



A SWIFT ENTERPRISES INVENTION STORY

## Tom Swift: Testing... 1, 2, 3...

By T. Edward Fox

Swift Enterprises has dealt with security issues since the very day they opened their gates. There have been intruders, simple thieves, imported industrial spies and even foreign agents all bent on getting something from Tom Swift and his father.

For more than four years Tom has been able to keep ahead of many of these attempts, even placing practically undetectable tracking coils in Enterprises' employee's watches to foil attempts.

Now, with the giant triple-decker jet, the *Sky Queen* nearing completion, one or more of the Swift's enemies and business competitors seem determined to overcome this marvelous security system.

Tom must take valuable time away from his work on the Flying Lab to come up with an all-new security system. But, what can be more secure than what he already invented? And, what can he do about electronic eavesdroppers?

©copyright 2011 by the author of this book (Thomas E. Hudson.) The book author retains sole copyright to his or her contributions to this book.

Although this manuscript has been self-published it is intended for public sale and is fully protected under all domestic and international copyrights. No publication or copying of this story, in whole or in part, may be made without the author's written consent.

This story is dedicated to Dr. Hans Berger, an Austrian gentleman who first "discovered" alpha brainwaves way back in 1908. By finding that our brains generated minute electrical signals he opened a whole new area of science. And, for Tom, he meant that there was a significant amount of research available so that this marvelous new invention could be possible.

## Testing, 1, 2, 3...

### FOREWORD

Tom Swift is the epitome of the great American inventor. He frequently comes up with the sort of inventions that will change the world in coming years, and he also is able to recognize when it is time to set an old invention aside and embark on an entirely new voyage of discovery.

The truly great ones realize that even their most pet of projects will someday be archaic and even useless. The ones who go mad are those who convince themselves they have created perfection and can't find it in their hearts or brains to let go.

Like his father before him and his great grandfather and great, great grandfather, Tom constantly challenges himself and accepts the challenges thrown at him by others and reacts with great and even greater inventions.

I admire him for this attitude. That is one of the reasons I have chronicled his adventures over the years.

Like Tom, I believe that I am smart enough to realize my own limitations and skills, in that I am best suited for the longer novels of his exploits. I gladly leave the writing of these shorter, back-stories to others.

To tell you the truth, I may be a little stuck in the past as I have rarely told you any of these background stories, hoping that you will just assume they all came about smoothly and perfectly.

*Victor Appleton II*

## CHAPTER 1 /

### THE NEW NEED

"I'VE GOT a new request for you, skipper," Harlan Ames, Swift Enterprises' chief of Security said as he entered Tom Swift's underground office and laboratory.

The three-room area was just off the main hangar floor that was about to become the home for Tom's first major invention, his *Sky Queen*. The floor and Tom's private office, lab and occasional apartment—for those late nights when he found himself too tired to drive home—were all more than one hundred fifty feet below ground.

"What's that, Harl?" the blond-haired eighteen-year-old asked.

"Well, way back four years ago you came up with that nifty security badge using a special wire insert..."

Tom nodded remembering how, at the age of fourteen when he first came to work at the four-mile-square facility owned by his family and run by his father, Damon Swift, he had developed the new badge. The old-style photo ID cards carried by their trusted employees had recently been counterfeited and an industrial spy had been able to gain entrance and steal some important plans.

Tom immediately realized that anyone with a photo printing set-up could duplicate the badges once they saw one, and had come up with the idea of embedding an ultra-thin strip of a proprietary metal alloy that could only be detected by using a special scanner he also devised.

"Yes. I remember that very well. That was the first time dad introduced me to the mysterious Mr. H. Ames."

Harlan and Tom shared a grin recalling how the nervous fourteen year old had looked up into the security man's face and trembled as he described how badly he believed the security system to be. Well knowing how inadequate it was, but having nothing better to change to, Harlan had listened closely, if not a little cautiously, to his boss' young son. Within less than one minute he realized how right Tom was and how simple but elegant the solution he proposed could be.

Enterprises had switched to the new badges within three weeks. They had done the job for better than two years.

"Right," Tom said. "But that only lasted a couple years before I came up with the RADAR detection system and the amulets."

These were actually wristwatches worn by Enterprises employees that contained a small coil of a magnetic alloy that put out a magnetic field of about five inches. Tom had specially designed a RADAR antenna than picked up everything within a two-mile radius, and a small computer that differentiated between buildings, vehicles and anyone wearing the special watch.

Everything else was electronically tagged and Security notified.

This system had been in use out at the Swift's nuclear research and power facility—The Citadel—in New Mexico, at Swift Enterprises and on Fearing Island off the coast of Georgia for over two years.

"Is there something wrong with the amulets and detection system?" Tom inquired.

Harlan sighed and pulled up a chair. He sat opposite Tom at the inventor's desk. "Ummm... sort of. We've had three intruders in the past month. All three had managed to figure out the amulets and came in carrying small magnets just powerful enough to simulate the same approximate size field."

Tom frowned a moment, and then offered, "Then I guess it is time to more finely tune the detector or use a different type of magnet. Something that makes a very definite-sized field. Anything not that precise size will kick off the alarms."

He looked expectantly at Harlan. When the former Secret Service man failed to respond, Tom sat back and pondered the situation.

