



# New Moon Rising

*By Doug Hilton*

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*New Moon Rising* is dedicated to my loving wife, Diane.

## Chapter 1.

"Demetrius stop playing with that stuff and eat your dinner," shouted his mom.

"Come on down, son. It's time for dinner," said his dad.

"I'll be right down," replied Demetrius, who was in the middle of a critical experiment with his new electronics kit. He could smell the fresh-boiled corn waiting for him downstairs.

"All that boy does is play with those gadgets," said his mom.

"I know dear. He likes electronics. I think we're raising a nerd," he said with a bit of pride in his voice.

"Hmmp. Like father, like son. You and those computers – ha! Between computers and those circuits you build, you'd think that you'd create something that would change the world. You need to take your son to a football game once in a while."

"You're right dear. But you know he doesn't like sports much. The kids at school are loud bullies and Demetrius has a quiet spirit. I say that it's okay for him to work on circuits and computers – at least he'll be able to get a job when he grows up. When he goes for an interview, I don't think they'll ask if he can shoot hoops."

"Demetrius stop playing with that stuff and eat your dinner," shouted his mom.

"I'll be right down" replied Demetrius.

When Demetrius turned 13, his dad took him shopping in the mall. When they passed the Radio Shack store Demetrius stopped and pointed at a colorful box in the window. "Dad, can I get that for my birthday, please dad? *Please?*"

Mr. Lincoln "Linc" Howard was a computer guy with a love of electronics that he got from his dad, so he couldn't resist. They went into the store and the sales clerk saw Demetrius' eyes fixated on a snap-together electronics kit sitting in the window.

The clerk said "If you're really going to learn electronics, I have one kit in the back that is left over from a couple of years ago. Let me go look for it."

A moment later he returned with a large, multi-colored box. "Here it is. It's the classic Radio Shack 1000-in-1 kit. This is the last one in the region. It blows the socks of the new kits." He looked at Mr. Howard. "I'll give you a good deal on it, and your son will learn a lot. Can I sell you some batteries to go with it?"

After a few minutes at the cash register, Demetrius was looking at the box with great joy. "I want to build all these circuits, dad. Look, there's a thousand of them."

"Sure son. If you need any help with it, just ask." So Demetrius was now the proud owner of 10 pounds of electronics and 4 pounds of batteries; all contained in familiar white and red plastic bags.

It was just before dinnertime when they got home. Demetrius unwrapped the kit and laid out the parts on the floor of his bedroom. When their dog, Suzy walked in and started sniffing around, Demetrius quickly realized that he needed a better plan.

"I'll need to keep this stuff off the floor," he muttered. "Shoo, girl. Dumb dog – those aren't food." Suzy knew that he was upset but didn't know why, so she hung her head and waited for him to explain it to her. "It's not your fault girl. I shouldn't have put those parts on the floor. Here – good dog," as he petted Suzy.

"The parts need a special place, away from dogs and prying eyes." He looked around the bedroom. "Got it – I'll use the dresser as a storage area." Underwear and socks migrated from the top drawer to the next drawer; drawer 2 merged into drawer 3; drawer 3 into the bottom drawer.

"I should have done that differently," he said as he looked at the overflow from drawer 3 that wouldn't fit into the bottom drawer. He took all the stuff out of the bottom drawer and laid it out on the floor. Then he added stuff from the other drawers in neat piles, all around. Finally he reloaded the dresser. "It still doesn't fit." He reshuffled the drawers and put the overflow in the small closet. "Hope mom doesn't notice."

Then he taped down a couple sheets of white construction paper in the top drawer and carefully arranged the new electronic components. Using a black crayon, he drew lines around different groups of transistors, wires, lights, batteries and hardware. "That's better," he said as he heard his mom's nightly call for dinner.

At the dinner table his dad reminded him "Be sure to read the manual before you start building stuff. And make sure that all the parts are there. If you need help, just ask."

"Okay dad," replied Demetrius, but his mind was already thinking about the integrated circuits that were waiting in his top drawer. What were those things for? They looked like black insects with 6 legs or 8 legs. He zoomed through the peas and corn and then rushed upstairs.

"That boy should be outside on his bicycle on a nice night like this," observed his mom.

"He'll be fine dear," replied Mr. Howard, who was reminiscing about his first electronics kit. "I remember when I bought my first electronics kit at Radio Shack. It wasn't nearly as nice as his. I built a crystal radio, and used a solar cell to power a small motor. I'll never forget all the small pleasures that came out of that box. Maybe I'll just go upstairs and see if Demetrius needs any help."

"Linc, you'll do no such thing. If Demetrius needs help, he'll ask. Just let him be."

Mr. Howard just looked at his wife, who had her hands firmly planted on her hips. "Ruth, are you taking Demetrius' side? Sounds like it. Looks like I just got stuck drying the dishes tonight."

"Just go on in there and put on a movie," she said, pointing to the TV room. "Demetrius is busy. We're going to spend some quiet time together tonight."

He shrugged his shoulders then uttered "Yes dear," and added a smile for effect.

That night, Demetrius started reading the fat manual that came with the kit. He wanted to know everything about everything, not just the integrated circuits. "Wow, that's cool," he said time after time as he rolled through the drawings and descriptions. Within a short time he realized that he needed to ask for help. He walked downstairs and was about to ask his dad for help, but he saw his parents hugging each other, watching an old black and white movie. When he saw a lot of smooching on the TV screen, he decided that it wasn't a good time to ask for help so he went back to his bedroom. He dug out a spiral notebook, sat down on his bed and started writing down questions.

"I'll ask dad about this tomorrow," he said as he drifted off to sleep with his clothes and the lights still on. He awoke with a start in the middle of the night.

"Shoot. I better get undressed." He looked at the notebook and added one last question before closing it up, turning off the light and dreaming about photocells and transistors.

In the morning his head was bursting with questions, but his dad always left for work early. He petted Suzy and ate a bowl of cereal. "Mom, I've got some questions for dad."

"Good Demetrius. Now don't miss the school bus."

## Chapter 2.

That day at school was tough on him. "How am I supposed to concentrate on this stuff when I've got important questions about electronics?" he muttered under his breath when the teacher asked him to go to the board and write out the homework assignment.

"Demetrius, did you finish your homework?" she asked.

He looked down at his desk and muttered "No ma'am." And then he quietly added "I had other things to do. It's my birthday."

"Well Demetrius, happy birthday. Now, you'll stay after school and finish up your assignment."

"Yes ma'am," he said very quietly.

That afternoon he sat there for 2 hours working on his class assignment. His thoughts were about electronics and the great experiments that he was going to do. "I'm going to invent things when I grow up," he said to himself. "Man, what kind of birthday is this?"

"What's that Demetrius?" asked Mrs. Brown. "Are you done with the assignment yet?"

"No ma'am," he said.

"Well young man, you're going to be here until you're done, so you might as well get used to it. It can take 5 minutes or 5 hours: it's all up to you."

Two other detained students laughed at him until Mrs. Brown stared them down. "You two have work to do, too. Football isn't everything. You have to learn enough to graduate. How do you expect to get into high school if you don't learn English, history and math?"

"We just don't care about it, 's all," muttered Ted, who was an overgrown troublemaker.

"Yeah, Mrs. Brown, we just don't care," echoed Bill, who thought it was cool to be like Ted.

"Ted Truman, finish up your assignment or tomorrow you will bring me a note from your mother. Do you understand?"

"Yes Mrs. Brown," replied Ted, because of course he recognized the Ultimate Threat.

It was almost 8 P.M. before Demetrius finished his paper and handed it in.

"I hope you understand how important this is Demetrius. You've been daydreaming a lot lately. Is everything okay at home?"

"Demetrius is daydreaming," laughed Ted and Bill as they nudged each other.

Demetrius clenched his fists. "Everything's fine Mrs. Brown."

"Alright Demetrius, don't forget to do your homework tonight. You can call your parents for a ride now."

Demetrius was thinking "I have more important stuff to do tonight," but he said "Yes ma'am" as he went out the front door and waited for his dad to come pick him up.

When his dad rolled up, he climbed into the car and his dad said "You're late tonight son. Is anything wrong?"

Demetrius was quiet on the ride home and then he just went up to his bedroom and closed the door.

"Some kind of birthday. I need to complete some dumb homework first, and then I can experiment. I don't want to be in detention with those dorks again." He raced through the days' assignments and then went down to a late dinner.

"Demetrius is anything wrong?" asked his mom. "The pot roast is cold. Let me heat it up for you."

He sniffed the roast, the carrots, the bay leaf and the potatoes. "No mom. I just had to do some homework."

After dinner they gave him a chocolate birthday cake, and he opened a card from his parents. But his heart wasn't in it. "Excuse me, please," as he wiped sweet frosting off his lip with his sleeve.

When he got upstairs, he opened the top dresser drawer and looked in at the carefully laid out electronic parts. He went back to his desk and looked at the Radio Shack manual. "I'm going to build them all," he decided. He started with the first project, selected the parts and started assembling the circuit. In a half hour, it was working.

He heard his mom shout "Time for bed, Demetrius." He turned out the bedroom lights and fell asleep immediately.

The next day at school, Mrs. Brown looked at his class assignment and said "Demetrius, this is not very good. I want you to put some effort into it and make it right. Next week is Parents' conference. You need to improve your work by then."

"Yes ma'am," replied Demetrius as he retrieved his homework. "I'll do better," as he shuffled back to his desk.

"Little Demetrius is going to do better. Ha ha!" laughed Bill and Ted.

Mrs. Brown shot them a look that shut them right up.

"Demetrius, you're capable of great things. Now I want you to concentrate. Your work has dropped off, and you need to improve. I'm going to watch your next assignments carefully, understand?"

"Yes ma'am," was all he could say, since everyone in class was staring at him.

That night he worked hard at his homework assignments. "I'll show her. I'll show 'em all."

He ate a late dinner again and watched his mom and dad in a quiet conversation in the living room. He decided that it wasn't time to ask his dad about electronics, so he went upstairs. He started Project Number 8. Soon he was on page 20 of his notebook of questions. He really wanted to know more about "transistor gain" – what did it mean? How was it used? "Dad'll know," he said confidently, as he closed the book and switched off the bedroom light.

By the end of the school term, Demetrius was in top-form. Mrs. Brown was happy; his mom was happy; Ted and Bill were picking on someone else, and life was good.



## Chapter 3.

One Saturday, his dad was going to the annual neighborhood garage sale, so Demetrius tagged along. "Maybe I'll find some new parts" he told his dad.

"Son, I like these big garage sales – you never know what treasures will be there. Here we are – let's see if we can park somewhere around here."

They went up one side of Windingham Drive and down the other. The warm southern sun beat down on the neighborhood and a few brave clouds floated above. Suddenly, Mr. Howard spotted a nice telescope for sale and he had to stop and look at it. "Demetrius, an 8-inch scope like this is just what we need. We can look at the moon and Mars and even Jupiter with it. Let's see how much the guy wants."

When the owner saw the interested buyers, he made them an offer they couldn't refuse, and tossed in several astronomy books, too. "I just upgraded to a 14-inch scope, so I don't need that one anymore. It works perfectly. If you have any problems just call me."

Demetrius and his dad carried the heavy scope to their car and headed home. "We'll have lots of fun with that, son."

"Yeah, dad, I want to see the moon with it."

Later that night they set up the scope in the backyard. Frogs were chirping, lightning bugs were playing tag and the evening dew was starting to form. "Where's the moon, dad?"

"I think it's a new moon tonight, son – let's see. On this control box, you can enter different objects and the scope will zoom right to them. Let's try it: here, I'll key in "moon" and see what it does." The scope slewed rapidly to the south and east.

"Gee dad, that's cool. How does it know where the moon is, if we can't even see it?"

"The scope has a microprocessor in it. Plus it has a table of positions built-in. It can calculate where 40,000 celestial objects are, because it knows where we are, and what time it is."

"How's it know all that?"

"It has a GPS unit built-in, son. That tells it where we are, and what time it is. Then it knows where all the stars and planets are for this time of day. So the microprocessor moves the motors in the right direction and then centers the object. Here, look."

Demetrius was trying hard to remember all the new stuff. He desperately wanted to ask questions, but right now he was just having too much fun. "I need to write these down in my notebook," he realized. Then he said "Dad, there's no moon there. It must be wrong. I don't see anything."

"It's a new moon tonight, son. You can't see it rising – it's completely dark but it's there. It still has a powerful effect on everyone."

Demetrius pondered that idea for a minute. "Where's Mars?"

"Here son, use the controller to find it."

Demetrius pressed the keypad and the telescope slewed south and up. "*Gee dad, look – Mars!*"

Sure enough, the scope was dead-centered on Mars. They both took turns viewing the red planet, and then the State Bird of Alabama, the *Culex* mosquito, finally won its battle for dinner.

"Son, we need to go inside – the mosquitoes are biting tonight. We have to be careful of the West Nile virus. The mosquitoes here can carry it." Cows in a nearby field mooed and the smell of burning lumber drifted by.

"I wish they wouldn't burn stuff in this low-humidity we're having. It's dangerous," said Linc.

"Hey, dad. Let's do this again."

"We will, son."

Demetrius filled 4 pages of questions in his notebook and then fell asleep, dreaming of the moon and Mars. The idea of a new moon rising without anybody seeing it was completely new to him – he'd never thought of something as big as the moon being invisible before. His sleep was fitful as he tried to figure out what his dad said about some kind of powerful effect the new moon rising had on everyone. In the morning, he wrote more questions in his notebook, and then went to school, tired and distracted.

Over the next few months, Demetrius built almost a hundred different experiments before he realized the power of that small clump of electronics parts in his top dresser drawer. He built things with switches and lights and buzzers. He built things that blinked and things that whistled. He made something that turned a light on and off when he clapped his hands.

"Mom, you gotta see this," he called downstairs.

"I'll be up soon, Demetrius. Is your homework done?"

Like father, like son: his favorite set of parts was a crystal radio, which he listened to every night while he drifted off to sleep, pondering the moon and Mars and his experience with the telescope last month. That little radio pulled in local AM radio stations, mostly talk-radio and country/western music, plus some gospel stations that he didn't particularly like.

## Chapter 4.

One Saturday, his dad came into his bedroom and announced "Well, son, I'm here to help out. Do you have any questions?"

Demetrius was concentrating on a circuit that triggered an alarm if the light was blocked from a solar cell. "Well sure."

He reached for his notebook and flipped to the first page. He looked at the question and it was primitive and stupid. He'd learned the answer to that a long time ago. He flipped the page and saw another dumb question. He went page after page, as his dad stood there waiting. He realized that by building circuits and reading the manual, he was learning about electronics. When he got to page 20 he finally asked "Dad, what's gain?"

"You mean in a transistor?"

"Yeah."

"Okay. That's a good question, son. A transistor amplifies a signal. The amount that it amplifies the signal is called gain – get it?"

Demetrius asked "Dad, why do they call gain 'hFE'? See, I wrote down. The manual says 'it's the small signal forward current gain of a bipolar transistor', but I don't understand why they call it hFE. Those letters don't make sense."

"Son, I don't know. Let's look it up online." They went to the antique computer that his dad had given to Demetrius several years ago. "Here, let's use a Web search engine." He keyed in 'hfe gain' and in a few seconds the computer spit out over 1,000,000 references to it.

"Your computer is sure slow. I need to get you a faster one," stated his dad, who didn't have a clue why transistor gain was called 'hFE' so he said "Let's go shopping tomorrow and pick you up a new fast computer. How 'bout that, son?"

"Cool, dad."

The next Saturday, the family went to Best Buy and picked up a speedy new laptop computer. When they got home, Demetrius rushed upstairs, plugged it in and keyed in 'hfe gain'. The 1,000,000 references to it downloaded much faster. He heard the lawnmower start and realized that his dad would be out of touch for over an hour, so he started poking around the Web, searching for facts. It took a while, but he finally got his question answered. Then he flipped to the next page of his notebook and looked for answers on Wiki and Google and Yahoo! He left notes for himself on the results of his research.

At dinner his dad asked "How do you like your new computer?"

"It's great dad. It sure finds answers fast. It just takes me a long time to write it all down in my notebook."

"I'll show you how to use a word processor. That'll speed things up."

During the next week, Demetrius learned how to use a popular freeware text processor, and he transferred his notes to the computer. "This is really cool dad. Is this what you do at work?"

"Well it's only one of the things I do. I'm a programmer. I write computer programs. But I use word processors all the time."

"Can you teach me how to program, dad?"

"I guess so, son. It will take some time, but you can learn it."

During summer break, Demetrius grew a couple of inches and spent a lot of time with his dad, learning a program called BASIC. One day his dad said "Look son, I stopped at Radio Shack and got this for you. It's a microcomputer kit. You can program it in BASIC."

"Wow – cool!" was all Demetrius could say in his cracked voice. The new kit had a microprocessor, some sensors and a big book of experiments.

Demetrius built a circuit that blinked a red LED, and then he compared that circuit to the one in his electronics kit – boy, were they different. Somehow the microprocessor plus the BASIC program were doing what two transistors, 3 resistors, and a capacitor did.

He built other circuits with the microprocessor that were similar in functionality to the old Radio Shack kit of parts. With each circuit and each BASIC program, he grasped a little more of the dance that went on between electronics and programming. A few parts here – a few lines of BASIC there, spin it together with a little solder or a few lines of code and you had some working thing that did what you wanted it to do. "But I need to learn how to do it myself," he thought. "I keep building stuff out of the book, but that's not what I want – I want to really understand electronics my way."

For Demetrius, the summer passed in the blink of an eye. As he learned more about microprocessors, he realized how important they were. "Dad, look – it's got a light sensor and a motor. It can follow a line."

"Yes son. It's going to open up a new world for you. If you build the line-following robot, you can learn all kinds of stuff. Here, let me show you some good websites about microprocessors and robots."

