



A SWIFT ENTERPRISES INVENTION STORY

## Tom Swift and the Idiot

By T. Edward Fox

Tom Swift has been working almost full time since he turned fourteen. After testing out of his final two years of high school, he started working more than full time.

On more than one occasion he has wondered how nice it might be to have instant access to a powerful computer. Something right at Enterprises and available whenever he needed it. Current major computers are the purview of universities and governments, and arranging to have even a few hours on one can take a year or more.

What can he do?

Well, if you know anything about Tom, you know that he gets determined to do something, and he usually does it or finds a way to do something better.

He's just seventeen and is very, very determined to have that computer. Very determined, indeed!

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This story is dedicated to all the John Vincent Atanasoffs and the George Stibitzs and the Alan Turings: progenitors, fathers and inventors of the modern digital computer. Armed with vacuum tubes, relays, capacitors, gates and all of the then modern electronic items, they shone the light on what we hold in our hands and take for granted today.

## Tom Swift and the Idiot

### FOREWORD

Tom Swift, Sr., has such a high opinion of his son's abilities that he first brought the young boy, age eleven, in to work running errands and delivering important papers all around the Swift Construction company.

When Tom Sr. was building the new Swift Enterprises, he outfitted a small office for fourteen-year-old Tom just down the hall from his own. That was the time young Tom almost built the very first Atomic Clock. In the end, he published a scientific paper on the concepts becoming the youngest person to ever be published in the major journals. A feat not surpassed in the next thirty years,

And, when he was building The Citadel out in New Mexico, he invited the sixteen-year-old along when Tom Jr. both proved his metal, but also had his first encounters with personal loss and grief.

So, now at seventeen, Tom wants to push the boundaries of science and electronics to build the very first portable digital, programmable computer. And his father is giving him full rein to do it.

My opinion of Tom Swift has never wavered, never altered. He is a young man of keen intellect and with a brilliant future ahead of him (and a brilliant past, too!)

*Victor Appleton II*

## CHAPTER 1

### LONG SIMMERING FRUSTRATION

"I'm getting really frustrated, Dad," he said with a growing look of determined on his face. "It makes me feel like a little idiot when I can't just find a formula."

Tom Swift: Age 14 to his father while trying to develop the first Atomic Clock

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IT HAD BEEN a tough three weeks for Tom Swift—seventeen-year-old inventor and son of Tom Swift, Sr. Tom had been inventing things for more than half his life and had become—without his knowledge—a millionaire by the time he turned thirteen. In the past few years he had worked practically full time first at the old Swift Construction Company, and then at Swift Enterprises once his father opened that four-mile-square research, development and manufacturing facility outside their home town, Shopton, New York.

The money meant nothing to Tom; his thrill came with the invention. And, since he was inventing just about seven days a week, he was generally happy.

His greatest joy had been realized about one year earlier when Tom, Sr. announced at a meeting of all the Enterprises and Swift Construction management that an entirely new, large to the point of fulfilling the definition of the word 'titanic,' and revolutionary new aircraft. To be powered by nuclear energy, it would be capable of at least Mach 2 speeds, be able to fly around the world non-stop, and would provide for vertical take-off and landing on a series of jet blasters.

And, that Tom, Jr. would spearhead the development and manufacture of it.

There had been no sound in the room except for Tom's racing heart and the muffled gasps of all the adults present. They all knew that Mr. Swift had complete confidence in his son's capabilities—Tom had, after all, developed the standards for building the very first atomic clock three years earlier and was the holder of eleven patents by the age of fifteen.

Tom had said nothing until dinner that evening when he tried to pin his father down on why such a momentous decision had been made.

“Because, Tom, there are three things that tell me you are the perfect person... er, *man*, to do this. One,” he began ticking things off on his fingers, “you have an unsurpassed knowledge of science, physics and design within this company. That makes you a prime candidate for the job. Two, you have proven yourself on each and every project you've taken on in the past nine-plus years and that has earned you the respect of every employee and executive we have. And third—“ he emphatically ticked off the final finger, “I know for a fact that you already have a design you are just aching to build!”

Tom smiled at his father while also blushing at having been found out. It was true that he had first envisioned a double-deck super jet back when he was just twelve and had fully designed it—and five specialty laboratory rooms that he felt must be included—a year later. And, while Tom was not a professional draftsman, he had created a set of mock blueprints for such a behemoth aircraft even before he had been able to take fling lessons. Lessons that he completed in record time and was soloing within a few weeks of his sixteenth birthday.