"It isn't that you shouldn't do that, Tom," Harlan told him. "But it might only be temporary and really addresses just one of my problems. It is just that Phil and I have been talking about this and feel that Enterprises is on the brink of a whole new problem. Electronic eavesdropping!"

Tom knew that Phil Radnor, Harlan's second-in-command was more attuned to the electronic world than his boss. It was logical that he would be someone to bring up that subject.

"What's he worried about?"

Ames sat forward and steepled his fingers in front of his mouth. "The Shopton Police caught a man in the woods across from the North wall with an antenna and equipment necessary to pick up anything on our walkie-talkie channels."

Tom was startled at first, then looked curiously at the older man and said, "But we use a scrambler circuit in the radios, Harlan. All he could get was garbled junk!"

When Harlan failed to look relieved, Tom asked, "What am I missing?"

The Security man reached into his jacket pocket and pulled out a folded piece of paper. He handed it to Tom. "Take a look."

As the young man read the article Harlan had clipped from a policing and security journal Enterprises subscribed to, his eyes went wide.

"Wait. You mean that some company out in Arizona is selling an off-the-shelf descrambling device? Something that can overcome our radio encryption?"

Harlan nodded. "Yes. I ordered one last week and tried it out. Now," he held up a hand to stop Tom from interrupting, "this guy out by our wall didn't have one, but he did have a recorder and could have delivered his tapes to someone who has one. The only good thing is that Shopton P.D. caught him on his first day there, got both of the tapes he had made in the five or six hours he admits to being there, and—and this is the 'whew!' thing—we are still one step ahead of this Arizona device. It can't quite break our code."

"But, not for long?"

"Not for long."

Tom sighed. "I guess I'll need to do some quick thinking and come up with both finer tuning for the physical security system as well as some more secure radios." His shoulders slumped. It had been a long few months working on the *Sky Queen*, and Tom Swift was one very tired young man. This was one more thing to keep him from getting a good night's sleep for the next few weeks.

Harlan left the article with Tom and went back to his office.

An hour later Tom was still sitting at his desk contemplating what might be done to enhance security when his best friend, and Enterprises test pilot, Bud Barclay popped his head into the office.

"You look so rapt in thought I kinda hate to interrupt," the dark-haired teen told Tom, "but I wanted to give you another chance to come along with Sandy and me to the beach dance tonight."

Tom blinked several times trying to disengage his brain from

the current problem and to concentrate on what Bud had just said. "Huh? Oh... right. Dance. Um..."

"Okay. I can see that you're still not with us so let me try again," Bud said with a smile. "Me, Bud. You, Tom. Bud dates Tom's sister, Sandy. Bud and Sandy are asking Tom to come to Lake Carlopa in about three hours to the beach dance that Shopton High is putting on to celebrate the forthcoming end of the school year. Remember?"

Tom grinned. "Sure. I remember. I don't think I can, Bud." He told his friend about Harlan's visit and the security problems. "I've been trying to come up with an idea, but absolutely nothing is clicking. I've got to really get this addressed quickly so I can finish the *Sky Queen* and we can finally take her up."

Now it was Bud's turn to grin. He had been looking forward to getting behind the control column of Tom's new Flying Lab for months. Triple-decked and soon to be outfitted with more than a dozen mini-laboratories to give Tom the ability to perform everything from simple chemical tests to detailed x-ray and magnetic resonance explorations of anything they might encounter, it was a marvel of engineering.

"Oh," Bud said remembering something. "That reminds me. I got the word from one of my acquaintances over at the Swift Construction Company that the little helicopter and that mini-jet you designed are going to be ready for my first flight tests in about three weeks." His grin widened. "And, I've got a couple of great names for them."

"You don't think that SR-M1 and SJ-M1 fit the bill?" Tom asked.

"Boring! Capital everything in that word. No, what I plan to call them is this." Bud took a breath and spread his arms to emphasize his forthcoming proclamation. "Skeeter and

Hoppy!"

Tom looked puzzled. "Skeeter I can understand. I admit that the little helo looks a bit like a mosquito with the twin bulbous windscreens. I'm happy that you weren't thinking what Sandy said they looked like."

"Buttcopter?" Bud inquired.

Tom nodded.

"No. It definitely looks like a Skeeter to me. As to Hoppy, that's because you've made the little jet capable of vertical takeoff and landing. Get it? She hops into the air?" Bud looked hopefully at Tom.

"Hmmm? You might need to work on that one. You're right, though. She will be capable of hopping into the air."

Bud thought a moment then he brightened. "Kangaroo. It'll hop into the air like a kangaroo. No, wait. She's small. Kangaroo Joey?"

Tom slowly shook his head.

Bud tried again. "Cub? But, with a K? Kangaroo Kub? It has that alliterative appeal."

"Okay, flyboy. Kangaroo Kub it will be. Now, about that dance—"

"Yeah. About that. If you're stuck on this security thing my diagnosis is 'stuffy office brain freeze.' The treatment, and I'm certain Doc Simpson will back me up on this, is to get the blood flowing and the best way to do that for any eighteen year old is to dance!"

Tom pursed his lips as he thought it over. Finally, he said, "But, you have Sandy. I've got nobody to take. I haven't had the time to even ask any girl out his past year or so. I'd just be out of place."

