it was the chief." "Maybe," said Joe. He hesitated.

"Hold up your hand."

She held it up. His ring was still there. She nodded. "Still wearing it. When will you be back?"

He shook his head. He didn't know. It was curious

that one would want so badly to talk to a girl after doing something that was blood-stirring—and left one feeling rather sick afterward. This business of space travel and even space battle was what he'd dreamed of, and he still wanted it. But it was very comforting to talk to Sally, who hadn't been through any of it.

"Write me a letter, will you?" he asked. "We can't tie up this beam very long."

"I'll write you all the news that's allowed to go out," she assured him. "Be seeing you, Joe!"

Her image faded from the screen. And, thinking it over, he couldn't see that either of them had said anything of any great importance. But he was very glad they'd talked together.

The first robot ship came up some twelve hours after the television call. It started up when the Platform was above the middle of the Pacific. It didn't attempt a spiral approach. It came straight up, and it started from the ground. No pushpots. Its takeoff rockets were monsters. They pushed it up at ten gravities until it was clear of the atmosphere, when it began to move really fast. Not too long later, the robot turned on its side and fired orbital speed rockets to overtake and match velocity with the Platform.

There were two reasons for the high acceleration and the vertical climb. If a ship went straight up, it wouldn't pass over enemy territory until it was where the Platform could protect it. And—it costs fuel to carry fuel. If the robot could get up speed for coasting in the first few hundred miles, it wouldn't need to haul its fuel so far, so it wouldn't need fuel to haul that fuel, or fuel to haul that. It was economical to burn fuel fast and get an acceleration that would kill a human crew. Hence robots.

The landing of the first ship at the Platform was almost as matter-of-fact as if it had been done a thousand times before. From the Platform its takeoff, of course, was invisible. But Joe was with Mike in the airlock, checking the space wagon Mike would use. Mike was already in his cut-down spacesuit, though his face plate was still open. A loudspeaker boomed suddenly, in Brown's voice.

*"Evacuate airlock and prepare to take off."*

Joe roared, "Hold that!"

Brown's voice again, very official: *"Withhold execution of that order. You should not be in the airlock,*

*Mr. Kenmore. You will please make way for operational procedure."*

"This is operational procedure," snapped Joe. "We're checking the space wagon."

*"It should have been checked ready for use before being stowed,"* said voice from the loudspeaker severely. *"I issued an order to that effect."*

Joe did not answer. He and Mike, together, painstakingly checked over the very many items that had to be made sure of. Every rocket had to have its firing circuit inspected. The tanks' contents and pressure verified. The air connection to Mike's spacesuit. The device that made sure that air going to Mike's helmet was neither as hot as metal in sunlit space, nor as cold as the chill of a shadow. Apparatus with so many functions to perform couldn't be checked and put away. It had to be checked before use.

This time everything was quite right. Mike straddled his red-painted mount and strapped in. Joe left the airlock and said curtly, "Okay to pump the airlock. Okay to open airlock doors when ready. Go ahead."

He heard the sounds of the operation. He went to a port and watched. He felt a deep, uneasy concern. But everything went off admirably. When Mike went scooting out the opened lock doors, the robot from Earth was five miles behind the platform, ten miles below, and perhaps fifteen off course, which was excellent automatic control. Joe saw Mike blast the space wagon toward it, stop short with a sort of cocky self-assurance Joe couldn't have matched, and hook the tow ring in the robot ship's nose. He blasted off back to the Platform with it in tow.

Everything went perfectly. He blasted again to check speed, nudged the unwieldy robot into exact position, and then followed it into the lock when the magnetic grapple hauled it inside. The lock doors closed. It was a perfectly routine job, the first time it was done.

But neither Mike nor Haney were out of their space-suits—Haney had been on standby, of course, in case of need—when Brent brought Joe a note. A note was an absurdity in the Platform. But this was a formal communication from Brown.

*From: Lt. Commdr. Brown*

*To: Mr. Kenmore.*

*Subject: Cooperation and courtesy in rocket recovery vehicle launchings.*

*1. There is a regrettable lack of coordination and courtesy in the launching of rocket recovery vehicles (space wagons) in the normal operation of this Platform.*

*2. The maintenance of discipline and efficiency requires that the commanding officer maintain overall control of all operations at all times.*

*3. Hereafter, when a space vehicle of any type is to be launched, the commanding officer will be notified in writing not less than one hour before such launching.*

*4. The time of such proposed launching will be given in such notifications in hours, minutes, and seconds Greenwich Mean Time.*

*5. All commands for launching will be given by the commanding officer or an officer designated by him."*

Joe didn't read the memo until after the mail was distributed, and then it barely registered. He had three letters from Sally. He read them in the great living compartment of the Platform with its sixty-foot length and its carpet on floor and ceiling and the galleries without stairs outside the sleeping cabins. He sat in a chair with thigh grips to hold him in place, and he wore a gravity simulator harness. It was necessary. The regular crew of the Platform was coming back toward normal, but they couldn't have handled space wagons in action against enemy-manned rockets, and very probably not for recovery of robot ships. Joe meant to stay able to take acceleration.

It was just as he finished his mail that Brent came back.

"Big news!" said Brent. "They're building a new gun-mick, half the size of the Platform. With powder metallurgy they can finish it in weeks!"

"What's it for?" demanded Joe.

"It'll be a human base on the moon," said Brent re-h'evedly. "They expect to make it in three months or even less. As long as we're the only American base in space, we'll be shot at. But a base on the moon will be invulnerable. So they're going ahead with it."

Joe said hopefully, "Any orders for me to join it?"



Brent shook his head. "We're to be loaded up with supplies for it. We're to be ready to take a robot ship every round. Actually, they can't hope to send us more than one a day for a while, but even that'll be forty tons of supplies to be stored."

The chief grumbled, but somehow his grumbling did not sound genuine.

"They're going to the moon, and leave us behind to do stevedore stuff?" His tone was odd. He looked at a letter he'd been reading and gave up pretense. He said selfconsciously, "Listen, you guys!... My tribe's all excited. I just got a letter from the council. They've been having an argument about me. Wanna hear?"

He was plainly embarrassed, but something had happened to make him feel good.

"Let's have it," said Joe. Mike was very still hi another chair. He didn't look up, though he must have heard. Haney cocked an interested ear.

The Chief said awkwardly, "You know—us Mohawks are kind of proud. We've got something to be proud of. We were one of the five nations, when that was a sort of United Nations and all Europe was dog-eat-dog. And my tribe's had a big pow-wow about me. There's a tribe member who's a professor of anthropology out hi Chicago. He was there. And a couple of guys who do electronic research, and doctors and farmers and all sorts of guys. All Mohawks. They got together in tribal council."

