WE HAVE LIFTOFF...

I slammed my locker shut, spun the combination lock, and turned to go to my next class. As I looked to the far end of the hall I noticed a kind of unusual milling of the kids. It wasn't anything terribly overt, but there appeared to be a little more commotion than usual; a sort of churning of bodies. This wasn't occurring everywhere, but just at the distant end of the hallway. I stopped to watch. The subtle agitation began moving my way, slowly, then picking up speed. The kids—mainly boys—were talking excitedly, moving their arms and heads in jerks and starts, and running short distances to each other. It was like watching a slow–moving ocean wave advancing toward me. Whatever was happening looked like it was big. I'd never seen anything like it before. Finally, the commotion got close enough to me so I could hear a little of what was being said. I was able to pick out some words, like "rocket," and "beeping." Then, in a final onrush of frantic activity, the kid right in front of me whirled and shouted, "The Russians did it! They shot a rocket into orbit! I mean a satellite! It's Sputnik!"

"What? When? What are you *talking* about? What's 'Sputnik'?"

"The *Russians!* They shot a rocket with a satellite into outer space and it's orbiting around the Earth! They did it today and they call it 'Sputnik'!" He pushed past me and continued sounding the alarm. I looked back down the hall at the tumult of kids. The activity was dying down nearly as fast as it had picked up, but there were still knots of heated conversation. I spotted Arthur Loya making his way in my direction, impatiently pushing through the crowd, wearing the incredulous, slightly exasperated look he donned when he had to make his way among us ordinary mortals. Art was a 'brain,' and I knew he would know all about whatever was happening. When he was close enough to hear me, I called out to him,

"Art!" he looked up at the sound of my voice and veered over my way, "What's going on? Did the Russians really launch a satellite?"

"Yeah," he replied, looking at me from under his dark lashes and curly black hair, "it's about a two–foot sphere that circles the earth every hour and a half. I think they said it's three hundred miles up."

"*Circles the earth every hour and a half?* How can it go that fast? Where did you hear about it?"

Art shifted his huge pile of books to the other arm, "Mr. Jenkins got a phone call from his wife and turned on his radio in class. We heard it on the news. The reason it can go that fast is that it's above the atmosphere—no friction."

"Does it go over us? I mean, over the United States?"

"Yes," he nodded gravely, "we'll probably be able to see it when it goes over at night. It'll look like a star moving fast across the sky."

"Well, what's it *do*? Is it a bomb or something?"

Art looked at me like I was just slightly slow, "No, probably not. It's only this big," he held his free hand a couple feet away from his books, "they don't know exactly what it's doing, but it *is* sending a beeping radio message back to earth," he looked at me with some concern, "I wouldn't worry about it too much. It had to happen sooner or later." Glancing at his watch he said, "I gotta go," and with that he pushed past me and made his way down the hall, his back hunched and head down.

The warning bell for next period rang and I took off running for my next class. I was unsettled by this news, to say the least. We'd been hearing about A–bombs and H–bombs for a long time now, and while it wasn't a topic of daily conversation, it was always there. Up till a couple of months ago we had to worry about bombers flying from Russia to blow us up. Then they announced the launching of their first ICBM with an atomic warhead. And now, now they had a *satellite* that went right over our heads every hour and a half! The date was October 4, 1957, and on that day I, along with a lot of other kids, decided to study science.

At home that night my dad was into his typical sensory overload mode. Almost every evening after dinner he sat in his easy chair simultaneously watching TV, reading the newspaper, listening to a ball game or prize fight on a transistor radio with an earphone in his ear, with a cigarette stuck in one side of his mouth and a toothpick in the other. He was usually hard to get through to. The day's news was so monumental even he remarked about it. My mom was always upset about the state of the world, so the day's announcement pretty much sent her over the edge. The newscasters (actually it was "top scientists") assured us that Sputnik was *not* a bomb, and that it was probably just sending back "scientific data" (whatever that was) to Russia. They played a recording of the "beep……beep……beep," that Sputnik was sending. They said it was possible to see it traveling roughly from west to east over the northern part of the sky. It would look, as Art had said, like a star moving swiftly through the night.

When I went to bed I couldn't stop thinking about that thing up there. It was 9:30 and that meant if it was overhead now, it'd be back at 11:00, 12:30, 2:00, 3:30, and on and on, without end. It took me a long time to fall asleep.

I woke abruptly at about 4:30. The tattered veils of the bad dream that had jolted me awake didn't accompany me to consciousness, but I suddenly remembered Sputnik. I got up and put my robe on, then went quietly outside. My room had a door that opened to our fenced back yard. I sat on the steps for awhile looking up at the silent immensity of the universe, trying to feel the distance to the stars. After I'd been out there for about twenty minutes, and the eastern sky was beginning to show the first signs of dawn, there it was! I was sure of it! It was very faint, and it sure was moving. It was a *lot* faster than I thought it would be. Its motion was purposefully smooth and inexorable. It looked

as if it *belonged* among the stars. I followed it all the way to the horizon—the roof of the next house—and wondered how something as lovely and peaceful–looking as a flying star could be the result of the U.S. and Russia trying to build weapons to blow each other up. I could feel my heart pounding in my chest, and I wondered if any of my friends were viewing this amazing sight. Before I saw Sputnik pass overhead I felt safe and secure in the dark of my back porch, but now I felt small, and exposed. I crept back inside and slid under the covers. I was asleep almost as my head hit the pillow.

