A SWIFT ENTERPRISES INVENTION STORY

Tom Swift and His Digital BigEyes

By T. Edward Fox

After perfecting his first model of the amazing device known as his SuperSight, Tom Swift is challenged by his best friend, Bud Barclay, to "Make that whole thing small enough that I can carry it around with me!"

Bud's reason is soon revealed as he tells Tom and Damon Swift about his recent stint flying a Search and Rescue training mission with the Coast Guard. Their target, a volunteer airman dropped miles off the coast with only a small life raft, almost loses his life when nobody can locate him in a freak storm.

Although finally rescued, Bud is positive that having a better way to see small things from high search altitudes would have made the difference.

Is it possible to build a better pair of binoculars? Tom is going to find out.

This story is dedicated to the first person who thought, "*If I grind down this piece of this clear stuff just so, it makes things look bigger. Wow!*" or words to that effect. Think what mysteries we have uncovered since.

Tom Swift and His Digital BigEyes

FOREWORD

Swift Enterprises, and the old Swift Construction Company before them, have been known for more than a century for finding ways to make life-changing devices. Things used by civilians and the military alike.

Typically, these are designed and built on request from the Government or the military or even in support of other Swift inventions. A few are things Tom or his father believe in so strongly they make them even before there is any known market.

It makes their advertising and communications chief, George Dilling, crazy, but so far it has worked.

And, while the things they make may change people's lives for the better, only a few are purpose-built for saving lives.

As I have mentioned to friends and associates in the past, never let it be said that Tom Swift ever shied away from a challenge, even when he honestly believes that it is impossible. Leave it to good old Bud to keep nagging at him and driving him toward success.

I suppose that it helps to have a sister and a girlfriend who are also on your best friend's side, agree with him and his motives, and continually try to help.

Victor Appleton II

CHAPTER 1 /

IT WAS FAR TOO CLOSE, SKIPPER

"HEY, HO, Tomonomo," called out the vivacious blond, Sandy Swift, to her brother Tom. Looking up and getting a big smile on his face, he hopped off the stool at his workbench and walked right past her. As she "Harrumphed!" he put his arms around the beautiful, dark haired girl that had entered his lab right behind Sandy.

"Fine!" Sandy said as she watched him give the other girl a big hug and a kiss. "Pay attention to Bashi, when *I'm* the one who's pining for her man!"

Tom stepped back and said, "Hello, Bash. I'm really glad you came by. Oh, and hey back at you, Sandy. Haven't heard from Bud?"

She shook her head causing her blond ponytail to swing back and forth behind her head. She had a slightly worried look on her face, one that was soon mirrored by Tom's girlfriend, Bashalli.

"Sandra is most distressed, Tom. Is there anything that you can do?" she asked.

It was Tom's turn to shake his head. "Not really, Bash. Sorry, San. I know he was supposed to be home yesterday, but his volunteer assignment with the Coast Guard was for *up to* two full weeks even though operations were slated to last just ten days. We're all going to have to sit and wait for maybe another three days. Emergency communications only he said."

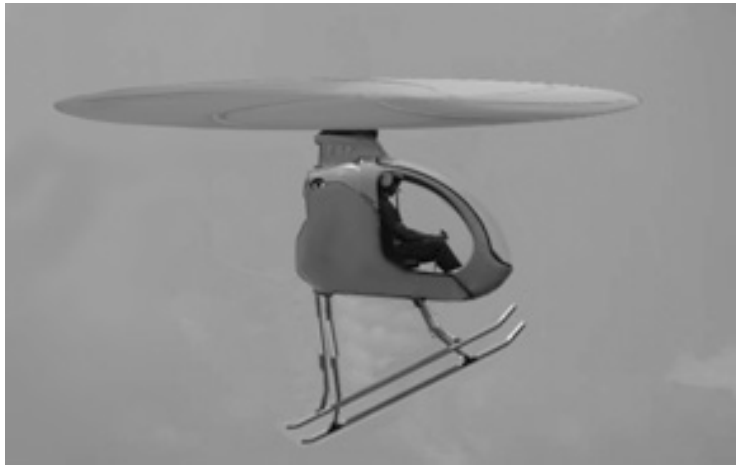
Bud Barclay, Tom's best friend and confidant, was not just Sandy's favorite—and only—date, he was a top Swift Enterprises test pilot. Although not enlisted in any service, he

often took advantage of working with different branches of the military, especially when he could fly exciting new aircraft. Part of this current Coast Guard operation was designed so he could demonstrate the viability of a new Swift mini-copter, the *Wasp*.

Standing about ten feet tall, the *Wasp* was just twenty-four inches wide with a cockpit large enough for one pilot just as long as he or she wasn't taller that six foot one. Thin, dangling landing struts and shock absorbers gave the appearance of the long legs of its namesake. With no tail section, it actually looked like just the front end of a wasp.

What truly set the *Wasp* apart was its revolutionary rotor system.

Unlike a typical helicopter, there were no visible blades used to lift and fly the aircraft. A twelve-foot wide, specially-shaped



disc rotated overhead at more than six thousand rpm, several times faster than was possible with traditional blades. A series of thin slits scooped air in from the top, compressed it centrifugally inside and shot it out the bottom of the new rotor, providing lift. Shaped like a popular flying disc toy, the large disc incorporated an internal flywheel of identical weight that rotated counter to the main disc. This provided neutral rotational torque.

In normal flight.

Flying with just the main disc as both lift and propulsion, the aircraft was able to lift its own three-hundred pounds plus a pilot of no more that two-thirty.

Tom originally designed it to be a search and rescue aircraft that could be easily stored on almost any ocean-going vessel. The rotor disc could be disengaged from the drive train and tilted ninety degrees and lowered down so that the entire *Wasp* needed just a twelve foot by twelve foot by three-foot storage space.

What made it a truly unique aircraft was its ability to deploy, even in mid-flight, a set of twelve small wings from the main rotor—each one just two feet long, six inches wide and an inch at their thickest point—evenly spaced around the disc perimeter that more than doubled the lift capability.

In this configuration, a downed pilot, stranded boater or even cargo of up to three hundred pounds could be winched up between the landing struts and carried away.

Powered by a new generation Swift Power Pod—a miniature atomic power plant Tom had first developed almost two years earlier—it was also the most stealthy helicopter around. Everything was run electrically so there was no exhaust or engine noise, and the rotating disc only made a whirring noise barely discernible from one hundred feet away.

Bud had taken the prototype to show the Coast Guard what a unique and effective craft it could be for them.