He stopped and flushed under his dark skin.

"I wouldn't tell you, only you guys are in it."

Still he hesitated. Joe found a curious picture forming in his mind. He'd known the chief a long time, and he knew that part of the tribe lived in Brooklyn, and individual members were widely scattered. But still there was a certain remote village which to all the tribesmen was home. Everybody went back there from tune to tune to rest from the strangeness of being Indians hi a world of pale-skinned folk.

Joe could almost imagine the council. There'd be old, old men who could almost remember the days of the tribe's former glory, who'd heard stories of forest warfare and zestful hunts and scalplings and heroic deed? from their grandfathers. But there were also doctors and lawyers and technical men in that council which had met to talk about the chief.

"It's addressed to me," said the chief with sudden clumsiness. "In the World-by-Itself Canoe. That's the Platform here. And it says— I'll have to translate, because it's in Mohawk."

He took a deep breath.

"It says, 'We your tribesmen have heard of your journeyings off the Earth where men have never traveled before. This has given us great pride, that one of our tribe and kindred has ventured so valiantly.' " The chief grinned abashedly. " In full assembly, the elders of the tribe have held council on a way to express then- pride in you, and in the friends you have made who accompanied you. It was proposed that you be given a new name to be borne by your sons after you. It was proposed that the tribe accept from each of its members a gift to be given you in the name of the tribe. But these were not considered great enough. Therefore the tribe hi full council has decreed that your name shall be named at every tribal council of the Mohawks from this day to the end of tune, as one the young braves will do well to copy in all ways. And the names of your friends Joe Kenmore and Thomas Haney and Mike Scandia shall also be named as friends whose like all young braves should strive to seek out and to be."

The chief sweated a little, but he looked enormously proud. Joe went over to him and shook hands warmly. The chief almost broke his fingers. It was, of course, as high an honor as could be paid to anybody by the people who paid this.

Haney said awkwardly, "Lucky they don't know me like you do, Chief. But it's swell!"

Which it was. But Mike hadn't said a word. The chief said exuberantly, "Did you hear that, Mike? Every Mohawk for ten thousand years is gonna be told you were a swell guy. Crazy, huh?"

Mike said in an odd voice, "Yeah. I don't mean I don't care, Chief. It's fine! But I—I got a letter. I—never thought to get a letter like this."

He looked unbelievably at the paper in his hands. "Mash note?" asked the chief. His tone was a little harsh. Mike was a midget. And there were women who were fools. It would be unbearable if some half-witted female wrote the sort of gushing letter that some halfwitted female might write.

Mike shook his head, with an odd quick smile. "Not what you think, Chief. But it is from a girl. She sent

me her picture. It's a—swell letter. I'm—going to answer it. She—looks kind of nice."

He handed the chief a snapshot. The chief's face changed. Haney looked over his shoulder. He passed the picture to Joe and said ferociously, "You Mike! You dogged Don Juan! Haney and me have to warn her what kind of guy you are! Stealing from blind men! Fighting cops—"

Joe looked at the picture. It was a very sweet small face, and the eyes that looked out of the photograph were very honest and yearning. And Joe understood. He grinned at Mike. Because this girl had the distinctive look that Mike had. She was a midget too.

"She's—thirty-nine inches tall," said Mike, almost stunned. "She's just two inches shorter than me. And—she says she don't mind being a midget so much since she heard about me. I'm going to write her."

But it would be, of course, a long time before there was a way for mail to get down to Earth.

It was a long time. Now it was possible to send robot rockets up to the Platform. They came. When the second arrived, Haney went out to pull it in. Joe forgot to notify Brown, in writing, an hour before launching a rocket recovery vehicle (space wagon) according to paragraph 3

of an official memorandum, nor the time of launching in hours, minutes, etc., by Greenwich Mean Time (paragraph 4) nor was the testing of all equipment made before it was moved into the airlock. This was because the testing equipment was in the airlock, where it belonged. And the commands for launching were not given by Brown or an officer designated by him because Joe forgot all about it.

Brown made a stormy scene about it, and Joe was honestly apologetic, but the chief, Mike and Haney glared.

The result was completely inconclusive. Joe had not been put under Brown's command. He and his crew were the only people on the Platform physically in shape to operate the space wagons, considering the acceleration involved. Brent and the others were wearing gravity simulators and exercising as advised, but they weren't up to par as yet. They'd been in space too long.

There was nothing Brown could do. He retreated into icily correct, outraged dignity. And the others hauled in unloaded rockets as they arrived. They came up fast. The process of making them had been improved. They could be made faster, sintered more quickly, and the hulls cooled to usefulness in a quarter of the former time. The production of spaceship hulls went up to four a day, while the molds for the Moonship were being worked even faster. The Moonship was actually assembled from precast individual cells which were then welded together. It would have features the Platform lacked, because it was designed to be a base for exploration and military activities in addition to research.

And only twenty days after the recovery and docking of the fortieth robot ship, an entirely new kind of ship came up as a robot. The little spacewagons hauled it to the airlock and inside. They unloaded it, and it was no longer a robot. It was a modified supply ship, designed for the duties of a tug in space. It could carry a crew of four, and its cargo hold was accessible from the cabin. It had an airlock. More, it carried a cargo of solid fuel rockets which could be shifted to firing racks outside its hull. Starting from the Platform, where it had no effective weight, it was capable of direct descent to Earth without spiraling or atmospheric braking. To make that descent it would, obviously, expend four-fifths of its loaded weight in rockets. And since it had no weight at the Platform, but only mass, it was capable of far-ranging journeying. It could literally take off from the Platform and reach the Moon, and land on it and then return to the Platform.

But that had to wait.

"Sure we could do it," agreed Joe when Mike wistfully pointed out the possibility. "It would be good to try it. But unfortunately, space exploration isn't a stunt. We've gotten this far because somebody wanted to do something. A lot of somebodies did! But—" Then he said, "The United Nations wouldn't do it. So the United States had to—or somebody else would have. You can figure out who that would be and what use they'd make of space travel! So it's important. It's more important than any stunt flight we could make!"

"Nobody could stop us if we wanted to takeoff," said Mike rebelliously.

"True," Joe said. "But we four can stand acceleration and handle any more manned rockets that start out here. We've lived through plenty. But Brent and the others couldn't put up a fight in space. They're wearing harnesses now, and they're coming back to strength, but we're going to stay right here and do stevedoring—and fighting too, if it comes to that—until the job is done."

