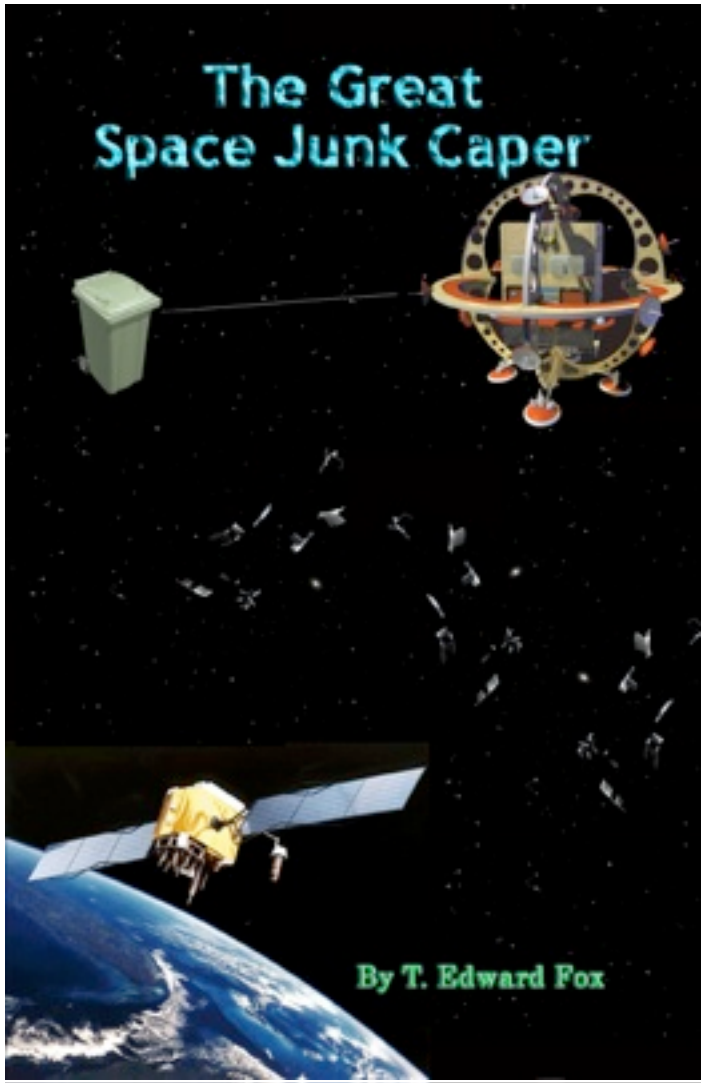

Tom Swift's—

The Great Space Junk Caper

By T. Edward Fox

There is enough space junk floating out in orbit to practically fill the Grand Canyon. Useless and dangerous, it circles the globe often coming within yards of other, active satellites. When some of this debris knocks out a primary GPS satellite, the Government decides that it is time to embark on a program to replace and safeguard this vital navigation system.

Tom Swift is asked to help find a way to quickly and quietly replace the aging system while coming up with a way to ensure that no debris will impact—or destroy—anything else.

Is it all possible? Tom has just a few weeks to come up with the solution.

This story is dedicated to the men and women who sit, day after day, night after night, in military and civilian tracking centers just watching for the next piece of debris in Earth orbit to become a nuisance. It is mostly thankless work filled with tedium and lots of coffee. But, without them we might have lost more satellites and even the ISS by this time. Keep those eyes peeled, folks!

A SWIFT ENTERPRISES' INVENTION STORY

The Great Space Junk Caper

FOREWORD

Right in the middle of another adventure, our young Tom is called to Washington D.C. to participate in a vital mission…

Sounds familiar?

It seems that there is no rest for the perpetually great. This time, Tom is faced with a situation that isn't exactly dire, but it is vitally important to our nation. We have come to rely on the little boxes and apps on our smart phones that tell us to "Turn Left in three point two miles" and "Right turn followed by a right turn… Recalculation route…"

That's right. The GPS system. It was originally launched for the military and proved so amazing at pinpointing almost any position on Earth below the Arctic Circle and above the South Pole region that some smart folks asked permission to tap into it for automobile navigation.

Great idea, until it starts to go wrong.

It is a lot of fun watching Tom tackle a problem. Especially when he has so little time to arrive at an elegant solution.

And, arrive he does. Enjoy this little story about the weeks Tom spent saving us all from making wrong turns.

Victor Appleton II

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PART 1

What Went Up Must Come Down

"SO IF I get this right," the tall, dark-haired young man was asking his friend, young inventor Tom Swift, pretty soon my little GPS navigation box is going to stop working. Is that right?"

Tom, son of the famous inventor Damon Swift, looked over at his best friend. "Bud, that's what looks like is going to happen if something can't be done to either resupply, repair or replace the satellites that are still functioning."

Several months earlier a meteor had just nicked the edge of one of the 30-plus "civilian accessible" and unknown number of "military-only" satellites up in various orbital paths around the globe. And, though it had not destroyed the multi-million dollar device, it had both knocked it out of its orbital position and had started it spinning wildly. With little precious fuel on board, all that the NASA people had been able to do was slow the spinning.

Now, exhausted of its hydrazine fuel, it had settled into an orbit that would bring it into an area of known space debris within a few months, most likely ending in its destruction.

"I thought those things would be up there forever," Bud Barclay commented. "You know, all solar powered and in a high enough orbit to be clear of most of the other satellites up there."

"Well, if you start with the premise that nothing is forever, and that space is a really inhospitable place to put something in, it is actually surprising that the system has lasted as long as it has. I mean, they've replaced some of the earliest ones already. But the majority of the ones up here have been in service almost twenty years. They were designed for fifteen."

Bud mouthed an "Oh" with his lips but said nothing.

What the Government is asking Swift Enterprises to do is to see if we can help them get replacements up there and to de-orbit the old ones. Safely and without impacting anything in lower orbits."

Bud was considering something, so Tom let him think while he turned back to the computer screen where he had been working on a computer program to help him with one of his current projects—trying to figure out how the Navy had managed to super-size one of his own propulsion systems for use in a new nuclear submarine.

"Okay, skipper. Here's a question. Why don't they just launch all of the new satellites up into geosynchronous orbit and just shut off the old ones?"