"Negative, skipper. You'll be swamped with dance offers from cute seventeen and eighteen year olds. From what Sandy's told me the ratio of girls to boys is expected to be about two to one. And, since most of the guys will already be there with their girls, that means dozens of girls all vying for a dance with the wonderful Tom Swift."

In the end, Tom gave in. When Bud dropped back by a couple hours later the young inventor was nowhere closer to a solution so he let his friend take him to the Swift home. From there, along with Tom's year-younger sister, Sandy, the trio drove to the Shopton Yacht Club and the dance.

Bud was right; as soon as it became known that Tom was there and unattached, he fielded dance offers from more than twenty girls. By the end of the evening he was exhausted.

On the drive back home he told Bud and Sandy, "You were right. That was fun. The only problem was that I couldn't hear anything any of the girls were saying to me over the sound of the records and those loudspeakers the AV club set up."

Sandy wiggled her little finger in her right ear, saying, "It *was* a little on the noisy side, wasn't it? But, you had fun and that's what matters. Except..."

"Except what, San?"

"Well," she said giving Bud a coy look that Tom, from the back seat, couldn't see, "except that if you couldn't hear the girls, and they couldn't hear you, how are you ever going to know who you want to start dating?"

Tom groaned. "Sandy. Don't get started on that again. I don't have any time right now. It wouldn't be fair. After all, you complain non-stop to mom about how Bud never has enough time for you."

Sandy swung around in her seat. "Nix on that, brother dear. I

merely, and quite by way of just passing the time, happened to mention to her—*once!*—that it might be nice if Bud had a little more spare time. *And, that's all!*" she said, glaring at him.

"Oh, yeah. My mistake. Just once. Right."

After dropping them off and getting a goodnight kiss from Sandy, Bud roared away in his red convertible.

As he was getting ready for bed, Tom was thinking about the noise situation at the dance. It had been too loud to converse, but he had been able to lip read a little.

Staring at the mirror on his bedroom wall he silently spoke a few words watching his mouth move. Then, tilting his face up, he placed his right fingers against his jaw and mouthed a few more words.

Tom's eyes went wide and he looked back into his own face in time to see a big grin form.

*That's it!* he thought.

## CHAPTER 2 /

### TACKLING A TWO-HEADED SERPENT

TOM QUICKLY finished breakfast the next morning and headed off for an all-too-frequent Saturday workday at Enterprises.

As he went out the back door, his mother, Anne, called out, "I do wish that you'd take a few days off once in a while, Tom." He smiled to himself as he climbed into his little two-seater and sped off.

He spent the next nine hours writing notes, making circuit diagrams and researching. By the time 5:00 p.m. rolled around he felt that he now had a good start on solving one of Harlan's problems. He also felt ravenously hungry.

Taking a look at his watch, he smiled and muttered to himself, "Ah. No wonder you're starved, master Swift. You've been going non-stop for a full work day." He looked at the pile of sketches and diagrams he had scattered around his desk and sighed. "Got to get these organized and into the computer before I forget where everything goes."

So saying, he swiveled his chair and pulled over a roll-around table containing a document scanner. One by one he fed the pages into the scanner taking time between each one to name and move the resulting computer files into their appropriate folders. It required about a half hour but he was satisfied with his progress when he left to head home.

At dinner an hour later he told his father what he had come up with.

"So, if I can design and build some way to sense and interpret jaw motion, and perhaps even unspoken or whispered

words, I think that I can create a new, fully-digital transmitter/receiver that can be so heavily encrypted that nobody is ever going to be able to unscramble it without the proper electronic key."

Tom's father, Damon Swift—himself a most accomplished and famous inventor—nodded. "Suppose that someone gets that key, or comes up with something that can try all sorts of progressive combinations?"

Tom smiled. "I've thought of that as well. For starters, it would take the very fastest supercomputer today at least nine months of number crunching and code combinations to break the sequence. That includes testing time for each possibility and that assumes that there is a constant stream of available transmissions. So, I'll make these radios with circuitry that can accept an ever-changing key sequence and adjust to that new encoding."

"What if someone is sort of listening in?" Sandy asked.

"I've thought of that as well, San. We could install an extremely low power transmitter right inside the gate so as each employee enters, their personal radio picks up the code of the day. People would have to be within a few feet for it to work, and the radios would be designed to stop working if they don't have the correct code."

Damon Swift nodded his approval.

"But, what if someone steals a radio, Tom?" his mother asked. "Couldn't they just, oh, what do you call it... reverse engineer it?"

"Well, for starters, each radio would be serialized so we could disable it once we knew it had been stolen... or even misplaced. And, as far as the security codes, all that functionality would be on a proprietary chip that would be practically impossible to duplicate."

"I'm looking forward to seeing what you come up with, Son. The only advice I'd give you is to make the whole thing as small as possible. The one complaint I hear time after time from everyone who carries one of our current radios is that they are bulky. Like cell phones were when they just got small enough to fit in a pocket."

Giving his father a little grin and a wink, Tom replied, "Oh, I think I've got that bit handled," and would say no more on the subject.

For the next several days, Tom's plans and diagrams took second place to an ever-increasing level of research. He felt certain that the best way to overcome outside noise, even to defeat casual or unintended eavesdropping, was to eliminate voice.

Initially, this idea caused him some level of amusement as he conjured up images of employees wearing backpacks filled with electro encephalographic equipment with each man and woman crowned with a helmet and array of electrodes and wires siphoning off their every thought. It was definitely the stuff of very bad science fiction.