In just two years Tom logged more than twelve hundred hours of flying and was rated to fly just about anything capable of flight using wings or even rotors.

He took on the project with both a fiery determination and a level of professionalism that surprised everyone. A team of draftsmen and engineers had been assigned to him the very next day following the announcement. Nobody looked at him with any questions. They knew that he was the 'boss' on this project and that they were to follow his lead.

Within minutes of them all looking through his blueprints it had been decided that if two would work fairly well and provide just about enough space, then a triple decked jet would be perfect.

And so, the giant jet Tom and his team referred to as the Flying Lab had begun taking shape. In three weeks the design was finalized and the engineering details were being worked out. Time and again he and his team ran into issues with the thousands of minute details such a structural giant entailed.

Tom knew that if he had unlimited funding and unlimited time, that many scale and full-scale experiments could be performed, but he had neither. In fact, he had just eleven months—an end point just three weeks after his eighteenth birthday—to get his aircraft flight worthy.

It was now almost five weeks into the project, the point he had wanted to start finalizing the blueprints.

When young Tom came into the large office he and Mr. Swift had been sharing since opening Enterprises, he had a look of frustration on his face.

“I'll do better than offering you a penny for those thoughts of yours, Son,” his father stated. “I'll go as high as a dime if you'll tell me what's got you down these days.”

Tom grinned at his father. “Sorry, Dad. I've been feeling kinda useless these days. At least, now that my plans for the new Flying Lab aircraft have been submitted to the engineering team. As much as I would prefer to not have to toss my

problem ball into their court, the plain fact is that I have hit a bit of a wall where it comes to doing some of the final stress and weight ratio calculations.”

“I’ve always found the slide rule to be a pretty good place to start,” Tom, Sr. said.

“Yeah... but that’s just the thing. Even using that five-foot slide rule in the drafting department, I can only get to about two decimal points accuracy. Everyone is double- and triple-checking each other to make certain we have solid numbers, but it’s eating up a lot of the time we have. For a lot of what I hope this plane will do, and as large as it is ending up, my guess is that anything less than four or even five decimal points in just the wrong place might spell disaster. Plus, that doesn’t even cover a heap of control and navigation issues I’m betting will pop up as we get to the flight testing stage of the build.”

Mr. Swift thought for a minute, rubbing his jaw as he did. It was a habit that young Tom had also picked up and did whenever deep thought was going on in his genius brain. Finally the older man said, “You’ll just have to find another way to do all those calculations, Son. In about ten weeks I’ll have to put most of those men and women to work on three other projects, and the computer in Albany we now lease time on is tied up for the foreseeable future.”

Tom looked curiously at his father. “Well, I know about the work you are doing for our nuclear plant, the Citadel, and you told me all about the engineering designs we will produce for others to build their own Swift Type II nuclear facilities... uh, but what is the third?”

Patting his desk to invite Tom over to have a seat on the corner, Tom, Sr. began, “This is absolutely on the hush-hush, Tom. I mean not even your mother or sister can be told. Do you understand me on this?”

“Yes, sir,” Tom replied.

“Okay, then. The U.S. Government is working to put a man in space at the same time our Cold War opponents are attempting to do the same. Who knows who will win that race. However, that is what might be termed small potatoes compared to what they have just funded Enterprises to build.” He went to one wall and pressed a hidden button. A drafting table rolled away from the wall and a hidden filing cabinet rolled into the room. This, Tom knew, was his father’s secret documents safe.

Pulling a single sheet from the top of the stack, Mr. Swift returned to the desk.

Tom’s eyes went wide. In a hushed voice, he said, “That looks like a rocket ship, Dad!”

“And, it is,” came the reply. “A revolutionary rocket that the Government hopes to someday use to ferry men and supplies up into orbit to build a space station, and then to carry us on to the Moon!”

He allowed Tom another minute to look at the radical new, almost circle-becoming-a-pyramid design before returning it to the safe and closing it back into the wall.

“That is why I need you to find another solution, Tom. I’m going to need all the computational assistance I can get from those engineers over then next four or five months. Even with the mix of talented employees we have available, it is proving to come up short. I’m sorry, but that is the way it will need to be.”

Saddened by the set back, Tom nodded. “If I could just get a really comprehensive computer into Enterprises, Dad. Something like the ENIAC. That would solve both our problems.”