Tom looked up at Bud. "Well, about half of the satellites up there are new enough to only require a bit of refueling. Difficult to do, but not actually impossible. Of course, since the Space Shuttles' time, there hasn't been anything that could haul up the necessary supplies and equipment. Even then, none of the old fleet could get into the twelve thousand mile orbit range."

"But we go up way beyond that, Tom. The outpost is up at over twenty two thousand miles and we've been millions of miles beyond that. Seems to me it will be a piece of cake!"

Tom grinned at his friend's absolute faith in all things Swift.

Bud suddenly brightened. "Say. What about all the other GPS systems up there. That one the Chinese launched and the ones the Russians use and even the ones that Europe started to put up and then abandoned?"

Tom nodded. While it was true that there were dozens of other satellites up there providing some sort of global positioning information, he had to disappoint his companion. "The problem is, my dear Budworth, that each of those systems is incompatible with the others, and only the Chinese system, what they call their Compass Navigation System, only covers the eastern portion of Asia and a thousand miles of so out into the Pacific."

"Meaning that my little device can't pick them up?"

"And, can't understand the data as well."

Bud sighed. He, like millions of people all over the world, had become almost addicted to the use of his GPS navigator. Even with the few human-induced flaws in the information provided—he had been directed down one long and dead-end road once—the system had practically done in the map printing business and was now accurate to within a few yards.

Changing the subject, he asked, "What's that you're working on?"

"You know how we were at the launch of *The Salem* a few days back?"

Bud nodded. The newest of the U.S. Navy's nuclear submarines had been christened by the First Lady and slipped down into the water to much fanfare. Tom and Bud had been among the honored guests to be on the platform.

"You recall that they couldn't tell us about the drive system other than to hint that it was built around the one I designed for our jetmarines and that they have licensed."

"Sure. But," Bud hesitated a moment before continuing, "didn't we agree that there was no way to make the jetmarine technology as stealthy as a Navy sub needs to be?"

Tom nodded. "Yes. So, I am trying to figure out what they might have done, using our tech as the springboard. So far I have come up with the possibility that after superheating the water by circulating it around the reactor core, they then super cool it as it exits the drive tunnels. It might keep the water from cavitating and making lots of noise."

Bud stood up straight and yawned. "Beyond my tiny brain, skipper. I'm heading off for a little flying. Want to come along?"

"Sorry. I've got an appointment in Washington in two hours. I've got to get ready for that."

"Uh... Tom? How are you going to get down there?"

Tom had to laugh when he saw the hopeful look on Bud's face.

Slowly, he replied, "I guess that I am going to ask you if you could put off your flight for another fifteen minutes, and then take me down there. Right?"

Bud gave an emphatic nod.

While Tom changed into a suit, Bud went to prepare one of the small commuter jets produced by Swift Enterprises.

Twenty minutes later the pair were passing five thousand feet and heading south. Minutes later they reached their cruising altitude and Bud made his contacts with the East Coast Control Center, providing all their flight information and flight plan.

"Roger, Swift One. We have an FAA clear zone request sixty miles due east of Harrisburg PA. Student group is launching a class project rocket and satellite. Suggest you vector directly over Trenton. Make a left turn to new heading One Nine Three at this time."

"Wilco," Bud radioed back, making the slight course correction. Fifteen minutes later Tom called out, "Bud. Look! There it is!" He pointed almost straight out of the right side of the cockpit.

"Wow. Not only is she making a lot of smoke," Bud said, "I'd say she's already up here around thirty thousand, like us. Next stop, space!"

"With any luck," Tom replied.

A moment later, the smoke trail behind the rocket—about the only thing they could actually see from this distance—stopped. two seconds later a new trail of smoke could be seen and the rocket appeared to be accelerating. Then, where the original smoke has stopped a tiny white object appeared. "Must be the chute," Tom said. "Dropping their first stage I guess."

Then, everything was too far behind them to see any more.

After dropping Tom off at Reagan International, Bud decided to fly over to Fearing Island to have lunch with some of the rocket technicians he had become friends with over the past couple years.

Tom went to his meeting at the offices of Senator Quintana, the senior representative of the State of New Mexico and a friend of the Swifts.

After introductions were made, they sat down to business.

"As you know, Tom," the Senator began, "the current GPS system is starting to have some problems."

"Of course. The meteor accident was well publicized, sir."

"Yes, well... actually that is one of the least of our problems. You see, when we opened use up to the public, it meant that we opened up the codes to the data being transmitted down." He sighed before continuing. "What we goofed up on, big time I might add, is that we only

slightly modified the access codes from the military side to the civilian."

"The ones that are built into the chips in GPS devices?"

"Right. What most of the public doesn't understand is that the very same satellites they access are the ones our weapons and navigation systems use. We just get a better quality of data and at a higher rate. And, that is where the problem has come up. Somebody is beginning to experiment with jamming our data signals."

Tom was horrified at the prospects the Senator's admission might mean.

"I see the look on your face. Believe me when I tell you that it is mild compared to what mine looked like when I heard." He turned and glared at a man sitting at the far end of the table.

"What can Enterprises do, sir?"

Taking a deep breath, another man, Senator Roberts of Maine, took up the discussion. "Tom. We are hoping that you can think of some way to do three things for us. First, we need to replace eleven of our current satellites with new ones. Ones that will now broadcast only on the civilian side."

"Couldn't you launch them yourselves, sirs?"

"No, this needs to be done quietly and with no fanfare. That brings us to number two. We need you to resupply the remaining twenty-one satellites with new fuel loads. But, while there we have to find a way to swap out the old electronics with the same, new electronics package as in the brand new satellites."

Tom was beginning to have a much better appreciation of the huge amount of work that would be involved.

"And that leads us to number three. We need to put an entirely new class of military GPS satellite. Eighteen in all. Half of them would be in a lower Earth orbit than the current satellites and the other half all the way up in geosynchronous orbit. Completely out of range of anything we or other nations have the ability to get to."

"How much closer, if I may ask?"

"Four hundred eighty miles up." This coming from the man at the end of the table. "I'm Doctor Fred Mars, Mr. Swift. I'm the one who developed the original signal codes and the one who screwed up by not insisting on completely new codes once we split the services."

Tom could see how miserable the man was. He felt sorry for him.