Once he was able to clear such ridiculous images from his mind he began looking more closely into brainwaves. It had long been known that human brainwaves could be detected and—to some extent—interpreted. Emotions were the easiest to determine with sheer hatred and fear being the easiest of them all.

Entire areas of the brain practically swarmed with electrical stimuli and activity when these emotions were in play. Even emotions such as love and physical attraction could be discerned from every day thought patterns.

Where research had bogged down was in the interpretation of individual thoughts regarding words and images.

Tom quickly realized that he was not at all interested in transmitting pictures; that would be, he strongly felt, a practical impossibility.

What he did need to accomplish was to take non-vocalized words, turn them into coherent sentences, and transmit them. Scrambled. Plus, do all this quickly enough so that normal conversations could be held.

And, this is where his in-the-mirror realization would come into play.

He spent the morning on Wednesday walking around Enterprises, carefully watching everyone. Specifically, their faces and necks. By lunchtime he concluded that it was obvious that everyone moved their mouths, lips and jaws as they spoke. What he was surprised to see was that a lot of people he passed, those seemingly alone and in thought, appeared to be moving their jaws ever so slightly as they unconsciously 'spoke' the words they were thinking about.

He placed a call to New York Medical College and asked to be put through to the head of the Speech Pathology department.

After introducing himself Tom launched into the nature of his call.

"Dr. Thigpen. Although I can't go into any details as to the reason for my call, I need your help. I hope you will be willing to assist me."

"Well. I have to say that I am loath to deal in anything cloak and dagger, but I will gladly make an exception for Tom Swift. Tell me. What is it an old voice box doctor might do for you?"

"I am in need of information to back up, or even disprove, a theory I have regarding non-vocalized speech. I have been watching a number of people here at our company, both those talking openly to others as well as those who seem to be, well, talking to themselves. I've noticed that many of the people in

this second group still do everything from moving their jaws all the way to forming words that a lip reader could probably understand, all without making a sound."

The medical professor laughed. "Ah. Yes. We call that subvocalization. It is akin to moving one's lips while reading. It is a natural thing for about eighty percent of people who have not been made aware of it. It easily can be trained to go away—except in times of great personal stress—and practically nobody is aware they do it. So, may I ask anything about the why of this?"

Taking a deep breath and hoping that he wasn't breaking some grave security protocol, Tom replied, "I am trying to develop a new style of microphone that can pick up these non—I mean subvocalized—movements. Uh, tell me... do most people mimic the same movements they might make if they were speaking out loud?"

The doctor confirmed this and gave Tom a few more bits of information. Near the end of the conversation, Dr. Thigpen inquired, "Is there some way I could talk you or someone from your company into coming to our little campus here in Valhalla and addressing our forthcoming graduating class about the latest developments in the electronic side of speech? I mean, give them an hour or so pep talk so they understand that the world of speech pathology is making great strides in the real world and that the use of electronics aren't just the stuff of science fiction?"

Tom agreed to come down three weeks later, just before graduation. He thanked the doctor and hung up.

He left the underground hangar and was heading to the Administration building where he shared a large office with his father when he heard a shout from his right.

Bud was jogging across the tarmac toward him.



"Hey, skipper. You look excited about something. What's up?"

Tom explained the basic radio project and his recent discovery about subvocalized speech. "If I can combine a sensor to pick up on jaw movement and even listen to the almost silent air passing through vocal cords, I think I might have a solution to the whole radio thing."

"Jetz! That's great. If you need a guinea pig..."

"By the end of this quick project I'm going to need probably a hundred people to test things."

"Count on me to pull together a pig brigade!" Bud exclaimed, slapping the inventor on the shoulder and then jogging off toward the employee parking lot. He called over his shoulder as he ran off, "See you later. Sandy wants me to check out some new coffee shop downtown. Bye!"

Tom chuckled. *Pig brigade*, he thought as he continued to the Administration building. *What won't Bud come up with next?*

After telling his father about his conversation with the doctor and making sure that their shared secretary, Munford Trent, had Tom's commitment to the school on his calendar, He raced over to the employee's cafeteria and grabbed a diced prawn and mayonnaise sandwich and a bottle of the latest sports drink.

The rest of the day and all of the next one were spent in front of his computer designing a new type of proximity motion sensor that Tom believed would be the centerpiece of his new radio.

It would be set to detect any movement of the wearer's jaw. As a person silently 'spoke,' Tom had read that the jaw flexed up, down, in and out according to the words they were reciting.

He spent almost four hours teaching the sensor his own jaw

movements by first saying a word and then entering the text for the word into his computer. As he built up his dictionary it occurred to him that he would need to make the final devices self-learning. And that, he realized, meant that he needed additional input from Dr. Thigpen. Surely there would be a set of a few hundred words that a person could first speak out loud and then subvocalize that might teach the device a wide range of movements.

From those, he hoped, it would be a matter of a little fine-tuning and then each person's secure radio would be personalized just to them.

Tom grinned as he realized that this meant one employee's radio could not be used by someone else and *that* meant another layer of security. *Harlan*, he thought, *will be happy about that.*

On Friday, he began building the first prototype of this sensor. It turned out to be almost as wide as a softball and a full inch thick—two things he knew could be minimized by placing all of the electronic components into a single processor chip. But, for now, he hung the sensor array on a chain and slipped it around his neck. He then attached the power lead to a belt pack containing a pair of long-life alkaline batteries and the test radio transmitter that would send his test signals back to his computer in the underground lab.