Mr. Swift chuckled at his son's almost innocence. "Tom, Tom, Tom," he said. "For starters, we don't have a spare million dollars lying around. Your giant jet is taking up most of our ready cash. Secondly, there is already a waiting list that the folks who build that amazing machine won't be able to satisfy for another three years. No. I'm afraid that if you want a computer, you'll just need to take some time away from your aircraft project to design and build one."

Tom went to his desk and sat there for a few moments. He got up and pulled several electronics supply catalogs from the long shelf opposite the door and took them back to his desk.

Three hours later, when Mr. Swift announced that he was headed for home, Tom looked up and at the clock on the wall. It was already six o'clock but he was just getting started on seeing what was available to him. Checking the list of items he already had copied out he realized that they were only about a fifth of the components he might need for even a rudimentary computer.

"You go ahead, Dad. Tell Momsie I'll be behind you by about thirty minutes, Now that I've got my first car I don't have to wait for you or head home with you. See you there," he called out as Mr. Swift left the office.

Sitting back in his chair, the inventor contemplated the task that lay ahead. It wasn't that building a computer was difficult, it was more that the types of computers easily obtainable or built from kits were woefully inadequate for the job.

Those analog devices took hours or even days or weeks to program with fairly simple problems. In fact, as he thought about most of them, they were more like sorting machines rather than computers. Put a large amount of data in and they could go through it and organize it, but coming up with anything outside of the information put in was impossible.

Tom smiled as he mentally recited the mantra of the computer programmer: put *everything* in you might need in order to get something usable back out, and make certain it is correct because garbage in means garbage out!

What Tom knew he needed was a computer that could be preprogrammed with a lot of information what could be called up at a moment's notice and utilized in many different ways.

That, he realized, meant that his computer could not be analog, it must be digital so that it could retain every bit of info that went in.

**PART 2****LIVING IN A DIGITAL WORLD**

TOM, JR. set his team on a course he hoped would allow them to complete everything necessary at least to begin building the wing assembly and the giant tail section for his super jet before his father took them away.

He also called in a favor from one of the scientists out at the Citadel.

“Dr. Suierveld? Tom Swift. Listen. I need a big favor. Can you put together a fairly complete rundown of what it will take to build a miniature atomic reactor for my Fling Lab project?”

There was a humming on the line Tom soon realized was the Dutch scientist himself. “Okay,” came the reply a moment later. “But, I need to know the required power output for the generator.”

“Generator, sir?”

“Yes. The electrical generator that the reactor will power. I assume that is what you wish, is it not?”

Tom explained that what he hoped to use the reactor for was to super heat, nearly to plasma, a hydrogen-rich fuel that would power both the vertical lifters as well as the forward thrust jets.

“Of course, we’ll also need some electrical power, and I have that right here,” Tom stated as he searched his desk. “Ah, yes. Fifty kilowatts.”

There was silence on the line, then, “Only fifty?” I could easily give you five times that much. Just fifty, huh?”

He promised to get Tom the facts and figures on the reactor

within a week and said that whatever Tom needed, and pending approval from the NRC, that such a reactor would be very easy to build now that Tom, Sr’s Tomasite shielding plastic was readily available.

“Plan on it weighing in at about fifteen hundred pounds, Tom.”

That out of the way, Tom returned to his envisioned digital computer. He knew that anything digital operated on the principle that all data could be broken down into on and off signals. These little bits of information needed to be standardized, and experiment she read about said that the number **0** was being used to indicate OFF and **1** to indicate ON.

That left him with a big problem. How to use them? In the case of large tape or card driven computers, a simple ‘language’ had been constructed that basically said if a hole appears in a certain location, it means X and in another location it might mean G, and so on.

Tom’s new digital language would need to recognize numbers, that was a certainty, but the more he thought it over, the more he realized that letters would also be necessary. In the most simple example, as he was describing it to his friend, Bud Barclay one morning, “Let’s say that you want to build a navigation system. You need to input where you are and where you want to go. That could be longitude and latitude, or a specific location based on a list of places, but you might also want to tell the system you want to go ‘to Baltimore.’ ”

Bud shook his head. “Been there, Tom. Pretty good seafood but it’s really a dismal place. How about we set your machine to take us to California so I can see my folks?”