"If I remember correctly, isn't the altitude you're talking about pretty full of junk right now," Tom asked, trying to take the subject off into another direction.

Senator Quintana cleared his throat. "I guess that adds number four to the list. We need to ensure that the only things likely to come within a hundred miles are fully functional objects, not space junk." He looked pointedly at Tom. "What are your thoughts, Tom?"

Tom sat back and thought. Leaning back forward he said, "Let's go down the list, sirs. Number one is easily doable. I have my spaceship, *The Challenger*, that can

easily take up three or four satellites at a time and get them safely deployed at the twelve thousand mile orbits the old ones use. I can bring the old ones back so you can either refurbish them or destroy them. Securely."

Everyone nodded and a few of the seven people there smiled at Tom's announcement.

"By the way, when will the new satellites be ready," Tom asked.

"Two months," Senator Quintana answered. "Ago. We've been sitting on the entire bunch of them for two months trying to figure out a way to do this ourselves.

"Ah. I see. So time is pretty important I suppose."

Everyone nodded.

"Okay, then. As for number two… I really hate the idea of hauling up Hydrazine. That's pretty nasty stuff. Corrosive, explosive and dangerous even in the vacuum of space. Give me some time to think about that. Maybe I can come up with an alternative fuel."

"What about the hydrazine still in their tanks, Mr. Swift," asked a man Tom had never met before but had identified himself as one of the Congressmen from the State of Oregon.

"Well, we can't just bleed it off. It would not only hang around in the vicinity, it would remain unstable and explosive." Tom knew that the fuel was one of the mono-propellants; a fuel that was both the power source as well as its own oxidizer. "Obviously, we'd have to either draw it off and devise some way to clean out the tanks before refueling, or we would need to detach the current tanks and attach new ones. But, that leaves us with transporting them back."

"What about number three, Tom?"

"Obviously, placing satellites into any orbital position can be accomplished the same way we would replace the older satellites. The issue is really your number four. Clearing the areas. Gentlemen, I'm going to need to go back to Enterprises and consult with my engineers and experts. Would it be alright if I got back to you in a week?"

The men around the table all nodded.

"That is actually sooner than I thought," Senator Roberts told him.

Tom arrived back at the airport before Bud returned, so he busied himself making notes on his tablet computer. He also made a series of sketches of possible ways to capture the space junk.

He was just tackling the issue of an alternate fuel when a shadow moved over the computer's screen. He pulled it up so nobody could see the screen and then looked up.

"Oh. Bud! You're back. Gee, what time is it?"

"Almost three, Tom. I've been waiting out on the tarmac for an hour. Didn't you get my phone message?"

Sheepishly, Tom had to admit that he had turned his phone off while at the meeting, and had completely forgotten to turn it back on.

On the way back to Enterprises Tom told Bud about the meeting and the possible tasks in front of them.

When he mentioned the hydrazine fuel issue, Bud's face split in a great big smile.

"You'll never guess what Peter Brock and Lisa Fitzgerald are working on, skipper. Go ahead. Guess."

Realizing that Bud's smile meant something big was up, and given what they were talking about, Tom guessed, "A new mono-propellant?"

Without lessening in intensity, Bud said through his smile, "That's right! They've been experimenting with a way to make a shelf-stable fuel using an altered version of hydrogen peroxide and some other stuff like methane. They say they've cracked the corrosive bit with the almost pure H2O2 and figure their new fuel to be about ten percent more powerful than hydrazine. And, get this… if exposed to air, it just breaks down into steam and methane. Almost harmless!"

"Well, if it's all they think it is, that could satisfy one of the four problems."

One arriving back at his office, Tom placed a call back to Fearing. Lisa Fitzgerald answered the phone in the office she shared with Peter Brock.

Once Tom identified the reason for the call, she became very excited. He could see her, in his mind, pacing back and forth as they spoke, arms waiving and fingers articulating various concepts. She was impossible to keep sitting at a table in any meeting.

"So, Tom. The good news is that Peter and I have been able to synthesize the fuel by the gallon, lately, and all our tests show that it is stable enough to be dropped onto the ground. Uh… we found out about that one by accidentally dropping a vacuum flask of the stuff on the ground the other day."

Tom had to smile. They weren't alone in making accidental discoveries by surviving a possible accident.

He arranged to come out the following day for a demonstration.

Next, Tom went to the office he often shared with his father. The older inventor was just getting off the phone. "That was Senator Quintana, Son. He wanted to know if we had spoken about your meeting yet. I had to tell him that you weren't back, as far as I knew. So, what is on your agenda now?"

Tom told him all about the meeting in Washington D.C. and the massive amount of work it might entail.

"You know, Tom," Damon Swift said rubbing his jaw in thought, "I think the only part of this that is going to be difficult is the whole clearing of the junk around the new satellite positions."

When Tom took consternated and seemed ready to speak, Damon held up one finger to stop him.

"Think about it, Son. They've got all the orbital information computed and plotted. They have all the satellites and the replacement components sitting, ready for use. You've got The Challenger, and she could be

outfitted with the necessary brackets to hold everything in a matter of a few days. And, if this new monopropellant is as good as our people think it is, you should be able to build new tanks, fill and pressurize them down here, and then just install them up there."

"But, the old hydrazine tanks. What about how dangerous they are?"

Mr. Swift nodded. "Of course, there is always some element of danger, but I think it can be managed using an external storage container out on the launching porch of *The Challenger*. Tomasite and durastress could be used in layers to provide maximum strength."

"So, that just leave me with coming up with some way to capture the space junk and get it down, out of orbit," Tom said, brightening.

"That's right, Son. You've got to come up with a better space mousetrap. Simple!"

PART 2

The Better Trap

TOM CALLED Senator Quintana's office just before the politician was leaving for a fund-raising dinner. He filled the Senator in on his conversation with his father.

"Dad is going to take of the job of prepping *The Challenger* for the job, sir. He will need full access to all the specs for the different components and complete units."

"Of course."

"And, unless we run into major problems, I believe we may have a way to pull the old tanks off and put new ones on. Safe ones," he added without naming anything specific in case the conversation as being tapped.

"Just keep me posted. You've got this number and I believe your secretary, Mr. Trent, has my private line. Use that if you really need to."

Leave it to the ever-efficient Munford Trent to have the private phone number of an important Senator.