The launching of Earth's first artificial satellite was the hot topic of conversation for the next few weeks. My friends and I didn't understand why *we* hadn't sent one up. We were nearing the end of the highly–publicized International Geophysical Year (IGY), a cooperative effort among many countries to share scientific data about the world, and U.S. scientists had confidently announced that they would be sending up "several" satellites as part of IGY. We had been hearing about the three–stage Vanguard I rocket for awhile now, but when it came time to fire it into space, it lurched off the launching pad and blew to smithereens.

The spectacle of new, experimental rockets exploding at, or shortly after, lift–off was something the news media never tired of showing us, but it was nerve–wracking to a public already nervous about the space race and scared to death of the Russians. Until the Sputnik event the Russians had been viewed as technically lagging the U.S. *Surely* we had scientists smarter than the Russians! In about two months, to everyone's relief, Sputnik fell back towards earth and burned up in the atmosphere.

Before *that* happened, though, they launched *another* satellite—Sputnik 2—and it had a *dog* on board. The news media reinforced our opinion (which they had planted in the first place) of what *scum* the Russians were when they reported that the Fox Terrier

Laika lived for only *one week* before her oxygen ran out and the satellite's electrical system ceased functioning. The Russians had not made any provision for bringing Laika down out of orbit. Until Sputnik 2's fiery reentry five months later they would be orbiting a dead dog, and not much else.

The U.S. finally got into orbit in January of 1958. Weary of the decidedly poor performance of the Vanguard, rocket builders had fallen back on a proven military rocket, the Redstone. Explorer 1 lofted an eighteen–pound satellite that detected what would later come to be known as the Van Allen radiation belts. This was followed by two more successful satellites—Vanguard 2 and Explorer 3. My friends and I knew that the United States, being good guys, would *never* put an animal on board it couldn't return alive. The space race was on in earnest.

After my initial shock and fear at the Russian accomplishment, I got used to the idea of satellites over head. Space travel was the plum at the top of the scientific tree, and all of us who had become "academic" majors really longed to go into space, or at the very least be scientists or engineers in the space program. Over the next year and a half it became only too clear, though, that the U.S. was lagging *way* behind.

By October of 1959 the Russians had sent up four more awesome satellites. Sputnik 3 weighed almost *3,000 pounds*. Lunik I missed hitting the moon by only 4,000 miles, and went into orbit around the sun, where it is to this day. Lunik II was the first manmade object to strike the moon, a feat, we were told, equivalent to shooting a needle through the eye of a fly six miles away. Lunik III

orbited and photographed the *far side* of the moon. Every single Russian flight was breaking ground and making history.

During these two years I had implemented my plan of studying math and science, but I ran into one little problem: I didn't have much aptitude for either. Math didn't come easily to me and, even though I had a lot of interest in science, I didn't have the study habits or discipline I needed to succeed at it. My solution to this dilemma was to start hanging around with the kids who *were* good at math and science. Art Loya was the first person I thought of.

Art was a loner among the brains. The other smart kids schmoozed their way through classes impressing teachers and each other, but Art didn't do that. He was usually off by himself, engaged in projects and hobbies the other brains weren't interested in. He was also very shrewd. When the big fad at school was to collect stamps, most kids just bought them helter–skelter, but not Art. He studied. He read. He asked questions. He purchased carefully. He had a very young–looking and innocent face, and he out–traded the other, older kids who were never any the wiser. He did the same thing collecting coins and, years later in high school, when these hobbies were no longer even memories among the kids who had once been so wild about them, Art sold his collections for *hundreds* of dollars—a lot of money at the time.

Anyway, I gradually became friends with Art, although he was a little suspicious of me at first. We had a mutual interest, and that was a complete obsession with the space race, although it wasn't looking like much of a race. He was more methodical than I, and had complete notebooks of newspaper and magazine articles on everything he could find referencing space. He knew facts, figures, and names of all the U.S. and Russian boosters, satellites, and people. He could quote orbital periods, apogee and perigee, velocities, and statistics on the information being telemetered back by each satellite. He was even more frustrated than I was with the U.S. effort. It was in our first semester in high school that Art started us on a project that we would continue with nearly until the time we graduated.

I was over at his house one weekend afternoon, a Saturday, I think. We were out in his garage where Art was putting a final coat of dope on a gasoline–powered model airplane. The ceilings of his bedroom and garage were littered with airplane and rocket models hanging from almost invisible threads. The night before we had watched photographs of the moon's far side being transmitted back from space by Lunik 3. It was finally too much for Art. He looked up at me, brush in mid stroke, shook his head and said,

"We've gotta build a rocket. A big one."

I looked back at him. I'd been around Art long enough now to know when he was serious about something (almost always) and when he wasn't (almost never). He had a *very* serious expression on his face right now.

"How?" I asked.

He looked down at the model and continued brushing, "I'm not exactly sure. I'll go to the library on Monday and see if there's anything there to help get us started. Even if there's not, I think I know how to do it. It's the fuel that we'll need to really find out about, though," he thought for a minute then looked up again, "it'll have to be solid fuel—liquid's too tricky."