Tom grimaced. “Wherever, Bud. The point is that you need to have the computer understand letters. Then, it needs to

understand that the letters s-h-o-p-t-o-n when typed in without any spaces spells Shopton, and then it needs to know what a 'shopton' is, where it is, and even how to compute the differential between where it is right at that second and where Shopton is if order for it to figure out how to get there."

Bud's eyes widened and he shook his head. "Call the auto club," he suggested.

Now, Tom shook his head. "Can't. There's no auto club for the skies. Heck. There's no auto club for South America, not that we'd ever want to go there. Anyway, you can start to see the issues. I doubt that a single computer could ever handle all of the things that are possible. It might even be necessary to build separate ones with different languages to do different things."

"You mean like your find-a-place one, and then another to help with my math homework?" Bud gave Tom a wide grin. Although he was a very gifted athlete and a pilot even more accomplished at age seventeen than Tom, Bud was a reluctant student.

"I think it might be something like that," Tom admitted.

Building the basic computer started out looking to be easy, but once Tom really got into it, he found that he had neglected to consider one thing. In order for his computer to be useful, it also had to be quick. It would not do to just be able to perform the same things a man might in the same or a longer period of time. To be useful, it needed to do them much faster, so much so that to the human eye it would seem that the computer was doing many things at once.

His original thought to build a large board with a thousand transistors soldered onto it and use them to indicate the ones and zeroes was too ponderous. And, slow.

What was needed was a miniaturized version of such a

board, possibly many of them working in concert.

He did some calculations—by hand—and decided that about two thousand, or perhaps twenty-five hundred, miniature transistors could provide as much power as the cherished 'Gold Standard' of computers, ENIAC.

And so, it now came down to finding a way to miniaturize those transistors.

The answer was shoved under his nose that evening by his younger sister, Sandy. Sandy had recently turned sixteen, and had insisted that she be allowed to do all the things she had been promised would be permissible, "when you turn sixteen." That included dating Bud Barclay, driving, learning to fly and wearing nylons.

She had quickly given up on the last item.

She had not, however, wavered very far from the path most teenage girls take and that was toward gossip and chit chat. Such chatting included sharing of stories, secrets and even photographs. She had brought a photo home taken by the father of one of her friends.

"See how he had it enlarged, brother dear?" she asked as she thrust it in front of his face. "You can see her underwear sticking out of the rear end of those shorts!"

Tom pushed it away, but a thought hit him and he grabbed her wrist and pulled it back.

"That's it!" he shouted, jumping up, giving her a big hug and racing out the front door. By the time SANDY recovered from shock, the sounds of his little car had disappeared down the block.

"Better make it just three for dinner, Mother," she said toward the kitchen.

After passing through the private gate at Enterprises the senior stall used, he pulled up to the parking lot next to the Administration building. Getting there now entailed a slight detour around an increasingly large hole in the ground. It would become, when completed, a giant underground hangar for his Flying Lab. For now it was cordoned off with a six-foot-tall wire fence and many sawhorses with battery powered flashing lights.

He practically tore upstairs to his office where he pulled out some drafting paper. Using a template, he traced about a hundred transistor symbols onto the page and then interconnected them with 'wires.' Satisfied with the page he took it down the hall to the new photocopier room where all Enterprise documents could be copied.

It had practically done away with carbon paper overnight with only a few of the secretaries—his father's secretary, Miss Trent being one—preferring the old way of doing things.

Tom placed the page face down on the heavy glass top being careful to align it correctly. He then pressed the COPY button and watched as the machine scanned the page, waited while it 'digested the information,' and then eagerly pulled the resulting page from the bin on the side.

As he assumed would be the case, the faint blue lines of the graph paper had not copied, so he was left with a perfect duplicate, in jet black, of his transistor array.

After replacing the original with the copy, he moved a switch from "Standard" to "Smaller" and pressed the button again. Less than a minute later he was looking at a half-sized version of his drawing. He repeated the process until his drawing came out just two inches wide and about one-and-two-thirds tall.

He ran back to the office and pulled out a magnifying glass.

"Yes!" he shouted to nobody. It had worked. The drawing,

now a little fuzzy from all the downsizing but still recognizable, was going to be the key.

Back home later that evening he showed his father the miniaturized array, explaining, "there has to be a way to do this in fine detail, I think some type of photographic process will work, Dad. I really do."

Sensing his son's enthusiasm and getting a little caught up in it, Tom, Sr. asked, "Can this do what I think it might? Can this array take the place of tubes and paper tapes and actually compute something?"