Tom spent two days on Fearing Island working with Lisa and Peter undertaking test after test on the potential new fuel. At first, Tom was disappointed at the results. Then, Lisa reminded him that even the ultra-fast exposure to the atmosphere was causing the fuel to degrade even as it ignited.

"Peter and I are certain, barring unexpected results

from an actual test in space, that at least fifteen and as much as eighteen percent of the fuel's power potential is dissipated before it can be realized."

She shrugged and smiled as Peter added, "It's because of the volatile safety measure that this formula presents. No explosions and complete breakdown in air is working against us. We didn't want to accidentally blow apart a vacuum chamber in case this fuel is actually more powerful than we think."

Tom smiled. "You're absolutely right. We're going to have to go up and give this a try. You two put together a small test rocket with a tank of this— uh… what *are* you calling it, by the way?"

The two technicians looked at each other before Lisa spoke. "The best we could come up with is Methoxide. We also rejected HydroPerThane, HyPerThane and a host of others."

"I like the one you settled on. Methoxide it is! Anyway, pull one of the smallest suborbital-capable rockets out of storage, rig it with the single tank of Methoxide, and put in a standard package of performance instruments. G-force, acceleration, duration, that sort of thing. How soon do you think you—" he stopped seeing that neither of the technicians were looking him in the eye.

"Okay," he said slowly, "bring the rocket that you've already anticipated I'd ask for over to *The Challenger* and we'll go up in a couple of hours."

They brightened and then turned and left the room.

Tom laughed out loud as they disappeared. He knew that he had great people working for him. Self-starters and real go-getters.

Peter arrived at the enormous repelatron-powered spaceship first. Cradled on a special trailer behind the small tractor he was driving was a nine-foot long rocket. Normally outfitted with four rear fins and four small forward fins for stability in the atmosphere, this one had no fins. Tom nodded realizing that in the vacuum of space, fins were neither necessary nor effective.

He and Peter Brock had just hoisted the rocket up onto the landing porch on the lower level of *The Challenger* when Lisa arrived.

"Got the instrument package," she told them as she climbed up the ladder and onto the deck. They moved the rocket inside the hangar and spent twenty minutes installing the electronics. Then, while the two techs strapped the small rocket down, tom went up to the top level and the control room. There, he prepped the spaceship for launch.

"Tom to Fearing Control," he radioed as Lisa and Peter came up and took seats behind him.

"Go ahead, skipper," came the call back.

"*Challenger* going up in five minutes. We're heading for high orbit, probably ten thousand miles. I'll let you know when we are coming back, but it should be in about four hours."

"Roger. Happy flying!"

Soon, the mighty ship lifted slowly off the tarmac. It then accelerated and was out of sight in less that half a minute. Tom had the main lower propulsion antenna aimed straight down and the upper, steering and braking repelatrons aimed at the Moon and at distant Mars.

After arriving at their proposed orbit, Toms et the autopilot and they all went down and climbed into space suits. It was the work of just a few minutes to unhook the rocket, open the hangar and set it up in a small launcher tube that was kept stowed against the outer hull. They returned to the control room, not taking time to get out of their suits, and began the launch sequence.

“All telemetry coming through, Tom,” Peter called out.

“Basic systems look great, skipper,” Lisa stated. “Fuel at proper pressure. She’s ready.”

Tom smiled at them and asked, “Would you two like the dual honor of pressing the launch button? After all, she’s your baby.”

The moved forward and reached for the red button. “On my three — two — one — launch!” Tom called out.

Half a second later they all saw the small rocket zoom silently away from *The Challenger* and off at an angle that would carry it into a safe orbit once the fuel was expended.

All they could do now was to wait for all of the data to come back and to be ‘digested’ by the onboard computers. Tom got up and made three cups of coffee.

One minute into the flight a light flashed on the control panel indicating that the fuel was exhausted. Five minutes later, the screen changed and displayed a series of reports.

All three whistled as they saw the results of the test launch.

“Oh, my,” Lisa said.

“As your friend, Bud, would say, Jetz!” stated Peter Brock, his mouth agape.

Tom chuckled. "You thought maybe fifteen to eighteen percent loss? Jetz! indeed. This all looks like you’re losing a full twenty-two percent in the atmospheric tests. This is going to be a real boon to a little project I’ve taken on. How much can you make in, say, a week?”

Peter shook his head to clear his thoughts. He was still stunned at the excellent results from the test. “Oh… our current set-up can make a gallon in twenty minutes. It’s actually a constant process so as we pump in the raw material, twenty minutes later the finished Methoxide starts to flow out.”

“That would mean that a constant run of twenty-four hours would yield about seventy-two gallons,” Tom said doing the calculations. “I need to have you fill about thirty tanks with the stuff, roughly seventeen gallons each.”

“When will we have the tanks, Tom?”

“Three days I believe.”

“Okay,” Peter said, “We’ll start batching it when we get back. It should all be ready by the time we got those

tanks."

"Don't bust a gut," Tom advised. I won't be needing more than the first six by this time next week, and then probably in groups of six every other day starting the week after that."

They landed at Fearing slightly ahead of schedule. Tom thanked the two and hurried over to his waiting SE-11 jet. Nicknamed The Toad by Bud, it was a squat plane with an overhead wing and two jet engines perched on top of that. From the front it did have a similarity to an amphibian.

He got back to his shared office just in time to speak with his father before the older inventor headed home for dinner. After filling Damon Swift in on the results of the test on the new fuel, Tom said, "So, almost as soon as we can start receiving the first replacement components I can have the new tanks built, filled and ready to install. How is all that going?"

"NASA is having a bit of a time with the military. One three-star General in particular is throwing wrenches into this whenever he is able."

"Why?" Tom asked, incredulously.

"From what I can gather, he feels that this should be a strictly military program. 'No civilians allowed,' or some such twaddle."

Tom sat down at his desk. This wasn't a new thing. It seemed that on four out of any five Government contracts there was someone who stood in the way. To date, the accountants at Swift Enterprises could detail more that ninety million dollars in additional costs paid by the taxpayers all because someone—often with no business getting involved—started causing problems or 'fighting' over territory.

"Who is this General, Dad?"

"A General Clayton Stockhouse. The third, no less! Out of the Pentagon. Why?"