For the next hour employees stopped and gawked at one of the top men in the company striding around on the many tree and flower-lined paths that wove through all of the central building complex, wearing what looked like a large hockey puck around his neck. Even those who didn't bat an eyelash at the sight of Tom with his rig had to do a double-take as the young inventor seemed to be reciting some great oratory, in absolute silence.

Several times Tom had to stop and grin at people who asked

him if he was all right. Because he didn't want any of his test samples to include his actual voice, all he could do was put one finger in front of his lips and shrug at them.

As he wandered away from one group of five secretaries, Tom could hear them discussing how, "...that poor boy needs to get a real girlfriend. Why, my cousin Millie has a daughter..." and so forth.

By the time he returned to the lab he had been subvocalizing for more than seventy minutes.

"And, that," he muttered as he took off the sensor and power belt, "had better be enough of a test. Anything more and someone will call for the white coated men with the nets!"

He sat down, took a deep breath and called up both the file containing the signals that had been radioed back, and the program he had written to turn those pieces of data into human speech.

When the first sounds came out of the speakers next to his monitor, Tom's heart sank a bit. Although he could make out a few words, most of the audio sounded like five drunken men all trying to out-slur the others. He was disappointed, but sitting there for a few more minutes he began picking out more and more intelligible words.

A thought struck him and he reached out and hit the SPACE bar to stop the audio. He quit out of his program and called up a programming environment. Twenty minutes later he saved out the modified program, opened it up and began replaying the audio.

It sounded better but not perfect. Muted, garbled, with more than half the words unrecognizable and in a series of monotone segments, usually changing pitch each time he paused.

By the end of the day he had made nine other adjustments to the program and was sitting there with a smile on his face when Bud dropped by.

"Listening to all the great speeches of Robbie the Robot, skipper?" Bud asked seeing the satisfied look on Tom's face and hearing the still partly recognizable words, but in a steady, computer-generated monotone.

After demonstrating the sensor and the program to Bud and telling of the improvements he still hoped to make, the flyer was enthusiastic to get started testing it himself.

"Of course, once you get this all dialed in and make it small enough to fit in a shirt pocket—" Bud made a squeezing motion with his hands, "—then all you need to do is figure out the whole new security badge or watch or whatever."

Tom slapped his forehead. "Bud," he moaned. "I completely forgot about that. Rats! I got so tunnel visioned on this radio that I let that one slip by. I hope I can get a good handle on that in the few days I have before we both need to concentrate on the Flying Lab."

"Why not combine that with this new radio thingie?" Bud asked innocently. "Fewer things to carry around."

Tom spun around and stared at his friend.

"Bud! That's perfect. It is already a radio and I can program it to broadcast a blip of data telling a master security computer where everyone is, then we use body heat scanners to locate anything larger than a mouse and let the computer tell us who shouldn't be there. Genius!"

He was about to launch into an explanation about how he hoped to accomplish everything when his private line buzzed.

"Tom. It's Harlan. We've had another incident. Phil Radnor was making his daily drive around the perimeter when he spotted an unmarked panel van parked in the woods across from the East wall. He snuck up and got the drop on the pair of men inside. And, get this. The van was full of listening gear and a powerful radio receiver. We turned them over to the Shopton police, but once I reviewed the tape they had just made, I had

to call you."

"What was on it?" Tom asked.

"The voice coming out of the speaker was some sort of *insane robot!*"

### CHAPTER 3 /

**AH..... OF COURSE!**

TOM LAUGHED, which confused his Security chief. However, after he explained that the eavesdroppers had only overheard his test broadcast of the new subvocal radio, Harlan was relieved.

"Sorry to have laughed at this, Harlan, but I completely forgot to scramble the broadcast. And, unless they also were able to grab the 'reader' program I just finished, all they would have ever heard was that garbled robot."

He explained his progress on the radio and the next steps he would take.

"Just be certain to see if you can also figure out something to replace our security system while you're at it," Ames pleaded.

Tom told him of Bud's suggestion. "In the end, we'll have a personal radio and security system all in one!"

In the few days he had allowed before he knew it would absolutely necessary to get back to the *Sky Queen* completion, Tom furiously worked as many as twenty hours a day, grabbing little naps in the small bedroom adjacent to his underground lab whenever he was too exhausted to continue.

Sandy Swift dropped by one morning suggesting that Tom take an hour off to come try out a new coffee shop downtown. He begged off explaining that he just could not spare the time. She had been disappointed, but realized that her brother was too intent on his latest project to be fit company, so she left with a heavy sigh.

"I am going to owe you more than one hour-long lecture, Dr. Thigpen," Tom told the speech and language professor during

their fifth conversation. "What I'm stuck on right now is trying to clean up what folks are saying." He explained how he had fine-tuned the sensor plate that picked up the small jaw movements, but it had not been enough.

"People have enough differences in the way they form words that I'm stumped. I was having problems just getting my own subvocalizations to be recognized. Now, I've got my best friend wearing my test rig about five hours a day. You'd think that by this point I could zero in on just his subvocalized words."