Tom nodded. "I'm sure of it, Dad. If I can come up with the language to control a larger version of this, maybe with two or three thousand transistors on it, I think I can downsize a computer like the ENIAC into a large suitcase. That's tiny!"

He worked with two photography engineers at Enterprises for a few days but soon realized that the equipment necessary existed in only a few locations. One of those was practically a neighbor.

Tom placed a person-to-person call to Dr. Albert K. Chapman, the president of the Kodak Company. Without giving away too many details Tom discussed his needs for a photo process that might take a single, large drafting design of almost four feet by three feet, and to miniaturize it to no larger than a standard piece of paper, but to print it on circuit board material.

"Just as long as you aren't going to make a camera or some sort of film replacement out of this, we can do the job. Let me put you onto the right people." And, within a few minutes Tom had arranged to come to Rochester in three days time with his giant sheet of paper.

The engineers at Kodak were intrigued with the large sheet of almost identical circuits. A special large magnifier was



brought in and every line and transistor was checked. Thirteen required minor touching up before they were satisfied the results would be what Tom wanted.

He watched the entire three-hour process carefully. In the end, he left the plant with three versions of his circuitry board: one was the size he had specified; one was about twenty-five percent larger; one was almost ten percent smaller.

Back at Enterprises he had a junior engineer spend a full day checking the traces of each of the boards. Everything appeared to be fine, so Tom started work on other electrical and electronic circuits that would be necessary to utilize the board he was not thinking of as his 'mini computational processing board.'

The day came shortly after that when Tom's team of engineers and draftsmen were reassigned by Mr. Swift. Before leaving, they presented Tom with a ninety percent complete design with full piece-by-piece specifications.

"Tom. We're awfully sorry to have to drop this back on you, but your dad must have told you. Least, I hope so," the senior engineer, Hank Sterling, said to the youth. "I was able to do all of the patterns for the body spars and the outer skin panels for better than seventy-five percent of the fuselage."

"Thanks, Hank. You're actually leaving me a little better off than I anticipated. The only thing I might ask is that if you get a few days of spare time, could I have those?"

The tall, broad-shouldered Swede smiled and nodded. "You've got it, skipper!"

While everything was turned over to the Construction Company, and they began turning out piece after piece, Tom turned back to his computer project.

For several more weeks, things went along smoothly. Ned

Newton, president of the Construction Company phoned him daily to provide updates. The latest one had been all good.

"You and your dad have the best engineers and drafter in the business, Tom. Why, we've only had to recut one body panel and tweak one of the wing spars and shave down eight or nine of the wing ribs. And by shave down, I mean just a hair of filing necessary for perfect fits. We'll have the entire wing assembly ready in less than two weeks."

"That's great, uncle Ned," Tom told the man who was no relation, but was such a close family friend that he and Sandy thought of their father's boyhood friend as their 'uncle.' "So, the Tomasite sheathing is working? I mean, structurally it is a good replacement for aircraft aluminum like we anticipated?"

"Better, Tom. Stronger by a factor of ten and lighter by a factor of four. Your finished fuselage is going to weigh in at about the same as one of Boeing's 707s and that's at eighth the total volume inside."

The even better news to Tom was that Hank Sterling, along with another of the men who make Tom marvel at their skills—Arvid Hanson—had been permanently assigned to the Flying Lab project. With them onboard, he felt comfortable spending even more time on his computer.

At the six-month point, the aircraft began looking like something that might some day actually fly.

And, by that time Tom had finished building the circuitry for his little computer. Only two things eluded him. The language that would be used to turn the inanimate collection of wires, boards and vacuum tubes into something that would do more than just heat up when electricity was applied, was the first. The second thing Tom had recently come to realize was a way to permanently store not only the language but extra information an operator might wish to add.

Mr. Swift had come to the rescue on the latter by suggesting that Tom include a brand new technology, magnetic tape. It would require licensing another company's technology, but a quick call and a favor asked had secured the rights—and design documents—for a one-time cost of just a few thousand dollars.

That was the turning point. Tom knew that he needed to store hundreds of thousands of characters of data and the more than two million character capacity of the tape would do just about everything he could hope for.

It would also, re realized a few days later, allow him to create basic computers and then customize their function by changing out the main data tape and feeding in some subtle language differences. In such a way he could program anything from a basic computation machine—a super adding machine—all the way to his needed navigation computer for the Flying Lab and even more.