## Chapter 5.

Sometimes, his dad would setup the telescope in the back yard and they would watch the stars, the moon and the planets. Demetrius looked on an astronomy website and knew what to look at for each night. Near the end of August the unpleasant odor of wild onions filled the night air as he punched "Moon" into the controller and watched the scope slew east. "Dad, look: I see the new moon rising. Whew, I don't like that smell."

His dad peered through the eyepiece at a razor-thin sliver of light on the eastern limb of the moon. He smiled at Demetrius and said "quite a 'scope, isn't it? Yeah, those onions stink. I don't like 'em either."

"Yeah, it's a cool scope. I think I'm starting to understand how the sun and the moon and earth really circle around each other. Dad, what did you mean when you said 'even though you can't see it, it still has a powerful effect on everyone'?"

"Well son, I was talking about the new moon. It's always exerting its gravitational pull on us here on Earth. So even if you can't see it, the new moon still makes tides. You can look up at a new moon and not see it, but the moon looks back at you, and still influences your life."

He looked at Demetrius, whose brow was furrowed from trying to understand. "Son, our lives are influenced by lots of things we can't see, or feel, or smell, or hear. Some of the most powerful influences on our lives are from ideas, which we see only with our mind, not with our eyes. Also, love is the strongest forces in the universe, but you can't reach out and grab it and tell anyone what shape and weight it is."

"The power of a new moon rising in the sky is that it makes you think about vast things that have great power over you and have deep meaning inside you. Look – anyone can look at a beautiful full moon and write music and poetry about it. To be a man, you need to be able to feel the effects of the hidden world around you and sort out all the forces that influence you – the good from the bad, even if you can't see them."

Demetrius pondered that for a while and decided that it was too complicated for him to understand. "I'm going to write that down and think about it later."

"Okay son," as his dad mussed his hair. "You're pretty much a man now, so it's okay to discuss a little philosophy. You'll see some things with your eyes and some things only with your mind. Tonight, you knew that the new moon was rising, but not because it was particularly visible. When you get older you'll understand that the most important things in life you'll only see with your heart – that's what I mean."

Suzu was taking it all in too – her tail bounced off some invisible stops – first left, and then right. She looked up at her master and begged for a pat.

"Look at you Suzy – so patient. Good dog," he said as he gave her a good pat and scratch behind her ears.

She shook her big body then and relaxed. Everything was going to be fine. Sam, the cat made sure that he walked by with tail raised high, as if to say "Foey on them for not petting me when they had the chance."

## Chapter 6.

Labor Day came and went, and then school started. Demetrius was pleased with his new teachers. Especially with his new science teacher, Mr. Jack Thompson, who had just taken a microprocessor training course during the summer break. They had lots to discuss. Demetrius wound up staying after school a lot – and enjoying it a lot more. Julie Josephs, his new math teacher had just moved into the area from Washington, where she had been awarded a teaching medal that was proudly hung behind her desk. "I'll have to ask her a bunch of questions" said Demetrius to himself.

Chemistry was a new experience for Demetrius, and the teacher was very old and experienced. During the first week, Sarah Kyle explained about valence electrons and bonding and moles that weren't animals. Demetrius was enjoying the whole experience and wrote notes that he could study later.

"Carbon is almost a miraculous substance," Miss Kyle started out one fine October day. "It is stable in some forms and unstable in other forms. Our bodies are made up of lots of carbon – in fact we're called carbon-based life forms. The lead pencil that you write with uses graphite, which is a form of carbon. The air we breathe has carbon dioxide in it, which our body produces. Another form of carbon is called carbon fiber, which is extremely strong and light weight." She held up a picture of a red ZR1 Corvette, which ignited the passion of the students, and then she said "The intake manifold, the dashboard and the front fenders and the roof are made from carbon fibers. Here is another form of carbon: look at my ring – the diamond is carbon. In fact diamonds come in many colors and forms. Here are some pictures from the Smithsonian gem exhibit."

A few days later she talked about valence electrons again: "The outer shell of electrons in an atom is what this course is really all about. Atoms form bonds with other atoms because of the different charges caused by a surplus or lack of valence electrons. Valence electrons also can absorb or release energy in the form of photons. When you put in energy, the atom can spit it back out, in the form of light – that's how a light-emitting diode works."

Demetrius was fascinated by the discussion. After class he asked her "How do valence electrons get into balance?"

"If you put energy in, they absorb it, but then release it later as a photon. That might be called heat or light, depending on your point of view."

"Is carbon stable?"

"Well no – and yes. A carbon atom has 4 valence electrons, so it has a negative charge. And an oxygen atom has 6 valence electrons. When they come in contact, 1 carbon atom forms covalent bonds with 2 oxygen atoms. Plants breathe it. We exhale it. Carbon dioxide is a fascinating chemical compound."

"Gee thanks Miss Kyle. I'll have more questions tomorrow."

"Yes Demetrius, I'm sure you will. Goodnight now."

Miss Julie Josephs was a tall, attractive woman with black fingernail polish, red streaks in her blond hair and a left ear loaded with earrings. She had a reputation for teaching math "by the book." Problem was, the wrong books were delivered at the start of the semester. "Class, we have Calculus I books, but we're supposed to have Algebra I books. I don't know how it happened, but here's what I propose: I'll teach you calculus instead of algebra. You only need a minimal amount of algebra, plus some trigonometry in order to learn calculus. You'll find that it's easier to learn calculus without going through the 5 or 6 courses that the school system usually requires. By time you're ready for calculus class, you're burned out – I know I was. What do you say? Is anyone ready for calculus?"

Demetrius' hand shot up. Then he looked around and only one other student put her hand up.

"Okay, class. Let me just show you what you can do with calculus, then I'll ask again."

"There are really only 2 basic principles of calculus. First: the idea of measuring the rate of change and next, the idea of finding the area under a curve. In order to make it complicated, mathematicians call these two ideas differentiation and integration. Calculus has some very cool ideas about speed, distance and time." Demetrius' ears perked up at that. "If the speed of a car varies on a trip, how do you know how far you went in a given time? In calculus, we take a little, itty-bitty bits of numbers called 'd', and simply throw them away – poof, they're gone. You know that it's impossible to divide by zero, but if you use 'a little bit of 'd' instead, you won't be violating any rules of math. How's that for cool? Now, how many students want to learn calculus?"

Three students raised their hands.

"Okay then, it's settled – calculus it is," and she passed out the only textbooks the classroom was likely to get anytime soon.



## Chapter 7.

In mid-October, Mr. Thompson told Demetrius: "I brought in this old electronics kit for you. I've had it for ages, and I never assembled it. Maybe you'd like to do it after school?"

Demetrius' eyes popped wide. The aged-box said 'Heathkit IO-18 Oscilloscope' "Gee, an oscilloscope. Wow!" When he opened the box a stale, musty smell of degraded cardboard came out. "Whew, that's old," he thought.

Night after night, Demetrius built the nearly ancient electronics kit, while Mr. Thompson watched from his desk. "If you need any help, I'll be here Demetrius."

"I'll be okay Mr. Thompson. Thanks." A few nights later, after he completely read the assembly manual he said "Mr. Thompson, can you teach me how to solder?"

"Sure Demetrius. I'll bring in a soldering iron tomorrow night. It's not too hard, but it is an important job to do right."

The next night Mr. Thompson showed Demetrius how to solder wires and resistors and transistors. He brought a handful of stuff from an old junk box and had Demetrius practice soldering just about everything to just about everything else. *Eau de rosin* filled the air. "Thanks Mr. Thompson. I'm ready for the scope now."

"Okay Demetrius. Be sure to ask questions if you have problems."

The check boxes in the assembly manual slowly filled up. Demetrius learned that resistor values are easily determined by colored bands that wrap around them. He learned to read the value of capacitors from just looking at stuff like "5 uuf" on the surface of the part. "What's the 'uuf' mean, Mr. Thompson?"

"That means micro-micro farads. On that capacitor it means 5 micro-micro farads. Let me explain about how we handle very big and very small numbers in the engineering world. You know about tens and hundreds and thousands and millions. If you go the other way, you have tenths, hundredths, thousandths and millionths. A 'micro' is a millionth and a micro-micro is a millionth of a millionth. Therefore, that capacitor has a value of 5 millionths of a millionth of a Farad, which is the basic unit of capacitance. It's just that you don't normally have a Farad of capacitance lying around. In the real world we usually measure capacitance in very small quantities. 5 micro-micro farads is a good small value."

"Some of these capacitors smell funny. Why's that?"

Mr. Thompson smelled a couple of the old caps and said "You're right. The electrolytic material must have dried out by now. I'll order some replacement parts tomorrow. You can continue with assembly, but we'll hold these parts aside for now."

He learned about tubes and transformers and high-voltage. "What is this tube, Mr. Thompson? It has a lot of pins coming out of it."

"That's a high-voltage sweep tube. It is used to make the beam of the scope trace across, from left to right. A couple of those pins are for the filament, a couple are for the grids, and the rest are for the anode and the plate. Tubes are mostly obsolete now, but 40 years ago when that scope was built, they were very popular. See the scope tube? It is a tube like all the others in the kit, except it is very large, and has a special coating on its flat surface."

Late in January, the scope was ready for testing and calibration. Mr. Thompson, who was an avid Amateur radio operator, brought in a calibration device, some meters and a modern scope. "Here, Demetrius. Let's go through the testing and calibration procedure."

When Demetrius flipped the power switch on, the red light glowed, and then nothing else happened. "What's wrong, Mr. Thompson? I followed all the directions."

"We'll find out Demetrius. Troubleshooting problems is a better way to learn than if things just work the first time. Let's trace out the schematic. We'll find the problem."

Night after night, they went through a long diagnostic process of proving the circuit was wired right. "You have to mark each circuit as we diagnose it. See here on the schematic are the correct voltages and waveforms that we're supposed to get. Be careful now, there's high-voltage in here. See that wire there, the one going to the display? Well it has a couple thousand volts going to it. If you get close, it will bite you real bad. It could even knock you down."

Demetrius looked at the wires carefully and thought about the high-voltage that was just sitting on that red wire. "Why do they need so much voltage if it's so dangerous?"

"Well, the high voltage is used to steer the electrons towards the face of the scope tube. If you want a bright beam hitting the face of the tube, you need high-voltage to accelerate the electrons to great speed."

Demetrius listened carefully – he always liked hearing about high-voltage and fast electrons.

Mr. Thompson taught Demetrius to read a schematic diagram like a wiz. Demetrius got to use a voltmeter, an ohmmeter and a signal generator. Mr. Thompson was a very patient mentor, and told him how each part of the scope's circuits worked. "Here is the horizontal oscillator – it makes the scope trace go back and forth on the CRT. It is a triangle wave form. Let's look at that circuit on my portable scope. Okay, I don't see it. So the error is right around this circuit."

The next day, they found a simple wiring error and the scope sprang to life. A green trace painted across the 5-inch tube. "Awesome, Mr. Thompson." Demetrius smelled the slight ozone smell from the high-voltage transformer. He remembered that smell from his home TV, so he made a connection that was unexpected.

"Here is a signal generator I brought in. Let's see some waveforms on that scope, shall we?"

By Spring Break, the scope was completely calibrated and Demetrius was properly initiated with its use.

"I'll bring it to your house tomorrow night, okay?"

"Sure. You should meet my mom and dad. They're wondering what we're doing at school every night."

"Well we'll sure show 'em, right?"

"Thanks Mr. Thompson," was all Demetrius could say.

Mr. Thompson's beat-up station wagon rolled up Redcliffe Drive about 6 P.M. When he rang the doorbell, Mrs. Howard answered the door, in her kitchen apron. "Please come in Mr. Thompson. We've been hoping to meet you."

"Thanks Mrs. Howard."

"Ruth, please."

"Thanks Ruth – call me Jack. Let me get Demetrius' oscilloscope from the car."

"Okay, please put it over there," she pointed towards the family room.

Dinner lasted for hours. "Mr. Howard, your son is exceptionally bright. I've been working with him on electronics and robotics. He says you're a programmer over on Redstone Arsenal."

"Yes, I've worked on the Base for 10 years. It's never boring. I work over in building 4300. We sure appreciate all the time you've taken with our son. He sure can ask a lot of hard questions."

"Key lime pie anyone?" interrupted Mrs. Howard.

They all said "Sure" at the same time, and then they all laughed together. After pie and coffee, Ruth said "Demetrius show Mr. Thompson your lab."

"Sure mom. That was a great dinner."

"Come on upstairs Mr. Thompson."

When they got to his room, Mr. Thompson looked around – it was neat as a pin. "This is the first time I've seen a teenage boy's room this clean."

"Well that way my mom doesn't bug me," replied Demetrius. "Here, look."

He opened the top drawer of his dresser, which was crammed full of electronics parts in various stages of assembly. Then he pushed it shut and opened the second drawer, and the third drawer, each of which was categorized and labeled with various circuits and microprocessors.

"That's quite nice, Demetrius. I never thought about organizing things that way. You can come over to my house this summer and sort out my stuff, would you like that?"

"Sure. I'll be glad to help."

## Chapter 8.

Summer passed quickly, and Demetrius hung out at Mr. Thomson's house and asked a thousand questions about his electronic parts and computer paraphernalia. "Some of this stuff is real old, isn't it?" He smelled the slightly musty odor of a damp basement that had been unventilated for too long.

"Yep – some of it is older than me. My dad was interested in electronics and that's why I have all those old tubes and stuff. Let me show you the old ham radio gear that my dad gave me when I was your age."

They went to an area of the basement that was surrounded by bed sheets, hung from the ceiling. When Demetrius pushed back the sheets he was totally amazed – a complete ham radio station from an earlier time was just sitting there like it was switched off yesterday.

"What's this?" asked Demetrius as he picked up a heavy brass mechanical object.

"That's a Morse code key. You can send messages all over the world with it. My dad used it a lot. I'm pretty rusty now, but I used to be real good with it."

Demetrius turned it around several times and asked "How does it work? There's no keyboard or microphone."

"See that paddle? You push it one way to make short sounds called 'dits', and push it the other way to make longer sounds called 'dah's'. I can see you don't understand that. Here – would you like to hear some Morse code? Let me turn on my rig."

In a minute, Demetrius recognized the slight ozone smell of high-voltage.

Mr. Thompson tuned around the ham bands for a few minutes and suddenly the sound of Morse code popped out of the speaker. "What're they saying, Mr. Thompson?"

"That's two ham radio operators, one is in California and one is in South Carolina. They're talking about the fires in California right now."

"You can tell that just from listening to those sounds?" asked Demetrius in awe.

"Sure. You can learn Morse code. It's not very hard. Are you interested?"

"Sure. I'd like that. How do I do that? It's just like birds chirping."

"Well, I'll setup a unit that will send Morse code to you. Every night you can practice copying the code until you understand it. Then you can send it with a Morse code key, like that one."

The next night Mr. Thompson said. "Let's begin. It's really easy if you open your mind. The Morse code was developed so that telegraphers could send lots of messages real fast. So it's built on the idea that

alphabetic characters that are frequently used are very short. Morse code is also based on the idea of patterns. You'll see. Listen..."

He pressed the Morse key mechanism to the left: "BEEP" came out of the nearby speaker. He pressed the key twice: "BEEP BEEP" came out. "Now listen to this: "BEEP" "BEEP BEEP" "BEEP BEEP BEEP" – those are the Morse code signals for the letters E, I and S. Here are T, M and O: "BEEEEEP. "BEEEEEP. "BEEEEEP., "BEEEEEP. "BEEEEEP. "BEEEEEP." Can you hear the difference between the short sounds and the long sounds.

"Sure, Mr. Thompson. Do it again."

So every night Demetrius and Mr. Thompson got better and better with Morse code. After a couple of weeks Demetrius admitted "It's easy. You just have to listen carefully."

"You're right. Plus, my code is really improving since I'm practicing every day. If you're interested in Amateur radio then during the 3rd week in August every year, ham radio operators from all over the Tennessee Valley get together in downtown Huntsville. If you study hard, you can get an Amateur radio license. Would you like that?"

"Sure Mr. Thompson. What do I need to do?"

"I bought you this book about ham radio for you. Read it and ask me questions. You have 3 weeks until the test. I'll drive you there."

Every night after getting home, Demetrius read and studied and then read some more out of the Amateur radio study guide. Finally the big day for testing arrived. Bright and early on a Saturday morning, Mr. Thompson's old station wagon was parked in the driveway and Demetrius zipped down the stairs and out of the house. On the drive downtown he read through the ham radio book one more time for good luck.

At the annual Huntsville Hamfest, Demetrius was overwhelmed by the electronics flea market and got to see and touch all the latest ham radio gear. Everyone knew Mr. Thompson, and he introduced Demetrius all around. "He'll be taking his test today," he kept telling folks.

"Good luck Demetrius," they all said.

But Demetrius didn't need luck – he had read and re-read the book until he understood it all.

## Chapter 9.

When Demetrius showed up for his Amateur radio license test, about 50 other people of all ages were already there. He filled out some FCC forms, paid ten bucks and started the test. Thirty minutes later, he was done – and thirty minutes after that he found out that he passed the test.

One of the volunteer examiners shook his hand and gave him a small piece of paper. "Mr. Demetrius Howard, congratulations. You are the newest Amateur radio operator in Huntsville, Alabama," he chuckled. "Be sure to check on the FCC website in a few days to get your new call sign. And Demetrius – have fun."

As he was leaving, he spotted one of the girls from his school. "I've seen her before – Debbie's her name," he recalled. He saw her look up at him, wave and smile. He waited for her to finish her paperwork and then she turned to him and said "Demetrius, I didn't know you were interested in ham radio. I just upgraded my license. How did you do?"

"I passed the test, Debbie. I got my ham license. What were you here for? I didn't know you were a ham radio operator."

"I upgraded to Extra Class," she said off-handedly.

Demetrius was well aware of how hard that technical test was. "Wow, congratulations Debbie."