On Monday after school, I went with Art to the library. Although it didn't have concrete lions, our town library was in all other ways a proper edifice. It sported huge stone lintels on either side of the entrance, a properly accusative/inspirational saying above the door carved in Roman capitals separated with the obligatory dot, hardwood shelves housing the book stacks, and stern, tight librarians whose mouths and index fingers were permanently pre–formed to fire at an instant's notice the fearsome *ssssssh!* at any patron audacious enough to utter even a single sibilant syllable.

I was always a little awed by the musty, formally proper atmosphere of the library, and just a little scared of the librarians. Art, however, had no such problems. He breezed in as if he owned the place, stormed the card catalogue, and within seconds had the card in his hand representing the *only* book in the library on amateur rocketry. It was with some anxiety that we walked to the stacks, afraid of disappointment. Art led the way as I followed, looking over my shoulder for prowling librarians. The call number for the book took us most of the way down one of the rows, to the top shelf. It was hard to see the numbers on the books, but Art spotted the title. "There it is!" he exclaimed in a whisper.

"Oh, *great!*" I was very excited about this project. Nothing has gotten my pulse up like the films on TV of rockets majestically lifting off their launch pads.

"*Shhhhhhhhh!"* said the librarian who had magically appeared at the far end of the row, her finger cocked to her lips in near–perfect form. We cringed from the admonition, then Art stood on tiptoe and pulled down our book. We took it to one of the tables and scanned it. It had *everything* we needed to know.

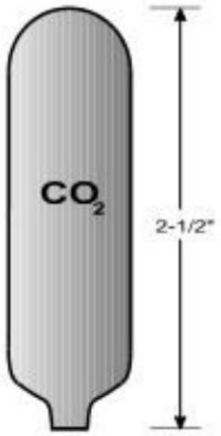
There was information on rocket design, including drawings of nozzles and nosecones along with the mathematical formulae necessary to design them, recommended materials, launch pad and electrical firing mechanism plans, instructions for tracking and recovering, suggested payloads (one payload was a strobe light for a *night* launch—too cool!) and, most important, information we needed about solid fuels. Something I hadn't thought about, but was on Art's mind, was the acquisition of fuel: would it be a controlled/illegal substance, difficult (not impossible—that word wasn't in Art's vocabulary) to get? As it turned out, the fuel described in the book contained only two chemicals. The first was sulfur in powder form and available at feed stores, and the second, zinc dust, was purchasable from a chemical supply house—no questions asked.

We were on our way.

Art took the book home with him to study. I saw him the next day at school before our first period class.

"Well?" I asked anxiously, "when do we start?"

He said, "To build a *real* rocket—and I think we can get one up at least 30,000 feet—is going to take a lot of time, and we should get started on it right away," he frowned, "there's a *lot* to do. *But*," he looked up and his face brightened, "I have an idea for small, *very* small, rockets we can experiment with right now to get the fuel right." He reached into his jacket pocket and pulled out a CO2 cartridge.



These metal, cylindrically shaped cartridges contained carbon dioxide under pressure, and were used in making carbonated drinks, and in some toys. They were available from hobby shops. The devices in which they were used would puncture the small end of the cartridge to release the pressurized gas. I didn't see how this had anything to do with rockets. My vision was *much* larger than this. I said,

"I don't get it. How can we use these?"

Art turned the cartridge around so I could see the small end. It had a tiny hole in it from having been previously punctured. "We get a drill and ream out the hole so it's bigger,

then figure out a way to put fins on it, fill it with zinc dust and sulfur" he looked up and smiled, "and we have a rocket."

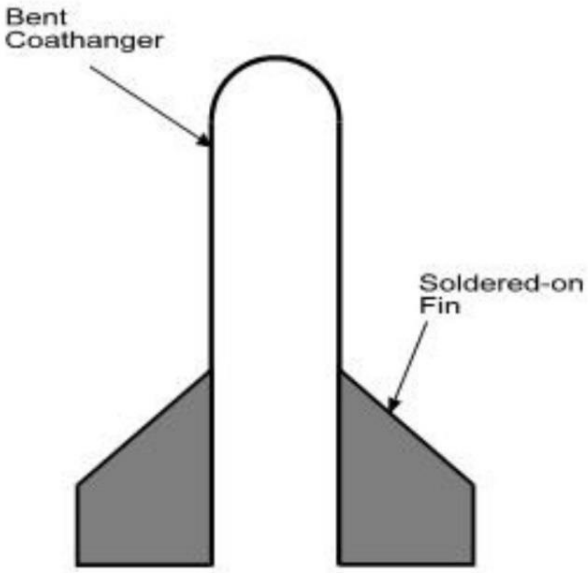
"Wow! That's neat!" I took the cartridge and turned it around, "How're we going to attach fins, though? We can't solder them, can we? Won't it get too hot when it takes off and melt the solder?"

"Yeah, probably. It would be too hard to solder, anyway. I don't even know what the cartridge is made of. No, I think we'll have to make a little harness that has the fins on it, then slip it over the cartridge. Come to my house after school today, and we'll see what we can do."

This was great! "OK, I'll be there about 3:30."