"So, you think they'll want to buy the *Wasps*?" Sandy inquired as she attempted to change the subject.

"I sure do. Think about it, ladies. One of their large helicopters costs around three million dollars. Ninety percent of their rescue missions are to rescue one or possible two people, and a third of those aren't even out over water. Climbers on seaside cliffs, people who are dumb enough to go out onto rocks during low tide, that sort of thing."

"I only saw the *Wasp* once as you were testing it," Bashalli mentioned. "Can it take the place of those larger helicopters?"

Tom nodded enthusiastically. "They can. First, they cost one tenth the price of the larger helos. Second, they fly about thirty percent faster. Third," he was ticking things off on his fingers, "their range is pretty much unlimited. Zimby Cox took the prototype across the country, up into Canada and back here three weeks ago and only had to land for bathroom and food breaks. Oh, and forth, it costs just a few dozen bucks to fly a five hour mission compared with thirty thousand dollars or more."

Sandy's face screwed up in concentration. "But, if they can only carry one heavy or two light people, what about the larger rescue missions?"

"Well, for starters, they might go out with a large inflatable lifeboat underneath that can be dropped for bigger groups. Being really fast, they can get out and back quickly. And, for some rescues, traditional helos can't make it in time. The sad fact is that about fifteen percent of ocean rescues are far enough outside their maximum range that those folks rarely get found in time." He sighed. "If ever."

He looked at the girls. It wasn't pretty news but it did put things in perspective.

"So, Bud is out with the Coast Guard with your little *Wasp* and he is performing rescues?" Bashalli asked.

Tom shrugged. "I don't actually know. He didn't get much info before he left and has not been able to communicate since due to some level of secrecy I can't figure." He rubbed his jaw in contemplation. "I wouldn't have thought the Coast Guard did anything that required communications silence, but there you are. And, there Bud is."

The three had a quick lunch in the Enterprises canteen before the girls drove off to go shopping for bathing suits. With summer just a few weeks away and the weather getting better with each passing day, they both felt the need for brand new outfits.

That evening, Tom and Sandy's mother, Anne, asked about the tardy flier. "If they are keeping him longer than he thought, I wonder why they won't let him call and tell us. I mean after all, he *is* there voluntarily."

Seeing his sister begin to tear up, Tom changed the subject. "We'll hear. Soon. Say, these are really great tacos you've made. Not at all like ones you've done in the past. Where'd you get the recipe?"

"Hmm? Oh, Chow gave it to me. He says that they are from a recipe he got out in New Mexico. Other than a few new ingredients, the difference is in how the tortillas are lightly fried in hot oil before being drained and then baked to make them stiffen up. You have to shape them over a wooded dowel."

"Well, I like them!"

"Me, too," said Sandy in a small voice, as she picked at her food.

The next morning Tom was driving into work when his cell phone beeped. It was the signal that a private call was being routed from the Enterprises switchboard to his phone. He pressed the button to activate the wireless microphone and speaker in his car.

"Tom Swift here."

There was a little garbling and then, "Hey, skipper. It's Bud. Miss me yet?"

"Hey, flyboy. Boy have we ever. And, when I say 'we' I mean Sandy! Where are you?"

"On my way back to Enterprises. I just took off from the base down here in South Carolina. I should be home in time for a late lunch. Meet me at The Barn. Okay?"

"Sure. Just call when you're about a half hour out."

The Barn was a large open-ended hangar on the premises of Swift Enterprises. With the exception of the underground hangar for Tom's first major aircraft, the *Sky Queen*, it was the closest hangar to the cluster of fifteen building in the middle of the four-mile-square facility. It was frequently used for final outfitting and construction of flying prototypes and was the current home for the *Wasp*.

When Tom's little electric car pulled up to The Barn two hours later, Bud was just coming in over the south wall of Enterprises. With no runway on this western side of the complex, the little *Wasp* disappeared behind the central buildings before circling at the north end and coming back to land one hundred feet away.

Bud climbed out with a smile on his face. He wrapped his arms around Tom and gave him a bear hug before stepping back and saluting.

"Mission, most probably accomplished!" he stated, trying to sound official. Then he broke his stance and got a goofy look on his face. "They loved it!" he told Tom. "Only three of the fifteen big wigs there had any questions even remotely non-positive. They're going to recommend a pretty nice purchase order as far as they've told me."

"Great! So, why the delay in getting back? Sandy's going nuts!"

Bud looked very serious suddenly. "Uh, I had to stay around. I'll tell you about it over a steak sandwich. Okay?"

Tom placed a quick call on his TeleVoc pin to the private chef who fed Tom, his father and most of the senior executives. "Hey, Chow," Tom silently intoned. "Can you rustle up a pair of steak sandwiches for Bud and me? ... Great! We'll be in my big lab in the Administration building in about ten minutes. Any time after that. Out."

He and Bud drove the little electric runabout, one of a fleet of identical cars used by many of Enterprises' employees to get around the huge complex, over to the parking area next to that building.

Bud was telling Tom about the demonstrations as they walked into the building. "Only had one problem," he explained to Tom. "I caught a gust of wind and brought her down a little hard a couple days before the end of the operation and bent the left landing gear. Fortunately, they have a really complete machine shop down at the base and we straightened things out in time for the final operation."

"What sort of action could the Coast Guard have?" Tom asked.

"Ah. Some of it I have to keep secret," Bud told him. "But, some of it was just because they were testing out ways to operate in the absence of reliable communications. One way seems to be a variation of your disguised underwater system that we use with the hydrolungs." He arched an eyebrow, questioningly.

Tom grinned. "We license it to them, in a slightly different form. Happened about five months ago," he told his curious friend.

"Ah...Thought so. Anyway, and this next part is the serious stuff," Bud cautioned him pointing a suggesting finger at one of

Tom's office chairs. He seated himself on one before continuing.

"The schedule called for a final operation two days ago. A simple search and rescue of a downed airman. Plus, a little friendly competition between two of their traditional helicopters and the *Wasp*. Everyone turned off their RADAR for a few hours while one of their cutters launched their helo with a petty officer outfitted with an emergency raft and all the other things a pilot would have when he bails out."

Tom nodded. This was, as he understood it, a fairly commonplace way of practicing recovery. "What was different?"

"For starters, nobody except for the two helo pilots knew where they dropped the man. Could have been anywhere in about two hundred square miles. They came back only to discover their flight recorder had been removed for maintenance and never replaced. They had no real idea exactly where they dropped the poor guy. Just personal estimates."

Tom scowled. "But, couldn't they just retrace the course they took?"