## PART 3

### IDIOT ON PARADE

THAT LEFT possibly the most difficult of all the necessary steps before he could claim to have a working, miniature digital computer.

The programming language.

The heart, soul and 'thinking' part of his machine. Without that, he had a sophisticated, suitcase-sized assembly of eleven circuitry boards—including his mini computational processing board, something he knew he needed a better name for—plus a heavy transformer to provide the appropriate power, and about sixty-seven feet of miscellaneous wiring criss-crossing and wrapping around everything. That all topped with the magnetic tape source and take-up spools and the reading head the tape slid over.

Just not a working computer.

At least Bud was able to help him out on one aspect. That afternoon, following a test flight on one of the Pigeon Specials, small, personal airplanes being built by the Construction Company, the dark haired flier practically floated into Tom's lab in the Administration building.

"Well, at least you look happy," Tom commented, perhaps a little bitterly.

"Oh. I don't like the way that sounds, Tom. What gives?"

The inventor's shoulders sagged. He got up and stretched a little before telling his friend about the problems he was now facing with coming up with a computer language that would allow him to program his miniature computers.

"Plus," he said almost off-handedly, "I've got to come up with

something better to call my special board than a 'mini computational processing board.' Any ideas?"

Bud's face scrunched in thought. It was a face that Sandy Swift said made him look like an angry chimpanzee. "Tell me again what it is and what it does," he requested.

Tom obliged, and Bud's face immediately brightened.

"Well then... just shorten it all down to 'mini-processor'," he said with a big smile. "It's a lot better than my first thought which was exactly how I feel when you explain all this technical stuff."

"What's that?" Tom asked.

"Makes me feel like an idiot. I was going to say you should call it the idiot board."

Tom shook his head. "You, Budworth Barclay, are one strange guy. There's nothing idiotic about this, or at least there won't be once I can get it to think. Right now it's just a little idiot box."

Bud suddenly remembered why he had dropped by. "Hey. Sandy wanted me to tell you she thinks you need a girlfriend, and she's certain her friend, Phyllis, is that girl. Want to double date tomorrow night?"

Tom stared blankly at Bud. While he found the young brunette attractive, and she was the daughter of 'uncle' Ned Newton, he always felt she was a little bit of a prude. While dress styles were about one inch below the knees for girls, Phyllis still wore hers halfway between knees and ankles.

Plus, she liked square dancing. Tom loathed square dancing. Or, he thought he would loathe it if he ever went out dancing. Having graduated from Shopton High School a full three years early, he had never been to a school dance. Still, yanking other people around by the arm as you spun in a circle didn't seem

very appealing.

"Nah, Bud. You and San have a good time. I'm so behind the eight ball that I'll pass. Maybe once I get things a little farther along."

For the next five days, and almost as many nights, Tom wrote out page after page of language code. Assigning data equivalents to letters and numbers had been easy. Only slightly ore so had been mathematic symbols, punctuations and some specific functions he knew would be used frequently so they would benefit from having brief shortcuts.

The hard work began when Tom had to begin to think not so much like a human being, but like a cold, 'only understands exactly what it knows from input' machine.

Slowly, it began to come together. And, he discovered that the more tired he was, the closer to the edge of exhaustion he got, the easier it was to focus on pinpoint issues.

The Flying Lab was now more than half complete and he spent an hour each day at the Construction Company walking around and inside of the giant aircraft. Like everyone working on her, he felt insignificant around it. Even the large tires that had been specially produced by the Goodyear Rubber Company made him feel small. Tom was just a fraction over six feet tall, but the tires were seven feet across.

Sitting in groups of four on each of the main four landing gear struts, they were gigantic.

But it was inside that anyone would feel dwarfed. When it had just been the nearly circular ribs of the jet with no floors, it had felt like being in some strange building. Now that two-thirds of the outer skin panels were in place and all of the lowest and half of the second decks were installed, it still felt enormous.

He returned to his lab and the computer language. Like the jet, it was coming along but with increasingly evident progress visible from day to day. Within a week he would be able to begin encoding it onto the magnetic tape and that would let him try things out.

It actually took a few extra days, plus a weekend Tom decided to take off to try to clear his head, before he would be ready for the first tests.

That weekend, Bud and Sandy worked relentlessly on him, finally breaking him down and making him agree to a date with Phyllis.

“Just no dancing,” he had insisted.