And that was the way it was. Of stevedoring there was plenty. Two robot ships a day for weeks on end. Three ships a day for a time. Most of the time everything went smoothly, and the little space wagons could go out and bring back the great, rocket-scarred hulls from Earth. But sometimes—not often, but sometimes—the robots were going too fast or too slow. The space wagons couldn't handle them. Then the new ship, the Space Tug, went out and hooked on and used the power it had to bring them to their destination. And sometimes the robots didn't climb straight. At least once the space tug captured an erratic robot four hundred miles offcourse. It used some heavy solid fuel rockets that trip.

The Platform had become, in fact, a port in space, though so far it'd had only arrivals and no departures save the first two ships. Its storage compartments almost bulged with fuel stores and food stores and equipment of every imaginable variety. It had a stock of rockets with which it could land on Earth, though there was surely no intention to do so. It had food and air for centuries. It had repair parts for all its own equipment. And it had weapons. In the robot hulls anchored to its sides it had enough fissionable material to conduct a deadly war, which was only stored for transfer to the moon base when that should be established.

And it had high-quality communication with Earth. So far the mail was only a one-way service, but even entertainment came up, and news. Once there was a television shot of the interior of the Shed. It was carefully scrambled before transmission, but it was a heartening sight. The Shed on the TV screen appeared a place of swarming activity. Robot hulls were being made. They were improved, now, fined down to ten tons of empty weight apiece. Their controls were assembly line products now. And there was the space flight simulator with men practising in it, though for the time being only robots were leaving Earth. And there was the Moonship.

It didn't look like the Platform, but like something a child might have assembled from wooden blocks. It was built up of welded-together cells with strengthening members added. It was sixty feet high and twice as long, and it did not weigh nearly what it seemed to. Already it was being clad in that thick layer of heat-insulation it would need to endure the two-week-long Lunar night. It could takeoff very soon, now.

The pictured preparations back on Earth meant around-the-clock drudgery for Joe and the others. They wore themselves out. But the storage space on the Platform filled up. Days and weeks went by. Then there came the time when literally nothing else could be stored. So Joe and his crew made ready to go back to Earth.

They ate hugely, and packed a very small cargo in their ship. They included one bag of mail and four bags of scientific records and photographs which had only been transmitted by facsimile TV before. They got into the Space Tug. It floated free.

*"You will fire in ten seconds,"* said a crisp voice in the cabin of the tug. *"Ten ... nine... eight... seven ... six five... four ... three ... two ... one ... fire!"*

Joe crooked his index finger. There was an explosive jolt. Rockets flamed in emptiness. The space tug rushed toward the west. The Platform seemed to rush away and become lost among the myriads of stars.

The space tug accelerated at four gravities in the direction opposed to its orbital motion.

As the acceleration built up, it dropped toward Earth and home like a tumbling stone.

## 10

THERE WAS bright sunshine at the Shed, and not a single cloud in all the sky. The radar bowls atop the roof—they seemed almost invisibly small compared with its vastness—wavered and shifted and quivered. Completely unseeable beams of microwaves lanced upward. Atop the Shed, in the communications room, there was the busy quiet of absolute intentness. Signals came down and were translated into visible records which fed instantly into computers. The computers then hummed and clicked and performed incomprehensible integrations, and out of the slot mouths poured billowing ribbons of printed tape. Men read those tapes and talked crisply into microphones, and their words went aloft again.

Down by the eastern door of the Shed, at the desert's edge, Sally Holt and Joe's father waited together,

watching the sky. Sally was white and scared. Joe's father patted her shoulder reassuringly.

"He'll make it?" asked Sally, dry-throated. Joe's father nodded. "Of course he will!" But his voice wasn't steady.

A loudspeaker close to them said abruptly, "*Nineteen miles.*"

There was a tiny, straggling bit of what looked like white fluff in the sky overhead. It thinned out to nothingness, but its central part was a speck of flame. It came down with an astonishing, an appalling speed.

"*Twelve miles,*" said the loudspeaker. "*Rockets firing.*"

The downward-hurling mass of white stuff spread as it grew nearer. It was like a crippled plane, burning, falling from the sky. But no falling plane ever fell so fast.

At seven miles the white-hot glare of the rocket flames was bright, even in the daylight. At three miles it was unbearably bright. At two, the light winked out. Sally saw

something which glittered, plummeting toward the ground below the vapor.

It fell almost half a mile before rocket flames flung furiously out again. Then it checked. Visibly, its descent was slowed. It dropped more slowly, and more slowly, and more slowly still...

It hung in mid-air a quarter mile high. Then there was a fresh burst of rocket fumes, more monstrous than before, and it descended steadily, touched the ground, and stayed there spurting incandescence for seconds. Then the bottom flame went out. An instant later there were no flames at all.

Sally began to run toward the landed ship. She stopped. A procession of rumbling, clanking, earth-moving vehicles moved out of the Shed and toward the upright Space Tug. A bulldozer prosaically lowered its wide blade some fifty yards from the ship. It pushed a huge mass of earth before it, covering over the scorched and impossibly hot sand about the rocket's landing place. Other bulldozers began methodically to circle around and around, overturning the earth and burying the hot surface stuff. Water trucks sprayed, and thin steam arose. <sup>x</sup>

But then an exit port showed and Joe stood in the opening.

Sally began to run again.

Joe sat at dinner in the Major's quarters. Major Holt was there, and Joe's father, and Sally.

"It feels good," said Joe warmly, "to use a knife and fork again, and to pick up food from a plate where it stays until it is picked up."

"The crew of the Platform—" Major Holt began.

"They're all right," said Joe, with his mouth full. "They're wearing gravity simulator harnesses. Brent's got his up to three-quarters gravity. They get tired, wearing the harness. They sleep better. I'd say Brent should be able to use a space wagon. But there's no likelihood of drones going up any time soon."

Joe's father said, "You'll be on Earth for a while, then."

Sally moved. She looked tense.

But Joe said, "They're going to get the Moonship up, sir. We really came back—my gang and me—to help train the crew. We on<sup>^</sup>have a week to do it in, but we've got some combat tactics to show them on the training gadget in the Shed." He added: "And, sir,—they'll have to take the Moonship off on a spiral going up. She can't go straight up. That means she has to pass over enemy territory and we've got to have a real escort for her. A fighting escort. It's planned for the Space Tug to take off a few minutes after the Moonship and blast along underneath. We'll dump guidable missiles out—like drones—and if anything comes along we can start their rockets and fight our way through. And we four have more experience than anybody else. We're needed!"

"You've done enough," said Sally.