Bud shook his head. "No. They took a random zig zag course out and another back. The best they could do was to estimate they took him out eighty to one hundred fifteen miles on roughly a bearing between zero-eight-zero to one-three-five degrees. That left a possible target area of over fifty square miles. The big problem was that a storm came up suddenly."

Bud looked sadly at his friend.

"Uh..." Tom hated asking it, but he had to. "Did he get, um, recovered?"

Bud nodded slowly. "It took the concerted efforts of the five helos the Guard had available plus three P3 Orions. And, me. I took the *Wasp* up nine times for about five hours each searching for the poor guy. Visibility was horrible and conditions from the surface up to about three thousand feet mostly forced us to fly above that. Made it all but impossible to spot anyone or anything that small."

"But, he's safe?" Tom persisted.

Bud took a shallow breath and looked down. "Recovered, skipper. Not safe. Oh, he was alive, but severely dehydrated, in thermo shock and nearly delirious. They're not certain he'll recover. Damn it, Tom!" Bud uncharacteristically swore as he pounded one fist on the top of Tom's desk. "If I just had some way of looking down from that height to see something basically a couple feet wide by four long. I could have seen him. I passed almost right over him three times!"

Bud buried his face in his hands. The experience had left him hurting, emotionally.

Tom placed a hand on his friend's shoulder. "There's no room to add much to a *Wasp*," he admitted, "but do you think something could be done on the ships?"

"They never got within fifty miles of the guy. It wasn't reported on the news because it was happening a couple hundred miles off the coast, but it was hurricane-type weather down on the surface between their starting positions and the petty officer. Even RADAR had problems cutting through all the clutter of the rain. Not to mention the high waves making spotting something on the water all but impossible. No, Tom. it was only dumb luck that one of the Coast Guard helos spotted him."

"So, they got him?"

Bud shook his head. "Nope. I did. That new rotor design of yours was the only thing that could get close enough, and the *Wasp* is small enough that the wind wasn’t trying to shove me

over. I hit a short break in the really bad weather and dropped down. I lowered the harness and prayed. Luckily, the kid had enough left in him to pull it over his head and attach it, so I was able to pull him up under the cockpit and get above the really nasty weather. Once I found one of the ships I put down on their deck and they took him to sick bay."

He stopped and looked at Tom.

"It was that rescue that cemented the deal with them. Too bad it almost cost a twenty-year-old kid his life!"

CHAPTER 2 /

PITY IT'S NOT POSSIBLE

TOM SAT IN his lab for another hour after Bud left to get cleaned up and go home for a few days of well-deserved rest. Dozens of things were going through his mind from improved giant searchlights, to ultra-small lifeboats with heating systems and water distillers, to trying to compact his SuperSight video camera with computer enhancement system.

While it seemed to be the obvious choice with its ability to filter down and use numerous alternate light sources, several combinations of which could cut through wet weather, the basic system began with a high-power zoom lens that was over four feet long and weighed in at better than seventy pounds.

With its incredible focal power feeding an array of high-definition video receptors, by itself that lens could bring something a mile away close enough to discern the difference between a red-haired woman and a brunette man.

But, that was just the first stage of the system. A set of computers processed and enhanced the inputs from the receptors feeding their results into an even more powerful computer capable of assembling everything together and giving the system the ability to bring something from an elevation of over fifty-thousand feet close enough to be able to read the numbers and letters on a license plate.

And that computer system was the size of a small chest freezer. Added to that were the control panel and the 42-inch ultra-high definition monitor. Including its built-in liquid cooling system, it weighed over five hundred pounds.

It was not going to be a possibility to place anything that large and heavy into even the largest of the Coast Guard's

helicopters, much less one of Tom's tiny *Wasps*.

When Bud returned to work the following day, Tom first tried to talk him into taking more time off.

"You should spend a day or two with Sandy," he suggested.

"I'm taking off at two today and we're spending the rest of the day and all evening together. No, skipper. I was just banging around my apartment and getting nowhere, so I had to come back here. You think of anything?"

Tom explained that the best tool for the job, at least a tool that was currently available, would be the SuperSight. They discussed the many reasons why it was not going to be the answer they sought.

"Pity," Bud commented. "I understand all the reasons. Believe me. I recall the trouble the system caused when you first created it. But, I also remember the great results we've had from it." He sighed. "A real pity."

"I'd like to table the search for a rescue tool for a little if you don't mind. Can we talk about how the *Wasp* handled and anything you or the Coast Guard can think of that it needs?"

Bud sat down. "Well, the officers and enlisted men I had the chance to talk to all love it. Three of their best pilots took it for flight tests and they all came back with big, silly grins on their faces. Of course, there's always somebody that says it needs to carry four men and a rescue basket and a special blanket heater and a full med unit and..." He looked at Tom and chuckled. "I told the Ensign who brought *that* up that they already had it. It's a perfect description of their current helicopters. Everyone else laughed but the little academy guy pouted for a couple hours."

"Anything solid? I mean, constructive criticism-wise?"

"Well, from a personal point of view I'd like a holder for a water bottle. After a couple hours I was wishing I'd thought to sneak a can of cola onboard." He saw Tom taking a note, so he waited until his friend was finished before continuing. "The other thing came to me last night as I was trying to get to sleep. If that sailor hadn't been able to get into the harness I would have never been able to rescue him. He probably had less than a half hour before it would have been too late."

Tom looked at his friend with curiosity. "But, the whole thing about this being a one-man aircraft would dictate that there will never be someone to help in a case like this."

"Ah," Bud held up a finger, "I have thought of that as well. What the little *Wasp* needs is the ability to let the pilot step out and do the functions of a rescue diver, then get back in and fly it away with the rescuee firmly held underneath!" He looked practically triumphant as he finished.

Tom was about to mention that it would be as practical as the proverbial screen door on a submarine until he recalled that he had created exactly that.

Five months earlier the commanding officer of the Swift's rocket launch facility on Loonaui Island in the Pacific had made a peculiar request. There was a special cargo and passenger seacopter permanently stationed at the base, used both to ferry man and materials to the underwater launch location and to scout the area for any undesired company.

A special demand by the U.S. Government meant that the seacopter was continually manned by a crew capable of getting underway in less than a minute.

Base Commander Frank Brinkman mentioned to Tom that it might be nice to let the crew enjoy the fresh air while they sat at the ready, but without the intrusion of the many forms of flying and crawling bug life to be found in the area. And so, Tom had developed a new two part hatch that featured a screen

door.