The date had gone fairly well and Tom not only had a good time, he found that he like Phyllis Newton. Though reserved, she had an easily and delightful laugh, was very cute when seen close up, and faintly smelled of lavender, a scent Tom didn't particularly like but found it to be nice when coming from the girl.

He even received a brief kiss on the cheek at the end of the evening. They parted, both red-faced, at her door. It had been a nice evening, he thought as he readied for bed.

But, now it was Monday and the time had arrived for his first test. The magnetic tape assembly had come with a programming keyboard that fed into a paper tape system that, in turn, would transfer keystrokes into magnetic information.

A group of young women from the typing pool at Enterprises had spent the previous week entering Tom's language notes. To avoid mistakes, they worked in pairs with one typing and the other double-checking what had been entered. Each hour a new pair of girls sat down to work. Thirty-seven hours of keystrokes later and the most basic form of his computer language had been encoded onto the tape. That included nine

pages of new code he devised Tuesday and Wednesday.

Tom sat down and looked at the wooden box that had been built to house his computer. He wondered if it might be possible to form a plastic case for it. Perhaps one that was a little more stylish and would have a door or hatch that might be opened to switch out magnetic tapes and spools. This one required a screwdriver.

It would also need to have ventilation slots he decided, noting that the current box didn't have any. It would be necessary to run it with the top off or face the probability of heat failure.

He found it a little difficult to breath slowly and steadily as he reached out to throw the electrical blade switch that would send power into the box.

With a tiny spark, contact was made and the tape mechanism lurched forward about an inch. A small lamp inside showed that power was now coursing through the system, and shortly after that he could see the soft, orange glow of the vacuum tubes as they warmed up.

*I've got to come up with some way to do without those tubes, he thought. They not only take too long to stabilize but now I can see they might have problems with vibration in the Flying Lab. Hmmmm?*

Two minutes later he was satisfied that everything was stable and ready for the next step. He depressed a spring-loaded button on the case front and connection was made to start the magnetic tape. It took ten minutes to 'load' the basic language, but Tom was grinning from ear to ear when the tape unit next to the computer clicked into life and typed out the word, 'READY.'

\* \* \* \* \*

Nine weeks later two milestones were reached.

The first was the final exterior panel installation on the Flying Lab. At least from the outside, she looked like a real flying machine. All of the windows had been installed, including the massive front viewport in the cockpit way up on the top deck. She had been hoisted up and all of the blocking holding her up removed, so the jet was resting entirely on the landing gear. And, the atomic-powered jet lifter package had been installed with its sixteen gleaming thrust tubes sticking out of the bottom of the fuselage.

The second milestone came when Tom's computer language, now dubbed TSUNaMI—for Tom Swift Utility Nemonic and Mathematical Instructions—was finalized and installed onto the computer's magnetic tape. It required all but the final three inches of the spool of tape to fit, but he was very happy with the results.

Of course, he realized, this left no room for specialty instructions and code. After conferring with the engineers at the company that provided the magnetic tape unit, he decided that there was so much of the actual tape surface that went unused, he could create a dual-level reading and writing head that would effectively double the capacity of the tape. That meant one huge leap; the TSUNaMI code would reside permanently on the lower half of the tape, protected from accidental overwrite or erasure by having a read-only section of the tape head, while the upper half was left free to hold a combination of specialty codes and instructions—even addendums to the programming language—that would be unique to the functions of each individual computer.

The third milestone was that Tom Swift and Phyllis Newton were going steady. At least in her mind they were. Tom's mind was a little confused about the entire issue.

"How are you going to give them a real world test, Son," Mr.

Swift asked that evening when Tom announced his readiness.

The youth smiled. "I was hoping to commandeer one of the Pigeon Specials, Dad. I figure that I can attach servo motors to all of the controls, make a simple program to run it around on our runways, maybe even respond on the fly, so to speak, to radioed signals. What do you think?" He looked hopefully at his father.

"Son. I've put implicit faith and trust in you on the Flying Lab jet project. That and a million dollars of company money. I guess I can add another eight thousand and let you *borrow*, and I hope you heard the emphasis on that word, borrow a Pigeon. Just promise me that the first thing you do is *not* take it off and fly it around Shopton."

"Emphasis on the word not understood, Dad."

"You won't be in it, will you?" Mary Swift, Tom's mother, asked anxiously. She was a loving mother and a wonderful cook, but sometimes Tom wondered why she was such a worrywart.