At Art's house that afternoon we fabricated—that is, *he* fabricated—our first prototype. Art had an amazing array of tools and materials. His idea was to form two lengths of wire coat hanger into 'U' shapes, solder them together at right angles, then attach fins onto each leg. The whole thing could then be slipped over the CO2 cartridge. With any kind of luck, we could reuse the harness on multiple cartridges.

He had a big soldering iron he used to make electrical chassis, and lots of sheet metal. It took until almost seven that night, but it was done at last. The final fin harness was attached to the cartridge with two tiny cable clamps to maintain equilibrium. As well as stability in flight (we hoped) the harness would hold the rocket upright for launch. As always, I was amazed by the fertility of Art's mind, and his deftness of craftsmanship. The only things we needed now were fuel, fuse, and a launching pad.



It turned out that there was a chemical supply house in the town next to ours, and Art was able to get both the Zinc dust and Sulfur there—his paper route financed this, and most of his other projects. Our fuel testing consisted of mixing a small amount of the two constituent chemicals in the proportions dictated by our bible and lighting it off with a fuse in a corner of Art's back yard. It flashed furiously and put forth a vast amount of white smoke and an impressive *whooshing* sound. Being that it was rocket fuel and not simply black powder, it burned very quickly, but not explosively. We were *very* impressed and anxious to launch our maiden flight. My contribution to the project was to buy a box of CO2 cartridges. A roll of fuse was available from the local hobby shop, where Art was well known. We had no idea of how fast, far, or *where* our little rockets would go, but we had a sense that they could do some serious damage if we weren't careful.

The obvious choice of launching sites was the L.A. river. The river, which flowed south along the eastern border of our town, was constructed to take runoff from the San Gabriel mountains and channel it to the sea. The whole area we lived in was a flood plain, and without this immense concrete structure there would have been frequent floods. Most of the year, though, water flowed only through the smaller channel cut in the middle of the riverbed, leaving plenty of bare, dry concrete available.

The sides of the riverbed sloped upward at about a 45o angle, and were composed of softball–sized rocks imbedded in concrete. There were occasional high spots in the flat river bottom that contained manhole covers. We chose one of these as our launching site and dubbed it "Cape Carnivorous."

The next Saturday, our projected launch day, I woke at dawn and fired up my ham radio. I wanted to get on my bike and ride over to Art's right away, but he didn't get up as early as I did. I knew it was going to be a great day when I made my longest–ever ham radio contact before 6 a.m. It was an amateur radio operator in Melbourne, Australia! His call sign was ZL1ZD and our contact was on the 15 meter band. My antenna was a 40 meter dipole. I enjoyed the challenge of long–range contacts using very low power—my transmitter was only 75 watts. By the time my parents got up I was so anxious I was buzzing like a hornet. My mom noticed, of course, and asked,

"What are you and Art going to do today, Rich? You're not going on another of your long bike rides are you? You kids go too far on those bikes. You might get hurt." Art and I occasionally took all day bike rides to go to hobby or specialty shops in other towns. There had been times when we didn't get home till well after dark, and my mom worried.

"Naw, we're just going to fool around in his garage," I lied, "we're building some model rockets." I assuaged my guilt by revealing a thin, almost transparent, sliver of the truth.

"Well, you kids be careful. That Art's going to get himself hurt some day, with all the crazy things he does."

"OK, mom. I gotta go," I gave her a peck on the cheek and got out the door as fast as I could. I rode hard over to Art's, jumped my bike up over the incline at the edge of his driveway, then came to a cool, skidding 'brodie' next to his back door. His dad yelled out the kitchen window,

"Hey, Richard! What the hell are you doing? Stop making skid marks on my driveway!"

I grimaced, "Sorry Mr. Loya."

He came banging out the back door and examined the black mark my back tire had made on the concrete, shaking his head and frowning.

"*Jeeesus!* I ought to make you clean this off," he said without looking at me. I got off my bike and kind of rubbed at the mark with my foot.

"Jeez, I'm sorry, Mr. Loya. Let me go get the hose and try to wash it off," I said as I put down the kick stand.

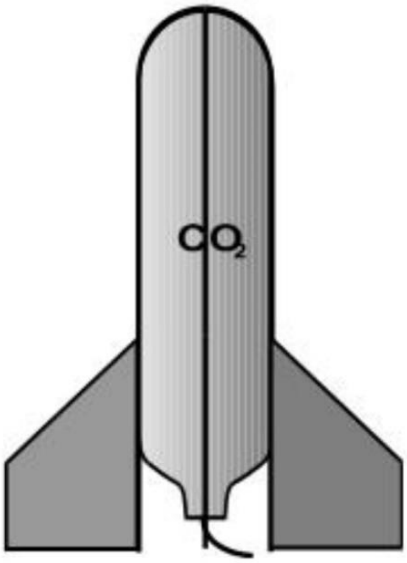
"No, you'll probably just make it worse," he shook his head again, still looking down, "Jeeesus, you kids. *Hey Arty! Richard's here*." he yelled. He gestured back toward the garage with his head—still no eye contact with me—"He's back there. Jeeesus, you kids!" Art's dad was involved in ¼ mile dirt track racing, mainly ¼ Midget Racers. He didn't race himself but was part of the support organization. A couple of times he took Art and me to races where we sat in the bleachers at the turns, getting pelted by dirt clods as the little machines roared around the track.

