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HANGING BY A THREAD

By DAVID GORDON

It's seldom that the fate of a shipful of men literally hangs by a thread—but it's also seldom that a device, every part of which has been thoroughly tested, won't work....

Illustrated by Douglas

 Jayjay Kelvin was sitting in the lounge of the interplanetary cargo vessel *Persephone*, his feet propped up on the low table in front of the couch, and his attention focused almost totally on the small book he was reading. The lounge itself was cozily small; the *Persephone* had not been designed as a passenger vessel, and the two passengers she was carrying at the time had been taken on as an accommodation rather than as a money-making proposition. On the other hand, the *Persephone* and other ships like her were the only method of getting to where Jayjay Kelvin wanted to go; there were no regular passenger runs to Pluto. It's hardly the vacation spot of the Solar System.

On the other side of the table, Jeffry Hull was working industriously with pencil and paper. Jayjay kept his nose buried in his book—not because he was deliberately slighting Hull, but because he was genuinely interested in the book.

"Now wait," said Masterson, looking thoughtfully at the footprints on the floor of the cabin where Jed Hooker had died. "Jest take another look at these prints, Charlie. Silver Bill Greer couldn't have got much more than his big toe into boots that small! Somethin' tells me the Pecos Kid has...."

"... Traveled nearly two billion miles since then," said Hull.

Jayjay lifted his head from his book. "What?" He blinked. "I'm sorry; I wasn't listening. What did you say?"

The younger man was still grinning triumphantly. "I said: We are approaching turnover, and, according to my figures, nine days of acceleration at one standard gee will give us a velocity of seventeen million, five hundred and fifty miles per hour, and we have covered a distance of nearly two billion miles." Then he added: "That is, if I remembered my formulas correctly."

Jayjay Kelvin looked thoughtfully at the ceiling while he ran through the figures in his head. "Something like that. It's the right order of magnitude, anyway."

Hull looked a little miffed. "What answer did you get?"

"A little less than eight times ten to the third kilometers per second. I was just figuring roughly."

Hull scribbled hastily, then smiled again. "Eighteen million miles an hour, that would be. My memory's better than I thought at first. I'm glad I didn't have to figure the time; doing square roots is a process I've forgotten."

That was understandable, Jayjay thought. Hull was working for his doctorate in sociology, and there certainly wasn't much necessity for a sociologist to remember his freshman physics, much less his high-school math.

Still, it was somewhat of a relief to find that Hull was interested in something besides the "sociological reactions of Man in space". The boy had spent six months in the mining cities in the Asteroid Belt, and another six investigating the Jovian chemical synthesis planes and their attendant cities. Now he was heading out to spend a few more months observing the "sociological organization Gestalt" of the men and women who worked at the toughest job in the System—taking the heavy metals from the particularly dense sphere of Pluto.

Hull began scribbling on his paper again, evidently lost in the joys of elementary physics, so Jayjay Kelvin went back to his book.

He had just read three words when Hull said: "Mr. Kelvin, do you mind if I ask a question?"

Jayjay looked up from his book and saw that Jeffry Hull had reverted to his role of the earnest young sociologist. Ah, well. "As I've told you before, Mr. Hull, questions do not offend me, but I can't guarantee that the answers won't offend you."

"Yes; of course," Hull said in his best investigatory manner. "I appreciate that. It's just that ... well, I have trained myself to notice small things. The little details that are sometimes so important in sociological investigations. Not, you understand, as an attempt to pry into the private life of the individual, but to round out the overall picture."

Jayjay nodded politely. To his quixotic and pixie-like mind, the term *overall picture* conjured up the vision of a large and carefully detailed painting of a pair of dirty overalls, but he kept the smile off his face and merely said: "I understand."

"Well, I've noticed that you're quite an avid reader. That isn't unusual in a successful businessman, of course; one doesn't become a successful businessman unless one has a thirst for knowledge."

"Hm-m-m," said Jayjay.

"But," Hull continued earnestly, "I noticed that you've read most of the ... uh ... historical romances in the library...."

"You mean Westerns," Jayjay corrected quietly.

"Uh ... yes. But you don't seem to be interested in the modern adventure fiction. May I ask why?"

"Sure." Jayjay found himself becoming irrationally irritated with Hull. He knew that the young sociologist had nothing to do with his own irritation, so he kept the remarks as impersonal as possible. "In the first place, you, as a sociologist, should know what market most fiction is written for."

"Why ... uh ... for people who want to relax and—"

"Yes," Jayjay cut in. "But what kind? The boys on Pluto? The asteroid slicers? No. There are four billion people on Earth and less than five million in space. The market is Earth."

"Also, most writers have never been any farther off the surface of Earth than the few miles up that an intercontinental cruiser takes them."

"And yet, the modern 'adventure' novel invariably takes place in space."

"I can read Westerns because I neither know nor care what the Old American West was *really* like. I can sit back and sink into the never-never land that the Western tells about and enjoy myself because I am not forced to compare it with reality."

"But a 'space novel' written by an Earthside hugger is almost as much a never-never land, and I have to keep comparing it with what is actually going on around me. And it irritates me."

"But, aren't some of them pretty well researched?" Hull asked.

"Obviously, you haven't read many of them," Jayjay said. "Sure, some of them are well researched. Say one half of one per cent, to be liberal. The rest don't know what they're talking about!"

"But—"

"For instance," Jayjay continued heatedly, "you take a look at every blasted one of them that has anything to do with a spacecraft having trouble. They have to have an accident in space in order to disable the spaceship so that the hairy-chested hero can show what a great guy he is. So what does the writer do? He has the ship hit by a meteor! A meteor!"

Hull thought that over for a second. "Well," he said tentatively, "a ship *could* get hit by a meteor, couldn't it?"

Jayjay closed his eyes in exasperation. "Of course it could! And an air-ship can run into a ruby-throated hummingbird, too. But how often does it happen?"