Sensing the young inventor's exasperation, Dr. Thigpen told him, "You need to remember, Tom, that you are attempting something nobody has ever done. That's the first thing. The second in that you have evidently made enormous strides in just a pair of weeks. My god, young man, do you realize that you are accomplishing what teams of scientists at General Electric and other mega corporations have been trying to do for years?"

"I know, Doctor, but it's frustrating. I feel that I'm so close, but have missed some tiny piece of the puzzle. Any suggestions where I should be looking?"

There was a full minute of silence on the line as the professor thought over the matter. Finally, he cleared his throat and said, "Mind reading."

The two words stunned Tom and he was now the silent party. After a moment he ventured, "Mind reading? Like in 'I see you are thinking of a number between one and ten?'"

Dr. Thigpen laughed. "No. Not exactly. No... what I am pondering now is the use of mental wavelengths. You know? Alpha and Beta waves the brain puts out. The sort of thing that EEG machines measure."

Tom told him, "I started out thinking about tapping into the brain's electrical signals but bogged down in how to go about

collecting the signals." He told the doctor about his helmet of electrodes concept. "I abandoned that in favor of jaw movements. Do you think I can collect the proper brainwaves using something small?"

"Now, don't get me wrong here. Most current machines need to have embedded needles and scalp sensors arranged around the skull in order to pick up useful information, but experiments have shown that there are detectable waves, particularly the Beta waves that are associated with thought, that may be successfully picked up from several inches away given a sensitive receptor. Even something as small as a few micrometers in width might be a possibility. Could that be of any help to you?"

Tom wanted to shout 'Yipee!' into the phone. Instead, he took a breath and replied, "Doctor. You've just given me that sliver of hope I needed. I'm certain that I can combine jaw movements with the Beta brain waves, compare them against both a practical dictionary of terms as well as a lexicon of logical phrasing and make this work! Thank you."

After researching various brain wave sensors, Tom discovered that he could create a tiny antenna less than two millimeters in length and about one-twentieth the width of a human hair that could pick up the brainwaves of a person from about four inches away.

"I may need to build my secure radios like hearing aids, Dad," he remarked as they sat discussing Tom's work over a lunch his father had all but demanded the youth attend.

"That's great, Son. Now, take another bite of that sandwich Chow made for you." There was a twinkle in Damon Swift's eyes, but he was worried about his boy.

Tom took another bite and realized that he was eating a roast beef sandwich. He had been concentrating so heavily on his

relating of his progress that the taste had failed to register.

"Can you build the radios that small?"

Tom stopped chewing and swallowed his current mouthful. "I'm pretty certain that I can get all the electronics onto a single chip, Dad. The antenna can lie parallel to the circuit board; it only needs to be separated by a tenth of a millimeter or so. So, yes."

"What about the power source?" Damon inquired.

"Well... that's where things sort of fall apart right now. I'd love to make these so they can call from one side of Enterprises to the other, but that's a lot of ground to cover for a tiny transmitter."

"And a lot of power," his father reminded him.

"Right. So, my thought is to install a series of small antennas around the grounds so that no call needs to go farther than a few hundred yards or so. Even at that, I'm not sure how long a battery will last."

"I think you need to take a close look at that. I don't believe that Harlan and anyone wearing one of these earpieces will want to also lug along a heavy battery pack on their belt. Or, have to change batteries every day."

Tom grinned and nodded. His father was almost always correct.

His hard work began to pay off on the last Tuesday of his self-imposed three-week schedule. He had spent the previous day reworking a processor chip design, combining it with a micro-transmitter chip he originally created for his small retractable pencil radio. And, while his microelectronic engineers went furiously to work coming up with the necessary schematics to create the single, all-purpose chip, Tom concentrated on the two main things he needed to perfect in

order for the new security radio to meet Enterprises' needs.

First, he had investigated micro batteries and found them to be sadly lacking in both power as well as longevity. The best would only be "good" for three or four days. He thought about adding a microwave pickup and converter to pull power from the very air around people, but ran into both a size and safety issue.

Doc Simpson, the young physician at Enterprises, had dropped by to check on Tom's welfare one morning. On hearing Tom's latest ideas he casually mentioned that recent experiments had shown a small but inconclusive possibility of concentrated microwaves causing tumors.

"As close as you intend to put these radios to folks' brains, I'd really advise against it," he cautioned Tom.

"I'd already come to the conclusion that it's not going to be feasible, Doc. I'll never get the conversion and pick-up stuff small enough for one, and I just found out that the presence of a microwave converter will interfere with picking up the brainwave patterns. So, no worries on that front. Now I just have to find a suitable substitute."

Doc glanced down at his watch. "Oh. Got to run, skipper. Just promise me that you'll grab a little more nap time today and tomorrow. Please?"

Tom nodded, eyes downcast. Suddenly, his head snapped back up and he stared wide-eyed at the doctor.

"What's the matter, Tom?" Doc asked stepping forward in case Tom was in distress.

Suddenly laughing, Tom smiled. "Nothing at all, Doc. You just gave me the solution to the power problem. That's all!"

The young doctor looked at Tom and then said, "Okaaaaayyyy... I'm going to leave now. Just as long as you

assure me that you are alright."

"Oh, believe me, Doc. Right now I am definitely alright!"