"Here are my mom and dad," she said. They congratulated her on passing her upgrade test to the highest-level. She introduced everybody. "This is Demetrius. He goes to school with me, but we don't get to see much of each other. He just got his license today."

"Congratulations Demetrius. My wife and I are both ham radio operators. This calls for a celebration. We're going to Sandoval's Mexican restaurant for dinner. Please join us."

"Okay Mr. Taylor. I'll need to tell my parents where I'm going."

Demetrius found his parents and told them that he passed his ham radio license test, and that he was invited to go to dinner with Debbie Taylor and her parents.

"Congratulations son," they both said. "Mr. Thompson has sure inspired you. Go on now; we'll pick you up in a couple of hours. Just call us when you're done. Have fun." His dad slipped him \$20 and said quietly "Here's some cash for your dinner. See you later."

On the way to the restaurant, Debbie Taylor sat next to Demetrius and he glanced over at her while she talked about ham radio and school. He thought to himself "she's kind of plain, but kind of cute, too." When they got to the restaurant, he helped her out of the car, and he saw her blush when he offered his hand. "Well, that's what they do in movies, right?" he asked.

Mr. Taylor jumped to his rescue: "Right, Demetrius – Southern women expect their men to be polite. Then, with a flourish, he helped his wife out of the car. Come on now, let's grab a table. Then he and Mrs. Taylor went hand-in-hand into the restaurant, and Debbie and Demetrius followed close behind. When they accidentally brushed against each other in the booth, they both felt a special energy, and they both looked down at the table and their tacos. All during dinner, the Taylors talked about ham radio while Demetrius and Debbie stole glances at each other. When they left, Demetrius offered to pay for his dinner, but Mrs. Taylor spoke up quickly. "You're welcome to come over any time Demetrius. I think that you and Debbie are both going to be good friends. You just save your money now."

Demetrius was feeling a little giddy and he thanked the Taylors and said goodbye to Debbie. Then he sat on the bench outside the restaurant and waited for his parents to pick him up. When his dad came, Demetrius sat quietly in the back seat, thinking about the events of the day. He wanted to ask his dad about his feelings, but he decided to wait till later.

Finally his dad broke the silence. "We were proud of you today, son. I've always wanted to get an Amateur radio license, and you've given me some inspiration. Next year, I'm going to do it. How were the Taylors? I heard you say that Debbie upgraded her license. You'll have to tell me about that later."

"I'd like to dad," was all he could say.



## Chapter 10.

For his 14th birthday, his dad asked him "Demetrius, you get to choose: a trip to Radio Shack or a trip to the Davidson Space and Rocket Center?"

Demetrius pondered carefully. He really needed a few more electronic parts, but he had never been to the big rocket museum in Huntsville. Every time they went whizzing by on Interstate 565, he looked at the huge rockets sitting there, like they were ready to launch.

"Space and Rocket Center, dad."

"Okay son. We'll go Saturday morning."

When they arrived at the U.S. Space & Rocket Center, Demetrius just couldn't believe all the treasures that he saw. The newly opened Davidson Center for Space Exploration had an unbelievable hoard of space memorabilia. He said "cool" and "way cool" possibly a million times that day.

Outside, the first thing he saw was the SR-71 Blackbird spy plane. "It looks like it could go a thousand miles an hour, doesn't it, son?"

"Wow, dad – can I touch it?"

"Sure. Everything here is accessible. You go ahead and look at the Blackbird. I'll be right back." Mr. Howard went inside the USSRC building and went to the Information Desk. "I'm Mr. Howard. I called last week and requested a docent. It's our first time here and we'd like to see as much as possible."

"Sure – we have docents that are glad to take you around. Let me get one for you."

In a few minutes a college student arrived and said "Hi, I'm Sue Brand. I'll be glad to take you around the space campus."

When they went outside, Demetrius was lovingly running his hands over the warm black skin of the Blackbird. "Feel it, dad. It's so cool."

"Okay son. Here is Miss Sue Brand. She's going to be our guide today."

Demetrius looked up at the lovely guide, but his eyes caught sight of a rocket out behind the building. Sue saw what he was looking at and said "Let's start right here – this is the SR-71/A-12 Blackbird. The U.S. used it as a reconnaissance aircraft. This one is a working aircraft – it flew 258 flights."

"It was built by the Lockheed *Skunk Works* as a classified 'Black project'. It's built from titanium. Here's a secret that most people don't know: we bought the titanium to build this plane from the U.S.S.R. during the cold war, and they didn't even know what we were doing with it. Also, it was really the first 'stealth' aircraft – that black paint contains minute iron balls that dissipate radar, so the plane was harder to spot by the Russians."

Demetrius asked "How fast does it go?"

"Right, everyone wants to know that. We're not sure, because that information is still classified, but it was designed to cruise at mach 3.2 at 80,000 feet, yet this plane flew 2,125 miles per hour and went up to 85,000 feet. It's almost 100 feet long and weighs 120,000 pounds when it's fully fueled. In fact, it required 84,000 pounds of fuel to fly so high and so far – it gulped 8,000 gallons of fuel per hour." She paused while they both did the mental math on that.

"Here's another thing that most people don't know: with the pictures that the Blackbird took, you could read a car license plate from 80,000 feet."

"How'd they do that?" Linc asked. "Is film resolution that good?"

"Well the camera took huge sheets of images, not little snapshots. Then they were processed in Washington at a super-secret agency called NPIC. I don't know anything about them, but I think they're part of the CIA or something."

Sue continued: "Towering over the entire USSRC complex is a replica of the mighty Saturn V, freshly restored to like-new condition. This is a replica of the rocket that took man to the moon."

They all stood under the rocket nozzles and Demetrius studied their curves and realized something about 3-dimensional geometry that he wouldn't have grasped any other way. "I could focus something with that kind of shape," he thought. "If I connect fiber optics up to the focal point, then the light-energy would be concentrated."

Linc said "Huntsville played a critical role in making a moon rocket, son. After the Second World War, some of the German rocket scientists came to Huntsville. They were led by a scientist named Doctor Werner von Braun. America couldn't have gotten into space so soon if he hadn't led his team of rocket boys – I think the Russians would have beaten us there. Where I work every day on Redstone Arsenal is where he did the calculations for building rockets – that's Redstone Arsenal, right behind the Space Center," he pointed.

Sue smiled and said "Most people don't know that Dr. von Braun was the person who suggested this whole complex. In the '60s, he talked to local leaders about building a permanent museum for the growing collection of space artifacts."

"Now let's look at the Saturn I, the Pathfinder, and the Apollo 16 command module, which was called '*Casper*'."

Then she pointed "There's the Space Shot simulator. If you get a chance, you gotta try it Demetrius – it's awesome. Just remember to do it BEFORE you eat," she chuckled.

Then she said "We also have great educational space programs called Space Camp, Aviation Challenge and X-Camp. Here's some literature that you can read. Maybe you'll come back and learn how to be an astronaut."

"I guess I'd like to be an astronaut and see space," he replied, but he was staring at the main building, waiting to go inside.

"The Aviation Challenge has an F-14 Tomcat; an F-16 Fighting Falcon; an F-4 Phantom II; a YF-111; an A-7 Corsair II; a Cobra; an Iroquois; a Harrier jump jet; a T-38, and a Russian MIG-15," she rattled off. But she saw that Demetrius was tuned out of the outdoor exhibits and anxiously awaiting the indoor-tour, so she suggested: "Let's go inside – there are 1,500 items on display in there. Plus we have a great Spacedome Theater that you'll enjoy."

Demetrius walked around with his mouth open for the next hour. "This is the largest space museum in the world," she said proudly. Then she discussed every exhibit in detail. She knew all the 'secret stuff' about every exhibit. "This space suit was actually worn by the astronauts. Here is some real moon dust. That's astronaut Sally Ride's signed picture there," she went on and on.

By late afternoon Sue excused herself and left them alone.

"How about an I-MAX movie – my treat," asked Linc.

"Sure, that's great."

They watched the giant Spacedome Theater present "*Magnificent Desolation: Walking on the Moon*."

By the end of the movie, Demetrius was as happy as a young man could be. "I'll go there someday, dad. Just wait and see."

"I just bet you will, son," as he mussed his hair and gave him a gentle nudge in the arm.

## Chapter 11.

Fall turned to winter, but Alabama winters are pretty mild. Once in a while he saw Debbie in school, but he didn't get many chances to talk to her – they both ran with different crowds. In November she spotted him in the hall one day and came and stood right by him.

"Hey, D," she said.

"Yo, D," Demetrius responded.

"Did ya' get your license in the mail?"

"Yup. Did ya' get your upgrade yet?"

"Yup." They stood around nervously for a minute, and then Debbie spoke up. "Want to come over for Thanksgiving dinner? My folks bought me a new ham radio."

Demetrius could feel the blood rush to his face. "Er – Ah – sure. I'll have to ask my mom and dad, but it should be okay."

Debbie reached out just a bit and touched his hand. "I'd like that Demetrius," she said, and then she rushed down the hall towards her next class.

"I really need to talk to dad," Demetrius said to himself as he felt himself blush.

When he got home he completed his homework quickly and then went downstairs for dinner. "Do you mind if I go over to the Taylor's for Thanksgiving dinner? Debbie invited me."

Linc and Ruth looked at each other and blinked.

"Okay, son. Fine with us."

"Ah dad, can I talk to you later?"

"Sure son, I'll be upstairs in about an hour." Ruth looked down at her plate – she knew the topic of the discussion, for sure.

After dinner, Demetrius buried his nose in an online robotics magazine. He had built a couple of pretty good line-following robots, plus one that used an ultrasonic pinger to calculate the distance to an object. But then he wanted the pinger to somehow sweep from left to right so that he could get a better idea of what was in front of his small robot. He didn't have enough parts or enough knowledge to do that so he was filling his electronic journal with notes and questions for his dad and Mr. Thompson.

Finally his dad walked in and said "What's up, son?"

"Well dad, I just wanted to talk about ... well, you know."

"No son, what?"

"Girls," he replied with a blush. "I kinda like Debbie, but I don't know what to do. When I'm around her I feel funny, ya know. I just don't know what to do."

"Well son: just be you. That's all she's looking for. That's all any woman is looking for. They want an honest man to talk to. It's really that simple. Your mom and I have been together for over 20 years and let me tell you, every day with her is as good as the first day. We still talk about the things that make us happy, and we still enjoy each other's company. We enjoy talking about you; we enjoy talking about work, and the yard, and her newest knitting project. Women aren't really different from men at all – they just want to be respected and loved. Do you understand that?"

Demetrius thought about that for a minute. "Yeah dad, I guess so. I didn't expect to find someone like Debbie, so I'm kinda nervous and maybe a little scared. Plus I'm afraid of what the kids at school might say."

"Son, feeling 'kinda nervous and maybe a little scared' is just fine. Every man feels like that around a woman, especially in the beginning. As far as the kids at school, don't worry – they'll finally give up the teasing when they see you two are together."

"How will I know if we're right for each other?"

"Son, I think you already know. You're old enough to make up your mind on things like that. Look Demetrius, you're going to make some good decisions and some bad decisions – but they're all your decisions, right? You're almost a man, and your mom and I are proud of you. You'll do just fine. Debbie is a nice girl. It's only up to you and to her where it will wind up. Some folks would tell you that you're too young, or that she's too young, or that you're a different race or religion, or you're too tall and she's too short, or intelligence or something will prevent you from having a great relationship. But couples get married every day of the week and the ones who are in it for the long-haul work out their problems in a spirit of giving and love. Son, you're a little young to be married, but you're not too young to be dating a nice girl. Enjoy her company – treat her with respect – 'nuff said."

"Thanks dad. I've seen enough of you and mom to know how some of that works. I can tell that you both love each other."

"We sure do, son. Now how's that line-follower project coming?"

"Not very well, dad: this Radio Shack robot doesn't have enough power. I need more gears and other components. I saw on the Web that they have a kit called a Vex robotics kit, but it is too expensive. But it would do the job, for sure."

"Well son, let's see if Mr. Master Card can help us out of a bind. Let's go on down to the mall and see that Vex robot kit, what'd'ya say? It's almost Christmas."

"Gee, thanks for everything dad."

His dad gave him a quick hug on the way to the car.

## Chapter 12.

When Demetrius was working with the new Vex Robotics kit, he felt like he was in heaven – it took him a couple of weeks of experimenting, but he was finally able to get the parts from the old kit and the new kit melded together into an impressive array of teenage electronics nirvana. From time to time he and Debbie sat together in the school lunchroom and endured the harassment from their school mates. "You're so immature" was her off-handed reply to them. Bill and Ted harangued him a couple of times, but then they left him alone, to pick on one of the new kids.

One day, as Thanksgiving approached, they were sitting together talking. Debbie gently touched his hand. "I'm glad you're coming over for dinner," she said quietly, and then she looked down at her food, and they both felt the warmth of new love coursing through their bodies.

"Me too, Debbie," he replied quietly, but he couldn't look up at her.

Demetrius dressed up in his Sunday suit, and his dad helped him tie his tie. "Now remember son, just be you," he said quietly.

"Okay dad."

Thanksgiving at the Taylor's home was very nice for everyone. Debbie and Demetrius sat together, across from the younger Taylor twins: Sue Anne and Anne Sue. They all had lots to talk about, especially the twins, who were studying for their ham radio licenses. "I love the smell of turkey and dressing, don't you Demetrius?" asked Debbie.

But before he could answer: "Di-di-di-dah," said Sue Anne, as a challenge.

"V" replied Demetrius.

The girls giggled at him.

Mrs. Taylor spoke up: "Okay girls, help clean off the table. Desert's next."

When the dishes were cleared and they sat down again for desert, Debbie reached over and put her hand on top of Demetrius' hand. He didn't flinch. Instead, he looked her right in the eye "Thanks for inviting me Debbie."

Mr. and Mrs. Taylor saw them holding hands, and so did the twins, who giggled out loud as they raced out the door for their bicycles.

"He's cute," said Sue Anne.

"Dreamy" replied Anne Sue, giggling all the way down the block.

The table was cleared again and the Taylors put on a movie. The four of them sat on the U-shaped couch and watched John Wayne play Rooster Cogburn in a famous old Western. Debbie and Demetrius sat through the whole movie holding hands. So did the Taylors.

When the movie was over, Demetrius called his dad for a ride. On the way home his dad asked "How did it go son?"

"It went great Dad. I really think I like her. Debbie, I mean."

"That's good son. Your mom and I missed you tonight, but I'm glad you had a good time."

Winter passed slowly. Demetrius spent a lot of time with his new robotics kits and electronics kits. Sometimes he visited Debbie at her house, and sometimes she came over and they did homework together.

"You need to get a ham radio so we can talk to each other," she offered. "We've got a couple of good repeaters around town. If you get a handheld radio, and we can talk anytime."

"You're right Debbie. I've saved up enough money for one. I'm going to go to the ham radio store and pick one up. I talked to the guys at the GigaParts store at the Hamfest, and they gave me a discount coupon. I'll go down there with dad this weekend and pick one up. Wanna come along?"

"I can't. We're going to Nashville for the weekend. But I'll see you in school next week, okay?"

That weekend Demetrius got a lightly-used handheld Amateur radio, called a walkie-talkie. He hesitated when he saw how much it cost, but his dad said "Son, you've been doing an outstanding job at school. I can't even keep track of all your A's. Let's see what's in my wallet. I'm going to get you that radio for you as a special present."

"Gee, thanks dad. I wasn't expecting that."

"It's okay son. Let's go home and get that thing programmed. I want to hear you on the air."

Demetrius and his dad spent a few hours charging the battery and loading the software, connecting the radio up to the computer and programming in the local repeater frequencies. Finally Linc said "Go on now. Call somebody on that thing."

Demetrius pressed the push-to-talk button and said "This is KW4WZZ. Is anybody listening?"

Immediately he heard "KW4WZZ, this is KW4OOT. My name is Jordan. I'm in New Hope. How's my signal?"

"Your signal is fine Jordan. My name is Demetrius. You're my first contact."

"Okay Demetrius. Glad you're on the radio today."



The friendly conversation lasted 5 minutes, and then another ham radio operator congratulated Demetrius on his new license. Several more hams joined in, and Demetrius was the center of attention for 30 minutes. He looked at his dad, who was watching all the radio activity, and he could see that his dad was slightly jealous, maybe?

"Well I have to go now. Thanks everyone and 73's," and then he put down the radio and thanked his dad again.

"You're welcome son. I'm glad you're having a good time with it."

Demetrius was right – his dad was jealous.

## Chapter 13.

After spring break, Mr. Thompson told Demetrius about a new robotics club that was forming at the school. "We're going to have a FIRST Lego League here, Demetrius. Are you interested in joining? It runs for 8 weeks, and students meet 3 times a week, plus Saturdays. You'll need to ask your parents if you can spend that much time on it."

"Gee thanks Mr. Thompson. I'll sure ask."

He went home and asked his mom to let him join the robotics club which met after school. "I'll learn a lot about robots and electronics. Plus they have adult mentors come in from some of the local companies to help out. I can ask them some of the real tough questions that I have. Is it okay mom?"

"Of course, son. Your father's in Colorado right now, but he and I will take turns picking you up after school. You can call us 30 minutes ahead of time, and one of us will be there. Is that okay?"

"You're the best, mom."

"You're pretty special yourself, Demetrius. Now finish your plate. It's time to study."

The FIRST Lego League team named *Team Ka-Blam!* met 4 times a week. The technical mentor, Mr. Donald Hilliard, was a little tough on the team – he actually wanted them to have fun, but learn something in the process. So he mentored the team on math, electronics, and physics. Armed with that new information, the team started asking better and better questions: "Mr. Hilliard, how do we calculate gear ratios?" "Mr. Hilliard, how do tank treads work?" "Mr. Hilliard, what's the sweep angle of a pinger?" "Mr. Hilliard, what is pulse-width modulation and how do servo motors work?"