Tom held up one finger. He then picked up his phone and asked their secretary to connect him directly with Senator Quintana's private line.

After giving the Senator a brief description of their progress he mentioned the issue with General Stockhouse.

"Good gravy!" the Senator exclaimed loud enough that Damon could hear him from his desk. "You're telling me that Blockhouse Stockhouse had poked his nose into this? Okay. Forget him. He will be dealt with before midnight tonight. You just go ahead with your plans and preparation. I'll make certain that the first batch of parts get out to your island in the next forty-eight hours."

"Calling in the big guns, Son?"

"The Senator gave me permission to call him about anything that was going a bit off course."

Tom had the first ten replacement tanks sent over the Fearing Island two days later. Built to the exact proportions of the tanks they would replace, each one should be able to be installed with relative ease while the old tanks with whatever remaining fuel they held would

be stowed in an ejectable pod on the porch of *The Challenger*. It could be jettisoned quickly should any problems arise.

Five days later, Tom, Bud and a team of space construction men normally stationed at the Outpost in Space—but currently on their one-month-in-three rotation back to Earth—headed skyward on the first of their secret missions. They would be replacing electronics and refueling the twenty-one satellites that would be remaining in orbit.

It was determined that the best time to perform the changeover of the electronics in the oldest GPS satellites would be between the hours of midnight and five a.m. in any given time zone.

They immediately ran into trouble with the first satellite. Although skilled at maneuvering objects with great mass in zero-G conditions, they ran afoul of the outstretched solar panels. Neither would budge as they tried to fold them in so the satellite would actually fit into the space where the mountain bracken had been attached.

Tom ended up putting small cables onto all four corners of the main body and using small electrical winches to draw it up to, and firmly against the main outer brace next to the hangar.

Two hours later, they were still trying to remove the last two of the twenty-eight bolts that not only held the outer cover to the framework, but also was attached to one of the difficult solar panels.

Using the efforts of three men at once and a makeshift lever, they got the last bolts loosened and the cover swung aside.

After that, it took just fifteen minutes to swap out the electronics and another half hour to seal off the old hydrazine tank, remove it and get the new Methoxide tank into its place.

The satellite was reassembled and released, and a special alignment signal sent from *Challenger* before she moved carefully away.

“Okay, folks. We’re so far behind schedule I think that we can only try for one more tonight. It’s just heading over Japan right now and we’ll intercept it as it passes over the West Coast, near Vancouver British Columbia.”

While the construction team rested and resupplied their backpacks, Tom and Bud piloted *Challenger* to the new rendezvous point.

Things started off very well with the solar panels easily being moved back to their stowed positions and the satellite attached to the work brackets.

Even removing the access panel proved to be fast and easy. The surprise came when Tom discovered that a micro pinhole in the pressure coupling of the fuel tank had allowed enough hydrazine to leak out to heavily corrode the entire fitting. Not wanting to chance rupturing anything he opted to just replace the electronics package and to ask the Government what they wished to do about the corrosion.

“It will,” he told Senator Quintana, after landing later

than morning with only two satellites completely upgraded and the third partially complete, “probably be the cause of the entire satellite failing in the next year or so.”

“Because of a simple leak?” the man in Washington asked, disbelief in his tone.

Tom explained the incredibly corrosive and volatile nature of hydrazine. He finished with, “So, if it does rupture, the chances of a big explosion happening is about ninety percent.”

It was decided that everything be left as is for the time being and that the satellite would be replace once a new one could be produced. All of the others on hand were ‘spoken’ for.

Two nights later Tom and his crew were able to complete the replacements of electronics and fuel tanks in six of the remaining older satellites, and over the next five days complete all of them. With no fanfare and evidently with nobody on the ground noticing any difference, these now provided both an easily usable civilian side as well as a highly protected military side.

They also now had enough fuel on board to provide repositioning power for at least a dozen years.

That left the tasks of hauling in and completely replacing the oldest of the GPS devices and then the launching of the new dual-level system.

Due to the size of the satellites it was only possible to take up and bring down three at a time. With eleven to swap out, this meant four trips up. And, because it would be necessary to exactly position the new where the old had been, and to do it so quickly that the switch from one to the other would not confuse any GPS devices on the ground, Tom and his team practiced the operation a dozen times before performing the first changeover.

The new satellite was positioned right next to the existing one, and a message was transmitted to the Earth station controlling them. On a countdown from five, the old satellite was sent a deactivation sequence at the exact moment the activation sequence was transmitted to the new satellite.

The only indication Tom’s team had was that a small indicator light bulb on the old one would go out and its associated LED would glow green on the replacement.

Then, they simply bumped the old one out of the way—tethered to *The Challenger* so it did not rift away—and the new one was manhandled into position.

It went smoothly for all eleven changeovers and Tom gave his team four days off to recover.

During that time he spent his working days and most of his evenings hunched over his keyboard and drafting stylus designing several methods for clearing out space debris that might impact any of the older and the lower nine of the soon-to-be-released super GPS satellites.

His first design caused Bud to laugh out loud. “That looks like cross between a giant Gatling gun and a bunch of fishing reels, Tom. What the heck is that all about?”

"That," Tom said, sighing as he realized it wasn't going to be the solution, "is exactly what you described. Only, we wouldn't shoot the space junk out of the sky, this would shoot a fine cable out with a very sticky tip on it. It hits and sticks to a piece of debris and we reel it back in."

Bud was looking at it closely, stepping back in hopes that a wider view would help. It didn't.

What's the Frisbee in the middle?" He was pointing at a dish recessed back from the ends of each barrel and completely surrounded by them.

"A RADAR aiming dish. I was pretty sure we could be accurate enough to grab onto anything at least a couple millimeters wide at up to a hundred feet."

"Was?"

"Yeah. It's a great idea and one that I'll stick in the 'to be revisited' files, but it would take years to do the job."

When Bud came back two days later, Tom—now on design five—was sitting back, slowly shaking his head.

Bud pulled over his favorite stool from Tom's workbench and sat down. Pretty soon, he found that he was mimicking Tom's head motions and didn't know why.

"Before I get dizzy shaking my head, professor, can you tell me what I'm looking at and why you're apparently unhappy with it?"

Tom turned around and grinned. "Oh. I'm not unhappy with it at all, Bud. In fact, I'm really, really happy with it. I'm just amazed that I didn't think of this earlier."