I pushed my bike back to the garage where Art was working. He looked up and said, "Hi, I'm glad you're here. We've got a problem and I don't know how to solve it."

"I got your dad mad at me. I skidded on the driveway."

"Yeah, don't worry about it," he shrugged and shook his head, then looked toward the front of the house, frowning, his gesture of dismissal a small mimic of his father's.

"Oh, wow, that's cool!" I looked past Art to his work bench. He had four CO2 cartridges laying there, neatly lined up, with their exhaust holes widened. The fifth was sitting vertically in the fin harness Art had made.



Three glass beakers with cork stoppers, one with silver–white Zinc dust, another with yellow Sulfur powder, and the third with the fuel mixture, were sitting off to the side, along with a roll of fuse. "Wow! That is so *neat!* What's the problem?" I was dying to go to the river and launch these babies!

"Well, I really should have thought of this, but the powdered fuel won't stay in the cartridge. It just pours out when I set it upright. I'm not sure how to get around it. We don't want to go jamming the fuel in there, it might ignite while we're tamping it.

I picked up our rocket and looked it over. It really did look great. I said,

"What if you didn't make the hole so big?"

"Well, I thought of that, but it would be hard to get the fuel in, and it *might* be too small," he turned toward me, "it could blow up. I don't think that's the solution."

I thought for a minute, anxious to be able to contribute something to this venture. "What about..." an idea was forming, "glue!" Art looked up.

"Glue?"

"Yeah! Look, if we took Elmer's glue and thinned it out with water, then made a kind of paste of fuel and thinned glue, when it dried it would all stick together, wouldn't it?"

Art nodded slowly, thinking, "That might work, but we don't know if the glue will affect the way the fuel burns.

"Well, sounds like an experiment to me!"

"All right," he said, smiling.

We mixed the glue with water as thin as we could, then combined a small portion of it with the powdered fuel. The resulting paste wasn't easy to get into the little hole, but we were able to do it with match sticks, a little at a time. When we had the cartridge full, we set it out in the sun to dry.

We also set out a dish with the left-over glue–fuel mixture for our experiment. It took about an hour for the open mixture to set, and the consistency looked, well, interesting. It was holding together in a sort of lumpy mass. We moved it to the "experimental" corner of the yard, stuck in a length of fuse, and lit it. As far as we could tell, it burned exactly the same, smoke, sound, and all. We decided to give the rocket another hour to set, and in the meantime mixed up more glue and fuel and filled the other cartridges.

Art's mom called us in to eat lunch about noon. Art's family was Mexican, which to my inexperienced and sheltered life seem wildly exotic. Besides the fact that they spoke Spanish (but not very often, it turned out), the whole concept of "family," was completely different than mine. My parents were reserved, somewhat distant, and there wasn't much of what could be called excitement in our collective life. Art's family, on the other hand, was sparking with energy and non-stop activity. Mrs. Loya never asked me whether or not I wanted to eat. She just called me in and sat me down. She was a short woman with a heavy accent, and she talked *very* fast. She always seemed just about at the end of her patience with everything, and clearly ran the show. Art had a little brother, Ricky, and a toddler sister, Lorrie, and his mom was continually barking orders at all of them. I was never there during a quiet meal. The only one apparently not affected by the activity and animation of Mrs. Loya was her husband. Nothing seemed to affect him. I was relieved that he appeared to have forgotten about the job I did on his driveway. Art's mom was in full swing at the lunch table,

"Arty, you sit there! Richar', sit here! Ricky, help your li'l sister, she can' get up to the table! *Now*, Ricky! Here's some bread, an' baloney, an' cheese. Arty, make your little sister half a sandwich, *just meat and bread*, Arty! Be careful, don' spill anything. Arty! Be careful, you're gonna spill the milk! Ricky! I tol' you to help your little sister! ***ART!***" she screamed to her husband in the living room, "***YOU WAN' SOME LUNCH?***"

"No," came his thin reply, "I'll eat later."

"OK," she looked my way, "Richar', why don' you eat, you sick or somethin'?"

"No, Mrs. Loya, I'm fine," I quickly slapped together a sandwich and started to eat. I watched in my usual amazement the bantering and jabbering and wriggling and sliding off chairs and crying and complaining and whining and shrieking and moaning and admonishing and threatening. It was so totally different than my family, but I really liked all the activity and frantic life within Art's family.

"Let's get out of here," Art whispered to me. I gulped the last of my milk and got up to leave.

"*ARTY!!* You an' Richar' clean up your plates. *Now*!"

"We *are*, mom. *God!*"

"*Don' you swear at me, Arty!* ***ART! ARTY'S SWEARING AGAIN!***"

The barely audible reply came floating in from the living room as Art's dad spoke directly into the TV screen, "Arty, don't swear, you heard your mom!"

We hustled our plates to the sink and made it out the back door without further incident.

As we walked to the garage the commotion in the kitchen gradually receded. We checked on the rockets cooking in the sun and decided that everything was well on its way to being dry. Art and I packed up the rockets and other stuff into cardboard boxes and lashed them to our bike racks. The ride to the river took about a half hour, and once we got there we spent another half hour trying to relocate Cape Carnivorous. It was nearly three o'clock by the time we got unpacked. That only left a couple of hours until we needed—I needed—to start for home.