"But the United States," said Joe awkwardly, "is going to take over the moon and—I can't miss having a hand in that! Not *if* it's at all possible!"

"I'm afraid you will miss it, Joe," said Major Holt. "The occupation of the moon will be a Navy enterprise. Space Exploration facilities are being used to prepare for it, but the Navy won the last battle of the Pentagon. The Navy takes over the moon."

Joe looked startled.

"But—"

"You're Space Exploration personnel," said the Major detachedly. "You'll be used to instruct navy personnel, and your tug will go along to the Platform as an auxiliary vessel. For purposes of assisting the Moonship to land at the Platform, you understand. You'll haul her away from the Platform when she's refueled and supplied, so she can start for the moon. But the occupation of the moon will be strictly Navy."

Joe's expression became carefully unreadable. "I think," he said, "I should say, 'No comment.'" Major Holt nodded. "But there's a reason for the Navy to take over. Just one day before the Moonship leaves, the United Nations will be informed that it is a United States naval vessel. The doctrine of the freedom of space—like the freedom of the seas—will be promulgated. And the United States will say that a United States naval vessel is starting out to space on an official mission. To attack a Space Exploration ship is one thing. But to fire on a warship on official business . . . Especially if that ship can shoot back ..."

"And they need me and my gang," said Joe slowly, "for tugboat work at the Platform. For nothing else." "Exactly," said the major.

"Then," Joe said doggedly, "they get us. My gang will gripe about being edged out of the moon trip. They won't like it. But they'd like backing out still less. We'll play it the way it's dealt,—but we won't like it." The major's expression did not change at all, but Joe had an odd feeling that the major approved of him. "Yes. That's right, Joe," his father added. "You'll— have to go aloft once more, son. After that, we'll talk it over."

Sally hadn't said a word during the discussion, but she'd watched Joe every second. Later, out on the porch of the major's quarters, she had a great deal to say. But that couldn't alter the facts.

The world at large, of course, received no inkling of the events in preparation. The Shed and the town of Bootstrap and all the desert for a hundred miles about, were absolutely barred to all visitors. Anybody who came into that area stayed in. Most people were kept out. All that anyone outside could discover was that enormous quantities of cryptic material had poured and still poured into the Shed. But this time security was genuinely tight. Educated guesses could be made, and were made, but nobody outside the closed-in area save a very few top-ranking officers had any real knowledge. The world only knew that something drastic and remarkable was in prospect.

Mike, though, was able to write a letter to the girl who'd written him. Major Holt arranged it. Mike wrote his letter on paper supplied by Security, and while watched by Security officers. His letter was censored by Major Holt himself, and it did not reveal that Mike was back on Earth. But it did rate a reply, and Mike sweated as he waited for one.

The others had plenty to sweat about. Joe and Haney and the chief were acting as instructors to the Moonship's crew. They taught practical space navigation. At first they thought they didn't have much to pass on, but they found out otherwise. They had to pass on data on everything from how to walk to how to drink coffee, how to eat, sleep, why one should wear a gravity harness and perform exhausting exercises every day, and the manners and customs of ships in space. They had to show why in space fighting a ship might send missiles on before, but would really expect to do damage with missiles it left behind. They had to warn of the dangers of unshielded sunshine, and the equal danger of standing in shadow for more than five minutes, and—

They had material for six months of instruction, but they had barely a week in which to pass it on. Joe was run ragged, but in spite of everything he managed to talk at some length with Sally. And he found himself curiously anxious to discuss any number of things with Ms father, who suddenly appeared to be much more intelligent than Joe had ever noticed before.

He was almost unhappy when it was certain that the Moonship would take off for space on the following day. He talked about it with Sally the night before takeoff.

"Look," he said awkwardly, "As far as I'm concerned this has turned out a pretty sickly business. But when we have a base on the moon, it'll be a good job done. There will be one thing nobody can stop! Everybody's been living in terror of war. If we hold the moon the cold war will be ended. You can't kick on my wanting to help end that!"

She smiled at him in the moonlight. "And meanwhile," said Joe clumsily, "well—when I come back we

can do some serious talking about—well—careers and such things. Until then, no use. Right?"

Sally's smile wavered. "Very sensible," she agreed wryly. "And awfully silly, Joe. I know what kind of a career I want! What other fascinating topic do you know to talk about. Joe?"

"I don't know of any. Oh, yes! Mike got a letter from his girl. I don't know what she said, but he's walking on air."

"But it isn't funny!" said Sally indignantly. "Mike's a person! A fine person! If he'll let me, I'll write to his girl

myself and—try to make friends with her so when you come back I—maybe I can be a sort of matchmaker."

"That I like!" Joe said warmly. "You're swell, Sally!"

Sally looked at him enigmatically in the moonlight. "There are times when it seems to escape your attention," she observed.

The next morning she cried a little when he left her to climb in the Space Tug which was so small a part of today's activity. Joe and his crew were the only Hving men who'd made a round trip to the Platform and back. But now there was the Moonship to go farther than they'd been allowed. It was even clumsier in design than the Platform, though it was smaller. But it wasn't designed to stay in space. It was to rest on the powdery floor of a ring mountain's central plain.

Let it get off into space and then to the Platform to reload. Then let it replace the rockets it would burn in takeoff and it could go on out to emptiness. It would make history as the first serious attempt by human beings to reach the moon.

Joe and his followers would go along simply to handle fighting missiles if it came to a fight, and to tow the Moonship to its wharf—the Platform—and then out to midspace again when it resumed its journey. And that was all.

So, eventually, the Moonship lifted from the floor of the Shed to the sound of hundreds of pushpot engines. She went aloft, she got to maximum height and velocity eastward, and the pushpots fired their jatos. When they burned out, the Moonship—a ship designers' nightmare—fired her own rockets and went on out to space.

The Space Tug went up after her. Her takeoff rockets substituted for pushpots. Her second stage rockets were also of a nonpoisonous variety, because she fired them at a bare sixty thousand feet. They were substitutes for the jatos the pushpots carried.

She was clearly out hi space before her third stage rockets roared dully outside her hull.

When the Moonship crossed the west coast of Africa, the Space Tug was four hundred miles below and not at all behind her. When the Moonship crossed Arabia, the difference was less, vertically, and no more in line.

Then the Moonship released small objects, steadied by gyros and flung away by puffs of compressed air. The small objects spread out. Haney and Mike and the chief had reloaded the tug's firing racks from inside the ship and now were intent upon control boards and radar. They pressed buttons. One by one, little puffs of smoke appeared in space. They had armed the tiny missiles, setting off flares which had no function except to prove that each missile was ready for use.