"I'll tell you the truth, Tom. It looks like a giant, short-handled fly swatter. You going bug hunting?"

"In a way, yes. This is a rectangular test version I'm going to build. It sticks out to one side of *The Challenger* and we fly through a debris field. It doesn't swat at them. The opposite, actually. It will have a slight negative charge and will grab onto anything that it touches. Once we get a load, we pull it in, scrape off the junk, and extend it back out."

Smiling as he finally figured out what Tom was saying, Bud asked, "So, what happens to the junk? Do we backhand it into the Sun or something?"

"Nope. That will go into a large container we'll send up to meet us. Probably one of the older supply rockets from Loonaui. We fill it, take it back to Earth, and everything gets disassembled and properly disposed of or recycled."

"I get it. An outer space wheelie bin! We're going into the trash business."

Four days later Tom, Bud, Zimby Cox and a representative from the Government soared into the skies above Fearing, the prototype collector stowed on the porch of the hangar.

"The most likely place is the debris field left when a Chinese and Soviet satellite collided back a decade ago," the Government man told them. "They then took out an old U.S communications satellite that we were trying to de-orbit. We have a field about a mile long, half a mile high and a quarter mile wide. Probably eight tons of parts. The one thing we need to be careful about it the nuclear

batteries the old Soviet box contained. We have never been able to verify that they burnt up."

"Why would they possible have and the rest of the junk didn't?" Zimby asked.

"Didn't I read that the Soviets believed they had some control over their satellite and tried to get it heading back down?" Bud inquired.

"All smoke and mirrors, Mr. Barclay. As my grandfather use to say… flummery! Actually, because they were the heaviest components we hoped they might be most affected by gravity. In any case, we need to scan everything for radioactivity."

They arrived at the chosen location, and Tom made a RADAR scan of the field allowing the computer to catalog everything larger than a small screw. In all, the readout showed more than nineteen hundred separate pieces. A scan of the area using a modified DamonScope showed nothing with more than residual radiation.

Tom extended the fifty by seventy foot collector—a rolled up, ultra-thin sheet of the same material he had first developed for his space solartron. Like that energy-to-matter converter the sheet was pushed into shape using special strips of metal that curled and uncurled with different applications of electricity.

Tom opted to move under the field and to make his first pass slowly. Half an hour later he retracted the collector and he and Bud suited up to go outside.

Once he was outside, Tom partially unfurled the collector and then used an alternating charge to move all of the debris down and into the storage bin.

That bin soon contained several hundred small pieces of metal, foils and tubes. He looked back along the path they had traversed and smiled.

Inside he told their Government man, "It worked! It left a rectangular hole right along the path we traveled. We'll make a couple more passes and then head back down.

"You're not going to use this opportunity to clear up the entire field?" the man asked, evidently shocked.

"Too much chance that we might get hit. No, the next time we're up here, perhaps in a couple days, it will be with a large, circular collector out in front of us."

"Voila!" Bud exclaimed. "Tom Swift's better space mouse trap!"

PART 3

Snagged

TOM GLANCED at the readouts. Everything looked good to go. On board *The Challenger* were the first three of the totally new GPS satellites. It had been deemed more important to get both the lower orbit and high orbit units up and working soonest than to clear their locations.

That work would happen beginning the day after the last of the GPS broadcasters was in position.

Things had not begun well. Less than five minutes before Challenger was due to launch alarms had gone off all over the island.

"*Air intruder. Air intruder. Three One Five degrees. Direct course for island. Drones are being positioned for intercept*," the base-wide announcement system blared.

Tom immediately shut down the launch systems and set the controls to the locked position. He got up and raced from the control room and out of the spaceship.

He arrived on the tarmac just as a large military jet appeared from the northwest. It appeared to be struggling to maintain its course. Soon, Tom and the gathering group of Fearing personnel could see six or more of the autonomous drones that constantly circled overhead. Their job was to intercept and seize control from any intruder aircraft.

They appeared to be winning against the large, gray jet. In a moment, the word came down from the tower that it was a U.S. Army C-17 transport jet and they were demanding to be released.

"Negative," Tom TeleVoc'd back to the controllers. "Bring that jet in and park it over in area nine." This would, Tom knew, bring the jet to within about five hundred yards of *The Challenger*. Before taking off he wanted to see who had the nerve to try to force their way onto Fearing Island.

He didn't have long to wait. The drones swung around with their captive and came in over the outer marker on the main North-South runway. With nothing to be done other than cooperation, the pilot of the Army jet had set his flaps and dropped the landing gear.

Eight Fearing Security SUVs could be seen heading to the end of the runway. They quickly surrounded the jet and escorted it at a slow taxi speed to the spot indicated by Tom. Knowing where they would end up, Tom and several others had already headed over to be ready to demand some answers.

Before the jet had come to a complete halt, the side door on the left side popped open and swung aside. Three Security vehicles immediately came to a halt and disgorged their personnel, now armed with Tom's eGuns.

"*Stop where you are and cease attempting to deplane!*" the head of Security shouted out over his vehicle's loudspeaker system.

Tom and the others also stopped. It was a standard security protocol and he knew it was a good idea in these situations to do what Security wanted.

From his vantage point Tom could see a large man in

full dress uniform coming to the door. He was bellowing and pointing, but the airmen inside did not move. They knew better. They realized they were the intruders and needed to obey the Fearing team.

Tom began walking to the waiting jet.

"Let me down out of this damn jet at once!" the man, now identifiable as a General, shouted toward Tom.

Tom watched as the security detail moved portable stairs close to the jet and a woman Tom recognized as the second in command of the island's forces walked up them, taking out a pair of handcuffs.

"Get this … this *woman* out of my way! I won't be handcuffed by some stupid b—"

"Watch what you say, General," Barbara Felderson yelled, cutting off the insult about to be delivered. "This woman was trained by the Rangers. I can take you and your entire crew down without breaking a sweat."

The General was almost apoplectic now. "Get her the hell out of my way!"

"I can't do that, General," called Tom. "For starters, I have no idea who you are. Secondly, I have had no advanced notice that you wished to visit our highly-controlled and very private airspace. And thirdly—"

"Do you think I give a tinker's damn about what you think, kid?" the General yelled.