He smiled at the thought and looked at Bud. "What about trying to control the thing in the sort of weather you experienced? That takes a practiced hand and a skilled brain. Probably takes the ability to anticipate, not a strong suit for automatic pilots."

Bud smiled back at him. "My guess is that that brain of yours will come up with the solution before bedtime tonight. I mean, you've developed autopilots for every other type of aircraft and submarine and spaceship we've got. You have that alignment thingie for the rockets going up to the outpost. You know? The thingie that lets a rocket dock in an emergency even if either the rocket or the outpost or even both are wobbling?"

Tom indeed had developed a remarkable auto-docking system that used gyroscopes and lasers to measure and compute the movement of both objects within seconds and to then micro-adjust the docking rockets to precisely match the conditions.

Though never used in an emergency situation, it had been tested and Tom believed it would be effective in about ninety-five percent of possible cases.

"Right. *That* thingie. I see." He considered what the system could do compared to what Bud was suggesting. "Actually, you might just be onto something, flyboy. If I use the lasers to shoot, oh, two or three-hundred spots each second for half a minute, I should be able to see any wave pattern, then combine that with input from the existing gyro-stabilizers to get wind effect. Hmmmm?"

Bud left him ten minutes later seeing that the inventor had gone off into 'inventorville' and would not return for some time.

It was just a few moments later that Tom snapped out of his deep thoughts and looked around. Grinning, he pulled himself over in front of his computer and called up specifications for the docking system.

By the time he left work seven hours later, he had the rudiments of the new system designed in the computer, and he could begin building the prototype circuitry the following morning.

He left work at six-thirty and drove to Bashalli's house. Surprised but very happy to see him, she readily accepted his invitation out for dinner, but not before disappearing upstairs to change into one of the summer dresses she and Sandy had picked out on their shopping trip.

He knew better, and he got a slightly unhappy look from her father when he did it, but Tom couldn't help but give a little whistle when she came back into the front room. "Gosh, Bash. That's... it's just..."

"Too little fabric for too high a price," her father grumbled before going back to reading his evening newspaper. Bashalli hid a little smile and winked at Tom.

They left the Prandit house a few minutes later heading for Bashalli's favorite Italian restaurant. It was a warm and inviting evening so they opted for an outside table on the rear deck of the restaurant, overlooking the shore of Lake Carlopa.

During the meal Tom described Bud's suggestions for improvements to the *Wasp*.

"I completely agree with Bud, Tom," she told him. "If you can make it so that the pilot can also jump into the water to rescue someone, why that would be perfect. But..." she looked at him with a little furrowing of her brow, "how will he get back in?"

"He climbs back in," Tom said as if it were obvious.

"Right... but *how does he climb back in?*"

Tom looked up at the overhead umbrella as he thought about what she was asking. Then, it hit him. "Oh! You mean if the *Wasp* is hovering, say, ten feet up, how does the pilot get back inside. Right?"

Bashalli kissed her beau on the cheek as a reward. "Yes."

Now Tom had to really think it over. He rubbed his jaw for a minute or so before turning back to her with, "I suppose I need to either add steps to the landing struts or a drop-down ladder for the pilot to climb back up. Of course, that's going to mean taking into consideration the weight shift... Hmmm. A little tricky, but you're right. I have to add that."

"Right," she said with an emphatic nod, "and then you need to miniaturize your Super Duper Sight system."

He wanted to tell her it would be impossible, but two things stopped him.

First, the look of implicit faith she had for him almost made him choke up with emotion, and second, a tiny seed of an idea had been planted when she used the word 'miniaturize'."

Following dessert, they spent the next two hours walking hand-in-hand along the beachfront of the lake and also through the large downtown park Tom's great grandfather, for whom he was named, had donated anonymously to the small town of Shopton.

Twice they spotted the familiar pair of Bud and Sandy as they strolled along on the opposite side of the park.

Back at Enterprises the next day, Tom first made some adjustments to his auto-hover design and then built the first of the three circuit boards he would need to control everything.

Before continuing, and feeling the need to take a slight break, he called up all of the design plans for the SuperSight and sat at his desk studying them for a couple of hours. He was interrupted near the end by the arrival of Chow Winkler and his ever-present lunch cart.

"Soup's on, Tom," he called out as he entered the large lab. "Wahl, ach'ully it's more like *chicken's* on. Got me a new recipe usin' boneless thighs 'n fresh figs 'n olives 'n capers and even some red wine. Goes great with my fresh-made pasta. Your daddy let me buy one o' them noodle extra-ooder things."

Tom laughed. "Do you mean an 'extruder,' Chow?"

"Wahl, shore. Ain't that what I said?" He soon had a plate sitting in front of Tom along with a glass of iced tea.

Tom had to admit, it looked and smelled wonderful. "Thanks, pard," he called out as the western cook's bulky frame disappeared out the door. Sight and aroma were correct. It was delicious! The plate was empty just minutes later.

He quickly returned to his SuperSight plans. Several things occurred to him including the probability that whatever he came up with would never be used from as high an altitude as the SuperSight. It was mounted in the *Sky Queen* and was generally used above fifty thousand feet. He made a mental note to ask Bud about that. Another thing that came to mind went hand-in-hand with that. If there was no need for such long-range vision, then the number of receptors could be greatly lessened, perhaps as low as one larger element.

That meant the need for using the special processing computers would be reduced to match the number of receptors, and that, he thought giving a little silent 'yippee!' could even mean that the entire computer enhancement system, start to finish, might be handled by a single computer.

Instead of a chest freezer, Tom was now envisioning a suitcase-sized unit in his mind.

He picked up his phone and was soon speaking with Millie Brossard, an expert in electrical engineering, formerly with the

Department of the Interior and the person who had assisted Tom in perfecting the SuperSight system, and who now worked at Swift Enterprises.

"Millie? It's Tom. I've got a project that's right up your alley." He gave her a brief description of the new downsized SuperSight he was attempting to design. After asking a few questions she agreed to meet Tom at his lab later that afternoon.

"I'm putting the finishing touches on a new remote flight assist system for those mapping drones we're building for my old bosses," she told him. "Tell you all about it when I get there. Say, four?"

Tom told her that would be a perfect time.

Once off the phone he turned back to the auto-hover circuitry. There were far too many things to consider to try to keep them all straight in his head, so he spent the next several hours making notes and diagrams.

He was so involved in his task that it took three tries for Millie to get his attention when she showed up.

"Oh! Millie," he said, slightly startled when she approached him and finally tapped his shoulder. "Gosh. Is it four?"

She showed him her watch and smiled. "How do you do it?" she asked.