We set up a workspace and observation lookout high up on the bank, behind a low concrete wall where we could squat down to watch the launch. Cape Carnivorous was a tear–shaped island of concrete about halfway between the bottom of the sloping bank and the central river channel. Whichever one of us lit the fuse would have about a 25–yard sprint up the sloping side. With his usual meticulousness Art set out the necessary supplies and went to work. He cut two short, equal lengths of fuse and set them on top of the wall, then lit the first one with a wooden match. He timed how long it took to burn using the sweep second hand on his watch. Then he did the same with the second fuse.

"Why two?" I asked.

"Just want to make sure we can depend on the burn rate of the fuse," he looked at me, "we don't want any premature ignitions."

"No, sir, that's for sure! No premature ignitions!" I was *really* excited now. I could hardly wait to see our rockets take to the sky.

Art estimated the length of fuse we'd need, and we were ready. We went over the wall and made our way awkwardly down to the bottom. Cape Carnivorous had a manhole cover at its center, so we set the rocket next to it, its full 2½" height gleaming in its custom fin harness. Art sat cross-legged and carefully poked the fuse into the hole. It went in easily and was snug enough, so we didn't have to worry about it falling out when he set the rocket upright.

I was standing, and he looked up at me,

"Who's going to light it?"

I was having a great time, but this whole thing wouldn't have happened had it not been for Art. "You go ahead—it was your idea."

He nodded, knowing this could have been my only answer, "OK, why don't you go on back up then. Make sure there's nobody around."

I ran back up the side, slipping and tripping on the rocks. I clambered over the wall and looked both ways down the service road that paralled the river, then back down at Art. I called,

"All clear! Countdown T–minus 60 and counting!"

Art gave me a thumbs–up and squatted down by the fuse. He hesitated there for a minute then stood up and looked north and south along the river. He raised his hand with the match in it and said loudly,

"*I dub thee Little Tyke! May you fly with honor!*" I had no idea Art had such a corny streak in him. I didn't care, though. I was so excited I thought I was going to pee my pants. Art squatted then and lit the match. When the fuse got going he turned and sprinted up the side, slipping a couple of times, but he had planned enough extra length into the fuse to allow for that. He flew over the wall completely out of breath and whipped around. We watched, the tops of our heads just above the wall. We could see the fuse sparking and burning closer to Little Tyke. The flame went into the exhaust hole, and—we held our breaths—

Little Tyke disappeared.

It was just *gone*. Oh, there was a little sound and a little plume smoke that showed it had taken off, but it happened so fast we didn't see a thing! Art and I held our positions, hardly breathing, listening to hear the sound of it falling back to the river bed. We heard *nothing*. We stood that way for about three minutes, then I turned to Art and said,

"Uh-oh."

"Yeah. Looks like we just lost our fin harness," Art replied, scanning the riverbed.

"Oh, no! Damn! Let's go down and see if we can find it."

"OK."

We climbed the wall and went down to the bottom, then split up and searched systematically for half an hour, but to no avail. Little Tyke had lived an incredibly short life, and gone out almost without us noticing it. Our first day of rocket launching was over. We packed everything up and pedaled home.

Over the next few weeks Art made more fin harnesses, and we looked forward anxiously to our next trip to the Cape. Our second launch attempt was pretty much the same as the first, except I had binoculars trained on the rocket. Art lit the fuse and hustled up the bank as before. When the fuel ignited, my magnified view of the rocket was instantaneously replaced with a small plume of exhaust smoke—again I saw *nothing*. Art said,

"*Shhhh!* Listen!"

We were both silent for a few seconds and were rewarded by the small *tink* of our rocket striking the concrete surface of the river.

"There!" Art said, whipping his head around and pointing off to our right, "Listen!"

We strained, motionless, and heard several more *ping!* sounds, closer and closer together. It sounded like our little rocket was skipping across the riverbed like a stone across a pond.

"It must have taken a turn somewhere," Art said, peering north along the riverbed. "Let's go see if we can find it!" We scrambled down the side and sprinted toward the last sound we'd heard. In about five minutes I found the rocket. I held it up and called to Art,

"Hey! Here it is! I found it!" He came running over.

Our CO2 rocket was beat to crap. The fins were bent and scraped and the harness was completely askew around the cartridge. The cartridge itself was blackened, one of the clamps was missing, and the whole thing looked like it had been hit with a sledgehammer.

"Wow! I wonder what happened," I said.

Art took the rocket and turned it over. "I think we need a different fin harness. It looks like the rockets are making a turn right after they leave the ground," he looked back up the riverbank to where our bikes were parked. "we can go ahead and launch the rest of them," he looked at me, "but I'll bet they're going to do the same thing."

In my usual frenzy, science took a back seat to adventure. I didn't care if they turned in flight! Let's just launch 'em! "OK! Let's go!" I shouted, grabbing the rocket from Art and sprinting up the side.

Art was taking his time, as usual, looking over the next few rockets, making sure everything was in preparedness, when we heard the sound of a car. We looked up and froze. It was a police black and white with two patrolmen in it. We didn't know if what we were doing was illegal, but being kids we assumed it was. I stood there feeling guilty as sin as they neared us. Art just kept on examining the rockets.