Debbie Taylor was one of the team members. Her knowledge of ham radio was invaluable in getting the robot to move around the playing field. As the weeks went by, Demetrius and Debbie grew closer. "You need to use a 5:4 gear ratio on that," she said, pointing at the robot's drive train.

"You're right. What frequency are you going to use for the transmitter?"

"Do you want to use pulse-width modulation or FM?" she asked. And so it went during each meeting.

Mr. Hilliard was having a good time explaining stuff and *Team Ka-Blam!* created a real work of art.

When the day of competition arrived, it was a stormy, nasty day. In case of a possible weather alert, both Demetrius and Debbie had their ham radios clipped to their belts. There were teams from all over Madison County in attendance. Demetrius and Debbie walked around the auditorium, meeting the different teams. The theme of the competition was "*Hoop Shots*," and the robots were supposed to toss as many tennis balls through a 1-foot wide hoop as possible in 2 minutes. The sturdy robots all had a different approach to the problem, and each team was decked out in wild colors and face-paint. One of

the adult LEGO leaders started the crowd chanting in the bleachers, and the auditorium became barely-controlled pandemonium as pair after pair of teams squared off for the test of robotics skills.

"Look D.," Debbie said, pointing to one of the teams dressed in flamingo-pink: "they're having problems with their radio. Their robot is just circling."

"Yeah, I'm glad we're using ham radio frequencies instead. There's too much interference with the stupid CB channels they picked."

Two minutes later, the robot, called *Pink Flame*, was ignominiously lifted out of the pit and the team left dejectedly. "Stupid 'bot. What's up with the radio? How come you couldn't control it?"

None of the team members had a clue why radio signals didn't work for them that day. The smell of burned nylon gears and worn out rubber wheels filled the air.

Debbie and Demetrius high-fived each other and then the other team members, who really valued their ham radio skills.

The next teams were up for competition, and the crowd of adults was cheering wildly. Debbie had to let go of Demetrius' hand to put her hands over her ears and block the noise. He tried to shout something at her, but she couldn't hear him.

Then it was time for *Team Ka-Blam!* and *The Ball Hogs* to face off. The robots were placed in the pits; the judges made sure that the kids were out of the way and then HONK! squawked the judges' air can, and hundreds of pent-up tennis balls were released into the gaming area. Jamie Swaronk was running the remote control, and boy was she good. The scooper on front of *Tem Ka-Blam!* opened and closed, and then dumped a scoopful of balls into a bucket on the rear part of the robot. Then a spring-loaded arm picked a ball and pitched it towards the hoop. The crowd was going wild. *Team Ka-Blam!*'s robot was swift and sure. In another minute, it was all over. The team members laughed till they cried. They heard the adults in the bleachers applauding them, and then they saw their score posted – it was the highest one of the day.

"*High 5!*" they all said as they danced in a circle, high-fiving each other. Then the lights blinked off and then back on. Suddenly, the auditorium got quiet, and then they heard loud wind and rain.

"I was trying to tell you before, Debbie. The National Weather Service issued a severe thunderstorm warning for Madison County. We're under the gun for the next hour."

Then the lights went out again and the crowd waited a minute, then another. Then they all reached for their cell phones. The results were predictable: cell phone service was denied when that many people asked for dial tone at the same time.

Debbie and Demetrius unclipped their ham radios from their belts and listened to the weather alert. Debbie looked around for the principal. "Mr. Bromson, please come here," shouted Debbie.

"What's going on Debbie? What's that, some kind of radio? Does it work in here?"

"Yes Mr. Bromson. We're both ham radio operators. The National Weather Service just issued a tornado warning for Madison County. You need to hear this."

"Thanks Debbie. Can you talk on that thing?"

"Sure. We're both familiar with emergency communications procedures."

"Okay. Can you find out if we're in the path of the storm?"

"Sure Mr. Bromson. Wait a minute."

Demetrius held up his radio so that the principal could hear. Debbie turned away and spoke into her radio: "Net control, this is KM4ZUT. We're at Butler High School. Principal Bromson wants to know if the school is in the path of the tornado."

Within two seconds she heard "ROGER KM4ZUT. I'll get an update and get back to you."

"There's a ham radio operator at the National Weather Service. He'll check with the meteorologist in charge and get back to us," she told the principal.

Less than two minutes later, the principal heard the latest weather report, and it was a bad one. But it sounded like the storm was moving to the north of their location.

"KM4ZUT this is net control. The National Weather Service says that your location is a little to the south of the main track of the storm. They urge caution, but you are not in the direct path of the twister."

"ROGER, net control. Thanks. KM4ZUT OUT."

The principal turned to Debbie "Thanks for that information. I've heard about ham radio, but this is the first time that I realized its true value."

"Attention parents and students. The storm is moving north of us. You are free to leave if you wish, or you can stay here and complete the games."

Just as he got done with the announcement, the lights went on, and stayed on. Within 5 minutes, the level of excitement was elevated and the threat of the storm was forgotten.

"Good show D," Demetrius said.

"You too, D," she replied.

*Team Ka-Blam!* won the robot competition by a wide margin. When the prizes were passed out, they won the prestigious "*Innovation Award*" and everyone stood up and cheered their team. Then they

were invited to the State finals. Everyone on the team knew that they would have to get much tougher to win.

At their next meeting, they asked questions that brought joy to Mr. Hilliard. He had been told time after time that "*at-risk* students will never have the time to give to robotics a chance," and "all these kids will do is fight all the time," and "these kids don't want to learn – they're just trouble."

"Just listen to you," he said to the team, "you asked how to speed up and slow down the robot in a smoother manner. I bet you never heard of P-I-D, did you?"

They looked at each other, shrugged and then looked back at him.

"Proportional, integral, derivative: P-I-D. If you want, I can explain it to you."

"It's a kind of control loop that corrects behavior by measuring something and then adjusting the result. Here's how it works." The next 3 evenings were spent explaining, coding, and putting hardware together to implement a PID controller for their robot. In the middle of the last night, the police came and arrested one of the team members. Apparently he had been involved in a gang shooting a few weeks before, which all the students knew, but Mr. Hilliard and the principal didn't know about at all.

The next week, Mr. Hilliard explained the basic principles of calculus, and how it applied to robots, to the students. He realized the total fulfillment of his dream: teaching. He'd been a teacher before, but it was really a lot of administrative hassle and paperwork. Evening mentoring of a robotics team was absolutely stone-cold fun. The kids were there because they wanted to be there. They didn't hold back on questions about math or science, or philosophy. He became their second father and they treated him with respect, instead of throwing spit wads and shouting curse words during class, these students peppered him with technical questions and made him a part of their group. He was glad that he was committed to the team's success.

One day, Demetrius asked: "Mr. Hilliard, what are phasors?"

Mr. Hilliard thought about that for a moment and replied "Demetrius, do you mean the weapons that they use on Star Trek?"

"No, Mr. Hilliard, 'phasors' like in calculus. I read about them in that on-line calculus course from M.I.T. that you pointed us to. I think I can use phasors to point my ultrasonic pinger in the right direction."

"Okay Demetrius. In electronics, we use the word phasors to describe the relationship between amplitude, phase and frequency of a sine wave. Let me show you on the board," and he drew an example of a circuit on the board. "See how the amplitude, phase and frequency are time-invariant?"

"Now I see, Mr. Hilliard. Thanks. Does that mean that a sine wave is a projection on the real axis of a rotating vector on the complex plane?" asked Demetrius. "Uh, sorry, Mr. Hilliard, I didn't mean to make you cry."

"No, Demetrius, I'm crying for joy. You have asked the most elegant question. It's too late tonight, but tomorrow I promise that we'll go into all of this in great detail. Is that okay?"

"Sure Mr. Hilliard. I'll be here."

"So will we!" shouted the rest of the team, who had been watching the board fill up with phase vector equations made up of Greek letters. "*Go Team Ka-Blam!*" they shouted on the way out. Mr. Hilliard just stood and pumped his fist in the air with joy.

The next few nights were spent testing and hardening their robot. Mr. Hilliard taught them about sine waves, the sine and cosine formulas, and how tangents and secants work. By Friday night, their robot was ready to compete, and the students were on page 86 of the on-line calculus textbook and were doing quite nicely. Demetrius constantly shot up his hand and pounded Mr. Hilliard with question after question, each probing deeper and deeper into the world of theoretical math, until finally he asked a question that Mr. Hilliard couldn't answer.

"Demetrius, I'm going to get you together with Professor Sally Karoom, over at the University. She's an expert in theoretical math, and I bet she'd like to talk to you."

## Chapter 14.

Sally Karoom, Ph.D. and Division Chair at the University of Alabama in Huntsville arrived at Butler High School in her black Shelby Mustang GT 500 at precisely 4:30. All the *Team Ka-Blam!* members turned out for the show (mostly to get pictures of the car with their cell phones). After introductions, that was the end of Demetrius as far as the robotics team was concerned. Every night, Sally and Demetrius filled board after board with equations that would choke a horse. The other students couldn't keep up with all the Greek letters and went back to robot-building.

A week later, Debbie told him: "Yo, D, you're getting pretty weird on us. What's up with all that math? You've got more Greek on the board than a novel by Aristotle. Join us for some fun."

"Sorry Debbie, I have so many questions that need answering. Doctor Karoom really knows her stuff. Can I just have a few more nights with her? Sorry about the team."

"Sure, you can have as many nights with the Doctor as you want – especially if you take me to lunch tomorrow."

Demetrius looked at her and saw her slight wink. "Sure, D. You got a deal."

Every night the robot got better. Tonight they were trying the new skid-steer program and it was working fine.

"Controller to robot," laughed Barbara, the student with the remote control. "When I say turn, I mean on a dime, hear? And I want a nickel change, too."

Everybody laughed at her as she made the robot do a weird Watusi across the table top. "Boom, chaka-laka. Boom, chaka-laka," the team chanted as they all got into it.

Mr. Hilliard started a Conga line and everyone joined in, followed proudly by the newly-rewired robot.

Suddenly he stopped. "Hey, we don't have a name for her – what's her name?"

The team members milled around and pondered that, and then the dumb ideas flowed. "Ethyl," "Robbie," "Sally Ride," "Ka-Blooie," "Barbara," cried Barbara, and everyone booed and hissed. "Lassie," "Roomba," "Cassiopeia," "Madam X," "Natasha" "Babe," said Mr. Hilliard, and everyone laughed. He said "No, really. Babe Didrikson was the first woman basketball star. We're shooting hoops, right? Let's put Babe's spirit to work in our robot. What do you think?"

Everyone applauded, so 'Babe' it was.

Every night Sally Karoom mentored Demetrius. "Let's go over that solid geometry again. You have a hole in your proof. Watch again."

He drilled with her over and over again until geometric proofs were a natural part of his life.

The team didn't wait for him to catch up -- every Saturday the team practiced for competition. Babe got better and Barbara got better too. Barbara really made the robot flow across the table, gather tennis balls and shoot them into the practice hoop. She made it look so easy that one of the boys challenged her "I can do it better than you," he shouted one afternoon.

"Can't," she said.

"Can too," he replied.

The challenge was on. The team formed a circle and Mr. Hilliard got out his pocket watch. "Okay kids: two minutes. Most basket wins. Ready – Go!"

Tom gathered 10 tennis balls and scored one hoop. The team applauded and laughed.

Then it was Barbara's turn.

"Go," said Mr. Hilliard. She gathered a whole bucket full of tennis balls and scored 10 hoops in a row. She had to stop because she was laughing so hard.

"The winner is Barbara – champion of the world!" he shouted, and the team hoisted her up and carried her around the table where Babe was sitting quietly.

Even Tom, who had just been beaten by a girl, was laughing and having fun.

Mr. Hilliard declared "Pizza on me. Clear the table, order the food. It's chow time for *Team Ka-Blam!*"

Sally Karoom, who was the most un-fun person on the planet was laughing so hard she was crying. "You go, *Team Ka-Blam!*"

She watched her prize student watching her and tried for the thousandth time to figure out where Demetrius was going with his line of questioning. "I wish you'd tell me what you're trying to figure out Demetrius."

"Ah, you wouldn't understand, Professor. No offense meant – you'd just say it was impossible."

She reached over and touched his cheek gently – just as Debbie looked over at them. An hour later, as the last of the pizza was being inhaled by the team, Debbie was fuming mad. "She won't take him away from me," she declared to herself. "He's mine and I'm going to keep him!"

When the Big Day came, it was an incredible experience for all the children. Mr. Howard was one of the adult chaperones, and of course Mr. Hilliard came along to root for his team.

"There must be over 800 people here, Linc," shouted Mr. Hilliard as he watched the teams compete in 4 islands of controlled chaos on the gym floor, while parents screamed encouragement from the bleachers above.



"You're right Don. This is really great turnout. I hope our team wins," replied Mr. Howard.

Six hours later, *Team Ka-Blam!* won the Regional match and they were invited to the National competition in Atlanta.

"Demetrius, listen to your mother: it's dinner time now. Leave that stuff *alone* and come down here," shouted his dad, mostly for effect, since he knew by now that Demetrius wasn't going to leave his computers alone for 5 minutes. "Dear, I'll bring him his food."

"Linc, I just don't know what's gotten into that boy," his mother said as she shrugged her shoulders. "He doesn't shoot hoops anymore, and he used to enjoy that. That robot stuff must be more interesting, I guess."

The next Thursday at school, Debbie cornered Demetrius by his locker, grabbed his hand, and looked up at him. "D, where have you been? What's that professor Sally got that I haven't got?"

"Huh?" replied Demetrius. "She's just a math teacher over at the University of Alabama. She doesn't mean anything to me." His mind was suddenly jarred awake as he looked down at Debbie and saw that she was wearing: lipstick – which she absolutely never did. Then he looked more carefully and saw that she was wearing a short skirt and a purple silk blouse – all completely out of character for her. Then he looked all the way down and saw high heels, and he finally understood – Debbie was jealous!

"Oh man, Debbie – have you got it wrong," he said sheepishly. "You don't have anything at all to worry about. I just talk calculus and set theory with her. You're my girl."

Debbie looked into his eyes. "Oh yeah, so what are you going to do about it, D?" as she stepped as close to him as she'd ever been.

He could feel her beating heart as he bent down and kissed her for what seemed like an eternity.

"'bout time, you big fool" she said. "Ha!" Then she turned around and made sure he watched her strut all the way down the hall. Her girlfriends whistled and applauded her. Demetrius' friends whistled and jeered.

Demetrius felt 27 feet tall – and very much in love.

## Chapter 15.

A month later, Dr. Karoom invited him to the University for an 'Informal Presentation' of his ideas. "You can meet my graduate students. Maybe they can answer some of your questions."

So Demetrius, in a white shirt with tie, and wearing presentable blue jeans, offered some of his ideas to Dr. Karoom and her post-doc students. Demetrius liked phasors a lot. He was excited about phasors, so he decided that that would be a most interesting topic for discussion.

Demetrius drew a picture on the white board. "As you know a phase vector just represents a sine wave whose amplitude, phase and frequency are time-invariant. We simplify the frequency factor, which includes the time-dependence of sine waves, see? Watch – here's how you can factor out the phasors, but just leave the static amplitude and phase information. Now we'll combine those algebraically here."

After a careful introduction, "Here we have an anomaly," he stated matter-of-factly. "A phasor diagram at angle zero can't have a meaningful vector. Look."

He lectured them for almost hour; but mostly, they didn't get it. His presentation was overwhelming.

He tried a different approach: "Euler's formula shows us that sine waves are the sum of two complex-valued functions, like this. Therefore, a phasor can refer to the complex constant  $A e^{-i\theta}$ . That's how to encode the amplitude and phase of a sinusoid."

He looked out at the blank stares in the room. "Look: let's use  $A$ , the amplitude with an angle  $\theta$  notation for a shortcut. Think of a sine wave as a projection on the real axis of a rotating vector on the complex plane."

The room was quiet – totally quiet. Finally Dr. Karoom broke the silence. "Demetrius has been working on this problem for a long time," she said. "He may have a point here. Can anyone see anything wrong with his work?"

One of the foreign students stood up, but then she sat down. "Okay, so we'll have to study this more and get back to Demetrius," she said with a Russian accent. "I think that we have some experts at home who would like to see all this."

"Thank you Tanya," said Dr. Karoom, who was looking at her watch real hard.

Demetrius tried one last time "I'm trying to explain the problem with the rotating vector at 0, 90, 180 and 270 degrees. Does everybody see the problem?"

Dr. Karoom looked at her watch again. "Well Demetrius, you'll have to forgive us for not understanding it the first time."

"But doctor, do you understand that the time derivative of a sinusoid is really just multiplication by the constant  $i\omega$ ? Surely you understand that integrating a phasor is the same as multiplying by the inverse function?"

Dr. Karoom looked at the board. It was completely filled with trig, calculus and algebra. And then she looked at Demetrius. "Actually, I think that we need to brush up a bit before we can answer you. Is that okay?"

"Sure, doctor. I've been working on this problem for over a year, so I understand how complicated it is."

"Demetrius, how would you like to go to the University of Alabama at Huntsville?" she asked. "You could be in my advanced math course." Here was truly a student that deserved a scholarship, and she would make sure that he was in her math program for sure. "After all," she thought "I have to develop his presentation skills."

"Sure doctor, of course I'd like that, but my parents can't possibly afford it. I'm going to go to the 2-year technical college over on Meridian Street."

"Well, maybe we can do something that will help you out a bit." She wanted Demetrius in her program so bad she could almost taste it. She was going to visit the Dean of Education, first thing Monday morning. This kid was too good to be true. She was fantasizing about the school getting the Fields Medal, and seeing her name listed as the Department Chair.

A month later, his parents opened the mail and fat envelope fell out of another fat envelope. It began: "*Demetrius Waltham Howard is the recipient of a full scholarship to the University of Alabama at Huntsville.*"

As they looked at form after form, they realized it was true – their son would be able to get a first-class education. "Linc, UAH is known for their math program. I just can't believe it's happening. Demetrius, we're so happy for you."