"Uh... do what?"

"How do you get so concentrated on something that you can just tune out the world? That's a real skill I wish I had. Any little thing off to one side gets my attention no matter how serious the work I'm doing. My mother used to call me Maggie instead of Millie. Short for magpie," she added seeing Tom's questioning look. "Any shiny object would catch my eye."

She pulled up one of the lab stools and sat down. "So, about this new, compact SuperSight..."

Tom filled her in on Bud's almost tragic adventure and his desire to have a better viewing system that just the pilot's eyes or even a small pair of binoculars.

"Well, that certainly sounds like a job for SuperSight," she said with a little smile. Turning serious, she continued. "What are the weight constraints?"

Tom looked embarrassed. "Because I never considered the need for a heavy system, I designed the *Wasp* to carry someone like Bud plus no more than about fifty pounds in normal flight. He's already taken up two or three of those pounds with a request, a realistic one, to carry a liter or two of water for the pilot."

"Have you come up with places to save weight in the SuperSight junior?"

"For starters, the monitor we use by itself is about fifty pounds. That cold be replaced by the same sort of screen used in a tablet computer. Just five or six ounces. But I think the really big weight savings is going to be in reducing the receptors and their individual computers."

He told her about his assumptions.

"I still need to talk to Bud about that, but I'm almost certain that a single receptor in the back of a, oh, maybe two-hundred millimeter zoom lens could feed a single computer which can do everything. My guess is that the ultra-fine details we get with the current model aren't needed as much as good old-fashioned close-up looks at things."

"Where is Bud?" she asked, hoping to keep her voice level and without emotion. Though ten years his senior, Millie Brossard had a bit of a crush on Bud Barclay.

Tom tried to hide his grin but she spotted it and blushed.

"I called him and asked if he could drop by just about—"

"Hey, kids!" Bud called out as he opened the door and entered the lab. Oblivious to the effect he had on the thirty-year-old woman, Bud gave her a little one-arm hug. "Hi, Millie. So, you and the skipper here are going to make my hopes and dreams come true. Right?"

Momentarily flustered, she couldn't immediately respond, so Tom replied, "That's right. We've come up with a few ways to downsize the system, but we need your input. Pull up a stool."

When the flier had perched next to Millie, he said, "Shoot."

"Well," Tom started, "when you were on the S and R mission, you told me—"

"Uh," interrupted Millie. "S and R?"

"Oh. Sorry," Tom said. "Search and rescue." She nodded, now understanding the abbreviation. "You were flying above the worst of the storm. How high?"

Bud though before replying. "As low as about two thousand and upwards of five thousand. Mostly around three thousand. Why?"

Tom explained his thoughts on building a reduced resolution system. Bud brightened.

"Oh, is that all? Sure. The whole things is that at the higher altitude it was impossible to even see the ocean. Too much wet in between. And, at the lower levels, it was still too stormy to get a good look. I even had troubles spotting a thirty-foot fishing boat that was traversing the area. Bet they got all sorts of wet."

The three discussed some of the needed capabilities. By five they had a list of seven items Tom and Millie agreed were technically possible, but perhaps not in something small enough for use in a *Wasp*.

"We might be able to come up with a system that can be mounted in one of the larger Coast Guard helos. Getting it down to something small enough and light enough for our little flier may be a few years off," Tom had to admit somewhat disappointingly for Bud.

"Whatever you can do, skipper, could easily be the difference between a successful rescue and a body recovery."

CHAPTER 3 /

GLIMMER OF HOPE

IN THE next two days Tom and Millie worked in their own labs trying to come up with smaller and still smaller components. They met at the end of the day on Friday to compare notes.

"Are you sure that one receptor isn't going to be enough, Tom?"

Tom sighed and nodded. "I've run computer simulation after simulation and the truth is that a single receptor, even the highest resolution one that can fit inside of that stubby three-hundred mil lens you found is only about as effective as a pair of military issue binoculars."

"And, it would be about ten times as heavy," she said, her shoulders sagging. "Sorry."

Tom looked at her. "Don't be sorry, Millie. We can only work with what's available. Listen. If you'll continue working on anything that might make the new system smaller but still powerful, I need to get back to a couple refinements to the *Wasp*. Before you go, can you tell me about your remote drone system?"

Though he had hoped it might help him now, Millie's system turned out to be something Tom might want to borrow for other projects, but not really applicable for this one. Capable of letting an unmanned aircraft remember and transmit terrain and route information to other drones to enhance their effectiveness, there was nothing about it that might be used for hovering flight.

She left a minute later.

Rather than heading home for the weekend, Tom carefully put all of his work on the video system away and called back up the original design plans for the *Wasp*. It only took an hour to come up with a strengthened and redesigned undercarriage that featured flip-up ladder rungs on one side and a drop-down ladder that would allow the little helicopter to hover about fifteen feet above the water. The negative side was that it added up an additional nine pounds of weight.

Before heading home he made a note to add a weight-shift stability algorithm to the programming of the auto-hover software. That way, once the pilot stepped out his weight wouldn't negatively affect the center of balance of the aircraft.

His mind was so consumed by all of the work necessary to improve his helo that Tom lay fitfully in bed that night unable to get to sleep until well past three a.m.

At nine he woke, showered and headed back to Enterprises.

He was so into concentrating on coming up with the necessary servo-controllers by ten that he was slightly startled when Bud, Sandy and Bashalli walked into the lab.

"Mother sends her regards and tells me to inform you that you might be twenty, Tomonomo, but she still thinks of you as her growing little boy and wants you to promise to eat this breakfast burrito she made for you." Sandy handed her brother a paper sack. He opened it and pulled out the foil-wrapped food along with napkins and a can of cola.

"Oh," Sandy told him as she began turning back to the others. "She also told me *not* to tell you that she can hardly wait for the day when you are Bashi's responsibility." She winked at the Pakistani girl who turned a bright shade of crimson.

"We're off to the lake, skipper," Bud said. "Any chance you might come along?" He inclined his head toward Bashalli who

stood there looking pensive.

"Well, if you three can sit quietly in the big office for about an hour, I think I can take a break." He referred to the large office he and his father shared that was just down the hallway.

The two girls let out little happy squeals and Bud gave his friend a thumbs up. After they trooped out the door and down the hall, Tom returned to his design work.

Forty minutes later he appeared at the office door.

"Well, I'm no further along that I was when you all got here, but I've had my burrito and probably need to get out and clear my head. Let's go!"