"Look: We're hitting it up at about one-fortieth of the velocity of light right now. What do you think would happen if we got hit by a meteor? We'd be gone before we knew what had happened."

"Why doesn't it happen? Because we can spot any meteor big enough to hurt us long before it contacts us, and we can dodge it or blast it out of the way, depending on the size."

"You've seen the outer hull of this ship. It's an inch thick shell of plastic, supported a hundred feet away from the steel hull by long booms. Anything small enough to get by the detectors will be small enough to burn itself out on that hull before it reaches the ship. The—"

Jayjay Kelvin was not ordinarily a man to make long speeches, especially when he knew he was telling someone something that they already knew. But this time, he was beating one of his favorite drums, and he went on with his tirade in a fine flush of fury.

Alas ... poor Jayjay.

Actually, Jayjay Kelvin can't be blamed for his attitude. All he was saying was that it was highly improbable that a spaceship would be hit by a meteor. In one way, he was perfectly right, and, in another, he was dead wrong.

How small must a piece of matter be before it is no longer a meteor?

Fortunately, the big hunks rarely travel at more than about two times ten to the sixth centimeters

per second, relative to Sol, in the Solar System. But there are little meteors—*very* tiny ones—that come in, hell-bent-for-leather, at a shade less than the velocity of light. They're called cosmic rays, but they're not radiation in the strict sense of the word. A stripped hydrogen atom, weighing on the order of three point three times ten to the minus twenty-second grams, rest mass, can come galumping along at a velocity so close to that of light that the kinetic energy is something colossal for so small a particle. Protons with a kinetic energy of ten to the nineteenth electron volts, while statistically rare, are not unusual.

Now, ten million million million electron volts may be a wee bit meaningless to the average man, so let's look at it from another angle.

Consider. According to the well-known formula $E = mc^2$, a single gram of matter, if converted *completely* into energy, would yield some nine hundred million million million ergs of energy. An atomic bomb yields only a fraction of that energy, since only a small percentage of the mass is converted into energy.

If *all* of the mass of an atomic bomb were converted into energy, the test in Alamogordo, New Mexico, 'way back in 1945, would probably have been the last such test on Earth; there wouldn't have been anyone around to make a second test.

So what does this have to do with cosmic ray particle? Well, if that atomic bomb had been moving at the velocity with which our ten-to-the-nineteenth-electron-volts proton is moving, it could have been made of sand instead of U^{235} . It would have produced ten thousand million times as much energy as the total disintegration of the rest mass would have produced!

Kinetic energy, my children, has a great deal more potential than atomic energy.

But we digress.

What has all this to do with Jayjay Kelvin?

If Jayjay had been a detective story addict instead of a Western story addict, he would have heard of the HIBK or "Had I But Known" school of detective writing. You know: "Had I But Known that, at that moment, in the dismal depths of a secret underground meeting place, the evil Chuman-Fu was plotting...."

If Jayjay Kelvin had known what was going on a few million miles away from the Pluto-bound *Persephone*, he would have kept his mouth shut.

The cargo-ship *Mordred* was carrying a cargo of heavy metals sunward. In her hold were tightly-packed ingots of osmium-iridium-platinum alloy, gold-copper-silver-mercury alloy, and small percentages of other of the heavy metals. The cargo was to be taken to the Asteroid Belt for purification and then shipped Earthward for final disposition. The fact that silver had replaced copper for electrical purposes on Earth was due to the heavy-metals industry on Pluto. Because of Pluto, the American silver bloc had been broken at last.

The *Mordred* was approaching turnover.

Now, with a gravito-inertial drive, there is really no need to turn a ship over end-for-end as she approaches the mid-point of her trajectory. Since there is no rocket jet to worry about, all that is really necessary is to put the engine in reverse. In fact, the patrol ships of the Interplanetary Police do just that.

But the IP has been trained to take up to five standard gees in an end-to-end flip, and the ships are built to take the stress in both directions. An ordinary cargo ship finds it a lot easier to simply flip the ship over; that way, the stresses remain the same, and the ceiling-floor relationship is constant.

The *Mordred* had been having a little trouble with her Number Three drive engine, so the drive was cut off at turnover, while the engineer replaced a worn bearing. At the same time, the maintenance officer decided he'd take a look at the meteor-bumper—the plastic outer hull. Since the ship was in free fall, all he had to do was pull himself along one of the beams that supported the meteor-bumper away from the main hull. The end of one of the beams had cracked a part of the bumper hull—fatigue from stress, nothing more, but the hull might as well be patched while the drive was off.

It was a one-man job; the plastic was dense, but under null-gee conditions it was easy to maneuver. The maintenance officer repaired the slight crack easily, wiped the sticky pre-polymer from the fingers of his spacesuit gloves, and tossed the gooey rag off into space. Then he pushed himself back across the vacuum that separated the outer hull from the inner, entered the air lock, and reported that the job was finished. Five minutes later, the *Mordred* began decelerating toward the distant Asteroid Belt.

Forget the *Mordred*. The ship is no longer important. Keep your eyes on that rag. It's a flimsy thing, composed of absorbent plastic and goosed up with a little unpolymerized resin, weighing about fifty grams. It is apparently floating harmlessly in space, just beyond the orbit of Uranus, looking as innocuous as a rag can look. But it is moving sunward at eight hundred million

centimeters per second.

The *Persephone* was approaching turnover. The ship's engineer reported that the engines were humming along smoothly, so there was no need to shut them off; the ship would simply flip over as she ran, making her path a slightly skewed, elongated S-curve—a sort of orbital hiccup.



Except that she never quite made it through the hiccup. The ship was almost perpendicular to her line of flight when she was sideswiped.

Her meteor detectors hadn't failed; they were still functioning perfectly. But meteor detectors are built to look for solid chunks of metal and rock—not thin, porous bits of cloth.