"And, thirdly—" came a deep voice from behind Tom, "You are here without authorization, General Stockhouse!" Tom turned and saw Senator Quintana and his retinue, who were here to witness the launch and watch the first of the new satellites being positioned via closed-circuit television. They had just driven up.

"Who the hell are you?" the General bellowed.

In a calm tone, the reply was, "I am Senator Quintana of the state of New Mexico. I am a five term Senator and am the Vice Chairman of the Senate Military Selection Committee. And, you are General Clayton Stockhouse. You are also in violation of several federal and at least one international law regarding entering restricted private airspace. You might soon lose those stars. Be very careful with your next words!"

The General had gone very red, but suddenly turned quite white.

Turning to Tom, the Senator suggested, "Why don't you go ahead and get going, Tom. By the time you come back, he will have been taken care of. And, I can practically promise you that you will never, ever be bothered by him in any official capacity again!"

Tom tried to suppress a grin, but failed. "Yes, sir!" he said, spinning and making shooing motions to the gathering crowd. "Let's get back on the launch sequence!"

Ten minutes later *The Challenger* soared up and away. The Senator and his group sat in the large conference room watching things unfold fifty minutes later when Tom, Bud and his team slid the new GPS satellite off of the porch. A brief firing of one of the small positioning rockets halted its relative movement once it reached a point about fifty feet away.

Using a small computer, Tom sent a very low power signal to the satellite. Two minutes later he received four

green LEDs on the computer indicating that the four major systems checks had peen completed and were a success.

He then keyed in a sequence and watched as the four solar panels—each almost twice as efficient as the ones on earlier models—unfolded and rotated to face the Sun.

Tom keyed his radio and sent back the message that everything was “nominal.” He couldn’t hear it, but a loud and rousing cheer went up in the conference room.

Things wend just as well with the other two satellites, and *Challenger* returned to Fearing just five hours after she departed.

There was no sign of the Army C-17 or the Senator’s Gulfstream. Tom thanked everyone and reminded them that this was the first of six trips up.

Zimby Cox would be taking up the next batch the following morning, with Slim Davis and then Bud finishing the first four runs. Tom would be involved in placing the last two sets of satellites.

During his ‘days off’ he worked with Hank Sterling and his team to construct the giant, circular cone-shaped collector that *The Challenger* would use to clear the areas and orbits around the lower satellites.

Built in triangular sections, it came together very fast. The entire collector would span almost four hundred feet from side to side and would be thirty feet farther out in front on the outer ring than at the central point. This allowed everything collected to be electro/mechanically moved to the middle and into the large collection debris container.

Two containers were being constructed at The Swift Construction Company. These cylindrical containers would fit exactly inside of the cargo areas of the two Swift supply rockets being quickly converted out at the Loonaui rocket base. Like their Earth bound counterparts, these giant garbage trucks had built-in hydraulic rams that would crush the space junk together so that as much space as possible could be utilized.

“If things go the way we hope,” Tom told Hank, “We’ll be filling a container every twelve hours.”

“Then what?”

“Well, then we spend about an hour moving the full tank to the waiting rocket, shove it in, close it up and down it all comes. Then we take the rest of that ‘day’ off and get ready to do the same thing the following day.”

“How long do you think this is all going to take, Tom?”

“Depending on what we find at the various locations, my guess is that we can just clear one satellite per day. We’ve got nine of the new ones to do, and the Government is asking if we can take a good look at five others. Two weeks? That would be my guess.”

Four days later *The Challenger* took off outfitted with the new collection system. Tom, Bud, Zimby, Slim and a crew of four others would work for at least seven days, but Tom hoped they might just remain up there for the entire time.

Simultaneously with *Challenger* lifting off, the first of the supply rockets was winched underwater and launched using the positive buoyancy launch system Tom pioneered when putting up the Outpost in Space.

This method entailed encasing most of the rocket in a highly buoyant foam enclosure and pulling it hundred of feet underwater. When released, natural forces shot the rocket toward the surface. Just below the surface the casing blew off and inertial forces flung the rocket into the air. This gave the rocket such a speed boost that the rocket didn't need heavy first stages to achieve orbit.

This saved time, materials, fuel and—most of all—cut down on pollutants.

The rendezvous took place nine hours later. With the rocket 'parked' a mile away, Tom pressed the button to unpack and open the collector. As it opened, they all watched the picture being beamed over from a camera on the rocket.

Everyone laughed as they saw it open and settle into its shape.

"You know what you've done, don't you, Tom?" Bud asked, trying to put on a straight face. "You've gone and built the first 'don't scratch that' spaceship protection cone!"

It did, indeed, look just like the sort of plastic cones veterinarians might put on a dog or cat following any kind of neck or facial surgery.

It may have looked humorous, but five hours later when Zimby and Bud went outside to clear a stuck aluminum brace piece, it was obvious that it was very effective.

RADAR checks showed that they already had been able to clear an area more than thirty miles long and a half-mile wide and deep. Because of the relative slow speed of travel, there had been no noticeable damage to the inner surface of the collector.

By the end of the twelve hours they had more than doubled the cleared area and were starting the process of detaching and moving the 'trash can.'

"A good day's work," Tom declared after they had sent the rocket Earthward and were sitting down to dinner.

The first five days went almost exactly the same. Two of the satellites had so much trash around them that it required a few extra hours to clear. Tom chose to manually pull out several larger pieces of what looked like an exploded booster rocket and to set them aside so that more small pieces could fit. He had a crewman pull them into the hangar and cinch them down.

It was on the sixth day that the only problem occurred.

"Skipper!" Slim shouted out to Tom who was one level down having a rest in the crew lounge area. "We just snagged something I don't think we were supposed to."

Tom hurried up the ladder and over to the control panel. He had four tiny cameras mounted around the perimeter of the cone. One of them appeared to be covered by something. The other three showed him what it was.

"Oh-oh!" he said, turning a little red. "It looks like we just pulled in a perfectly good little satellite."

"What is it?" Bud asked coming into the control room.

The object in the collector was just about the size of a basketball and had a pair or thin-foil solar panels sticking out. Tom captured a still picture of it and radioed down to Fearing. "I've just sent a picture to you. Can you check the

catalog and tell me who owns this. I'll try to get some designation from it when we go out."