They had a wonderful picnic lunch that Sandy and her mother, Anne, had packed, and a refreshing if slightly cool swim in Lake Carlopa. The girls were happy for the excuse to show off their new bikinis. As the foursome sat under the shade of a large beach umbrella Sandy had brought along—her blond hair and fair complexion required protection from the sun—the talk turned to Tom's *Wasp* refinements and to the SuperSight project.

He gave them all as many details as he figured they could either understand or wanted to hear before asking a question.

"If most searches take place at around a thousand feet or so, besides the distance thing, what else do I need to take into consideration. I mean, the big SuperSight has all sorts of circuitry to recognize alternate light sources, including low-light, and can project its own infrared laser light up to ten miles to illuminate an area."

Bud raised a hand. "Speaking personally, skipper, I'd say that both the ability to bring things in close as well as the night vision and the looking through clouds and rain are the biggest things. All that alternate light source stuff, unless it is part of the night vision capability, isn't really necessary."

The girls could add nothing as neither fully understood what was needed from a technical point of view. However, Sandy asked, "If downsizing the SuperSight small enough for your *Wasp* isn't going to be practical, can you come up with something entirely different?"

It made Tom think hard for several minutes. He finally looked back at her. He spoke slowly, as if choosing his words carefully. "If we tried to do that, my guess is that we'd just start reinventing a lot of the things we've already done. Oh, sure, we might find ways to make things smaller, but there are a couple factors that really restrict us. If we are using just a single receptor, even the most powerful and pixel-rich ones available are perhaps fifty percent too small. And for every receptor we use, we need to have a computer performing all of the enhancements. In the most practical sense, that ups the weight and size by about twenty percent for each receptor. And, so far there isn't any other way besides larger and longer and heavier lenses to bring things closer."

He lay back in thought.

"How large are these computers, Thomas?" Bashalli asked.

"Oh," he sat back up and held his hands apart. "About ten inches square and four high. Why?"

"And, they are fairly standard computers? I mean, they do not do things that other computers can not do. Right?"

Tom nodded. "Right. They are the latest versions of my L'il Idiot computers. Liquid cooled because of how fast we need to run them. Why?"

Bashalli wasn't certain of her facts, but replied, "When I was very little in Pakistan, my father brought home a small computer. It was designed more to look like a doorstop. Very

wedge-shaped and flimsy. Even with it's little keyboard it could not have been more that five inches by five inches and one inch at its thickest. It did not work so he allowed my brother, Moshan, to take it apart. Inside, almost everything was on a tiny circuit board. Just four little computer chips."

She looked hopefully at Tom.

"It seems to me that if someone perhaps three decades ago could put a whole computer into four chips that you could do it in one. Look at cellular smart phones today. Tiny but with enormous computing power."

Tom wiggled his way closer to her and kissed her on the cheek.

"Bash. I'm not certain why the glaringly obvious hides from me, but you're right. Heck. That new touch tablet computer Sandy just got can do about the same number of computations that my Idiot can, and it's a tenth the weight and a sixth the size." He kissed her again and jumped to his feet. "Sorry to cut this short but I have to get back to Enterprises."

They all understood Tom's particular genius and the need to get him back in front of his computer, so they packed up and headed back to work.

Once at his desk, Tom pulled out his own tablet computer and jimmied the rear cover off. The manufacturer had done an amazing job of micro-miniaturizing everything. In fact, once he opened the case he realized that the only reason it was as large as it was, was due to the screen dimensions as well as that of the battery. Remove those as well as the audio circuitry and the entire computer would fit into a pack of playing cards.

He checked all of the components on the motherboard and found that with two exceptions, they were off-the-shelf items. The two that were not were the main processor and a smaller processor he guessed was responsible for feeding information into the multi-core primary processor in an orderly fashion.

Tom worked furiously at his desktop computer trying out circuit design after design without coming up with anything as elegant as the tablet computer.

He let out a deep sigh. It wasn't in either his or the company's nature to steal another company's designs, so just reproducing what they already had created wasn't going to be a viable option. He headed home.

Damon Swift, Tom and Sandy's father, sat in his easy chair next to the large picture window in the Swift living room. He looked up as Tom came through the front door and smiled. "Evening, Son. Your sister tells me that you've got a very good start on your reduced video system."

Seeing the look of disappointment on his son's face, he added, "What's the matter? Did you run into something?"

"I sure did," Tom said, dropping down onto the wide sofa. He told Mr. Swift about the computer design and how he believed it was precisely what he needed.

"Well, then," Mr. Swift told him, "on Monday we call Barry Pierce out in California and see if we can license the design of the circuit board from them. My guess is that once he hears the reason why, he won't put up too much of a fuss or even ask for too much."

Monday morning rolled around and Tom and Damon went into work at nine a.m. Waiting for them was their secretary, Munford Trent. Perhaps the most efficient secretary around, Trent already had placed a call to California and arranged the teleconference to begin at seven-thirty West Coast time, ten-thirty in Shopton.

He also had fresh coffee for Damon and Tom's newest beverage of choice, a hot cocoa made with half milk and half

brewed coffee. Trent had come in early, stopping by the commissary and picking up a selection of pastries the night chefs always baked for the breakfast crowd.

Barry Pierce listened carefully to Tom's description of the Coast Guard's close call and of his hopes to be able to provide them with the new all-weather vision system. When he finished, Mr. Pierce was quiet for about ten seconds.

Tom and Damon heard the man clear his throat, and when he spoke there was a hint of deep emotion in his voice.

"Tom. I lost my little brother about fifteen years ago in a boating accident. He was a crew member on a fishing trawler in the North Atlantic and they hit a floating tree trunk in the middle of the night. Got tossed overboard. He had a rescue suit on at the time, but it took far too long to locate him. Nobody realized he'd been knocked overboard for probably an hour. The Coast Guard station out of Portland, Maine couldn't send a copter out until sunrise. By the time they—" his voice closed off.

They let him have a moment. When he spoke again, it was with resolve.

"If your little helicopter and any sort of high-power video system could save one life, I will be eternally grateful. So long as this never becomes a commercial product, I'll have the paperwork drawn up today to give Swift Enterprises permission to copy our circuit design. Oh, and Damon?"

"Yes, Barry?"

"I've got to commend you for raising a son as honest and honorable as your Tom. There are a lot of folks out there who would just copy away and then deal with the implications later. So, how's Anne?"

Tom sat back as his father caught up with a man who turned out to be an old friend from MIT. When the conversation ended, Damon faced Tom.

"I was fairly certain Barry would come through for you. He's one of the great guys. Heck of a visionary and driven almost as hard as you are by internal desires to come up with the best. Next trip out there I'll arrange for you to meet him."