The rag had traveled a good many millions of miles since it had been cast overboard; it was moving sunward with almost the same velocity with which the *Persephone* was moving Plutowards. The combined velocities were such that, if it had hit the *Persephone* dead on, it would have delivered close to seventeen thousand kilowatt-hours of energy in one grand burst of incandescence.

Fortunately, the tip of the rag merely gave the ship a slap on the tail as it passed. The plastic meteor-bumper wasn't built to take that sort of thing. The plastic became an expanding cloud of furiously incandescent gas in a small fraction of a second, but the velocity of that bit of rag was so great that the gas acted as a solid block of superheated fury as it leaped across the hundred feet of vacuum which separated the bumper hull from the inner hull.

A rocket-driven missile carrying a shaped-charge warhead weighing several hundred pounds might have done almost as much damage.

Jayjay Kelvin moved his arms to pick himself up off the floor and found that there was no necessity for doing so. He was floating in the air of the lounge, and, strictly speaking, there was no floor anyway. He opened his eyes and saw that that which had been the floor was now just another wall, except that it had chairs bolted to it. It rose on his left, reached the zenith, and set on his right, to be replaced by another wall, and then by what had been the ceiling. The second time the floor came round, Jayjay began to wonder whether he was spinning around his longitudinal axis or whether the ship was actually rotating about him. He closed his eyes again.

He didn't feel more than a little dizzy, but he couldn't be sure whether the dizziness was caused by his spinning or the blow on his head. He opened his eyes again and grabbed at the book that was orbiting nearby, then hurled it as hard as he could toward the sometime ceiling. "The Pride of the Pecos" zoomed rapidly in one direction while Jayjay moved sedately in the other.

The ship was spinning slightly, all right. When he finally grabbed a chair, he found that there was enough spin to give him a weight of an ounce or two. He sat down as best he could and took a good look around.

Aside from "The Pride of the Pecos" and a couple of other books, the air was remarkably free from clutter. There hadn't been much loose stuff laying around. A pencil, a few sheets of paper—nothing more.

There was one object missing. Jayjay looked around more carefully, and this time he saw a hand protruding from the space "beneath" the low table. He bent down for a better look and saw that Jeffry Hull was unconscious. Blood from his nose was spreading slowly over his face, and one eye looked rather battered. Jayjay grasped the protruding wrist and felt for a pulse. It was pumping nicely. He decided that Hull was in no immediate danger; very few people die of a bloody nose.

The lighting in the lounge was none too good; the low-power emergency system had come on automatically when the power from the ship's engines had died. Jayjay wondered just what had happened. There had been a hell of an explosion; that was all he knew.

He wondered if anyone else aboard was alive and conscious, and decided he might as well find out. He took a long dive toward the central stairwell that ran the length of the ship's long axis

and looked down. The emergency door to the cargo hold was closed. No air, most likely. The way up looked clear, so he scrambled up the spiral stairway.

A few feet farther up, he found that he had passed the center of the ship's rotation. The *Persephone* was evidently toppling end-over-end, and the center of rotation was in the lounge itself. The heavy cargo in the hold was balancing the lighter, but longer, part of the ship above the lounge. He began climbing down the stairwell toward the navigation and control sections.

Somewhere down there, somebody was cursing fluently in Arabic.

"Illegitimate offspring of a mangy she-camel! Eater of dogs! Wallower in carrion!" And then, with hardly a break: "Allah, All-Merciful, All-Compassionate! Have mercy on Thy servant! I swear by the beard of Thy holy Prophet that I will attend more closely to my duties to Thee if Thou wilt get me loose from this ill-begotten monstrosity! Help me or I perish!" The last words were a wail.

"I'm coming!" boomed Jayjay in the same tongue. "Save thy strength!"

There was silence from the control room as Jayjay clambered on down the stairwell. Fortunately, the steps had been built so that it was possible to use them from either side, no matter which way the gravity pull happened to be. By the time he reached the control room, he weighed a good fifteen pounds.

Captain Atef al-Amin was staring up at the stairs as Jayjay came down. He was jammed tightly into a space between two of the big control cabinets, hanging head downward and looking more disheveled than Jayjay had ever seen the usually immaculately-uniformed captain.

"Oh," said Captain Al-Amin, in English, "it's you. For a moment I thought—" Then he waved his free hand. "Never mind. Can you get me out of here?"

What had been the floor of the control room was now the ceiling. The two steel cabinets which housed parts of the computer unit now appeared to be bolted to the ceiling. They were only about five feet high, and the space between them was far too narrow for a man to have got in there by himself—especially a man of the captain's build. None the less, he was in there—jammed in up to his waist. Only his upper torso and one arm was free. The other arm was jammed in against the wall.

Jayjay took the leap from the stairs and grabbed on to the chair that hung from the ceiling nearby. When you only weigh fifteen pounds, you can make Tarzan look like an amateur.

"You hurt?" he asked.

"It isn't comfortable, sure as hell," said Al-Amin. "I think my arm's broken. Think you can get me loose?"

"I can try. Give me your hand." Jayjay took the captain's free hand and gave it a tug. Then he released the chair he was holding, braced both feet against the panels of the computer housings, and gave a good pull. The captain didn't budge, but he winced a little.

"That hurt?"

"Just my arm. The pressure has cut off my blood circulation; my legs are numb, and I can't tell if they hurt or not."

Jayjay grabbed the chair again and surveyed the situation. "Where's your First Officer?"

"Breckner? Down in the engine room."

Jayjay didn't comment on that. If the hold was airless, it was likely that the engine room was, too, and there was no need to worry Al-Amin any more than necessary just now.

"Can you use a cutting torch?" the captain asked.

"Yes, but I don't think it'll be necessary," Jayjay said. "Hold on a minute." He went back up the stairs to the officers' washroom and, after a little search, got a container of liquid soap from the supplies. Then he went back down to the control room. He made the jump to the chair, holding on with one hand while he held the container of soap with the other.

"Can you hold me up with one hand? I'll need both hands to work with."