"Roger, Tom," came the radioman's call. Can you give me some basic dimensions? Might help."

"Right. I'm going out right now. I'll get back to you within the hour. Out."

Bud was already waiting, suited up, when Tom got down to the lower level. Together, they stepped off the porch and into space. Then, using their backpacks they maneuvered out and over the front end of the cone.

Now that Tom could see it right in front of him, he say that it was a bit larger than a basketball; it was perhaps 13 inches wide, about a third larger than an official basketball. He could also see that the solar panels were not mechanical. The sides were built like blow-tickler party favors. As a gas was released—he was pretty sure the builders had used compressed nitrogen—the hollow tubes on both sides filled, expanded and unrolled the panels.

"This has to be some sort of amateur effort," he explained to Bud. "They've left no way to control or turn the panels. If this isn't positioned at the correct angle, these panels would be pretty useless. Let's get it into the hangar. Looks like we punctured one of the panels."

Together, they rolled up the deflated panel and then, at Tom's suggestion, put small puncture in the other to assist them in getting it wrapped up as well.

Once inside, Tom closed the hangar and re-pressurized the space. Soon, he and Bud were in civilian clothes and were unrolling the two solar panels. Tom took several measurements before turning the package over. He let out a little laugh and pointed at the hand-written words on the back side.

They went up to the control room. Tom got back on the radio.

"We've been scanning the records, skipper," the radioman told him, "but nothing so far."

"I think I can help, Doug," Tom told him. "Get on the phone and call over to the Harrisburg University of Science and Technology in Pennsylvania. Bud and I saw their rocket launch more than a month ago. Let them know that we found the satellite they put up here, then ask if they want us to leave it alone or bring it back to them." He had a thought. "Oh, and if they start to complain that they've just lost contact with it, tell them we… uh… are willing to do a little on-site repairs for them."

Half an hour later a call came back up. "They evidently lost contact with the thing a few days after launch. Supposedly lost power. They say that if you can just recharge the battery inside—and there is some sort of USB plug on the underside—they would be appreciative. Otherwise, if it's toast they would be tickled to get it back."

"I'll let you know. Out."

While Tom let the rest of the crew handle the continuing collection process, he opened up the little round satellite. Inside, to no surprise, he found a single battery that was much too small and weak to power the three electronics boards. *It's no wonder they lost power,* he thought. *First, no control of the power panels and*

then this dinky battery.

He pulled the battery out and then checked the three boards. As he surmised, one was a radio transmitter sending out a non-directional signal. It was connected to, and probably getting info from the other two. One was an electronic thermometer while the other was a radiation dosimeter. They seemed to be in good working order.

An interesting but fairly useless combination. Especially the thermometer. Once in space, the satellite would go from full sunlight to darkness every few hours at this orbital height. The temperature would change, but would not differ day-to-day or even orbit-to-orbit.

He spent an hour upgrading the transmitter. As it was working on an open and uncontrolled frequency, there was not a real limit to the power of signal it could output, but Tom knew the more powerful the signal the more power it required.

In the end he settled for doubling the signal strength and replacing three high-consumption components with low-consumption ones. Overall, it would use the same amount of power yet send a much stronger signal.

Before sealing it back up, he inserted a Swift Solar Battery and a small recharging circuit. If he carefully placed the satellite so it aligned with the Sun, the trickle recharge and the much stronger battery should let this little satellite 'live' for about a year.

The final thing to do was to repair both of the solar panel tears. This was simple and took a few minutes. He noted, and shook his head about it, that the university team had used an off-the-shelf CO_2 cylinder to fill the hollow tubes.

He replaced it with a small nitrogen tank and valve.

Bud had come in just as Tom finished repairs. Together, they took the satellite outside.

"Slim?" Tom radioed. "Can you take me into the clearest part of our current area? I need to release our bird."

Ten minutes later Tom and Bud were taking off their helmets back inside the ship. The little satellite, it's panels now properly facing the bright rays of the Sun, was beginning to move away as the ship maneuvered back to its collection path.

In all it required fifteen days to clear the areas around all of the new GPS satellites. Only two of them were anywhere near anything active and would remain undisturbed for years barring micrometeorite contact.

On their first evening home, Tom and Bud took Bashalli and Sandy out to dinner. The girls could tell how tired the boys were so they suggested an early evening.

When Tom arrived back at the Swift home, his father looked up from the newspaper he had been reading. "I think you might want to read this little article, Son." He rattled the pages he had in his hand.

Tom walked over and took the section. It was that day's Shopton Bulletin. "What am I looking for?" he asked wearily.

"I believe it is on page five. Top, left column."

Tom turned to the indicated page. As he read, first the headline and then the short article, his eyes grew wide.

"What's that?" Sandy asked having just come in from her good night kiss with Bud.

Tom read it to her.

CONTROVERSIAL ARMY GENERAL RETIRING

It has been announced, through his personal adjutant, that three-star General Clayton Stockhouse III has tendered his resignation from the U.S. Army. It is believed to be effective as of today.

"The General has courageously served in times of war and times of peace. It is his wish to quietly retire and to enter into private life at the same time he turns sixty," Commander Felix Silverman said in a prepared statement. "That is today. General Stockhouse wants to go out at the top of his field and make room for other men, or women, to advance through the Army's ranks."

Known for several occasions where the General publicly disagreed—sometimes, evidently, to the detriment of his career—with both his military superiors as well as members of the Government, it is none the less deemed to be a loss for the armed forces.

No retirement ceremony is planned.

* * * * *

Two days after returning to Enterprises, Tom received a phone call from Admiral Hopkins, the man he had been recently working with on a propulsion system for a new U.S. nuclear sub.

Tom hadn't yet picked back up on trying to determine how his own technology might have been adapted to power a large, stealthy submarine, so it was a surprise that the Admiral was calling him.

After a curt greeting, the Admiral got down to business. "You will remember our new submarine, *The Salem*, correct?"

Tom told him that he remembered the sub very well. he and Bud had attended the launch as guests of the Admiral.

"She was completed and hit the water for her sea trials about seven weeks ago," he told Tom. "Of course, you know that already. You were there. While I can't go into details of her position or her track, I can tell you that as of 0800 today we had to declare an emergency. With no trace and no communication, *the USS Salem is missing!*"

Oh, boy! Tom thought. *Here we go, again!*