Tom returned to his large lab feeling a satisfied glow.

By the end of the day he had identified a replacement chip for the secondary processor and had spent several hours with a team of processor designers from the Electronics department at Enterprises on coming up with a brand new, purpose-built main processor.

The specifications were clear. They were all a subset of the capabilities in the SuperSight system. All that really needed doing was to turn that into reproducible microprocessor.

It took almost five weeks before they called Tom back and invited him to review the giant schematic for the chip.

During that time he had worked to perfect the refinements to the *Wasp*, including Bud's cherished beverage holder. With no room on either side, and the control panel taking up all available space in front of the pilot, Tom quickly found that the only place for such a holder was under the front of the seat, right between the pilot's legs.

He added a pair of spring-loaded holders under the seat that were large enough to each hold a one-liter bottle.

When Bud climbed into the retro-fitted Wasp for a flight and testing of the new auto-hover system, he was delighted when Tom showed him the holders.

"Now all you need to do is add a microwave oven and a selection of sandwiches, skipper."

CHAPTER 4 /

MIRACLE OF MODERN INDUSTRIAL DESIGN

DAMON SWIFT looked at his son over the dinner table. "You have the look of the canary that swallowed the cat, Son," he said with a smile. "Do I take it that you've had some degree of success?"

"I have, indeed, Dad." Tom told the family about Bud's test that day of the auto-hover capabilities of the *Wasp*. With no facility to make the sort of waves needed at Enterprises, and the ocean conditions out at Fearing Island off the coast of Georgia being too calm, Tom sent Bud to the Robert Moses Dam located near Lewiston in upstate New York.

A hydroelectric generation facility, the Niagara River dam was currently finishing it's early summer flush which meant that the water just below the spillways was rushing and roiling with ten-foot waves, heavy mist, and swirling winds. A call to the facility manager had secured permission for a thirty minute test flight.

With Tom tied up on the project Bud had nicknamed the Big Eyed People Spotter, the flier had taken the *Wasp* on a solo flight to the dam where he set the helo into auto mode. Sitting in the pilot's seat Bud was amazed at the stability of the craft as it was buffeted by both winds and the occasional heavy spray of water.

It remained steady as a rock, in Bud's words, when he stepped out onto the rungs that were now part of the right side landing gear. "I even jumped up and down a little, skipper," he had told the young inventor. "She held straight and true."

The only thing he had not been able to do was to climb down to get close to, or into the water. Tom realized that a safety cable needed to be one final item to add to the military version of this *Wasp*. By removing the stability circuits and the new vision system, plus swapping the complex military radio out for a smaller two-channel one, Swift Enterprises also intended to sell the *Wasp* to aviation enthusiasts starting the following year.

As Tom related more and more details of the test, Mr. Swift smiled to himself, proud of both his children but extremely impressed with his son's tenacity in perfecting this little aircraft.

"What about the small version of your SuperSight? What are you calling it now?" he asked.

"Well, Bud likes Big Eyed People Spotter, and I'm more in favor of the technically-descriptive, Digital Enhancement Vision System. DEVS."

Mr. Swift thought for a moment. "What is it the Navy and Coast Guard call those giant binoculars they have mounted on their ships? Big eyes? Yes. That's it. Big Eyes."

"How about Swift Digital Big Eyes," Anne Swift asked.

Tom pondered the name before replying. "Right now it only is a single eye, like a digital telescope. Hmmm. Okay. I'll drop the 'Swift' from the beginning and I think I'll put the last two together, so how does the Digital BigEye sound to everyone?"

They agreed that it was a fine name.

The next morning Tom arrived to find Millie Brossard sitting in his lab. She looked up from the catalog she was reading and greeted him.

"Morning, Tom."

"Hi, Millie. Good morning to you. What brings you around at this hour?"

"This." She shoved the catalog over to him open to a particular page.

He looked at the item on that page. "Well," was all he could say. "Uh, it's a combination binocular and camera? Right. I've seen those in stores down in New York. Not very high resolution or even very good quality. Lots of them coming out from Eastern Asia." He looked at her, questioningly.

"I think we can do that," she said, pointing at the catalog.

"Well, sure. We could do that, but why? There are so many companies building them—" He stopped talking as her point finally occurred to him. "Oh! You mean our BigEye, right?"

She looked at him as if he had spoken in a foreign language.

He grinned. "Sorry. We came up with the name of Digital BigEye last night," he explained.

"Well, prepare to add an 's' to that, Tom. I did some calculations and I'm pretty certain that if we take advantage of a new technique for using electro-magnetics to shape flexible plastic lenses inside each side, and then feed into two receptors, we can still do all the processing in your new computer circuitry right in between the lens tubes and behind an infrared laser emitter up front."

They sat staring at each other for several minutes before Tom smiled. It was coming clearer and clearer to him.

"Millie? You do realize that you are wonderful."

She blushed, but favored him with a brilliant smile.

Tom appeared to be looking inwardly for a moment before asking, "Where ever did you come up with the flexible lens idea?"

She looked blankly at him until he realized, "Oh. That's one of mine. Right?" She nodded. "I'd almost forgotten about that. I was trying to create self-adjusting glasses for people who hate or can't wear bi- or trifocals. The idea was to have a distance sensor in the front of the glasses that registered how far away the thing was a person was trying to see, and then to adjust the lenses to the exact prescription for them to see it." He grinned at her. "Never really worked very well. Too bulky and relied on the wearer looking directly at something. We almost had to put a tiny crosshair mark on each lens to help them."

"Well, that very technology is exactly what we need here," she told him. "And, because it doesn't have to accommodate close objects, the 'infinity' setting you came up with will work for anything more than fifty feet away."

"And, with plastic lenses—"

"And one of your small Solar Batteries powering it all..."

"... the entire thing wouldn't weigh more than... well..." He looked at her.

"I figure that everything including the monitor will weigh about three pounds. No more that a good pair of traditional binoculars that are much weaker."

They talked about the design, agreeing that a single four-inch high-resolution monitor would be better than traditional eyepieces. It could be used to show the consolidated picture coming from the dual-receptors.

"Besides," Tom told her, "that leaves us with an extra inch or more inside that doesn't need to contain the eyepiece lenses. I guess we have a possible solution."

They discussed several design features before Tom suggested, "How about if we divide the picture coming down through the lenses. Use two highly-polished mirrors, and then run half of each image into its own receptor. Can we focus things finely enough to have two receptors in each side?"

Now it was Millie's turn to contemplate a radical new idea.