"In this gravity? Easy. Give me your belt."

Captain Atef Al-Amin grabbed Jayjay's belt and hung on, while Jayjay used both hands to squirt the liquid soap all over the captain from the waist down.

It would have made a great newspaper photo. Captain Al-Amin, wedged between two steel cabinets, hanging upside-down under a pull of one-fifteenth standard gee, holding up his rescuer by the belt. The rescuer, right-side-up, was squeezing a plastic container of liquid soap and directing the stream against the captain.

When Al-Amin was thoroughly wetted with the solution, Jayjay again braced his feet against the steel panels and pulled.

With a slick, slurping sound, the captain slid loose, and the two of them toppled head-over-heels across the room. Jayjay was prepared for that; he stopped them both by grasping an overhead desk-top as they went by. Then he let go, and the two men dropped slowly to what had been the ceiling.

"*Hoo!*" said the captain. "That's a relief! Allah!"

Jayjay took a look at the man's arm. "Radius might be broken; ulna seems O.K. We'll splint it later. Your legs are going to tingle like crazy when the feeling comes back."

"I know. But we have other things to worry about, Mr. Kelvin. Evidently you and I are the only ones awake so far, and I'm in no condition to go moving all over this spinning bucket just yet. Would you do some reconnoitering for me?"

"Sure," said Jayjay. "Just tell me what you want."

Within half an hour, the news was in.

There were five men alive in the ship: Jayjay, Captain Al-Amin, Jeffry Hull, Second Officer Vandebosch, and Maintenance Officer Smith. Vandebosch had broken both legs and had to be strapped into a bunk and given a shot of narcolene.

Jayjay had put on a spacesuit and taken a look outside. The whole rear end of the ship was gone, and with it had gone the First Officer, the Radio Officer, and the Engineering Officer. And, of course, the main power plant of the ship.

Most of the cargo hold was intact, but the walls had been breached, and the air was gone.

"Well, that's that," said Captain Al-Amin. Jayjay, Smith, Hull, and the captain were in the control room, trying not to look glum. "I wish I knew what happened."

"Meteor," Jayjay said flatly. "The bumper hull is fused at the edges of the break, and the direction of motion was inward."

"I don't see how it could have got by the meteor detectors," said Smith, a lean, sad-looking man with a badly bruised face.

"I don't either," the captain said, "but it must have. If the engines had blown, the damage would have been quite different."

Jeffry Hull nervously took a cigarette from his pocket pack. His nose had quit bleeding, but his eye was purpling rapidly and was almost swollen shut.

Captain Al-Amin leaned over and gently took the cigarette from Hull's fingers. "No smoking, I'm afraid. We'll have to conserve oxygen."

"You guys are so damn *calm!*" Hull said. His voice betrayed a surface of anger covering a substratum of fear. "Here we are, heading away from the Solar System at eighteen million miles an hour, and you all act as if we were going on a picnic or something."

The observation was hardly accurate. Any group of men who went on a picnic in the frame of mind that Jayjay and the others were in would have produced the gloomiest outing since the Noah family took a trip in an excursion boat.

"There's nothing to worry about," Captain Al-Amin said gently. "All we have to do is set the screamers going, and the Interplanetary Police will pick us up."

"Screamers?" Hull looked puzzled.

Instead of answering the implied question, the captain looked at Smith. "Have you checked them?" He knew that Smith had, but he was trying to quiet Hull's fears.

Smith nodded. "They're O.K." He looked at Hull. "A screamer is an emergency radio. There's one in every compartment. You've seen them." He pointed across the room, toward a red panel in the wall. "In there."

"But I thought it was impossible for a spaceship in flight to contact a planet by radio," Hull objected.

"Normally, it is," Smith admitted. "It takes too much power and too tight a beam to get much intelligence over a distance that great from a moving ship. But the screamers are set up for emergency purposes. They're like flares, except that they operate on microwave frequencies instead of visible light.

"The big radio telescopes on Luna and on the Jovian satellites can pick them up if we beam them sunward, and the Plutonian station can pick us up if we beam in that direction."

Hull looked much calmer. "But where do you get the power if the engines are gone? Surely the emergency batteries won't supply that kind of power."

"Of course not. Each screamer has its own power supply. It's a hydrogen-oxygen fuel cell that

generates a hell of a burst of power for about thirty minutes before it burns out from the overload. It's meant to be used only once, but it does the job."

"How do they know where to find us from a burst like that?" Hull asked.

"Well, suppose we only had one screamer. We'd beam it toward Pluto, since it would be easier for an IP ship to get to us from there. Since all screamers have the same frequency—don't ask me what it is; I'm not a radio man—the velocity of our ship will be indicated by the Doppler Effect. That is, our motion toward or away from them can be calculated that way. Our angular velocity with respect to them can be checked while the screamer is going; they will know which direction we're moving, if we're moving at an angle.

"With that information, all they have to do is find out which ship is in that general area of the sky, which they can find out by checking the schedule, and they can estimate approximately where we'll be. The IP ship will come out, and when they get in the general vicinity, they can find us with their meteor detectors. Nothing to it."

"And," Captain Al-Amin added, "since we have eight screamers still left with us, we have plenty of reserves to call upon. There's nothing to worry about, Mr. Hull."

"But how can you aim a beam when we're toppling end-over-end like this?" Hull asked.

"Well, if we couldn't stop the rotation," said the captain, "we'd broadcast instead of beaming. Anywhere within the Solar System, a screamer can broadcast enough energy to overcome the background noise.

"The IP would have a harder time finding us, of course, but we'd be saved eventually."

"I see," said Hull "How do we go about stopping the rotation?"

"That's the next thing on the agenda," Al-Amin said. "This seasick roll is caused by the unevenness of the load, and I'm pretty sick of it, myself. Smith, will you and Mr. Kelvin get out the emergency rockets? We'll see what we can do to stabilize our platform."