Demetrius didn't know what to say. "I just talked to them about a couple of problems I'm trying to solve, 's all. I should be able to figure it all out, but I'm having trouble with a zero-length vector. Dad..."

"Son, give it a rest. Let's spend the night looking at these forms and celebrating, what do you say?"

He just stood there quietly with his hands in his pockets and shrugged.

Ruth and Linc Howard looked at their son with enough pride to break a planet apart.

His mind was still cranking on the zero-length vector problem.

## Chapter 16.

Demetrius spent a long time learning and building circuits and then learning more. He bought a small white board at the office supply store and used it to work out different formulas that were rattling in his brain. Problem was: the board too small for his large ideas. One day he woke up with a thought: he'd cover his bedroom walls with white boards. Then he'd have enough room to work out his problems. He waited until after dinner one night, when his dad wasn't outside mowing the grass.

"Dad, I'd like to get some more white board space in my room. Is that okay?"

"Sure son. We can pick up another one of those at the office store this weekend."

"Er... dad, I want to cover all the walls of my bedroom with white board. I need lots of room to think. I checked with Home Depot store – they have sheets of white board for about 20 bucks each. We could buy enough to cover my walls for less than 200 bucks. I have that much in my savings. Is it okay with you?"

Linc blinked and then looked at his son and quietly pondered. "I think that's okay with me – we can just use sheetrock screws to hold them up. Let's wait till your mom is in a good mood and ask her. But we have that spare bedroom where I store my stuff – I don't think it would be a problem converting that to a lab. We could have a garage sale. What do you think?"

Two days later, Ruth agreed and the white boards were purchased and screwed onto the walls of Demetrius' "lab." Then the old junk was moved out and the big desk that was already in the room, but used to be buried under boxes of junk, was moved into the center of the room. Demetrius had a real first-class lab. Now he began designing in earnest.

Demetrius thought and thought about the calculus and the problem of the disappearing small numbers. "Newton called it the science of fluxions," he remembered. "Fluxions and fluents were the original ideas he developed. I need to review that stuff."

He found lots of information on the Wikipedia website. Some of it made sense, and some was just nonsense. "How can something be 'infinitely small' he kept thinking. Almost every day he bugged Miss Julie Josephs for answers.

"Limits and functions replaced the idea of infinitesimals," she told him. "Limits describe the value of a function at some input, by talking about higher and lower values around the input value. Here, let's work some problems with limits."

"Sure Miss Josephs, I can't get numbers that small into my head."

"It's okay. When you see how easy it is, you'll wonder why everyone doesn't get it."

Demetrius called Mr. Hilliard one evening. "Mr. Hilliard, do you remember telling us about calculus and phasors? I have a few new questions if you don't mind."

"Why go ahead Demetrius – my wife and I are just relaxing now, so it's a fine time for questions."

"Remember the phasors at angle zero? How can I compute a tangent if the length of the hypotenuse is zero?"

"Well let's see...  $Y = mx + b$ , where  $m$  = the rise over the run. Now then, the change in  $Y$  over the change in  $X$  gives us the slope of a line. So, let me think – ah yes... If the graph of the function isn't a straight line then we expect the change in  $Y$ , divided by the change in  $X$  to vary. That's derivatives. Now let me think about tangents: the derivative is the slope of the tangent line to the graph of  $F$  at  $A$ , so it's the limit of difference quotients. So Demetrius, you have a definite problem there. I think that when you have a vertical line, it doesn't have a slope, so  $F$  is non-differentiable."

"Yeah, Mr. Hilliard. I thought so. Can I ask another question?"

"Sure, but I hope my answer is better than the last one."

"As you divide some number by a fraction, you get a result that is bigger than the fraction, right? Like 1 divided by 0.1 is 10. And as the fraction gets smaller, the result grows larger, right? If I divide 1 by 0.000001 the result is 1,000,000, right? Well the real small numbers called infinitesimals – what if I divided by them: could I throw away the really, really big number that is produced? Here's my question: If I can throw away an infinitesimal, why not its inverse?"

"Demetrius, you're right on the first part, but I'm confused about the second part. Why would you want to throw away those big numbers?" asked a very puzzled ex-math teacher.

"I don't necessarily want to throw them away – I just want to know if I 'can' throw them away."

"I'm sorry Demetrius, but I can't visualize a problem where you'd divide by an infinitesimal, or use the result in any meaningful way. I guess I'm not going to be a big help tonight."

"Mr. Hilliard, you were a big help after all. I just wanted to be sure that I wasn't ignoring something obvious. You've made sure of that. Thanks for your help. I'll call back when I get my invention working. Good night."

By now he knew that the answers to his problems didn't lie in the 2-dimensional world, and he was pleased. "Like dad said: If it was easy, everyone would be doing it."

Now he had some questions about electrical stuff. He picked up his ham radio and called Mr. Thompson. "What do you know about LED's, Mr. Thompson?"

"I can show you how to use them, but I'm not familiar with the theory of how they work. Do you have a new project Demetrius?"

"Yes sir, I'm trying to modulate some LED's at different frequencies. I want to use different color LED's and different frequencies."

"Okay, kinda like a color-organ. I built one of those in the 60's. I can come over next Saturday and draw some schematics for you – that should help."

"That would be great, Mr. Thompson. See you then."

When Mr. Thompson's beater station wagon rolled up, Demetrius raced downstairs to greet his friend.

"Wait till you see my new lab. What's that, Mr. Thompson?"

"Well it's a color-organ. I built it almost 50 years ago. Let's see if it still works, okay?"

When they entered the lab, Mr. Thompson gasped. "Well I never saw such a great lab. How did you manage that?"

"Well, my dad was just storing junk in here, and he knew that I was out of space in my bedroom, so we set it up. Let's see that thing work. What are all the colored spotlights for?"

"Here, let me plug it in," as he set it on the workbench. Do you have a radio in here?"

"Well, I use internet radio all the time. Here's a speaker plug."

"Internet radio – hmmph. Times are changing for sure." Mr. Thompson plugged in the cable and turned on his antique color-organ. It immediately sprang to life – the spotlights followed the music exactly.

Demetrius liked it. "I see the deep bass notes trigger blue light and high notes trigger yellow. Some notes make the green, orange and yellow lights work. I'm not so good at music, so I can't tell exactly what instruments are making the lights pulse. How's it work?"

"I use filters. For the low notes, I use a low-pass filter. For the high notes, I use a high-pass filter. For the middle notes, I use 3 different bandpass filters. Let me show you how filters work," and he drew the schematic for a filter on one of the walls.

"See here's a capacitor and a resistor hooked to this transistor. The resistor and capacitor are called an R-C circuit. They set the resonant frequency. Here's the simple formula for that," and he wrote it on the board. "A bandpass filter is really just a low-pass filter plus a high-pass filter hooked together. The transistor amplifies the signal and feeds that part right there called a triac. It drives the lights."

Demetrius pondered that for a minute then said "So, can I filter light like that? Can I use an R-C circuit to filter out one band of light?"

"It depends on the frequency of the light, but sure. Problem is that light is at such high frequencies that it's impractical to do that. Visible light is something like 540 terra Hertz. Resistors and capacitors don't really work at those kinds of frequencies. Why do you ask?"

"Well, I just have an idea, that's all. Gee Mr. Thompson; I sure appreciate the light show and your explanation of filters, too."

"Well I'm glad you liked it. Here, why don't you keep this mess – I don't really use it anymore."

"That would be nice. Thanks."

For the next several evenings, Demetrius watched in fascination as the lights flickered in time and in phase with the music. He thought about filters and stared at the formulas and schematics that were on the board. After a couple of days he realized why the R-C formula wouldn't work so well at 540 terra Hertz, so he packed up the light organ and put it away.

"I need to think of a filter that works at super high frequencies," he thought as he wandered off to another board and started doodling something that looked like a snail shell with a point.

"Maybe if I can send the light around something like this, I can filter it." He drew pictures of waves in a pond, just like after a rock was tossed in.

"That's what I want to see. That's what I want to control. I need to reinforce the waves and the troughs. I need some kind of filter and a feedback loop," he muttered.

It took him a while to realize that the monochromatic light from a light-emitting diode, or LED, was just right for what he wanted. "I could use these without any filtering. I just need to generate some kind of beat-frequency. Let's see – what frequency is best to use?" That was also the first time that he really understood that he wasn't always right. His ideas might be flawed; he might go down the wrong path and waste precious time and resources – it was a very scary thought. For the first time he realized that he was fallible, imperfect, mortal.

He sat with Suzy and petted her. He watched her eyes twitching at him and wondered what she thought. "That's silly, girl: dogs don't think – and they sure don't talk. Good girl. Let's go for a nice walk. You stink. Let's give you a bath first."

Suzy liked that idea for sure. Sam the cat strutted by at the wrong instant – Demetrius snatched him up and gave him a good scrubbing. Like all proper cats, Sam hated baths intensely.

"There, Sam. Now you smell as good as Suzy," laughed Demetrius as he fluffed the cat with the low-setting of his mom's hair drier.

Demetrius didn't find out until a couple of months later that he was also wrong on the issue of dogs thinking.

## Chapter 17.

Over the next couple of months he spent a lot of time at the local Radio Shack store, plus the local Amateur radio store, Gigaparts. What he couldn't get there, he purchased online from electronics companies. He used a bunch of LED's, some fiber optic cable, a power supply that he built himself and a high-frequency oscillator that he built himself. He reached over to adjust a control on the LED panel and brushed against an exposed wire on the power supply. Next thing he knew, his mother was bending over him screaming his name. His dad called an ambulance which arrived in 15 minutes, and Demetrius was transported to Huntsville Hospital.

Doctor Sinkin asked Mr. Howard "What happened? Did you say he got an electrical shock?"

"Yes, he was messing around with some of his electronic parts – he's busy inventing something – and he must have touched that big transformer he's got. My wife saw him lying on the floor. We don't know how long he's been unconscious."

"*Demetrius?* Demetrius: can you hear me?" asked the doctor, who was pointing a flashlight in his eyes. "Are you okay?"

"bRarrar. rRrr," he replied.

"I guess that means no. Look son, we're going to keep you here overnight. You received an electrical shock. We're going to have to monitor you for 24 hours. Get some rest now."

Demetrius tried very hard to understand the doctor, but he couldn't, so he relaxed, closed his eyes and felt the room spinning around at the speed of a tornado.

"Blaz N'knin," he said, but the doctor wasn't listening. Demetrius just wanted his world to stop spinning so fast.

The doctor wasn't sure that his young patient would live until morning. Mom and dad were unsure too. "Look at that big black spot on his arm. That must be where he touched the transformer. Linc, I hope he'll be okay."

"Don't cry dear – Demetrius is a pretty tough kid. Let's see what happens in the morning."

Demetrius was in a white room with black blobs all over the walls. He was sitting cross-legged on the floor with his dog, Suzy.

"Here – good dog," he said as he petted her. "I'm not feeling too good. I wish the room would stop spinning." Suzy looked up at him and begged for more ear-scratching.



"I'm sorry I hollered at you once – you didn't do anything wrong. He rubbed her head real good. "I think I'm dying." Suzy looked up and moved her black eyes and somehow managed to let him know that she knew what was going on.

"Love is as love does," she said, and her tail started swaying left and right.

"That sounds like something mom said once," Demetrius said.

"You're wrong, master. She said that a thousand times a day to you. You just didn't hear her very well. Falling in love with your dad was the defining event of her life, but you were the refining event. You never thanked her for changing your diapers 20 times a day, or washing your blue jeans just yesterday. If you die, then part of her will die too."

Demetrius hugged Suzy and started crying.

"I think I'm dying."

"Well master, one of us has to go," she said with sad eyes. "There's a price to be paid for your action."

"I didn't know that dogs talked with their eyes," he said, as the salty tears flowed from his face.

"You just don't listen very well, do you?" she blinked at him.

"Sorry, girl. I'm sorry." The white room was getting whiter and brighter, and suddenly it exploded like a lightning bolt.

"MMmmmmmm. BEEP. BEEP. BEEP, CLEAR!" he heard. "OUCH!" he wanted to scream, but his throat was plugged full of concrete.

Then "MMmmmmmmmm. BEEP. BEEP. BEEP, CLEAR!" He knew someone was shouting something.

"Please tell them to stop. Is someone mad at me, Suzy?"

She licked his hand and her eyes said "Only if you give up, master."

"ZZZZAPPPPPPP!" went his chest. "OUCH-OUCH-OUCH! STOPIT STOPIT!" he tried to shout, but his lips were glued tight.

And then everything was dark and cold for a long, long time. Demetrius tried to open his eyes, but they wouldn't respond.

"Where's Suzy? Here, girl," he tried to say, but she was gone. The room stopped spinning. THE ROOM STOPPED SPINNING! I'm going to live. I better start figuring out my problem.

"P-H-S-E-R" he said. "F-A-SR" – it doesn't sound right. I forgot how to spell it. "P-S-H-E-A-R" – I can't remember. I'm not feeling good. He looked around for Suzy – maybe she could help him; but that made the room start spinning again.

"*Demetrius!*" commanded the doctor, who was sticking a light into his eyes: "Are you okay?"

"pssPsts," he replied, but he meant "No – please stop the room from spinning."

"Mr. and Mrs. Howard, your son is in grave danger. His brain is scrambled and his nervous system has been shocked half to death. I don't want to worry you but if you're praying people, now's the time. We have an experimental procedure for treating serious electrical shock, but I'm very hesitant to recommend it. It basically forces the body to stop the heart and then it stops all brain activity. Then we restart the system and hope for the best. It's pretty dangerous, but it may be his only hope. If you're interested, I want you to read about the treatment online. Here's a computer you can use. If you have questions, I'll try to answer them. I don't think he's going to get better, and the longer he's out of it, the worse it gets. At some point, his autonomous nervous system will start malfunctioning, which could cause him a slow, painful death. I really don't know what to recommend."

The Howards read the article about the procedure and held hands.

"Clearly we want our baby to survive," said Linc with a long sorrowful look. "But the treatment is worse than the disease, me thinks."

Ruth was crying and just said "Let's do it. I don't want him to die, but it's out of our hands now."

"Right. Doctor, where do we sign?"

The doctor thought he heard Demetrius whisper "xsp da Suzy" in a thick, dry voice. The young black teen looked a hundred years old. His mom and dad sat by his bed and held his hands until he twitched a couple of times.

In his coma, Demetrius was petting Suzy again. "Suzy: are dogs our conscience? I was listening to what you said. I guess I haven't thanked my mom and dad very much. I thought you were speaking with great wisdom."

Suzy licked her chops and panted in his lap. "Sure, master – dogs and cats are watching over their owners all the time. I don't think cats are as good as dogs, but I've met some cats who think they're better than dogs. Dogs are just more serious about it, that's all. Take Sam for example – he's one of the more responsible cats around here, but you know he's mostly a flake."

"How come people can't figure all that out Suzy?"

"I don't know master," her eyes spoke with the wisdom of old age. "I just don't know." Then she licked her snout and waited for more petting but Demetrius saw his old bicycle sitting in the grass and he stood

up. The old banana seat was still in good shape, and he didn't see any rust on the high-bars. What a treasure – he couldn't wait to try it out. He looked around and saw that he was in a small clearing in a forest – ah ha – "I remember a picnic here when I turned 9."

He remembered the smell of the forest from when he was young, and then he started riding around the circumference of the clearing, but the clearing kept getting smaller and smaller until the spinning made him dizzy and he fell off the bike.

When he woke up, his head was pounding. Suzy was chasing a rabbit into the forest and her swishing tail told him "Sorry master, after all, I'm just a dog." Sam the cat had his tail in the air and walked by himself, far away.

Demetrius shouted "What did you mean when you said '*There's a price to be paid for your action*'?" but Suzy was nowhere in sight. I think I'll just take a nap for a second or two.

Finally the doctor and his parents looked at Demetrius and saw his eyes were fluttering open and bright again. Since he was intubated, he couldn't talk, but he squeezed their hands in a Morse code rhythm, which they didn't know, but they knew that he was communicating.

"Let me call his girlfriend Debbie – she knows Morse code," offered Linc.

"Sure Mr. Howard, I'll be right there," replied Debbie to the urgent request.

Less than 30 minutes later, she showed up at his bedside. She brought a Morse code key and a small practice-oscillator that had a speaker. Within a couple of minutes, they were communicating by Morse code.

"He says he's fine, just tired. He doesn't know what happened, but he thinks he died. He says he's sorry."

His dad bent towards him and said "Son, we're glad you're alive, and yes, you definitely were dead – twice. You've been here 3 days."

Debbie looked at the Howards and then back to Demetrius. As she listened to the Morse code he was sending she said "Me too," and stroked his hair and cheeks and wept.

Linc and Ruth both reached out and touched Debbie – they knew what message he'd sent her, for sure.

A week later, Demetrius was home. When he hobbled in, the first thing he did was call for his dog. "Suzy – come on girl!"

Ruth and Linc each one took one of his hands.

"Demetrius, poor Suzy died the week you were in the hospital. She was a very old dog, you know. We had her buried in the pet cemetery over on University Boulevard. We'll take you there when you're well enough."

Demetrius crumpled on the carpet and cried deep, sobbing tears.

"She was my friend. She told me some things that nobody ever told me before."

Seeing him cry like that just tore his mom's heart out. When she reached over to him he said "Mom, I sure love you. I won't ever forget to tell you that again."

Ruth cried and pulled him close. She stroked his head. "You're going to be fine Demetrius. Thanks for being my strong, loving son."

A week later Demetrius was back in his lab, but some things just weren't the same. He didn't recognize some of the formulas on the white boards. Some of his circuits didn't make sense either.

"I must have really been zapped," he realized. "I need to concentrate on getting my memory back."

A few weeks later, he was fine. With extreme care, he went through all the equipment with a fine-tooth comb, looking for safety issues. By time he was done with that exercise, he was ready to restart his experiment.