Three minutes later, and without saying a word, she pulled a sketch pad from her purse and made a rough drawing. Showing it to Tom, she inquired, "Like this?"

Her drawing now showed a ninety-degree angled piece right in the middle of the eyepiece areas with receptor discs on either side.

Tom smiled. "That way I'm certain we can still run with the single computer but double the available data. It may lag just a little, but that will help stabilize the image. Millie? I think we have a winner!"

They worked together and individually over the next week coming up with the proper mix of lenses to provide the best possible image down onto each receptor. As Millie finished the micrometer-precise spacing, Tom delved into the older programming designed to control the electromagnetic collars that squeezed and loosened to shape the individual lenses.

Twice he had to rewrite or even eliminate portions of the code once he determined that it would not properly function within the capabilities of the new microprocessors.

The last thing Tom needed to create was a simple multiplexer to combine the input from the two receptors from each side into a single image of very high resolution. It turned out to be more of a job than he believed initially and ended up with far more circuitry than the first outer case could contain.

Calling Arv Hanson, Enterprises' chief model maker and the man who had constructed the first case, Tom explained the new predicament.

"I've got all of the lens and receptor systems contained in the two outer tubes," he explained, "but this new board plus the existing computer and the battery are all too big to fit. Can you enlarge the center case for me?"

Arv took a look at Tom's computer design. He manipulated the new image over the older, smaller internal workings image. For several moments he made humming sounds, tilting his head from side to side as if it would let him see something that wasn't there. Finally, he broke out into a smile.

"There's your problem, skipper," he said, pointing at the screen. "You've got too much guts to fit. Seriously, I'm pretty certain that I can lengthen the central section an inch or so. You *did* tell me that the user won't be needing to put this up to their eyes. right?"

"Yes."

"Fine. Then all I need to do is to build a new tiltable housing for the monitor and the battery and attach it to the top, lengthen the body that extra inch, and that leaves you with room for the new circuits."

It made sense. Tom had designed the original monitor to sit right at the back of the housing in a thin rectangular frame, between what would be the eyepieces in traditional binoculars.

Now, the BigEyes would look even more like the current crop of binocular/video recorders on the market, but they would provide exactly the functionality Tom wanted. Functionality that Bud assured him would someday save lives.

Arv promised to have a new central housing with the monitor encasement ready within the next thirty hours. He left to return to his own office where he set about making changes to the CAD files of the existing case. An hour later he called Tom to tell him the new one was being processed and sent to his 3D printer. "Hope you still want silver, skipper. That's the color I've got loaded in the printer."

By the time it arrived, complete with the bright red, hand-painted, TSE logo on the back of the monitor, Millie and Tom had finished their work. The only thing left was to get back the

first of the test processors from the manufacturing group. But, as Tom well knew, creating a new processor was painstaking work and ofter required dozens of tries before the first chip came out in full working order.

When it did arrive, Tom carefully grounded himself and the BigEyes circuitry, then he removed the processor from its anti-static case and pressed it into the waiting socket. He had insisted on a full two days of testing for the chip, testing that simulated about a full year of actual use.

It passed with zero defects or problems. And, his quick test of the BigEyes showed that everything was working now that it was installed.

He put the finished product, now about fourteen inches long, eight inches wide and just three inches tall—except for the monitor—into a satchel and headed over to the small room Bud called his office, located in one of the repair and finishing hangars northwest of the main building complex.

"Hey, skipper," the flier greeted him, not getting up from his desk chair. "You rarely come out here. What's up?"

Tom pulled the device from his satchel and handed it to Bud. "The very first Digital BigEyes, flyboy. I need to have you take a little trip out over the ocean and see if they're all I think they're supposed to be."

"Jetz! You bet!" Bud hopped up from his chair and took the BigEyes to the door. Pointing them across the hangar he asked, "What do I do?"

Tom showed him the on/off button, the zoom wheel, the button to take up to one hundred still photos and the switch that allowed the binoculars to function in daylight, stormy and cloudy conditions, and at night.

Pointing them toward the main gate of Enterprises, about a half mile away, he spotted a small poster on the guardhouse. Bud said, "Wow. Three hundred fifty two days without an accident! These are great, skipper."

Half an hour later Bud climbed up into the small cockpit of the *Wasp*, the BigEyes slung around his neck. "Well, I guess my water bottles are going to have to find a new home," he said as he discovered that under the seat was about the only spot to store the glasses.

"Not to worry, Bud. I'll come up with a bracket that attaches to the floor for the bigEyes and leaves them within reach. Your bottles can stay where they are."

Bud gave Tom a little salute and closed the cockpit door. With only about a half minute of spin-up, the *Wasp* rose from the ground and soon disappeared over the east wall of the complex.

EPILOG

TOM WAS sitting at the desk of his small lab in the underground hangar where the *Sky Queen* was berthed. He was hard at work on a design for a new version of the Swift Solar Battery. Deep in his mind he was convinced that it was possible to reduce the weight while increasing the available power. He was currently on his fifteenth design.

The phone rang on the desk next to his monitor. "Tom here."

"Tom? It's the switchboard. You have and outside call coming in from what sounds like a young girl. I've screened her. You're going to want to take this one."

Tom pressed the button for the blinking line.

"Hello? This is Tom Swift. What can I do for you?"

"Um. Mr. Swift? My name is Annika Petersen. I live here in Hilton Head, South Carolina," she said with a slight drawl. "Uh, I had to call you to thank you."

A little confused, Tom replied, "Well, I'm sure that you are welcome, but I probably need to know a little more. Such as, what I did you want to thank me for."

As the girl began unfolding her story, first a chill ran down Tom's spine followed by a pair of tears that welled up and then spilled down his cheeks.

"You see, Mr. Swift, about a week ago I borrowed my grandfather's boat and did a really stupid thing. I took it out into the ocean. I wanted to take a picture from out there of the shore. For my high school's newspaper. The problem is I didn't realize that the tide was going out along with a pretty strong northeast current. I even forgot to check to see if there was any gas in the tank. So, I ended up drifting out to sea. Nobody noticed I was missing until about dinnertime. By then, I was pretty far out."

She sighed and took a deep breath.

"Anyway, it got stormy and really cold out there and I didn't have a jacket and... what I'm trying to say is that the man in Coast Guard helicopter that found me told me how lucky I was that they had just received a special thing that let them find me. Something like binoculars that they say you made for them. So, thank you. You saved my life."

Tom sat there with big grin on his face, a few more tears of joy cascading down, for more than five minutes after the girl hung up.