It took better than an hour to get the ship straightened out. For the main job, emergency rockets were set off at the appropriate spots around the hull to counteract the rotation. The final trimming was done with carbon dioxide fire extinguishers, which Smith and Jayjay Kelvin used as jets.

Getting a fix on Pluto was easy enough; the lighthouse station at Styx broadcast a strong beep sunward every ten seconds. They could also pick up the radio lighthouses on Eros, Ceres, Luna, and Mimas. Evidently, the one on Titan was behind the Jovian bulk.

They were ready to send their distress call.

"It's simple," Smith said as he opened the red panel in the wall of the control room. "First we turn on the receiver." He pushed a button marked *R*. "Then we turn these two wheels here until the pip on that little screen is centered. That's the signal from Pluto. It comes in strong every ten seconds, see?"

Jayjay watched with interest. He'd heard about screamers and had seen them, but he'd never had the opportunity of observing one in action.

Like flares or bombs, they were intended for one-time use. The instructions were printed plainly on the inside of the red door, and Smith was simply reading off what was printed there.

"These wheels," he was saying, "line up the parabolic reflector with the Pluto signal, you see. There. Now we've got it centered. Now, all we have to do is make one small correction and we're all set. These things are built so that they're fool-proof; a kid could operate it. Watch."

Facing each other across a small gap were a pair of tapered screw plugs, one male and one female. The male was an average of half an inch in diameter; the female was larger and bored to fit the male.

"The female plug," Smith said, "leads to two tanks of high-pressure gas inside this cabinet on the left. One tank of oxygen, one of hydrogen. See how this male plug telescopes out to fit into the female? All we have to do is thread them together, and everything is automatic."

Jayjay was aware that Smith's explanations were meant to give Jeffrey Hull something to think about instead of his fears. Hull was basically an Earth-hugger, and free fall did nothing to keep him calm. Evidently his subconscious knew that he had to latch on to something to keep his mental equilibrium, because he showed a tremendous amount of interest in what should have been a routine operation.

"How do you mean, it's all automatic?" he asked. "What happens?"

"Well, you can't see into the female plug, but look here at the male. See those concentric tubes leading into the interior of the cabinet on the right? The outer one leads in the oxygen, the inner leads in the hydrogen. We need twice as much hydrogen as oxygen, so the inner tube has twice

the volume delivery as the outer. See?"

"Yes. But what is the solid silver bar in the center of the inner tube?"

"That's the electrical connection for the starter battery. There's a small, short-lived chemical battery, like the ones in an ordinary pocket radio, except that they're built to deliver a high-voltage, high-ampere current for about a tenth of a second. That activates the H-O cell, you see. Also, that silver stud depresses the corresponding stud in the female plug, which turns on the gas flow before it makes the connection with the starter battery. Follow?"

Hull didn't look as though he did, but he nodded gamely. "Then what happens?"

"Then the hydrogen and the oxygen come together in the fuel cell and, instead of generating heat, they generate electric current. That current is fed into the radio unit, and the signal is sent to Pluto. Real simple."

"I see," Hull said. "Well ... go ahead."

Smith telescoped the two leads together and began turning the collar on the female plug.

He screwed it up as far as it would go.

And nothing happened.

"What the hell?" asked Smith of no one in particular. He tried to twist it a little harder. Nothing happened. The threads had gone as far as they would go.

"What's the matter?" Jayjay asked.

"Damfino. No connection. Nothing's happening. And it's as tight as it will go."

"Are the gases flowing?" Jayjay asked.

"I don't know. These things aren't equipped with meters. They're supposed to work automatically."

Jayjay pushed Smith aside. "Let me take a look."

Smith frowned as though he resented an ordinary passenger shoving him around, but Jayjay ignored him. He cocked his head to one side and looked at the connection. "Hm-m-m." He touched it with a finger. Then he wet the finger with his tongue and touched the connection again. "There's no gas flow, Smith."

"How do you know?" Smith was still frowning.

"There's a gap there. That tapered thread isn't in tight. If there were any gas flowing, it would be leaking out." Before Smith could say anything Jayjay began unscrewing the coupling. When it came apart, it looked just the same as it had before Smith had put it together.

In the dim glow from the emergency lights, it was difficult to see anything.

"Got an electric torch?" Jayjay asked.

Smith pushed himself away from the screamer panel and came back after a moment with a flashlight. "Let me take a look," he said, edging Jayjay aside. He looked over the halves of the coupling very carefully, then said: "I don't see anything wrong. I'll try it again."

"Hold on a second," Jayjay said quietly. "Let me take a look, will you?"

Smith handed him the torch. "Go ahead, but there's nothing wrong."

Jayjay took the light and looked the connections over again. Then he screwed his head around so that he could look into the female plug.

"Hm-m-m. Hard to count. Gap's too small. Anybody got a toothpick?"

Nobody did.

Jayjay turned to Jeffry Hull. "Mr. Hull, would you mind going to the lounge? I think there's some toothpicks in the snack refrigerator."

"Sure," said Hull. "Sure."

He pushed himself across the control room and disappeared through the stairwell.

"Get several of them," Jayjay called after him.

Captain Al-Amin said: "What's the trouble, Mr. Kelvin?"

"I'm not sure yet," Jayjay answered. "When did you last have the screamer units inspected?"

"Just before we took off from Jove Station," Al-Amin said. "That's the law. All emergency equipment has to be checked before takeoff. Why? What's the matter?"

"Did they check this unit?" Jayjay asked doggedly.

"Certainly. I watched them check it myself. I—" He brought himself up short and said: "Give me that torch, will you? I want to take a look at the thing."

Jayjay handed him the flashlight and grasped the captain's belt. With one arm in a splint, Al-Amin couldn't hold the flashlight and hold on to anything solid at the same time.

"I don't see anything wrong," he said after a minute.

"Neither do I," Jayjay admitted. "But the way it acts—"

"I got the toothpicks!" Jeffry Hull propelled himself across the room toward the three men who were clustered around the screamer.