By the time the two spacecraft floated over India—and would shortly cross an area from which rocket bombs had been known to rise—there were more little weapons floating with them. One screen of floating, hurtling objects went on before the Space Tug, and another followed behind. Anything that came up from earth would instantly be attacked by dozens of miniature robots intent upon suicide.

Radar probed the space formation, but the enemies of the Moonship and the Platform very wisely did no more than probe. The Moonship and its attendants went across the pacific, still rising. Above the longitude of Washington, the Space Tug left its former post and climbed, nudging the Moonship this way and that.

And from behind, the Platform came floating splendidly.

Tiny figures in spacesuits extended the incredibly straight lines which were plastic hoses filled with air. Very, very gently indeed, the great, bulbous Platform and the squat, flat Moonship came together and touched. They moored in contact.

And then the missiles that had floated below, all the way up, flared simultaneously. Their rockets emitted

vapor. In fine alignment they swept forward through emptiness, swerved with a remarkable precision, and headed out for the stars beyond the Platform's orbit. Their function had been to protect the Moonship so far on its way. They'd performed it. There were too many of them to recover, so they went away to nowhere.

When their rockets burned out they vanished. But a good hour later, when it was considered that they were as far out as they were likely to go, they began to blow up. Specks of flame, like the most minute of new stars, flickered against the background of space. But Joe and the others were in the Platform by then. They'd brought up mail for the crew. And they were back on duty.

The Platform seemed strange with the Moonship's crew aboard it. *With* twenty-five naval ratings plus the three of its crew and the Space Tug's *complement*, it seemed excessively crowded.

And it was busy. There were twenty-five new men to be guided as they applied what they'd been taught aground about life in space. It was three days before the stores intended for the journey to the moon and the maintenance of a base there began to move. The tug and the space wagons had to be moored outside and reached only by spacesuits through small personnel locks.

And there was the matter of discipline. Lieutenant-commander Brown had been put in charge of the Platform for experience in space. He was considered to be prepared for command of the Moonship by that experience. So he turned over command of the Platform to Brent—making a neat ceremony of it—and took over the structure that would go out to the moon. He made another ceremony out of that.

In command of the Moonship, his manner to Joe was absolutely correct. He followed regulations to a degree that left Joe blankly uncomprehending. But he wouldn't have gotten along in the Navy if he hadn't. He'd tried to do the same thing in the Platform and it wasn't practical. But he ignored all differences between Joe and himself. He made no overtures of friendship, but that was natural. Joe had defied him—unintentionally, but in fact. He now deliberately overlooked that matter and Joe approved of him, within limits.

But Mike and Haney and the chief did not. They laid for him. And they considered that they got him. Brown naturally maintained strict naval discipline and required snappy naval salutes on all suitable occasions, even in the Platform. And Joe's gang privately instructed the Moonship's crewmen. Thereafter, beginning at a specific moment, Greenwich Mean Time, each naval rating unostentatiously detached his magnetic shoe soles from the floor before coming to salute. A really snappy salute was a triumph. When he was free of a magnetic grip on the floor, a salute caused, first, his body to bend forward as his hand was raised. More, the upward impetus was onesided, and every man who saluted Brown immediately *made a spectacular* kow-tow which left him rigidly at *salute, floating somewhere overhead, and with his back to his superior officer*. With a little practise, a somersault could be included. On one historic occasion Brown went clanking into a storeroom where a dozen men were preparing supplies for transfer to the Moonship. A voice cried, "Shun!" And instantly twelve men went floating splendidly about the storeroom, turning leisure somersaults, all rigidly at attention and all wearing regulation poker faces. An order abolishing salutes in weightlessness followed. It took four days to get the transfer of supplies properly started. It took eight more to complete the job. Affixing fresh solid fuel rockets to the outside of the Moonship called for long hours in spacesuits. During this time Mike floated nearby in a space wagon. One of the Navy men was a trifle overcourageous. He affected to despise safety lines. Completing the hook-in of a landing rocket, he straightened up too abruptly and went floating off toward the Milky Way.

Mike brought him back. After that there was less trouble.

Even so, the Moonship and the Platform were linked together for no less than thirteen days. On the fourteenth the two celestial objects sealed off and separated. Joe and his crew in the Space Tug hauled the Moonship a good five miles from the Platform.

The Space Tug returned to the Platform. A blinker signal came across the space that separated the huge objects. It was a crisp, formal, Navy-type message.

Then clouds of rocket fumes came out of the Moonship's rocket tubes. The angular creation began slowly

to move. It picked up speed. In any resisting medium its shape would have made it the least possibly moveable of moving things. But here it headed out toward the Moon, in a curve which was almost flat where it matched the Platform's orbit, and almost a vertical line where it crossed the meeting place of Earthly and lunar gravitational fields.

From there the Moonship would have only to brake its fall under a pull of gravity one-sixth that of Earth and reaching out a vastly shorter distance.

Joe and the others watched the masses of rocket fumes as the Moonship seemed to become infinitely small in the distance.

"We should've been in there," said Haney heavily, when the Moonship was past discovery by the naked eye. "We could've beat her to the moon!"

Joe said nothing. He ached a little inside. But he reflected that the men who'd guided the Platform to its orbit had been overshadowed by himself and Haney and the chief and Mike. A later achievement always makes an earlier one look small. Now the four of them would be forgotten. History would remember the commander of the Moonship.

Forgotten? Yes. Perhaps. But the names of the four of them would still be remembered in a language Joe couldn't speak, in a little village he couldn't name, on those occasions when the Mohawk tribe met in council.

The chief grumbled. Mike stared out the port with bitter envy.

"It was a dirty trick," growled the chief. "We should've been in the first gang ever to land on the moon! We earned it!"

Joe grimaced. His crew needed to be cured of feeling the same way he did.

"I wouldn't say this outside," he said carefully, "but if it hadn't been for us four that ship wouldn't be on the way at all. Haney figured out the trick that got us back to Earth the first time, or else we'd have been killed. If we'd been killed, Mike wouldn't have figured out the metal concrete business. But for him, the Moonship wouldn't be even a gleam in anybody's eye. And if the chief hadn't blown up that manned rocket we fought in the space wagon, there wouldn't be any Platform up here to reload and refuel the Moonship. So we got left behind? But if it hadn't been for us—"

Haney grinned slowly at Joe. The chief regarded him with irony.

Mike said, "Yeah. Haney, and me, and the chief. We did it all."