Once Doc left, Tom pulled off his own wristwatch. It was the standard issue watch all employees carried. Doc's glance at his watch had set things off in Tom's mind.

Carefully prying the back off, he slipped the metal disc into his shirt pocket. It contained the security coil that he needed to keep on his person to avoid having the current security system go off.

During the next fifteen minutes he dismantled the rest of the watch. Then, with great care and under a large and powerful magnifying lens, he moved the self-winding power components over to where he had his current radio circuitry. He was in the process of maneuvering them close together when Bud knocked softly on the door and came in.

"Anything good happening, skipper? Anything for me to test?" he asked.

"Give me thirty minutes, Bud and I may have something."

Stepping closer and peering over the inventor's shoulder, the dark-haired flier asked, "What's that?"

Tom stood back up straight and pointed at the watch components with his small pliers.

"That is the power plant out of one of our Swift Enterprises security watches. It's what keeps them running day in and day out. Each watch has a tiny flywheel inside that is just heavy enough to react to any movement. As we walk, our arms naturally swing. As they swing, the flywheel rotates inside the watch. That, in turn, swings over a tiny magnetic coil. And, each time it swings over the coil, a little electricity is generated. That goes into a wafer-thin polymer battery that powers the watch."

Bud stood there, silent, waiting for Tom to continue. When the blond inventor did not, Bud asked, "And, that means what?"

Tom turned to face his friend. "That, Bud Barclay, means that I can now make our secure radios even smaller. All I have to do is allow enough room for the circular power components and I know I can build a small and powerful polymer battery to go right under it. "

Bud smiled at his friend. He truly enjoyed it when Tom succeeded at one of his endeavors.

**CHAPTER 4 /****TESTING, TESTING...**

MR. SWIFT looked at the small computer and radio transceiver Tom had set up at the halfway point down the shortest north-south runway at Enterprises. He and several other people—including Harlan Ames and Phil Radnor from Security and George Dilling, head of Communications—stood under the canopy that had been erected to give them some relief from the scorching sun overhead.

"Okay, skipper," Phil was saying to Tom. "I have a good idea what you are hoping to accomplish, but can you tell me, tell us..." he motioned to the others, "...what you've come up with?"

"Sure, Rad. As you all know we have had a pretty effective security system here at Enterprises for the past couple of years. The watches we all wear have allowed authorized personnel to be detected and ignored by the security system while anyone else on the grounds here, out on Fearing Island and at The Citadel, are immediately detected, located, tracked and then apprehended if necessary."

The assembled group all nodded.

"Right. The problem has been this. We've had a few instances where employees have been waylaid, their watches stolen and intruders have made it onto the grounds. Luckily we've only ended up with a couple injured employees and a few stolen items. But, this is still a problem. As we get smarter, so do the bad guys. Right, Harlan?"

Ames gave a wry grin. "Yeah. An unfortunate truth."

"Okay, so that's issue number one. Issue two is one of

communications. I'll let Harlan tell you a bit about that."

Ames stepped forward. "Hmmm? Where to begin? Well, over the past few months we and the Shopton P.D. have interrupted three attempts to listen in on and record radio and even telephone conversations here at Enterprises."

He noted that a few of the attendees were shocked to learn this information.

"We've stopped them, but there are some very determined individuals, groups and even countries out there who want our secrets. The radios we have been using have a simple garbling circuit inside, but it's just a matter of time, possibly just weeks or a few months, before off-the-shelf equipment can defeat that. So, I asked the skipper here to come up with a more secure radio. One that can't be listened in on and then run through some sort of decoding box. The other issue is that there are amplifying microphones out there that someone could poke up over the wall and point at people. A few of these are so sensitive that they can pick up and decipher a conversation at more than two miles. Anyone talking about their current project outside on a walk might be overheard. It makes my job incredibly difficult!"

He looked back at Tom. The inventor picked up the narrative.

"We now have two issues... no, let's call them problems because that's exactly what they are. I wanted to tackle both of them. The first one I tried to solve was the radio thing. I won't bore you with details, but in looking into things I found out that there is something called subvocalized speech. As it was explained to me, think of it like reading while moving your lips. You may be completely quiet, but a good lip reader should be able to tell what you are reading just by watching your mouth. Anyway, if a person consciously moves his or her jaw and mouths words, even with their lips closed, that movement

can be picked up on a sensitive receptor plate and interpreted by a computer turning the movement into speech."

He let that sink in and waited for a few conversations to conclude before continuing.

"The breakthrough came when I learned that brainwaves could also be gathered, and the combination of them interpreted with great accuracy. This electronic data can then be transmitted from one transceiver to another."

There was a collective gasp from his small audience. Tom grinned.

"All I needed to add was a scrambling circuit that changes codes at specific intervals—such as each time an employee enters the main gate—and we have a secure radio system that is very portable and has no practical way of being intercepted and unscrambled. Especially since it only will work within the boundaries of Enterprises, and at that, I'm going to set things up so that it all stops about one hundred feet from any wall except for the main gate."

"What's it look like?" came a question from one of George Dilling's men.

"I've got it with me right now," Tom replied. "You guess."

The man came forward and Tom turned around so he could be seen from all angles. The man asked him to empty his pockets, and the inventor did so.

"I don't see anything, skipper," the man admitted.