Jayjay took the toothpicks, selected one, and inserted it into the female plug. "Hard to see those threads with all the tubes blocking that plug," he said offhandedly.

Hull said: "Captain, did you know that the refrigerator is off?"

"Yes," said Atef Al-Amin absently. "It isn't connected to the emergency circuits. Wastes too much energy. What do you find, Mr. Kelvin?"

After a second's silence, Jayjay said: "Let me check once more." He was running the tip of the toothpick across the threads in the female plug, counting as he did so. "Uh-huh," he said finally, "just as I thought. There's one less thread in the female plug. The male plug is stopped before it can make contact. There's a gap of about a tenth of an inch when the coupling is screwed up tight."

"Let me see," Smith said. He took the toothpick and went through the same operation. "You're right," he said ruefully, "the female plug is faulty. We'll have to use one of the other screamers."

"Right," said Jayjay.

Wrong, said Fate. Or the Powers That Be, or the Fallibility of Man, whatever you want to call it.

Every screamer unit suffered from the same defect.

"I don't understand it!" A pause. "It's impossible! Those units were tested!"

For the first time in his life, Captain Atef Abdullah Al-Amin allowed his voice to betray him.

Arabic is normally spoken about half an octave above the normal tone used for English. And, unlike American English, it tends to waver up and down the scale. Usually, the captain spoke English in the flat, un-accented tones of the Midwest American accent, and spoke Arabic in the ululating tones of the Egyptian.

But now he was speaking English with an Egyptian waver, not realizing that he was doing it.

"How could it happen? It's ridiculous!"

The captain, his maintenance officer, and Jeffry Hull were clustered around the screamer unit in the lounge. Off to one side, Jayjay Kelvin held a deck of cards in his hands and played a game of patience called "transportation solitaire." His eyes didn't miss a play, just as his ears didn't miss a word.

He pulled an ace from the back of the deck and flipped it to the front.

"You said the screamers had been checked," Jeffry Hull said accusingly. "How come they *weren't* checked?"

"They *were*!" Al-Amin said sharply.

"Sure they were," Smith added. "I watched the check-off. There was nothing wrong then."

"Meanwhile," Hull said, the acid bite of fear in his voice, "we have to sit here and wait for the Interplanetary Police to find us by pure luck."

The captain should have let Hull cling to the idea that the IP could find the *Persephone*, even if no signal was sent. But the captain was almost as angry and flustered as Hull was.

"Find us?" he snapped. "Don't be ridiculous! We won't even be missed until we're due at Styx, on Pluto, nine days from now. By that time, we'll be close to two billion miles beyond the orbit of Pluto. We'll never be found if we wait 'til then. Something has to be done *now*!" He looked at his Maintenance Officer. "Smith, isn't there some way to make contact between those two plugs?"

"Sure," Smith said bitterly. "If we had the tools, it would be duck soup. All we'd have to do is trim down the male plug to fit the female, and we'd have it. But we don't have the tools. We've got a couple of files and a quarter-horsepower electric drill with one bit. Everything else was in the tool compartment—which is long gone, with the engine room."

"Can't you ... uh, what do you call it? Uh ... jury-something—"

Hull's voice sounded as though he were forcing it to be calm.

"Jury-rig?" Smith said. "Yeah? With what? Dammit, we haven't got any tools, and we haven't got any materials to work with!"

"Can't you just use a wrench to tighten them more?" Hull asked helplessly.

Smith said a dirty word and pushed himself away from the screamer unit to glower at an unresisting wall.

"No, Mr. Hull, we couldn't," said Captain Al-Amin with restrained patience. "That would strip the threads. If the electrical contact were made at the same time, the high-pressure oxygen-hydrogen flow would spark off, and we'd get a big explosion that would wreck everything—including us." Then he muttered to himself: "I still don't see how it could happen."

Jayjay Kelvin pulled a nine of spades from the back of the deck to the front. It matched the four of spades that had come three cards before. Jayjay discarded the two cards between the spades. "You don't?" he asked. "Didn't you ever hear that the total is greater than the sum of its parts?"

"What?" Captain Al-Amin sounded as though he'd been insulted—in Arabic. "What are you talking about, Mr. Kelvin?"

"I'm talking about the idiocy of the checking system," Jayjay said flatly. "Don't you see what they did? Don't you see what happened? Each part of a screamer has to be checked separately, right?"

Al-Amin nodded.

"Why? Because the things burn out if you check them as a complete unit. It's like checking a .50 caliber cartridge. The only way you can check a cartridge is to shoot it in a gun. If it works, then you know it works. Period. The only trouble is that you've wasted the cartridge. You know that *that* one is good, but you've ruined it.

"Same way with a screamer. If you test it as a unit, you'll ruin it. So you test it a part at a time. All the parts check out nicely because the test mechanisms are built to check each part."

Smith squinted. "Well, sure. If you check out the whole screamer, you'll ruin it. So what?"

"So suppose you were going to check out a cartridge," Jayjay said. "You don't fire it; you check each part separately. You check the brass case. It's all right; the tests show that it won't burst under firing pressure. You check the primer; the tests show that it will explode when hit by the gun's hammer. You check the powder; the tests show that the powder will burn nicely when the flame from the primer hits it. You check the bullet; the tests show that the slug will be expelled at the proper velocity when the powder is ignited.

"So you assume that the cartridge will function when fired.