"Uh-huh," said the chief sardonically. "Just us three. Joe didn't do anything. Just a bum, that's all. We ought to tell Sally to give him the gate and pick out somebody who might amount to something someday! Come on, guys! Let's get something to eat!"

The four of them marched down a steel-floored corridor, their magnetic-soled shoes clanking on the plates. Their progress was uncertain and ungainly and altogether undignified. Suddenly the chief began to bellow a completely irrelevant song to the effect that the inhabitants of the kingdom of Siam were never known to wash their dishes. Haney chimed in, and Mike. They were all close together and they were not at all impressive. But it hit Joe very hard, this sudden awareness that the others didn't really care. It was the first time he'd suspected that each of the other three would rather be left behind with him, as a gang, than go on to individual high achievement in a first landing on the moon.

It felt good. It felt very good!

But that, and all other sources of satisfaction, was wiped out by news that came back from the Moonship when the Platform was only on the other side of its round-the-Earth orbit.

The Moonship was in trouble. The sequence and timing of its rocket blasts were worked out on Earth, and checked by visual and radar observation. The computations were done by electronic brains the Moonship hadn't room to carry. And everything worked out. The Moonship was on course and its firings were on schedule.

Then the unexpected happened. It was an error no machine could ever have computed, and for which there was no calculable remedy. It was a human error. At the signal for the final blast to build up the Moonship's velocity, so it would carry on past the neutral point and from there on need deceleration to slow it down—at the signal for the firing that should have given the Moonship the barest minimum of



extra thrust that would get her into the moon's gravitational field, somebody fired the wrong set of rockets. The rockets that should have braked the Moonship's descent were fired to fling it headlong to eventual destruction. *When the mistake was realized, they'd had sense enough to cut loose the still-firing giant rockets. But the damage had been done.* The ship still plunged on. It would reach the moon. But it wouldn't land hi Aristarchus Crater as had been planned. If every rocket remaining mounted on the Moonship's hull were fired at the best possible instant, the Moonship would hit near Copernicus, and it would land with a terminal velocity of eight hundred feet per second—five hundred forty miles per hour. It could even be calculated that when the Moonship crashed, the collision should be visible from the Platform with its better astronomical telescope. Not on Earth, because of atmospheric conditions, but from the Platform, yes. If every rocket were fired at exactly the optimum instant, the Moonship should crash to destruction in so many\_\_ hours, so many minutes, and so many seconds.

## 11

THE OTHERS got the Space Tug into the Platform's airlock and did things in the way of loading that its designers never intended. Meanwhile Joe was calling Earth for calculations. The result was infuriating. The Moonship had taken off from the Platform at the other side of the Platform's orbit. It used its orbital speed in the moon's direction as part of its velocity toward the moon. Now, with the Platform and the Space Tug on the opposite side of the Platform's path, the orbital speed of both of them was away from the moon. The calculations from Earth said that they could wait long hours before starting out, to save rocket fuel, or waste rocket fuel to save time.

"We can't wait!" snapped Joe. Then he said suddenly "Look here! Suppose we dive at Earth and make a near graze and let its gravity swing us on course? Like a comet's path! Figure that! That's what we've got to do!"

He kicked off his magnetic-soled shoes and went diving down to the airlock. Over his shoulder he flung an order for the man on communications duty to propose that course to Earth and get the calculations for it. He arrived at the airlock to find Haney and Mike in hot argument over whether it was possible to load on an extra ton or two of mass. He stopped them. Load it!

"Everything's aboard?" he demanded. "Okay. Space-suits? All set? Let's get out of this lock and start blasting!"

He drove them into the Space Tug. He climbed in himself. The chief was already aboard, bracing cargo—exclusively drive rockets—against shifting hi flight. Joe closed the entrance port, the plastic walls of the lock bulged out, drew back, and the ship's steering rockets jettied. The tug came out of the lock. It spun around,

headed for Earth, and monstrous bursts of rocket fumes billowed out behind it. It dived.

Naturally! When a ship from the platform wanted the most economical passage down to Earth, it obviously headed out to space to save fuel. Now that the Space Tug needed the quickest maximum speed away from Earth, it dived toward it.

The ship would plunge toward the planet, and Earth's gravity would help the ship's rockets attain a maximum speed. Gravitation plus rocket thrust would give the ship the highest velocity it could hope to attain. But the tug still had its orbital speed around the Earth, so although it aimed straight for its home world it would go by, past its edge. Yet Earth would continue to pull. As the Space Tug skimmed past, its path would be curved by the pull of Earth. At the nearest possible approach to Earth, the tug would fire its heaviest rockets for maximum acceleration. And it would swing around Earth perhaps no more than three hundred miles high—just barely above the limits of the atmosphere—and come out of that crazy curve a goocT many hours before the Platform would have come halfway round its orbit. And the tug would then have a course which was exactly in line with that of the runaway Moonship, and with vastly greater velocity than that eccentric structure could have attained.

So the Space Tug dived to carry out that maneuver. And it happened that it had left the Platform and plunged away deep into the black shadow of Earth, so the look and feel of things was that of a suicidal plunge into pure oblivion. The ship started for that at four gravities acceleration, and Joe got his headphones to his ears and lay panting while he waited for the calculations he had to have.

He got them. When the four-gravity rockets burned out, the ship's nose was most painstakingly aimed in a certain direction. They flung themselves back into the acceleration chairs and Joe fired a six gee rocket. They came out of that, and he fired another. The three rockets gave the ship a downward speed that—as speed toward Earth—was enough to give anybody a slight crawling sensation up and down his spine. Earth's pull added to it.

Down on Earth, radar bowls wavered dizzily, hunting for them to feed them observations of position and data for their guidance. Back on the Platform, members of that object's crew feverishly made their own computations. When the four hi the Space Tug were halfway to Earth, they were traveling faster than any human had ever traveled before—except perhaps themselves when attempting a landing in the long-destroyed first supply ship. When they were a thousand miles from Earth it was certain that they would make a perfect grazing passage. Joe proposed and received an okay to fire ten-twos to speed the ship still more. When they burned away, the chief and Haney panted up from their chairs and made their way aft. They went to reload the rocket clamps outside the Space Tug. It could be done, in this ship. In no other could rockets be taken from cargo and fired outside.

Haney and the chief came back. There was dead silence in the ship, save for the small, tinny voice in Joe's headphones.

"We're doing all right," he told the others. "We'll pass under four hundred miles. Lower, and we'd lose velocity and maybe melt. But we'll do all right. We'll be over enemy territory, but I doubt they could hit us. We could speed up some more but we're going to need to stop, presently. We'll ride it out."