They stopped the car, said something into the microphone, then got out, sort of hitching up their pants the way cops do. The driver was putting on his hat and said,

"How's it going, fellas?"

"OK,"

"Fine."

He surveyed our little field of rockets, canisters of fuel, and roll of fuse, "So, what are you boys up to this morning? What are those things you've got there?"

Art looked up at the guy, unafraid, "These are amateur rockets we built. We're down here launching them off because this is the safest place we could think of to do it."

"Rockets? Like fourth of July rockets? *That* sounds dangerous. Do your parents know where you are?"

Art looked slightly disgusted, "Yes, they do. And they're not fireworks. They're rockets like the ones they launch at Cape Canaveral. They're perfectly safe.

I was feeling *way* too guilty to say anything, but I was wishing Art wasn't talking like such a big shot. We might get into serious trouble. While the one cop was talking to Art, the other one had walked around us and was looking at our arsenal.

"What's this? Some kind of blasting powder?" he held up the beaker of fuel.

Art frowned even more, "No. That's rocket fuel. It's made up of zinc dust and sulfur in proportions to burn with the correct specific impulse for rockets of this size. It won't explode."

The cop's partner walked over to examine the fuel. I nudged Art with my elbow and whispered,

"Be nice!"

He looked up at me, still mad, but nodded. He picked up one of our rockets from the top of the wall and walked over to the cops. Art could schmooze with the best of them when he set his mind to it, and that's what he did now. I stood apart, only too willing to let him do the talking. He held up the rocket and showed it to them, slowly turning it over and pointing out the fins and the harness, explaining the reamed–out exhaust hole, telling them about my glue idea for the fuel, and smiling and looking innocent, like when he was trading stamps with the kids at school. In a couple of minutes they were nodding and acting as if he was their *kid* or something. It was amazing. Art finally looked my way and said, "Richard, cut off a couple on inches of fuse and bring it over here."

I twitched like I had been shocked, but tried to appear cool and competent, like Art. "Right! No problem." I cut off the fuse and went over to them. Art had taken the fuel beaker from the cop and was dipping a plastic spoon into it. He poured out a spoonful of fuel onto the top of the wall, took the fuse from me, and inserted it into the little mound. The cops and I automatically moved back a couple of steps as Art lit it. The fuel behaved as it always did, burning predictably with sound and smoke.

Art looked up at the cops and smiled, "So as you can see, it's not explosive at all, it burns at a pretty slow rate and pushes our rockets up, oh," he looked down at the Cape, pretending to gauge the height, "about fifty feet or so." One of the cops looked like he was ready to take Art home with him, but the other one was bored and said,

"They're OK. Let's get going," and nodded toward their car.

The cops took off with us waving at them as they sped away. I turned to Art,

"Fifty feet, huh? Sounds pretty safe to me. Man! I thought we were in trouble."

Art said, "I don't think they'll be back. They seemed satisfied."

We continued with our planned launch for the day and even managed to see one of the buggers make its right–angle turn about twenty feet above the launch pad and go screaming down the riverbed. We agreed that if we could get them to go straight up, they were going to go a lot higher than fifty feet, that was for sure.

Our initial rocket designs and launching took place during our first semester in high school. It was a lot to be happening to me at once. I was in the process of settling in to a completely new environment, getting used to both more responsibility and more freedom, and meeting new people. It was exciting and scary all at the same time. One thing that was a big improvement was the proximity of the school. I'd had a couple of miles bike ride to junior high, but high school was a short three block walk.

Art managed to make inroads with the older, brighter kids within a short time. The reason for this was twofold: first, they were more mature and intellectually sophisticated than the younger kids, and, second (probably the real reason—Art was nothing if not a pragmatist), some of them had drivers licenses and access to their parents' cars. Bike riding was OK as long as we were firing off our little rockets, but the next phase—now getting underway—would require transportation of parts and systems too big for our bikes.

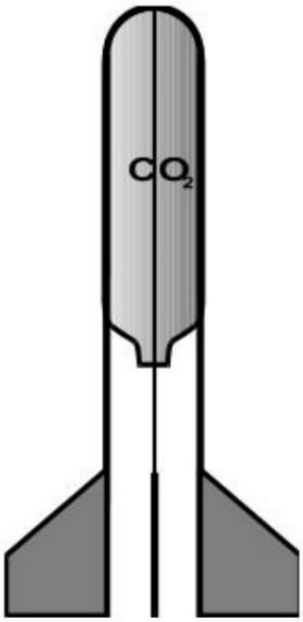
At first the older kids ridiculed us for our little CO2 rockets, but it wasn't long before they were building them themselves and driving us to Cape Carnivorous for launch parties. There were six or eight of us who built rockets off and on, but Art and I formed a core alliance with two guys who were seniors, Larry Jones and Roger Shelby. Even though they were only two years older, to me they seemed much more mature and far more experienced.