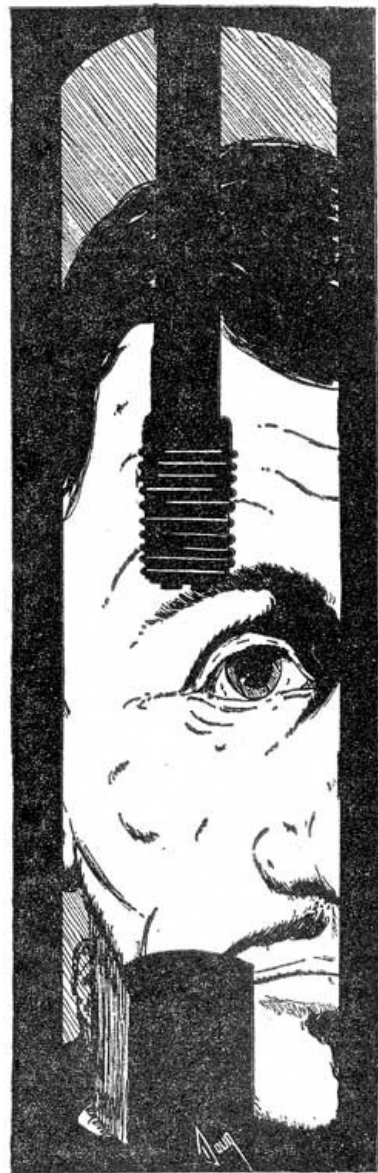
"But will it?"

"Why wouldn't it?" Smith asked.

"Because the flame from the exploding primer can't reach the powder, that's why!" Jayjay snapped. "Some jerk has redesigned the primer so that the flame misses the propellant!"

"How could that happen?" Hull asked blankly.

"How? Because Designer *A* decided that the male plug on the screamer should have one more turn on its threads, but he forgot to tell Designer *B*, who designs the female plug, that the two should match. The testing equipment is designed to test each part, so each part tests out fine. The only trouble is that the thing doesn't test out as a whole."



Captain Al-Amin nodded slowly. "That's right. The test showed that the oxyhydrogen section worked fine. It showed that the starter worked fine. It showed that the radiowave broadcaster worked fine. But it didn't show that they'd work together."

Smith said a short, five-letter word. It was French; the Anglo-Saxon equivalent has only four letters. "What good does all this theorizing do us?" he added. "The question is: How do we fix the thing?"

"Well, can't you put another turn on the thread?" Hull asked.

"Oh, sure," Smith said sarcastically. "You give me a lathe and the proper tools, and I'll make you all the connections you want. Hell, if I had the proper tools, I could turn us out a new spaceship, and we could all go home in comfort."

"Couldn't you drill out the metal with that drill?" Hull asked plaintively.

"No!" Smith said harshly. "How do you expect me to get a quarter-inch bit into a space less than a sixteenth of an inch in diameter?"

Hull wasn't used to machinist's terms. "How big is an inch?"

"Two point five four oh oh oh five centimeters," Smith said in a nasty tone of voice. "Does that help you any?"

"I'm just trying to help!" Hull snapped. "You've got no call to get sarcastic with me!"

Smith said the French word again.

"Enough!" the captain barked. "Smith, control your tongue! That sort of thing won't help us." He jerked his head around. "Mr. Kelvin, do you have any suggestions?"

Jayjay played another card. "No. Not yet. I'm thinking."

"Smith? Any ideas?" The tone of the Arab's voice left no doubt that he meant business.

"No, sir. Without a properly equipped machine shop, there's nothing we can do."

"How so?"

"Because that's a precision job, sir. The threads are tapered so that the fit will be gas-tight. That's why the threads have a ten-thousandth of an inch of soft polyethylene covering the hard steel, so that when the threads are tight, the polyethylene will act as a seal. Everything in that connection is a precision fitted job. The ends of the tubes are made to be slightly mashed together, so that the seals will be tight—they're coated with polyethylene, too. If the oxygen and hydrogen mix, the efficiency of the fuel cell goes down to zero, and you run the chance of an explosion."

"Show me," Al-Amin said.

Smith took a pencil out of his pocket and began drawing a cross section of the connection on the top of the nearby table.

"Look here, captain, this is the way the two are supposed to fit. But they don't, because the male plug can't get far enough into the female socket to make the connection. Like this, see?"

The captain nodded.

"Well," Smith continued, "there's a thirty-second of an inch clearance there. If the female had one more turn of thread, the fit would be perfect. As it is, we get no connection. So the screamer doesn't function."

Al-Amin looked at the drawing. "Odd that there's never been any complaint about this error before."

Jayjay turned another ace. "Not so odd, really."

All heads turned toward Jayjay.

"What does that mean?" Smith asked.

"Just what I said." Jayjay turned another card. "A screamer is supposed to call for help, isn't it? It's only used in a dire emergency. Then the only test of the whole unit comes when the occupants of the spaceship are in danger—as we are. If the things don't work, how could there be any complaint? If we can't get ours to work, will we complain? To whom?"

"How many ships have been reported missing in the past year or so? All of them presumed lost because of meteor strikes, eh? If a ship is lost and doesn't signal, we presume that it was totally destroyed. If it wasn't, they'd have signaled. As *Mister* Smith says: See?"

There was a long silence.

Jayjay Kelvin turned the last card, saw that he had lost, and began shuffling the deck.

"I think I've got it," Smith said excitedly, several hours later.

Captain Al-Amin glanced around. Hull was dozing fitfully a few inches above the couch. Jayjay Kelvin was still methodically playing solitaire.

"Keep your voice down," the captain ordered. "No use giving our passengers false hopes. What do you mean, you've got it?"

"Simple. Real simple. All we have to do is file off the last thread of the male plug. Then it will fit into the female." Smith's voice was a hoarse whisper.

"Won't work," said Jayjay Kelvin from across the room.

Smith blew up. "How do you know?" he roared. "You sit over there making wiseacre remarks and do nothing! Play cards, that's all! What do you know about things like this, *Mister* Joseph Kelvin? What does a businessman know about mechanical equipment?"

"Enough," Jayjay said quietly. "Enough to know that, if you try to file off the final thread of the male plug, you'll do an uneven job. And that will mean leakage."

"What do you mean, an uneven job?" Smith was still furious.