Silence. Stillness. Speed. Out the ports to Earthward there was nothing else but black. On the other side there was the usual multitude of stars. But the blackness grew and grew until it neatly bisected the cosmos itself, and half of everything that was, was blackness. The other half was tiny colored stars.

Then there was sound. A faint sound. It was a moan. It was a howl. It was a shriek ... And then it was a mere thin moan again, and then it was not.

"We touched air," said Joe calmly, "well up in meteoric speeds. Maybe we left a meteor trail for people to admire." Nobody said anything at all. In a little while there was light ahead. There was brightness.

Instantly, it seemed, they were out of night and there was a steaming tumult of clouds and earth and sea below—but they couldn't actually see anything before it was left behind—and Joe's headphones rattled. He listened.

"Now for course correction! And maybe a trace more of speed ..."

Rockets roared and boomed outside the hull. Earth fell away and presently lay far behind. And they were plunging on after the Moonship, which was so very far ahead of them.

It was, obviously, very many hours indeed before they overtook it. They couldn't afford to overtake it gradually, because they had to have time to work in after they caught it. But overtaking it swiftly would cost extra fuel, and they hadn't too much. So they compromised. When they did catch up to the runaway Moonship they were traveling at just about two thousand feet per second—a little less than a high velocity rifle bullet—and all creation was blotted out by the fumes of the rockets they had to fire to stop. \_.

Then the Space Tug maneuvered cautiously close to the Moonship. Mike climbed out on the tug's sintered hull, with the chief also in space equipment playing out his safety line. Mike leaped across two hundred yards of emptiness with light years of gulf beneath him. His metal soles clanked on the Moonship's hull. Then the vision screen on the tug lighted up. Lieutenant-commander Brown looked out of the screen, quietly grim. Joe flicked on his own transmitter. He nodded.

"Mr. Kenmore," said Brown evenly, "I didn't disturb you before because frankly I didn't think you could overtake us. But since you have, how many passengers can you take back?"

Joe blinked at him.

"I haven't any idea," he said. "But I'm not taking passengers! I'm going to hitch on and use our rockets to land you."

"I don't think it practical," said Brown calmly. "I believe the only result of such an attempt would be the loss of both ships with all hands. I will give you a written authorization to return, on my order. But how many of my men can you take? I have ten married men aboard. Six have children. Can you take six? Or all ten?" Then he

said without a trace of emphasis, "Of course none of them will be officers."

"If I tried to turn back now," said Joe coldly, "my crew would mutiny. I'd hate to think they wouldn't! We're hooking on, to play this out the way it lies." There was a pause. Brown spoke again: "Mr. Kenmore—ah—intelligent

defiance has always been in the traditions of the Navy. Of course you aren't Navy, but right now—*ah—I* feel there isn't as much difference as I thought. Good luck to you!"

Joe flicked off with something of the bewilderment with which Lieutenant-Commander Brown always filled him. Mike worked deftly. In minutes the Space Tug had a

line made fast. In more minutes the two spacecraft were bound firmly together, but far enough apart for the rocket blasts to dissipate between them. Mike returned to the interior of the tug. A pair of four-twenties—takeoff rockets—burned in emptiness.

The Moonship was slowed by a fraction of its speed.

The deceleration could barely be felt.

There were more burnings. Back on Earth there were careful measurements. A light beam tends to attenuate when it is thrown even one hundred thousand miles. A laser does much better. But when speech is conducted even by laser at such distances, the lag between comment and reply is perceptible. It's not great,—half a second or so for a hundred thousand miles—but one notices it at Earth-to-Moon distances. And that lag could be used to measure the speed and distance of the two craft from the moon. The prospects seemed dim.

The Space Tug burned rocket after rocket after rocket. There was no effect that could be detected on board, of course. It would have been like noticing the effect of single oar strokes in a rowboat miles from shore. But the instruments on Earth found a difference. They made very, very, very careful computations. And the electronics brains did the calculations which battalions of mathematicians would have needed years to work out. The electronic calculations which could not be mistaken said—that it was a tossup. The moon came slowly to float before the two linked spacecraft. It grew slowly, slowly larger. The word from Earth was that, considering the rockets still available in the Space Tug, and those that should have been fired but weren't on the Moonship, there must be no more blasts just yet. The two ships must pass together through the neutral point where the gravities of Earth and moon exactly cancel out. They must fall together toward the moon's rocky surface. Forty miles above impact such-and-such rockets were to be fired. At twenty miles, such-and-such others. At five miles, the Moonship itself must fire all that was left outside, of the rockets it had started with. With luck, it was no worse than a tossup. But it was certainly no better.

There was a long time to wait, though. Joe and his crew relaxed.

The chief looked out a port and observed, "I can see the ring mountains now. Naked eye stuff, too! I wonder if anybody ever saw that before!" /--"Not likely," said Joe. Mike stared out a port. Haney looked also. "How're we going to get back?" "The Moonship has rockets aboard," said Joe, "for exploration and such stuff. Stores. But they couldn't be mounted to fire in space. They're stowed away all shipshape, Navy fashion. After we land, we'll ask politely for rockets to get home with. It'll be a

tedious run, mostly coasting. But we'll make it."

"If," said the chief, "we don't blow everything when we land."

"There is that," acknowledged Joe. Then he said somehow doggedly "Look! Ordinarily you don't say this sort of thing. But—things make sense. It's necessary that we humans get to the stars or we'll crowd the Earth to where we won't stay quite human. We'll have to have wars and plagues to keep our numbers down, and that sort of thing. It seems to me that there's something, somewhere, that hates us humans. It doesn't want us to reach the stars. It didn't want us to fly. Before that it didn't want us to know how to cure disease, or have steam, or—anything that makes men different from beasts!"

Haney turned his head.

"Maybe it sounds superstitious," said Joe, as doggedly as before. "But there's always been somebody trying to smash everything the rest of us wanted. As if—something alert and hateful went around, whispering hypnotically into men's ears while they slept, commanding them to do things to smash all their hopes."

The chief grunted, "Huh! D'you think that's new stuff?"

"I learned it," said Haney mildly, "when I was a kid. In Sunday school. They didn't put it that way, but—"

"Maybe I mean that," said Joe helplessly. "But anyhow there's something we fight, and—there's something that fights with us. So I think we're going to get the Moonship down all right."

Mike said sharply, "You mean you think all this is worked out in advance? That we were bound to be here, and—"

The chief said impatiently, "It's figured out so we can do it if we got the innards to do it with. We got the chance. We can duck it. But if we duck it it's bad and somebody else will have to do what we had the chance to do, later. I know what Joe's saying. Us men, we've got to get to the stars. There's millions of 'em, and we need the planets they've got swimming around 'em."