"No, Momsie. I will not be inside. For the taxi around tests, we'll do it with just the remote control and a special kill switch that will shut everything off in case of a problem. For any flight test, Bud will be inside ready to take the controls if there is something going wrong."

Another week went by before Tom was able to rig the small plane with all of the necessary remote control equipment, but word quickly got around Swift Enterprises about what he was doing.

On the morning of the test, so many people asked their managers for permission to "just step outside for a few minutes..." that Tom, Sr. finally made the decision to call a one hour work break for the entire facility.

With Tom at the large control board now set up on a table next to taxiway number 3, the one directly behind the growing cluster of buildings at the center of Enterprises, final checks were made of the plane by Bud and three of the other test pilots from the company.

A thumbs up from his friend told Tom that everything was ready. He flicked a toggle switch on his control board and watched as three lights began shining. He strode over to the plane and leaned in through the open door. Inside, he turned on the electrical power supply—a set of a dozen large automotive batteries—and the computer.

There had been sufficient time in the last few weeks to reduce the number of tubes in the computer to just three. This would mean, he hoped, increased reliability and a faster starting up time.

He was rewarded for this work by now having a computer that could be turned on and ready to accept the date tape in just about one minute, practically immediately compared to before.

The magnetic tape ran one way first, then reversed direction and fed in the rest of the programming. Fifteen minutes later, Tom straightened back up and motioned for Bud to come start the little plane up. As the flier approached, Tom walked back to his control equipment.

Five minutes after that he picked up and waved a flag to signal the control tower of his readiness. The aircraft traffic controller picked up his microphone and announced to the crowd: “Please stand well back behind Tom Swift. Aircraft test is about to commence in thirty seconds. Thank you!”

The few people who had bravely ventured a little closer to the plane that they should have now moved back.

Bud was standing next to Tom, one hand on his friend’s

shoulder as Tom moved a slide control forward and the engine of the plane sped up. A second later he released the brakes and the plane began moving forward.

“Now,” he said as he pushed a button to turn over control of the plant to the computer, “let’s see if it does what it’s supposed to.”

The program, set to taxi the plant almost to the end of the taxiway, turn right and then right again onto the runway and taxi at various speeds down that two mile stretch of asphalt, finally bringing the plant back to its starting point, went flawlessly.

It even flashed the landing lights on and off just before shutting the engine off, all automatically.

“Wow, skipper!” Bud enthused. If you can make your idiot box do that with a dinky plane, imagine what it will be able to do in the Lab?”

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Two days later the Pigeon Special, with Bud in the co-pilot seat, took to the air and flew around Shopton, no human hand ever touching the controls.

## EPILOG

MR. SWIFT was watching over Tom's shoulder as the young inventor completed the installation of the last of five specialty computers in a cabinet at the rear of the Flying Lab's cockpit.

Arv Hanson had really come through for Tom. The model maker had designed a shiny gold case for them with all of the control knobs and switches on the front, a cabling connector on the back, ventilation slots designed to flow air across every hot surface, and a molded top that hinted at the double-spool magnetic tape mechanism just under the lid.

It was beautiful, functional, and exactly the right size to fit Tom's miniature digital computers that now measured just sixteen inches from front to back, eight from side to side, and eight inches tall.

Even Tom, Sr. was amazed to the point of being speechless when he saw the final units.

The Flying Lab, once it actually was flight worthy, would be partly controlled by four of them with one spare. They would not be controlling things that a standard automatic pilot might, but rather they kept the pilot from making any errors in balancing the great jet on its lifters, stalling the only nominally-stable jet in slower flight, navigating to any airport in the world—where signal beacons could be relied on to keep them on track—and one to control all of the environmental aspects of the jet.

With three levels—including a hangar in the aft, lower area—and a total of thirty-seven rooms and corridors, it would be necessary to monitor and control air conditioning and even cabin pressure at all times.

“Are you still going to call them ‘Little Idiots,’ Son?” his

father asked.

Tom nodded. “Yes. With no programming in them, they really are idiots, just shiny boxes of nothing. I don't know if you remember a couple years ago when I was trying to make that atomic clock, but I think I told you that I felt like a little idiot without the ability to compute things. The name is sort of in honor of how I felt. Is that okay?”

Mr. Swift chuckled. “Son. You get that giant airship of your up and flying by this time next month, and I'll let you call them anything you want to!”

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And, Tom did!