"Trimming off the end of the male plug would have to be done on a lathe," Jayjay said, without looking up from his cards. "Otherwise, the fit would be wrong, and the gases would mix. And we would all go *phfft!* when the mixture blew."

Smith started to say something, but Jayjay went right on talking. "Even if we had a lathe, the male plug doesn't turn, so you'd be out of luck all the way. You can't take the screamers apart without wrecking them—not without a machine shop. You're going to have to work on that female connection. She's got a sleeve on her that will turn. Now, if—" Jayjay's voice faded off into silence, and his manipulations of the cards became purely mechanical.

"Huh!" Smith said softly. "Just because he's related to Kelvin Associates, he thinks he's hot—" He said the French word again.

"Is he right?" Captain Al-Amin asked sharply.

"Well—" Smith rubbed his nose with a forefinger. "Well, yes. I was wrong. We can't do it with a file. It would have to be turned on a lathe, and we don't have a lathe. And we don't have any measuring instruments, either. This is a precision job, as I said. And we don't have a common ruler aboard, much less a micrometer. Any makeshift job will be a failure."

Captain Al-Amin brooded over that for a moment. Then he looked at Jayjay again. "Mr. Kelvin."

"Yes, captain?" Jayjay didn't look up from the cards in his hands.

"*Are* you related to Kelvin Associates?"

"In a way."

Al-Amin bit at his lower lip. "Mr. Kelvin, you registered aboard this ship as Joseph Kelvin. May I ask if your middle name is James?"

After a short pause, Jayjay said: "Yes. It is."

"Are you *the* J. J. Kelvin?"

"Yup. But I'd rather you didn't mention it when we get to Pluto."

Smith's jaw had slowly sagged during that conversation. Then he closed his mouth with a snap. "You're Jayjay Kelvin?" he asked, opening his mouth again.

"That's right."

"Then I apologize."

"Accepted," said Jayjay. He wished that Smith hadn't apologized.

"Why didn't you say so in the first place?" Captain Al-Amin asked.

"Because I didn't want it known that I was going to Pluto," Kelvin said. "And—after the accident happened—I kept quiet because I know human nature."

Jeffrey Hull, who had awakened during the argument, looked at Jayjay and said: "What's human nature got to do with it, Mr. Kelvin?"

"Nothing, except that if I'd told everyone I was J. J. Kelvin, all of you would have been sitting around waiting for me to solve the problem instead of thinking about it yourselves."

Hull nodded thoughtfully. "It makes sense, Mr. Kelvin. If they'd known that you were ... well ... Mister Spaceship Himself, they'd have let you do all the thinking. And that would have left you high and dry, wouldn't it?"

Jayjay put the deck of cards in his pocket. "You're a pretty good sociologist, after all, Mr. Hull. You're right. Face any group with Authority—with a capital *A*—and they quit thinking for themselves. And if they do, then the poor slob of an Authority doesn't have anything to tickle his own brains, so everybody loses."

"Well, *do* you have an answer?" Captain Al-Amin asked.

Jayjay shook his head. "Not yet. I think I've got one coming up, but I wish you two would go on talking while I think."

"I'll try," Smith said wryly.

The problem was both simple and complex. The female socket lacked one single turn of thread to make a perfect connection. A few hundredths of an inch separated success from disaster.

Five men, including the unconscious Vandebosch, were only a fraction of an inch away from death.

Jayjay Kelvin listened to Smith talk for another half hour, throwing in objections when necessary, but offering no opinions.

"All we have to do," Smith said at last, "is get rid of that little bit of metal beyond the thread in the female socket. But there's no way to get it out. We can't use a chisel because the force would warp the threads. Besides, we couldn't get a chisel in there."

"And we don't have a chisel," Captain Al-Amin added. "We don't have any tools at all."

"Except," said Jayjay, "an electric hand drill and a quarter-inch bit."

"Well, sure," said Smith. "But what good will that do us?"

"If we rigged a belt between the drill's motor and the sleeve of the female socket, the sleeve would rotate as if it were on a lathe, wouldn't it?"

Smith blinked. "Sure. Yeah! Hey!" His face brightened. Then it looked sad again. "But what good would that do us?"

"You said that all we have between us and success is a fraction of an inch of metal. If we can remove that fraction of an inch, we're successful."

"But how can you put a thread into that socket?" Smith asked.

Jayjay beamed as though it were his birthday. "We don't have to put a thread in there. All we have to do is give the thread on the male plug room to move in. All we have to do is clear away that metal. So we'll use the drill motor to turn the sleeve as if it were on a lathe."

Smith still didn't look enthusiastic. "All right. We have a lathe. But what are we going to use for tools? What are we going to cut the metal with?"

Jayjay's smile became broader. "Carbon steel. What else?"

"Oh?" said Smith. "And where do we get these tools, Mr. Kelvin? From the circumambient ether?"

"Not at all," said Jayjay. "Did you ever chip flint?"

"What?"

"Never mind. All we have to do is use that quarter-inch bit."

Smith still looked confused. "I don't get it. A bit that big won't fit in."

"We simply crack a piece off that hard carbon steel," Jayjay said. "We can make a lathe tool that will fit into the small space between the inner and outer tubes. The fractured edge will be sharp enough to take out the excess metal. The male plug can move in, and we'll have contact."

"Well, I'll be—" Smith used another French word.

Captain Atef Al-Amin cast his eyes upwards. "*Creatio ex nihilo*," he said softly.

When the Interplanetary Police ship took the five men and the cargo from the wreck of the *Persephone*, the major in command of the ship, who knew that he had rescued the great J. J. Kelvin, asked him: "Mr. Kelvin, what do you plan to do when you return to Ceres City?"

And Jayjay, who knew that both he and the major were speaking for the newsfacs and for posterity, said:

"I'm going to make sure that Kelvin Associates learns to make emergency equipment properly. We will never again put faulty equipment aboard a ship."

The major looked perplexed. "What?"

"I'm going to have some designer's head!" said Jayjay Kelvin.

THE END

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