Haney said, agreeing, "Some of them do have planets. Yes. That's known."

"And those planets aren't going to go on forever with nobody using 'em," grunted the chief. "That wouldn't be sense. And in general things do make sense. All but us humans." He grinned dourly. "So Joe's right. We'll get by this time. And if we don't, some others guys will have to do the job of landing on the moon. But it'll be done, as a starter."

"I can see lots of mountains down there. Plain!" said Mike.

"What's the radar say?"

Joe looked. Back at the Platform the radar had shown the curvature of the earth. Here a dun line was beginning to form. It was the curve of the surface of the moon.

"Let's get set," said Joe. "We've got time. Spacesuits

on. Check the towline. Then we'll check everything else. All firing racks loaded outside?"

"Yeah," said Haney. He grimaced. "You know, Joe, I know what I know, but still I'm scared?"

"Who isn't?" asked Joe.

But there were things to do. They took their places. They watched out the ports. The moon had seemed a vast round ball a little while back. Now it appeared to be flattening. Its edges still curved away astonishingly, and the ring mountains were amazingly distinct. There were incredibly wide, smooth spaces with mottled colorings. But the mountains ...

When the ships were forty miles high the Space Tug blasted valorously, and all the panorama of the moon's surface was hidden by the racing clouds of mist. The rockets burned out.

Haney and the chief replaced them. They were gigantic, heavy-bore tubes they couldn't have stirred on Earth. Now^ they loaded them into the curious locks which conveyed them outside the Space Tug's hull for firing.

The ring mountains were gigantic when they blasted again. They were only twenty miles high, then, and some of the peaks rose a quarter of that distance toward them. And the ships were still descending fast.

Joe spoke into a microphone. "Calling Moonship! Calling Moonship—" He stopped and said matter-of-factly, "I suggest that we fire our last blast together. Shall I give the word? Right!"

The surface of the moon came toward them. Craters, cracks, frozen fountains of stone, and swelling undulations interrupted without rhyme or reason by the splashings of missiles from the sky a hundred thousand or a million years ago. The colorings were unbelievable. There were reds and browns and yellows. There were grays and dusty deep-blues and streaks of completely impossible tints in combination.

But Joe couldn't watch such matters. He kept his eyes on the radar rangefinder. He hadn't used it about the Platform because of tin cans and other debris round about. It wouldn't be reliable. But it did measure the exact distance to the nearest solid object.

"We'll fire on a count of five," said Joe. "Five... four ... three ... two... one... fire!"

The Space Tug's rockets blasted. And for the first time since they overtook the Moonship, the tug now had help. The remaining rockets in the Moonship's firing racks flamed stupendously. Out the ports there was nothing but flashing white vapor. The sensation of weight was shocking. The rockets droned and rumbled and roared...

The main rockets burned out. The steering rockets still roared. Joe had thrown them on for what good they might do.

"Joe!" said Haney in a surprised tone. "I feel weight! Not much, but some! And the main rockets are off!"

Joe nodded. He watched the instruments before him. He shifted a control, and the Space Tug swayed. It shifted over to the limit of the towline Unking it to the Moonship.

There was a peculiar, gritty contact somewhere. Joe cut the steering rockets. It was possible to look out. There were more gritty noises. The Space Tug settled a little and leaned a little. It was still. There was no noise at all.

"That's natural enough," said Joe. "We're on the moon."

They went out of the ship in a peculiarly solemn procession. About them reared cliffs such as no man had ever looked on before unless in dreams. Above their heads hung a huge round greenish glob, with polar ice caps plainly visible. It hung in mid-sky and was four times the size of the moon as seen from Earth. If one watched, it would presently be seen to be rotating. In fact, it could be discovered to turn upon its axis once in every twenty-four hours.

Mike scuffled in the dust in which he walked. Nobody had emerged from the Moonship yet. The four of them were literally the first human beings ever to set foot on the surface of the moon. But none of them mentioned the fact, though all were acutely aware of it. Mike kicked up dust. It rose in a curiously liquidlike fashion. There was no air to scatter it. It settled very, very, deliberately back again. The gravity on the moon is only one-sixth of that on Earth.

Mike spoke with an odd constraint: "Well—there's no green cheese."

"No," agreed Joe. "There isn't. Let's go to the Moonship. It looks all right."

They went to the object from Earth which no longer pretended to be a ship, and was plainly now a base for the military occupation of a globe with more land area than all the Earth's continents together, but not a drop of water. The Moonship also was tilted slightly askew, but it was patently unharmed. There were faces at every port in the hull.

The chief stopped suddenly. A sizeable boulder rose from the dust. It looked as if it had been flung there, eons ago. The chief struck it smartly with his space-gloved hand.

"I count coup on the moon!" he growled. "Tie that!"

He joined the others.

"Shall we knock?" asked Haney mildly. "I doubt they've got a doorbell."

But a lock door was opening to admit them. They crowded inside. Lieutenant-commander Brown was w<sup>^</sup>ifr--ing for them with outstretched hand when the inner door opened.

"Glad to have you aboard!" he said. There was a genuine smile on his face.

Joe talked with careful distinctness into a microphone. His voice took a little over a second to reach its destination. Then there was a pause of the same length before the first syllable of Sally's reply came to him from Earth.

"I've reported to your father," said Joe carefully, "and the Moonship has reported to the Navy. In a couple of hours Haney and the chief and Mike and I will be taking off to go back to the Platform. We got rockets from the stores of the Moonship."

Sally's voice was surprisingly clear. It wavered a little, but there was no static to mar the reception.

*"Then what, Joe?"*

"I'm bringing written reports and photographs and the first specimens of rocks and stuff from the moon," Joe told her. "I'm a mailman. It'll probably be sixty hours back to the Platform—free fall most of the way—and then

we'll refuel and I'll come down to Earth to deliver the reports and such."

Pause. One second and a bit for his voice to go. Another second and something over for her voice to return.

*"And then?"*

"That's what I'm trying to find out," said Joe. "What day is today?"

*"Tuesday,"* said Sally after the inevitable pause. *"If 3 ten o'clock Tuesday morning at the Shed."*

Joe made calculations in his mind. Then he said, "I ought to land on Earth sometime next Monday."

Pause.

*"Yes?"* said Sally.

"I wondered," said Joe. "How about a date that night?"

Another pause. Then Sally's voice. She sounded glad.

*"It's a date, Joe. And—do you know, I must be the first girl in the world to make a date with a man in the moon?"*

THE END