Tom pointed to the quarter-sized pin he had affixed to his collar. It was primarily white with a silver band around the outside. A design of two circles with small stars in between ran near the outer edge and 'TSE' in red could be seen in the middle.

"This," Tom explained, "is the new communicator. A Tele-Vocalizer Communicator if you will. It is completely self-powered and only requires that employees move around a bit each day to keep it powered up."

He explained the self-winding charging system inside. There were whistles of amazement all around, even from his own father.

"With one of these pinned on your collar, all you need to do is to lightly press the center of the pin and it activates. You get connected to a main computer in microseconds."

"How does it know who to connect you with, Tom?" Damon asked.

"You either say—I mean subvocalize—a name or a department. The person you want gets a small beep from their pin that they touch to accept the call. From that point on, it's a connection just between the two people."

"And," Bud added, "all you have to do is speak without actually speaking, and the other guy hears you inside their brain!"

There was a look of shock and disbelief from everyone. Tom explained.

"Basically, Bud's right. The pin picks off Beta brainwaves plus jaw movement and then transmits Beta brainwaves right into the receiver's head. It is all perfectly natural and safe, and is undetectable even to someone standing inches away."

"Are you gonna tell them the best part?" Bud asked his friend.

Tom looked puzzled for a few seconds and then it hit him. "Ah. What I believe Bud refers to is that the voice you hear as a receiver, is the voice of the person Tele-Vocalizing to you."



Phil Radnor was the first to recover from this startling news and find his voice. "Are you telling us that if Harlan Tele-Voca...whatever's me that I hear his voice in my head. Not some computer simulation?"

"That's exactly what I mean," Tom said with a smile. "And, someday, I intend to enhance the security by verifying that it is actually the caller's voice and nothing else. No simulation. No recording. Just the real-time subvocalization being sent via Tele-Vocalized Communicator."

Bud shook his head slightly. "Skipper. Tele-Vocalized Communicator is too clumsy. Can't we just shorten it to TeleVoCom, or even shorter like TeleVoc?"

The group nodded their agreement, so Tom gave in.

"Fine. TeleVoc it is! Now, for the demonstration. I've set up an interim receiver here so you can all hear what Bud and I will be talking about. Bud, if you want to head north, I'll head south. Let's make the separation about a half mile for this test."

Both boys began walking to their assigned spots. Within ten minutes they had turned and were facing each other. The receiver came to life.

"Okay," Tom's voice came through the speaker. It sounded exactly like him. "I'm going to call Bud." There was a slight pause, then he said "Call Bud Barclay." An almost imperceptible click indicated that the connection had been made. "Bud, do you hear me?"

"Absolutely, skipper. Loud, clear and totally awesome. And, a bit freaky to boot! Am I coming through to you?"

"Like you're standing here next to me. Can someone at the central station wave their arms to tell me if you all are hearing us, and that it sounds good and complete?"

Several people walked out from under the canopy and began waving their arms enthusiastically.

"Great! So, here goes the test to see if these can keep up with fast speaking." Tom began reciting the Gettysburg Address as fast as he could. At the end, one of the gathered crowd walked out and waived his arms, hoping that Tom would see that they understood every word.

"Wonderful. Now, I'm going to let Bud tell you a story using made up words and even a few animal noises. Bud?"

Everyone could hear a slight rumble as Bud evidently cleared his throat.

"Gibble-te-farbit and razzle-grazzle, said the fleegle-boo as he clammydowned the neverwhence and tumble-nubbled fizbit." He then made a roaring noise like a lion followed by a fairly accurate horse whinny and pig grunts. "Did you all get that?" he asked.

Again, the man walked out and waived his arms.

"I can verify that what came through to me is exactly what Bud practiced this morning. I'd say this is a success." Tom told everyone. "Bud, let's head back to the group. End call."

Once back at the canopy, Tom received slaps on the back and congratulations all around.

"That's going to revolutionize my security skipper. Great radio. Thanks for doing that. Now, the question comes about what you are planning to come up with to replace the amulet coils inside people's watches."

"You mean, to keep track of our good, honest employees versus intruders?" Tom asked, suddenly the picture of innocence.

"Yeah," Harlan replied, now a bit warily. "Something like

that."

Tom smiled. "Did I fail to mention, Harlan, Phil and others, that I intend to outfit each and every employee with one of these?"

"Uh, as a matter of fact, you did," Phil stated.

"Oh. Well, then let me tell you. This new TeleVoc pin is both a radio for communicating as well as our new security system. You see, as each employee comes in the gate each morning, they will be asked to subvocalize the word of the day from a monitor. They will just tap their TeleVoc, say the word, and the master computer will register who they are, check to see that the voice matches the specific pin, and then makes certain that they are not classified as an intruder for the rest of the day."

"Oh. Is that all," Harlan asked almost incredulously.

"Well, no. As each employee passes through the gates they will be automatically checked in and out. If someone doesn't show up, and they aren't on vacation or taking some known personal time, we can check on their welfare."

Harlan Ames walked over to Tom and wrapped his arms around the youth, giving him a bear hug. Stepping back, he said, "Tom Swift. You amaze me each and every day. In my wildest dreams I couldn't have conceived something like this. Unless I'm not understanding you, this will make it impossible for anyone to steal a TeleVoc pin and to come into Enterprises without setting off the alarms. Right?"

Tom smiled and nodded.

He loved it when things just worked out like this.