"That was close – I'll have to be doubly-careful," he thought. He noticed that his parents hung out in his lab a lot more than ever before, which was okay.

"Love you mom," he said. "Love you dad."

"We love you too, son."

## Chapter 18.

A FED-X package addressed to Demetrius arrived from Ohio. When he got it opened up he celebrated. He'd been Web surfing and found a small rocket nozzle for sale at a government surplus outlet. He remembered having to sign some forms promising that he wouldn't resell it or send it to some Communist nations, but he didn't have any intention of selling it – this was what he was going to use to focus the LEDs in a null-field configuration.

"When I saw that rocket motor at Space Camp, I realized that 3-D parabolas could be used to focus the energy of a rocket blast – surely they can focus the energy of a bunch of LEDs," he thought.

The nozzle was 8 inches in diameter and about 5 inches high – just perfect for his calculated requirements. "If I can drill holes all around the circumference, then I can run the LEDs into here and put the fiber optic at the focal point here and crank it up. Cool."

He went to the basement and setup the drill press that he'd used while making parts for *Team Ka-blam!* He marked the nozzle with a black marker and set the unit on the bed of the drill press and lowered the spinning chuck. *SCREE!* it cried – the metal was way too tough for the bit.

"I got a better bit somewhere here," he said as he went through the cigar box full of metal-working stuff. "Where did that bit go?"

His dad came downstairs and saw the rocket nozzle on the drill press. "Are you going to drill that thing?" he asked. "Cause if you do, you'll be disappointed. It's titanium – we don't have anything remotely strong enough to drill that thing. Where did you get it, son? I remember seeing stuff like that out on the base."

"I ordered it from FED Surplus Auction a few weeks ago – just before I got shocked. I was thinking that I could use it pretty much as-is, except I need to put in holes around here, and mount a clamp right here."

"Well son, I don't think we're going to do that here. But on the base, they have a machine shop that can drill right through this stuff – they use a LASER instead of a drill bit. If you mark where you want the holes, I'll get it drilled out for you. How's that?"

"Gee thanks dad. I'll mark the holes for you and bring it upstairs."

The LASER was recalibrated for titanium and the proper hole-size was entered into the computer interface. Then: *Blam, Blam, Blam, Blam!* Within a few seconds, 16 holes were punched through, clean as a whistle.

"Okay, Mr. Howard, here's that piece for you. Good luck with it."

"Thanks Smitty – my son is building some kind of project for school and he needs this to mount some LEDs in. Appreciate it."

When Demetrius saw the nozzle he jumped out of his chair. "That's perfect dad. How'd you do it?"

"One of my friends at work used a LASER to punch out those holes. It only took him a minute. We'd have never gotten even one hole drilled – this stuff is really tough."

Demetrius laid out the LEDs that he had calculated would generate the best wave fronts. One by one he aligned them and glued them in place. "That'll do," he thought. Now if I can get that clamp installed at the focal point, I'm in business."

He looked at the white board and realized how hard it was going to be to put a clamp inside of the rocket nozzle. "I should have asked for 2 small holes here and here," he realized. "Well, maybe there's another way to do it." He looked in his junk box but came up empty. Then he decided to ask his dad for help.

"Dad, how can I mount a clamp right here, near the focal point? I don't want to bug you again for LASER drilling."

"Can you just use a couple of plastic strips – bend them right here, around the lip. Make them intersect like this," as he drew a mechanical drawing on the white board.

"Gee dad, that'll work. Thanks."

A couple of hours later, there it was, and Demetrius cranked up his soldering iron and soldered leads to each of the multitude of LEDs. He ran the bundle of wires to a solderless breadboard and added current-dropping resistors to each LED.

"That'll do. Next stop: testing."

## Chapter 19.

The night before his 17th birthday, Demetrius was busy – he had a huge pile of electronics hooked up to a multi-computer network in his bedroom lab. His phasor array was distributed among the processors and network elements. The electronic boards glowed red and green with LEDs. He'd managed to order dozens of different color LED's from eBay and the online electronics stores. He had one for each critical frequency – they were arranged in a parabolic pattern that looked like the nozzle of a rocket ship, focusing the power into a small spot where a fiber optic bundle lay, just waiting for photons. Software programs were running on multiple screens. More fiber optic cables ran between the various subsystems. A small blue field was glowing near one of the boards. Frequencies from DC to daylight were ready to interfere with each other – all they were waiting for was the command from the processor.

Today, for his birthday present, Demetrius figured he'd do some non-time travel.

"What's that, D?" asked Debbie, who had dropped over for his birthday. "That blue light stuff looks dangerous. I know that it's not a K-Mart special," she joked.

Demetrius looked over his left shoulder. He saw that Debbie was wearing lipstick and her fancy skirt and purple blouse.

"It's where the laser diodes are creating a destructive interference field. My phasor experiment is ready to test."

Debbie could smell the ozone emanating from the big black transformer at the back edge of the desk. "Ya going to let me give you your birthday present?" she asked with a wink as she went to the bedroom door, closed it and quietly turned the lock. Then she walked slowly to him with the sexiest walk that she could muster in high heels on a shag carpet – but it was lost on him: he was in the middle of his experiment, and that's what counted to him, and nothing else.

"Look Debbie, I have to do this – I just have to." He pointed to one of the white boards and said "See how these 3 waves of the phasor diagram are in perfect destructive interference. I really believe I can nullify the 4th dimension with this invention, but I can't actually move forward and backward in time. Actually I use time as an 'anchor', since I know that it's invariant."

She looked at the white board, covered with drawings and formulas. "Excuse me – you're going to do 'non-time travel' with that thing? I never heard anything so improbable before. You can't do that – we learned in physics class that time travel is impossible. And remember Mr. Hilliard talked about it once. He said that time travel is impossible, too."

"Look Debbie. My formulas converge there in step 130. I agree with you: I know I can't move in time, just like Mr. Hilliard said. But my theory is that you can freeze motion in one dimension by setting that particular phasor quantity to zero. That's what the destructive interference diagram is, there. I checked

it with Dr. Karoom, but I never told her why I wanted to verify that formula. I didn't tell anybody about my non-time travel experiment. They'd just laugh like you and dismiss it because someone told them that it's impossible to do. But remember: I said I can't really travel in time."

"Sorry D. I shouldn't doubt you, but this is really too far out even for me to grasp. Actually, I just came over to give you a very special birthday present."

She reached over, ran a red fingernail across his cheek and then gently touched his shoulder.

He shivered for a second and then said "Okay, Debbie, but can you just wait a second?" He keyed-in "T = -1 SECOND; PHASOR-H = 0," and pressed the Enter key.

His formula was correct; the computer program worked just fine and the thousands of electronic parts functioned flawlessly. Waves of photons from a hundred LED's bunched up and tried to fight their way to the front of the line, but they got caught in a traffic jam. Wave upon wave of them pushed and jostled, trying to plunge deep into the waiting fiber optic cable. A thousandth of a second later, the bluish/purple cloud of destructive interference traveled up his arm, covered his body and instantly Debbie felt the cold touch of outer space on the palm of her hand where Demetrius had been, a single heartbeat before.

She gasped for air: "AIEEEE!!" she shrieked as she saw the cold, hard face of the moon right there in the bedroom for a split second, before the chair was empty and Demetrius was gone.

He'd moved in the X- and Z-dimensions alright, minus 1 light-second in the T-dimension, all without moving in the Y-dimension. Line number 130 on the whiteboard showed exactly why and how. But you had to understand the other 129 lines before that to see what really happened.

The last thing Demetrius realized was how right he was. In that last second, his skin froze. His blood boiled away. He saw a blue ball, about the size of his basketball, between his feet as his last breath escaped from his lips and froze into eternity. In 1 second, the Earth had moved out from under him in the Y-dimension, since that was the zero-phasor in his formula. Everything worked perfectly – too bad.



## Chapter 20.

Within minutes, NORAD's powerful long-distance meteor-detecting radar detected a new object about 1.7 meters in length abruptly pop up between the moon and Earth. Alarms sounded in a cave, cut deep in the granite of a Wyoming mountain. With the turn of a coded key and the push of a round, red button, Airman First Class Laura Jacobs put the entire array of U.S. missile systems on Red Alert status all around the globe. Gyroscopes on satellite cameras rotated and panned to the designated location and then zoomed and focused. In a couple of seconds they acquired thousands of images of the new spatial object which the computer tracked, calculated the orbital properties of, and automatically classified it as *NM-01*. To the lifeless but perfectly logical computer, anything that orbited Earth was, by definition, a moon; thence the designation *NM-01*.

High-speed inter-satellite networks bounced the 1's and 0's of the encoded images to huge radio dishes scattered across the free world. Within minutes, *NM-01* was painted on a 60 foot wide screen for the men and women of the Aerospace Warning Command, all of whom sat up and stared for a full minute. One by one, they turned towards the Officer of the Day, looking for answers.

Major Morten, O.D., spoke in a formal Air Force command voice: "Airman: forward the data to N-pic. Let's make sure we got it right before we discuss it publically."

"Yes sir. Did you say NASA, sir?"

"N-P-I-C, Airman; November Papa, India, Charlie," replied Major Morten. "I want the Photographic Interpretation Center to look at those images."

Airman First Class Laura Jacobs had to refer to her *Black Book* in order to find the commands that would connect her to the top-secret agency that she'd never heard of – there they were, on page 353: "National Photographic Interpretation Center, Division of Central Intelligence Agency (CIA) provides skilled interpretation of photographic images obtained by aircraft and satellites. Command Chain: Central Intelligence Agency (CIA) / National Imagery and Mapping Agency (NIIMA) / NPIC. Access routing code: CIA-NIIMA-NPIC."

She pushed the buttons on her console and a simple "login:" appeared. Her *Black Book* had the answers to the challenge questions, and she was logged in. Uploading the files took less than 10 minutes – the governments' high-speed fiber optic network was truly up to the task. Then she logged off and waited for her shift to end.

In the over-air-conditioned environment of NORAD, she noticed that she was perspiring. She looked back at the huge screen and the gruesome image blotting out part of the moon and she knew why.

The photo analysts at NPIC didn't want to tell the Air Force what they saw, because it was too obvious. They thought it was a joke – a very poor joke. When they received the classified images from NORAD,

one of the analysts quipped: "Aren't these the guys who track Santa Claus every year? Is today April Fool's day over there?" and they all laughed.

But the mood quickly changed: "Whoa – now what do we have here?" as the images unfolded on the monitors all around the darkened room.

"What indeed, Mr. Salizar; what indeed," replied the shift supervisor. "Get me that NORAD Major on the line. He's going to have to explain the context of these images."

When they were connected by secure-link, Major Morten spoke with Mr. Salizar "Yes sir, we just picked up that object on our meteor tracking and warning radar. It's just about the size of a meteor or comet that could do some serious harm to Earth, that's why our alarms went off. We slewed our KH-11 satellite cameras around as fast as we could, and that's what they captured. You've got it there, unenhanced. I just need for you to confirm that it is what it looks like."

"Well Major: it is what it is," replied Mr. Salizar coldly. "The only question is how did it get there?"

"Thank you, sir. NORAD appreciates your help," and then Major Morten hung up the secure phone.

Every eyeball in the command center was on him. He said: "Nobody is going to believe us if we tell them that a young black male suddenly appeared in outer space, but I'll call the General and tell him."

Major Morten, Officer of the Day and Commander of NORAD that night glanced at his watch, muttered something crude and then called General Kleesen on the scrambled phone at 0300 local time.

"Major, did I hear you right?" asked the General, who was used to awakening instantly and making rapid decisions at all hours of the day and night. "I couldn't have heard you right."

"Sorry sir. You heard me right. There is a young black male spinning in outer space – he is between the Earth and the moon. Our radar system has plotted his vector with great accuracy. We're still actively tracking the bogie. Sir: this is a teenage boy, wearing blue jeans and a flannel shirt. The computer ID'd him as *NM-01*, sir."

"Major, if this is a joke; it's in very poor taste!"

"General, if this is a joke, then we're all in trouble. I had the folks at NPIC verify the image, sir. It's real. I'll upload the images to your secure fax now."

After he reviewed the images, General Kleesen called the White House and awakened the President at 0515, Washington time. "Sir, this is General Kleesen at NORAD. Our radar has picked up the most unusual object in space. I apologize for waking you up sir, but these are my standing orders."

"Go on General – just tell me. Are the Russians shooting at us? Is it the Chinese? I bet it's the North Koreans...what's happening?"

"Sir, it's a teenage boy." The General waited a moment for that to sink in. "NORAD radar picked up a new object orbiting between Earth and the moon. Our satellites got pictures of a black teenage male, wearing blue jeans and a flannel shirt. I'll send you a picture on your classified link."

A minute later the President quipped "Alright General, you've been under a lot of stress...are you kidding me? What's this a picture of? Is that boy dead? If so, how did he die?" demanded the President.

"Sir, we don't know how he got into space. Our computers calculated that he's in a synchronous, circular orbit around Earth, so technically he's a moon, sir. We've classified him as *NM-01* for identification purposes. Just who he is, or where he came from, or who he belongs to is anybody's guess, sir."

The President bellowed "Guess? What do you mean guess, General Kleesen? I want to know all the answers. Brief me in the Oval Office at 0900."

"Yes sir," and the line clicked dead.

The President looked at the images of the spinning teenage boy, with the moon as a backdrop and wondered if he'd have answers in the morning before the Press got hold of the pictures. He picked up the secure phone and pressed 'Redial'.

"General, make sure that this is all classified Top Secret until we understand what we're dealing with. I don't want the Press to get hold of this stuff, understand."

General Kleesen looked at the images of the spinning teenage boy on his roomful of oversized monitors and wondered how in the world he was supposed to find out the answers that the President demanded.

"Poor kid," he said softly to the President. "We'll find out who he is sir, that's for sure."

He was right, but it took over a week for the answer to unfold.

## Chapter 21.

Ruth Howard heard Debbie scream through the closed door of Demetrius' bedroom. Then she heard her shriek like she was being ripped apart by a mean crocodile. By time she got to the top of the stairs and tried to open the door, she realized that it was locked. She flung herself at the door it popped open. She saw Debbie collapse to the floor in front of the mess of electronic junk that Demetrius was building.

He'd tried to explain it to his mom once, but she didn't have a clue what he was talking about – something about a phaser, she recalled. Something about Star Trek, she thought.

Ruth focused on the present – why did Debbie faint? "Oh my God, girl – did you get electrocuted too?" She checked for her pulse and it was weak and thready. Her Red Cross training kicked in – she raced downstairs and found the first aid kit in the kitchen closet and then she raced back upstairs. She yanked open the pack of goodies and found an ammonia inhaler, cracked it open and let the fumes waft into Debbie's nose.

Debbie regained consciousness immediately and saw Mrs. Howard bending over her; and then the image of the naked moon came back into her brain, followed by the feeling of awful cold on her hand as her boyfriend disappeared. She put her left hand in front of her face and it still felt cold and sore. She looked at the chair where Demetrius was sitting just a minute ago and screamed "*Demetrius! My God – Demetrius!*"

Ruth looked at her, but Debbie just screamed and screamed and screamed. She finally grabbed Debbie and shook her shoulders gently: "Debbie! Debbie! It's alright."

"No it isn't, Mrs. Howard. Demetrius is gone!"

"No, Debbie, he was just here a minute ago. He's probably in the bathroom. You fainted. Are you feeling okay?"

"Mrs. Howard, listen to me: Demetrius is gone! His experiment went wild. He's in outer-space right now. I think that he went to the moon."

"No, Debbie, I'll go see if he's in the bathroom. Just lay there for a minute – I'll check."

After Ruth checked the bathroom and the closet, she went into all the other rooms upstairs before panic set in.

"Demetrius! Where are you? You've got Debbie worried. *Demetrius!*"

Debbie was holding her hand in front of her face when Ruth came back into the bedroom.

"Are you hurt dear? Did something happen to your hand?"

"Yes, Mrs. Howard. I was touching Demetrius when he went into outer-space. My palm feels like it was frozen. I couldn't breathe, and then something smelled like popcorn. I think we were linked up when he wound up out there. Where's Demetrius, Mrs. Howard?"

"I looked for him, but I didn't find him. That's not like him at all. Maybe he went downstairs – maybe one of his friends stopped by. That nice Mr. Hilliard was going to see him tonight I think."

"No, Mrs. Howard – nobody's going to see him tonight. He's in outer-space or on the moon somewhere. Demetrius' invention worked. He was trying to do something with 'non-time travel', but not exactly that – um, he was trying to do something with canceling movement in one of the 4 dimensions – and I guess it worked."

"What's that?" asked Ruth, pointing at the glowing blue of the null-field circuit. "Why is it glowing blue and purple? It smells like ozone."

"That's his invention, Mrs. Howard. When he touched that blue glow, he went away. I was touching his shoulder when that light just crawled up his arm and engulfed his whole body. I saw the moon, huge and plain, right in front of me. For 1 second, I couldn't breathe. Then I was here, and he was gone. My hand hurts, Mrs. Howard."

"Let's get you to the doctor's office. I'll call your mom on the way there. Demetrius will show up for dinner. He probably ran over to Radio Shack for parts – you'll see."

Debbie got up and walked slowly downstairs. She started crying. The image of the blue glow and the moon terrified her.

"I loved Demetrius, Mrs. Howard."

"You'll still love him tomorrow dear. He'll be back – you'll see."

Mr. and Mrs. Taylor picked Debbie up at the Emergency Treatment Center on Highway 72. Doctor Patel cleaned and bandaged her hand real good.

"Debbie, looks like you got a slight burn there. Did you grab a hot pot or something?"

"No doctor – my hand was in outer-space for a second."

Dr. Patel looked at her closely – he was looking for signs of abuse. Before he could turn her over to her parents he was obligated to make sure that they didn't injure her.

"Debbie, did someone put your hand in hot water, or did some hot water get poured onto your hand? You can tell me the truth now."

Debbie realized that nobody would believe the truth about what happened. "No doctor. I must have just grabbed my cocoa wrong. I'll be okay."

"Okay, Debbie. If you need to talk, be sure to call me. I'll be here for you."

Debbie held up her bandaged hand and it brought a flashback to her. She started crying. She smelled the antiseptic smell of the hospital and cried even more.

"It will hurt for a couple of days, but then it will be alright. Keep putting on the medicine that I gave you," replied Dr. Patel, who was genuinely concerned that Debbie was a victim of abuse.

When he turned her over to Mr. and Mrs. Taylor, he said "Maybe you need to bring her back in a couple of days. I'll have a couple more questions then," and he gave Mr. Taylor a stern look.

Mr. Taylor just looked at Debbie and gave her a big hug, and they drove off. "Mom said that you were with Demetrius when something happened. Can you tell me about it?"

"Daddy, you won't believe it either: Demetrius is gone."

"Well, Debbie, he'll be back. Did he hurt your hand?"

"No daddy! Demetrius didn't hurt me. Nobody did. I was with him when he used his invention. He made a machine that could do something with the dimensions. I can't explain it, but he's in outer-space, probably on the moon."

"How do you know that, dear?"

"Look at my hand, daddy – it's not burned; it's frozen. My hand was in outer-space for a second. I'm telling you Demetrius is gone – dead and gone!"

"It's okay Debbie – we'll sort it all out when we get home," said Mrs. Taylor.

"See – none of you are going to believe me."

Debbie's hand twanged with pain and she started crying again. She cried all the way home.

## Chapter 22.

The next day, Mrs. Howard called the Madison County Sheriff's office and told them that her son was missing. They sent a couple of patrol cars out and gathered information about him.

"What was he wearing? When did you see him last? Was anyone with him? Did he have any enemies?"

She answered all the questions as well as she could: "He was wearing blue jeans and a flannel shirt. He was with his girlfriend, Debbie Taylor. Let me think: she fainted yesterday; I had to take her to the doctor for treatment."

Two of the officers exchanged silent but knowing glances. Then one of them asked "Where does Debbie live? We'll need to talk to her about it."

"Debbie Taylor – she lives just over on Silverthorne Drive – about a mile away."

"Okay Mrs. Howard. We'll get back to you."

When they rang the Taylor's doorbell, Mrs. Taylor was having a fit – Debbie had cried all night long and was complaining about the pain in her hand.

"What can I do for you?" she asked the officers.

"We understand that your daughter was with Demetrius yesterday, is that right?"

"Sure – they're dating. They always hang out."

"We understand she fainted at the boy's house. Is that right?"

"As far as I know, she burned her hand on a cup of hot cocoa, and that nice Mrs. Howard took her to the doctor's office. He bandaged up her hand. Is everything okay over there? Did Demetrius ever show up?"

"No ma'am, he didn't. Mrs. Howard reported him missing today. Can we talk to Debbie please?"

"Debbie, come downstairs. The police are here to talk to you."

Debbie, still in tears, came down the stairs. She was a real mess.

"Are you Debbie Taylor?"

"Yes sir."

"Were you with Demetrius Howard yesterday evening about 8 P.M.?"

"Yes sir."

"Can you tell me what happened?"

"You won't believe me anyway."

"Well let's try, okay. Just tell me what happened."

"Demetrius was experimenting with something that he invented. He was trying to do something with the dimensions. He was real bright. When he turned on the machine he turned blue and disappeared. My hand was on his shoulder. I saw the moon and it was very big. I couldn't catch my breath. Then he was gone. I passed out. My hand was frozen in outer space."

The officer writing the report stopped about halfway through. "Mrs. Taylor, we'll need to talk to you alone for a minute – do you mind?"

Debbie went and sat on the couch, crying.

"Mrs. Taylor, sometimes we see teenagers make up wild stories to cover up other activities: sometimes its drugs or alcohol, and sometimes its sex. They don't want their parents to know, so they just invent stuff that they think is believable. I hope you understand, we're not saying that your daughter is inventing stuff, but we've both seen dozens of cases like this. Probably they were doing something they shouldn't be doing and they're afraid of being caught."

"I don't think Debbie's sleeping with Demetrius, if that's what you're implying. I know that she doesn't drink or smoke pot."

"Mrs. Taylor, we're just saying that sometimes these things happen and parents don't always know their children as well as they think. We're going over to the Howards' again. If you think of anything else, please call us."

As the door closed, Debbie started bawling her eyes out again. "You're never going to believe me, are you?" as she buried her face in the pillow.

The next day, the Madison County Sheriff's Office issued an AMBER Alert for Demetrius Howard – he'd been missing long enough that everyone was concerned for his welfare. Debbie and her mom were visiting Ruth Howard when the Sheriff rang the doorbell.

"Good afternoon Mrs. Howard. We'd like to bring you up to date on what's being done to find your son Demetrius." Debbie started crying again and her mom comforted her. "We've issued an AMBER Alert for him. As you know, when children disappear in America, the Department of Justice provides information to the public. They maintain a database and help get announcements out. They can even request local media to broadcast an emergency alert, like on your weather radio. We're all taking this very seriously Mrs. Howard. We were wondering if you had any other information that we could use?"

Judy Taylor was sitting on the couch, holding her daughter Debbie.



Ruth shrugged "All I can tell you is what Debbie told me a couple of nights ago. It's not very likely, because she wasn't very coherent, but it's the only thing left."

"Tell us again, Mrs. Howard. Maybe we missed something."

"Debbie said that Demetrius was experimenting with some kind of electronic circuit that he built. I know that he's been putting all kinds of formulas on the white boards in his room. Two months ago his father helped him screw in white boards all over the walls in the spare bedroom. I objected but..."

"Mrs. Howard, excuse me – can we see the bedroom please?"

"Sure, come on upstairs."

The two officers looked at Demetrius' lab and couldn't make the slightest sense of it. "Er, Mrs. Howard, any idea what that thing there is?"

"Sure – Debbie said it's a null-field generator. Somehow Demetrius was going to do something with the dimensions. Don't ask me – I'm only his mother."

"Look at the boards, Sergeant Crowley. How old did you say this kid is? I graduated from Auburn and I never saw stuff like that. What's that say? Its math, but it's all letters and arrows."

"He just turned 17," replied Ruth.

The three of them looked around the room at 140 steps on the boards. Each one of them shrugged at the others and then left.

"Mrs. Howard, we'll be back tomorrow to update you. In the meantime, please don't disturb this room, it might contain some clues."

"Okay officer. Just bring my son home."

"Yes ma'am. We'll do that."

## Chapter 23.

The Department of Justice computers posted Demetrius' picture on their Active AMBER Alert site, along with his vital statistics, but that's not where it ended, because Department of Defense computers talk to Department of Justice computers.

Department of Defense computers talk to the classified computers at the CIA and their secret child, the National Photographic Interpretation Center analyzes every picture that flows through the heart of the internet and the classified internet.

By 6 P.M. a red light lit up and an old-fashioned bell that sounded like a school fire alarm sounded. NPIC employees had never, ever heard that particular sound, or saw that rotating red light on the ceiling, so they scrambled to find out what the problem was.

The problem was that their image of the young black male identified as *NM-01* now had a name: Demetrius Waltham Howard. The AMBER Alert site was notified, via CIA links to DoD links. Demetrius had been located. The Analyst-in-Charge said "Here's his exact coordinates: 34 degrees, 46 minutes, 38.9 seconds North latitude; 86 degrees, 41 minutes, 95.4 seconds west longitude. Altitude: 299,792.548 kilometers."

Then, since the altitude was above 100 kilometers, the giant NORAD computer was notified automatically, so that it could hang all the right attributes on object *NM-01*. General Kleesen was waiting. So was the President.

Actually, the President was waiting and fuming.

"Mr. President," began General Kleesen. "We have the information you asked for. We have the identity of the boy in space."

"General, exactly how many days does it take to get a simple answer to one of my questions? It's very hard for me to believe that with billions of dollars of classified dollars at your disposal, the entire military can't find out who one young boy is. So, exactly who is it?"

"His name is Demetrius Waltham Howard, from Huntsville Alabama. He was reported missing a couple of days ago. There is an AMBER alert out on him. According to our records, his father was in the Army and had a Top Secret clearance, so we have records on the entire family. He was a Sergeant First Class with the Guardrail ELINT aircraft. Our records show that he received a Purple Heart, a Unit Citation and an Honorable Discharge."

"Well, General, what do you plan to do about this?" demanded the President.

"Mr. President, I'm sure that you will want to speak to the family directly. We've never had a situation like this before. My advice is to 'get ahead of it', sir, meaning that if you take charge, then the family

can't come back later and say that they were treated poorly. If they get a call directly from your office, you'd be best-able to control the situation, sir."

The President mulled that over for a minute. "You're right, General. The ball's in my court. Thank you General."

A few hours later, the speech writer was done and the President of the United States called the Howard home and told them the bad news.

"We have pictures of your son Demetrius, floating in outer space. We've positively identified him from his school pictures. I express my condolences to you."

Linc said "His girlfriend was with him when it happened, Mr. President. She said that he turned silver, then crystal clear, and then he disappeared in a clap of thunder. She said that she saw the moon right where he was. We didn't know what to think."

"Well Mr. Howard, we've checked and double-checked. There is no basis for what happened, but we're looking into it. I have ordered a special team to investigate. If there was foul-play, then we'll get the culprit. In the mean time, the First Lady and I would like to have you stay with us for a few days. We want you to know that we are grieving with you."

"Thank you Mr. President. When we voted for you, we didn't ever expect that you would be so nice. We love your wife, too. We'd love to spend some time with you. We'd like it if the Taylor family could come along too. Their daughter Debbie was with Demetrius when he disappeared. Just a second, there's someone at the door."

"Yes Mr. Howard, it's my escort from the Secret Service. They're there to help you pack up and come to Washington. I'll make sure they pick up the Taylor family too. We'll see you tomorrow. Please have a good flight."

For the second time ever, the mighty 747 aircraft, known occasionally as Air Force One, lifted off from the Huntsville International Airport and headed for Washington. Aboard were two grieving families, 6 Secret Service agents, and a cat named Sam.

The speech-writers who crafted the President's phone call "leaked" word of "a brave young hero" to the news media. A picture of "a dead astronaut" drove the news media into full-time high-gear mode. The Washington Post headline was "*A New Moon Named Demetrius*," and pictures of the new "moon" blasted front pages all across the world. Media trucks choked the streets of Huntsville Alabama, each demanding an interview with the Howard family. But they had just arrived at 1600 Pennsylvania Avenue, and were unpacking in the Lincoln bedroom, preparing to meet the First Family.

The First Lady greeted the two families at dinner. "I'm Belinda. This is my husband, the President," she started out. "We're so sorry for your loss. Please let me know if there's anything we can do to make your stay here comfortable."

Ruth Howard started: "This is very gracious of you and your husband, Mrs. Toland. This is my husband Lincoln Howard, but we call him Linc. These are Mr. Tom and Mrs. Judy Taylor; and their daughter Debbie. She was dating my son. This is our cat Sam. I hope he doesn't get in the way."

"Please call me Belinda; and no Mrs. Howard. Sam's no bother – we're used to animals. The staff will take care of him."

A White House staff photographer snapped some 'grip-and-grin' pictures and then left. Within 30 minutes, the pictures blanketed the Web and the media. They carried the caption "*Parents and friends of the new moon named Demetrius visit the White House.*" Some of them said "*The President is concerned for the well-being of all our children.*" Some of them said "*First Lady consoles Alabama family,*" which wound up as the headline in the *Huntsville Times*.

The next day, the President and First Lady visited them just before lunch. He was fully-briefed by NORAD, the Army, the Air Force, the FBI, and the super-secret Homeland Security Enforcement Team or H-SET, who was his personal quasi-military force, at his disposal 24 hours a day. They all begged him to get as much information as possible from the Howard and Taylor families. This was a bigger mystery than anyone had ever encountered before.

After the tasty lunch was served, the President left and the First Lady sat on the couch between the mothers. Debbie was sitting in one of the antique armchairs, sobbing softly.

"Debbie, you couldn't have done anything," the First Lady said, patting her hand. "You knew him well enough to know that he was going to pursue his ideas, no matter what."

Debbie, who couldn't stop crying, tried to talk, but she just broke down crying some more.

A few nights later Demetrius visited his dad in a dream. Demetrius made him realize that the formulas that he developed could be a dangerous weapon in the wrong hands.

## Chapter 24.

"Airman Jacobs, get me the Duty Officer at ELINT Code 999. And activate the *Cone of Silence* over here, please."

Laura Jacobs was really perspiring now – this was indeed an unusual request. She glanced at Major Morten one more time to make sure of his coordinates in the room and then pressed 2 blue buttons on her console. Then she turned away from him and said in a loud voice: "MAJOR MORTEN, CAN YOU HEAR ME?" Since he gave no visible indication that she was speaking, she knew that he was immersed in the Top Secret audio beam called C/S. Everything that was said in that part of the room was for his ears only. She chuckled as she reached for her Yellow CEOI manual – when she was a kid, there was a TV program that had bumbling spies who tried to use an umbrella as a "cone of silence" – and of course it was a gag that drew plenty of laughs. Boy, would they freak out if they really knew.

She thumbed through the manual labeled *Communications Electronic Operating Instructions (CEOI)*. It had the day's code words and procedures that could hook NORAD to literally anywhere in the universe that had a radio. Page 33 listed ELINT Code 999, and she scanned that page carefully, because messing up was not an option. She pushed a series of buttons and sent the day's codes to Major Morten's console. He waved acknowledgement to her and then he picked up his headset and pressed the connect button.

"Pawn to King 5," was all he heard.

He glanced at the sheet from the CEOI: "Knight takes Pawn," he replied.

"India takes Pakistan," came the reply.

"Good day sir. This is Major Jeremy Morten, Duty Officer at NORAD. May I have your name and rank please?"

"G'Day sir. This is Lieutenant Colonel William Huffines, Duty Officer, Woomera Outpost. How may we help you today?"

"Well sir, I have a request from Chain of Command to add some keyword monitoring traps into the ECHELON computer system."

"Right, sir. Please stand by."

"There we are, sir. I had to activate our C/S. Now sir, what would you like?"

"Colonel, this event is classified Top Secret, Special Compartmented Intelligence. Code word: ENEMA. We are tracking a bogie that popped up between Earth and the moon at these coordinates," and he punched them into his console.

"Here is an image of that object from our Keyhole," and he punched a series of functions. "I'll wait until you have them."

"Major, we may be in the Outback, but our satellite downloads work perfectly well. I've got the images, sir."

"Okay Colonel. You see what it is. We don't know how it got there, but we've tagged the bogie as *NM-01*, that's NOVEMBER MIKE ZERO ONE. We now know that his real name is or was. His name is Demetrius Waltham Howard, from Huntsville Alabama, U.S.A."

"NORAD General Kleesen has been in touch with the President, who wants to make sure that we find out as much as possible about this ah, incident. We'd like the ECHELON system to monitor for his name, and report back to me if you get a trap. I'll upload the list of keywords now."

"Right, Major. We're on it. To catch a spy, sometimes one just has to shut up and listen, eh what?"

"Yes sir. And sir: if you get near our part of the world, please stop by and have a cool one with us."

"Right then, old chap. We'll be monitoring telephone calls, fax, e-mail and all other data that is routed through the public switched telephone networks of the world. There's really nothing that can escape us except for some Japanese high-level traffic and some parts of Russia around Moscow, which use fiber optic cables that we can't get our hooks into. Other than that, you'll be hearing from us. G'Day, mate."

Major Morten knew basically how the ECHELON system worked: behind every microwave dish, sometimes far, far behind was an intercept dish. In fact he knew that there were dozens of satellites parked in permanent orbits for the sole purpose of picking up the microwave beacons from hostile countries. Computer software and hardware performed signals intelligence collection. The 'trap words', programmed in every known language, were compared with the output of high-speed digital signal processing circuits. Every electronic conversation everywhere on the planet was being harvested all the time, and if a 'trap word' was detected, then humans were pulled into the loop, and the last chunk of conversation was replayed and analyzed. Usually it turned out to be junk, but you never knew what you might get. Of course the free-world governments all disavowed knowledge of ECHELON, and convinced the media that it was a big joke.

He sent a text message to Airman Jacobs, and she switched off the audio scrambler, and he suddenly heard the low buzz of noise in the office.

"I hope they spring a trap," he thought, and then he re-thought it "On the other hand, I hope they don't."

It wasn't long before the first trap sprung. Professor Sally Karoom's student from Russia, Miss Tanya Dubrova placed a call to the K.G.B. and tried to describe the conversation with the young student who visited UAH. She didn't recall much of what he said, but she did her best to recount it to the Motherland. ECHLON handlers were on it in a flash.

"Colonel Huffines, we've got a trap. Here's a plain-language conversation in Russian that includes the target words. We're sure this is what you're looking for."

At 0700 Zulu, Major Morten's phone rang the double-double ring of a classified incoming call. He pointed to Airman Jacobs, who was ready to immediately enable the C/S device.

"Good afternoon, Lieutenant Colonel Huffines. I guess you've bagged a conversation thread for us?"

"G'Day Major. Right. Here's the upload, and you'll find it very interesting. Some math professor at one of your Universities is trying to recall a conversation with that young man, Demetrius Howard. Seems like whatever he was talking about was above her pay grade."

"Okay Colonel. In your debt and thanks again."

"G'Day, mate."

Lieutenant Colonel Huffines turned to his lead radio intercept operator and said "RIO, let's not count out the Chinese and the North Koreans. How many assets do we have monitoring them right now?"

"Sir, right now six dedicated satellites are acquiring their radio frequency spectrum. If they mutter, we'll hear it, sir."

"Right then. Steady on, RIO. We can't afford to miss this one. Major Morten's a fine chap, what?"

"Sir, we just got a hit. It's the Israelis sir. Apparently the Mossad has a tap on the Russians. They're echoing the original conversation now, sir."

"It's going to be one of those days, RIO. Get me the Major – he'll want to know this right away, eh?"

"Yes sir."

## Chapter 25.

In the morning, Linc sat bolt-upright in bed. "Ruth! I had the most horrible dream last night: Demetrius came to me. He sent me a warning that chilled me to the bone – even though he's dead, he may still have a powerful effect on everyone. Dear, we have to get home immediately."

Ruth looked puzzled, and then her husband stood right by her and grabbed her in a bear hug. He whispered in her ear: "We need to talk in private, but we can't do that here. There are cameras and microphones everywhere. Come into the bathroom with me. We need to shower together."

"But..."

"Shhh. Do what I ask, just this once."

When the hot water was running full blast, Linc stood close to Ruth and said "I told Demetrius once 'you need to be able to feel the effects of the hidden world around you and sort out all the forces that influence you, even if you can't see them', and he reminded me of that last night, verbatim. Dear, we can't let the world have the kind of power that's hidden in Demetrius' invention."

"Imagine a government that had the ability to fling people into outer-space. It would be the ultimate weapon. Wars as we know them would be obsolete. This is a destructive force beyond anyone's comprehension. We must destroy the evidence before someone comes and copies down the formulas or reverse-engineers that infernal machine."

The hot water flowed around them; the steam filled the bathroom. Ruth's eyes lit up as it dawned on her that Linc was right, and they were all in grave jeopardy.

"Linc, you're right dear. No government can be trusted with that kind of power. We're not going to get our beautiful son back, but we don't want his legacy to be that he invented the ultimate weapon."

"We have to get home tonight. We have to get rid of all that stuff," whispered Linc.

"Oh my dear Demetrius – my beautiful baby boy, dead in outer space. And now we have to get rid of your work in order to save our world," as her bitter tears flowed with the hot water and ran down the same drain.

Mr. Howard held her tight until she stopped crying. She looked up at him and said "We need to go home, and right now. Thanks for thinking of this clearly, Linc – I'm sure I wouldn't have made the connection."

"No dear: Demetrius thought of it – he simply alerted me to the grave danger last night. Somehow I saw him in my dream, petting Suzy. What he said turned my blood to ice."

Within hours, they were all packed and ready to go.



"Belinda, thanks for your great hospitality, but we have pressing matters in Alabama. We hope you and your husband can join us sometime."

"Why, we'll look forward to it, dear. Now here's the Secret Service to see that you get home safely. Good bye now."

During the ride to the airport, and during the whole flight, The Howards spoke as little as possible. Food was served on the flight, and they were offered drinks, but they were both too uptight to enjoy the hospitality of the giant plane.

As the graceful 747 aircraft taxied on the runway at the Huntsville International Airport, the Howards were waiting at the plane's door to get off and get home. They said their goodbyes to the Taylors and promised to call them tomorrow. Then they walked briskly to a taxi and Linc said "50 bucks if you can get us home in less than 20 minutes."

The Jamaican cab driver shrugged his shoulders and floored it. "No problem, mon."

They entered the house and deactivated the burglar alarm. Then they both took the stairs, two at a time and looked around the roomful of formulas. On the workbench, a small blue field was beckoning them with a thousand unanswered questions.

"Our son's legacy," Ruth said.

"Yes, and the quicker we get rid of it, the better," replied Linc in a low voice.

So Ruth erased the board in Demetrius' bedroom, and then Linc burned the notes in the fireplace. Then Linc destroyed the computers and electronics with a sledgehammer in the garage.

Mr. Howard called and left a message on Dr. Karoom's answering machine. He knew that she was the mathematician that Demetrius hung out with: "Dr. Karoom, please let me speak to you tomorrow about Demetrius. It's extremely important. I'll be there at 9."

## Chapter 26.

The next day, he strode into Dr. Karoom's lab and without uttering a word; he erased the white boards all around the room.

"Well, I never!" cried Dr. Karoom. "Please leave immediately, or I'll call security."

"Doctor Karoom, I absolutely had to do that. Let me apologize and explain my rude behavior to you," and he spent the next hour explaining the awesome power of the zero-phasor formula to her.

"Demetrius was looking at how to switch 2 dimensions. He knew that time travel was impossible, so he used that as an anchor, against which he pushed one of the regular dimensions until it cracked and broke. He talked to me several times about what he learned from you: he learned finite field operations.

"When I went to school, my major was computer science, but my minor was mathematics. You see, I heard and understood what Demetrius was saying – I just wanted him to discover his own boundaries and not impose my own. Trouble was: I didn't realize how he was thinking about tearing down the boundaries entirely.

"See professor, he knew that division by zero was impossible, so he skirted around the problem by inventing a finite field that contained exactly the number of elements that he wanted to define in order to create a multiplicative group of the field. Trick is, he didn't stop there: he learned from you that a multiplicative group of a Galois field is a cyclic group. But you didn't explain how he could use that to create an isomorphic set. That let him leap ahead and create a null-set in one dimension that was the exact inverse of another dimension.

"On his white boards at home, that's what he was working on. It pained me terribly to leave him alone and just be his dad. After I saw 'GF' on his board, I brushed up on my old finite field algebra, and then every day, I watched as he proved rule after rule, grinding towards a proof that cost him his life.

"There was nothing I could do or say that would have changed a single thing: he was going to discover the power of inverse multiplication without me meddling. What blew my mind is how he proved, in only a few steps, that a finite field has prime-power order. His steps were elemental and beautiful. I could no more have stopped him than I could stop time itself. He thought about phasors and nullification since he was 13 or 14. When he started building circuits that dealt with energy nullification, I guessed where he was going.

"The circuits that he wired up created interference, or rather octaves of interference, which amplified each wave-crest efficiently, but more importantly they made rock-solid null-troughs. The math was only the backing for the hardware, and the computer programs that he wrote were for creating and validating the null-troughs in the wave vectors.

"When he asked you about Fermat's 'little theorem' last month, I knew that he knew enough about congruency to form the group that he wanted, and he did just that. He replaced each modulo-p in one dimension with the inverse modulo-p in another dimension. But he knew that the T-dimension was inviolate, so he quickly leaped to the conclusion that any other dimension could be swapped in and out with T and cause a shift in the local field.

"I believe that when Demetrius hit that switch that night, he knew exactly what he was doing. He just didn't have the courage of his conviction. He thought that his little experiment would fail. He'd been told 'you can't divide by zero', which is only partially true. His conjecture was the exact opposite of the basic calculus idea of an infinitely small amount, which we call delta something, as we casually throw the baby away with the bath water. His proof number 103 was: as you divide by smaller numbers, and get closer and closer to zero as a limit, that you can throw away the infinitely large amounts, which he called inverse-delta something. It was a real crackpot idea, so he was afraid of you asking for a formal proof. Worse than that, he was afraid of asking me. I would have just told him why he couldn't violate the laws of physics, and I guess he didn't want to call me a liar or treat me gratuitously.

"Now, professor, here's the bad part of all this: Demetrius' invention – it turns out that it's a terrible weapon – the most powerful and terrible weapon ever invented. That's why I erased your boards – lest our government be tempted to perfect his formula and use it as a weapon. It would be the most horrible power ever, since it could fling a person or a whole army into a different dimension. Think of it: if the government didn't like what you said, zap! You're gone for good – floating like a moon at some great distance from wherever you were standing one second before."

"But it gets worse – much worse. You know darn well that your research here has been ripped off by Russians, Chinese, Pakistanis, and North Koreans. Now consider for a minute if a country like that had a weapon like this... life as we know it would cease. The destruction of free civilizations would start immediately and cease when the whole world was dead or subjugated by some maniacal dictator or religious zealot.

"Now professor Karoom, I hope you'll think about what I've said carefully. I know that you know what you taught Demetrius. At some point, the FBI or some other agency will come knocking on your door and say 'please help us sort out this thing that Demetrius invented'. They'll be kind at first and then insistent, and finally, they will threaten you with force or detention if you don't cooperate.

"I want you to know the price for cooperation: death for all of us. And the reason that I'm sure of that is that Demetrius told me so. He came into my mind and showed me how to interpret his equations, and then he told me that they all had to be destroyed; lest the human race would be destroyed. He begged me to talk to you and asked you to resist talking about his work, no matter what the cost. Can you do that, professor? Will you?"

Sally Karoom just pushed up her large glasses, blinked and said "Mr. Howard, please leave or I will call security."

## Chapter 27.

Agents from H-SET visited the Howard home many times over the next few months. Agent-In-Charge Ted Riggs led a team of 5, whose job it was to find out what projected Demetrius Howard into outer space.

"Mr. Howard, I see that you were honorably discharged from the Army, and I see you were awarded a Purple Heart. I know that means that you're a patriot, and that you'd like to help us out. Sir: we're trying to figure out how your son's circuits and mathematics did what they did – you understand why we have to ask – we don't want anybody to accidentally stumble on his invention, do we? Someone might get hurt," he said in a friendly voice.

After a second of thinking Linc replied "Agent Riggs, I'm not sure that I can help you out. Although I took math in college, I really don't remember much of it. I erased the white boards in his room because it was just clutter from a disturbed teenager – just gibberish actually."

"Then why did you use a sledge hammer on his electronic circuits? Why were the computers smashed to bits?"

Linc paused for a second: "I was mad that he was dead and gone, that's all. I was frustrated and mad. Somehow that circuit had something to do with it, and I just hauled off and smashed it to bits."

"Well Mr. Howard, would you mind if we remove those white boards from your son's room and bring them to our forensic lab in Virginia? We'll return them when we're done."

"No, Agent Riggs, you may not. My son is dead and floating in outer space – you should find out why and how. The answers to that are not on erased white boards."

"Mr. Howard, we'd like to take the remains of the computers and electronics to our lab. Would you mind that?"

"You may not do that either. Whatever he was playing with was just parts from Radio Shack. I suggest you ask them what parts they sold him, and go buy some of your own."

"Sir, we did just that: we got a printout of all the parts that your son bought over the last 3 years. Here's the list, if you'd like to look at it. We'd like for our technicians to reconstruct the circuits. Surely you don't mind that?"

"Agent Riggs, you're upsetting my wife. You should leave now."

Late Saturday night, Agent Riggs' team entered the Howard home and took what they wanted – all in the name of national security, of course.

Too bad all they got for all their work was brand new white boards and a Vex robotics kit that Linc Howard retrieved from his son's dresser drawers, and then smashed to bits, where the infernal machine used to be located – that stuff was pulverized almost into dust, and then spread out by a road in remote Blount County. The original white boards were smashed to bits, soaked in kerosene and ignited in a field in deep-south Morgan County, Alabama.

A week passed and the spooks from H-SET rang the doorbell again. Linc stood in the door and would not let them in.

"Mr. Howard; now sir, we know what you did. Those were new white boards, and those parts weren't part of the machine that sent your son into outer space. We think that you're a patriot, and you'll be willing to work with us to recover your son's formulas and help us rewire his machine – isn't that so, Mr. Howard?"

"Agent Riggs, I don't remember enough of those formulas to do you any good. And yes, we replaced the white boards – they gave my wife the creeps, thinking about what might have killed Demetrius. Do you understand that?"

"Yes, Mr. Howard, however, we don't really feel like you're treating us honestly and respectfully. We'd like you to come to the H-SET office downtown and let our experts interview you. Would that be okay?"

"No Agent Riggs, I really don't have the time. The system I'm working on at the Base is running into a deadline, and I have to be there."

"We talked to your boss, Colonel Kirker, and he said that it would be okay if we needed your time for a couple of weeks. Our Director explained to your Commander how important it was to get some of your time."

"Well in that case, I guess I'll make some time. Please come back after Christmas."

"No, Mr. Howard – we're leaving now. We're putting you into protective custody," as he spun Linc around and handcuffed him. "That way we won't have to worry about your safety."

Linc was pushed into a brightly lit white room where he was allowed to sit for a couple of hours. Someone came in and un-cuffed him and then gave him a bottle of water and left. Linc poured the bottle of water on the floor – he knew that it would contain chemicals, probably truth serum. A large man rushed into the room and put his handcuffs back on.

"We don't want you injuring yourself, 's all," he said. Then he shoved Linc down in the chair so hard that it took his breath away.

"I want my attorney," he shouted.

"Yes, Mr. Howard, I bet you do. Too bad you won't get a free phone call either. But you can earn a phone call if we get the information we need, understand?"

"I want my attorney," he stated coldly.

"Yes, Mr. Howard, I bet you do."

Agents picked up Ruth Howard and held her in protective custody for 2 days, until they realized that she was useless. She understood less than they did about math and electronics.

"Where's my husband you animals? I demand to see him right now."

"He's not with us, Mrs. Howard. Maybe he's on the Arsenal – he still works for a living, doesn't he?"

"You goons better leave him alone or you'll answer to the President. He and the First Lady had us visit them a couple of weeks ago. I'll call her up if you mess with us anymore."

"We're not going to hold you. Go ahead home. Sorry to have troubled you."

The agent didn't bother to tell her that they reported only to the President and that all her threats of phone calls were utterly absurd.

"Professor Karoom, please sit there. Good afternoon, professor – do you mind if we ask you a few questions about one of the students you mentored? His name was Demetrius Howard. He was a young black male about 16 or 17 years old. Do you remember him?"

Sally pushed up her glasses and blinked. She was really irritated to be here. She clearly remembered the warning from Mr. Howard. After a couple of seconds she replied "Yes, I remember him. He asked some basic questions about math that anybody could answer. Frankly, I don't know why he thought that I was the only one to answer them."

"What kind of questions did he ask, professor?"

"He asked about dividing by zero, for one, which you know is impossible."

"Of course professor – everyone knows that."

"Right, well he didn't. Then he asked about fields and inverse multiplication – he was a disturbed young man if you ask me."

"Okay, professor – sorry to waste your time here. If you think of anything more, please call us."

"Lincoln Howard, we know you're hiding the truth from us, but we're going to figure it out without you. Remember that we'll be watching you. We consider you to be un-patriotic and possibly subversive. Watch yourself, sir."

"Agent Riggs: I hope you find it, whatever you're looking for. And I pray that you're the next new moon rising in the eastern sky one night."

"Is that some kind of threat Mr. Howard?"

"No – just a fervent prayer," he said as he realized that these guys wouldn't hesitate for a second to use Demetrius' invention against him, or anyone they deemed unworthy.

"Mr. Donald Hilliard, please sit down there. We'd like to talk to you about one of the teenagers you mentored. Do you recall a young man named Demetrius Howard?"

Mr. Hilliard recalled a lot about Demetrius. He loved the young man's spirit; his never-ending questions; his respect. He remembered teaching him how to install tank treads onto a robot. He remembered the team spirit. Mr. Hilliard broke down and sobbed. "Yes, I remember him."

He was finally asked to go home after an hour of weeping.

## Epilogue

Sometimes at night, friends and acquaintances look up at night and think about the new moon named Demetrius.

...Lincoln and Ruth Howard, who lost their only son; and they are still followed everywhere by spooky agents who seek Demetrius' secrets – the Presidents' own team, proud and strong – they will never give up.

...and Tom and Judy Taylor, who hold Debbie every night – although her hand healed, she never stops crying from the pain in her heart.

...and Dr. Patel, the Emergency Room doctor, who has notified Child Protective Services of Madison County that they need to investigate why Debbie Taylor's hand was burned – and the report notes that Mr. Taylor was hugging his daughter too tightly when he picked her up, so they need to find out what that's all about, too.

...and Mr. Hilliard, who sits in his bedroom and refuses to come out – he's had a total meltdown and cries all the time – his wife wants to commit him to an asylum for his own protection.

...and Mr. Jack Thompson, who joined a monastery, where he is known as Brother Paul to the Benedictine monks who pray every day for him to heal – he quietly asks for forgiveness every night, as he looks to the sky and realizes that he'll never see Demetrius again.

...and Sally Karoom, Ph.D., who ponders the questions that Demetrius asked her and her students, but she can't quite put it all together enough to get a grant from the National Science Foundation, yet not reveal Demetrius' ideas – too bad. H-SET interviewed her twice, and she apologized both times that she didn't take notes during the meeting. She doesn't think they believe her, but they confiscated the white boards in her office and removed them to an unknown location for forensic analysis. She just doesn't grasp Demetrius' zero-phaser formula, and probably never will, but she remembers Linc Howard talking to her that day, and she knows that the Fed's will hound her until she dies, or until she slips up. "*A more powerful weapon will never be devised,*" she thinks to herself. "I'm not going to be in the history books as the one that handed it to them."

...and Agent-In-Charge Ted Riggs, who is looking for the last lead: a certain 'Mr. Jack Thompson', whom, it seems, disappeared off the face of the planet. He watches several likely "suspects" and hopes that one of them will eventually get tripped up, and then he can get the information that Washington is demanding.

...and the dedicated personnel at NORAD and NASA, who track a bogie identified as *NM-01*, which they know is really a young man named Demetrius Howard, who will be wearing blue jeans and a flannel shirt for the rest of eternity. He rises at 8:21 P.M. every night over Huntsville Alabama, in a perfectly circular



orbit, 299,792.548 kilometers away – one of their bright scientists realized that that distance is 1 light-second in distance from Earth, but none of them can tell you why.

...and the operators of the Super Secret ECHLON network who silently suck on signals from absolutely everywhere. Next week the State Department will be deporting Tanya Dubrova to the U.S.S.R. for her phone call to the K.G.B. Then the H-SET team will visit Professor Sally Karoom once again and turn the screws ever tighter. They'll want to know why one of her students was a K.G.B. agent, and exactly what she knew about Demetrius Howard's experiment.

...and the new moon named Demetrius who rises every night at 8:21 and looks down from his small place in heaven onto Huntsville Alabama. And he still has a powerful effect on everyone, even though he is invisible to all but the most powerful eyes on Earth.

...and Suzy, the Dog Star, who is watching over her master and moving her eyes in a special way that communicates her love and understanding of it all.