Larry was the first of our group to get his license. His parents had a green and white '53 Chevy that we spent a lot of time in. Larry was an only child with a father transposed from farming to factory work. Hid dad was strictly no nonsense—a trait that transferred to Larry in a positive and supportive way. He was a leveling voice in our sometimes zany escapades. Larry was the only one of our group to decide on a career early on and succeed at achieving it. He set his sights on becoming a nuclear physicist, a dream he pursued with relentless determination straight through his Ph.D., and ended up as a research scientist at Los Alamos, New Mexico. Larry had a long face with a small mouth set in a big square jaw. He wore his dark hair short like most of us, but, unlike most of us, was quite unconcerned about how he looked or dressed. He, along with Art, made no attempt to look good or be cool the way most of us did. Larry was regarded at school as just another nerd by the student body mainstream, although his physique belied that stereotype. He was very muscular with a build that looked like it was designed for wrestling. Larry had a lot of self–esteem and wouldn't be intimidated by anyone.

Roger Shelby was the youngest of three children whose mother and father were so old I at first thought they were his great–grandparents. They were from Joplin, Missouri, and the whole family—except Roger—fit my definition of hillbillies. It was obvious to me that Roger loved his parents, but there was a severe generational/cultural disconnect between them and him. He introduced me, among other things, to classical music, smoking cigarettes, and Cricketeer suits. Roger and I got along famously and he became another best friend. He and I shared many common traits, but chief among them was our need to be the biggest cut-ups in any group. We were both wild about words and never tired of attempting to make puns or double entendres. Roger had straight blond hair parted on the side that swooped down and across his brow, and fair complexion. He looked exactly like the classic stereotype of a surfer, but he would probably have killed anyone who made that observation.

The defining traits of our group were the need to learn, understand, and explain. It was the atmosphere in which we were immersed: science and technology had become not only desirable, but defined salvation in the eyes of our country.

On our first trip to the Cape in a car with Larry driving, we had several rockets Art and I had built, and a couple made by a friend of Larry's named Jim Buss. Jim, who wanted to become a chemist, was very tall and slim, arrogant, and usually in a bad mood. Jim had taken Art's fin harness idea and altered it slightly. On his models the fins were bigger than ours and were almost integral to the CO2 cylinder. Art had warned him that stability in flight was a problem, but Jim had ignored him. Jim was usually half angry and cynical to boot, and I for one didn't see why Larry and Roger let him hang around. For his part, Art had redesigned our fin harness to place the fins farther below the cylinder body in an effort to give it low speed stability, but it made the whole thing a little rickety as it sat on the launching pad.



Jim Buss was singularly unimpressed with Cape Carnivorous and let us know it. He stepped out of the car and looked around, then sneered and said,

"Huh! You call this a rocket launching site? Looks like a sewer to me," he looked down at Art and me, "well, now you boys are going to see how a real rocket flies." We had told everyone about our misguided rockets, and Jim decided to hold it against us. Art looked at me and rolled his eyes, then at Jim, "Yeah, we'll see, Jim. Why don't you go first?"

Jim said, "No problem," and pulled the box with his rockets out of the car. He got out one and took a whole roll of fuse with him. He was about halfway down the sloping side when he stopped and looked back up at us, "Down there, by the manhole cover, right?"

"Yup, that's right," I answered, "once you light it you jump down the manhole."

Jim gave me a dirty look and continued on down to the bottom. He carefully set his rocket up, but as he reached for a match the fuse fell out. He pushed the fuse back in, but the rocket fell over and the fuse fell out again. He set it up once more, but this time not only did the fuse fall out but the zinc–sulfur fuel mixture came pouring out. Art and I had sort of neglected to tell him about the glue idea. He came back up the side in a decidedly bad mood. Art and I looked at each other and smiled.

"Shit! What are you two laughing about?" He grabbed his other rocket from the box and went back down. This time everything stayed together. It was obvious from the way he went about lighting the fuse that Jim was pretty nervous about the whole thing. He squatted on his long thin legs, leaning his whole body away from the rocket, stretching out his right arm so far I thought he was going to dislocate his shoulder. When he thought the fuse had caught he sprinted for the wall. The fuse sputtered and died. I started to yell at Jim that the fuse hadn't lit, but Larry touched my arm, laughing softly, "Let him come. This'll be good."

Jim about broke his neck getting over the wall, and when he whipped around to watch the big liftoff we all busted up laughing.

"Maybe," Larry said, "you should light the fuse before you kill yourself getting up here."

"Very funny," Jim scowled, "what a bunch of assholes." He threw a leg over the wall and descended once more. This time the fuse lit but he remained there for a few seconds so he wouldn't look like a fool again, then came up the side of that riverbed faster than I thought any human could. He *flew* over the wall and whirled to join the rest of us with our noses on the top of the barrier. We squatted there, tense, and waited, and waited, and *waited*.

"Think you used enough fuse, Jim?" Roger asked.

"No, no," I said, turning to him, "I think six feet is just about right, don't you Art?"

"Well," Art replied in a droll voice," it's probably enough, but I prefer at least ten feet, just to be on the safe side."

Jim was not amused, "Aw, just shut up and watch!"

We turned our attention back to the fuse burning along. When the flame got to within six inches of the opening in the CO2 cartridge, the rocket fell over on its side, pointing toward the other side of the river.

"Oh, shit!" Jim moaned.

"This out to be good," Art muttered.

We all pulled our heads down lower and held our breaths.

When the fuel finally ignited the rocket *screamed* out across the concrete, *whanged* against the opposite side of the middle channel, and caromed about thirty feet into the air, slowly turning end over end. It hit the river bottom, still smoking, with a metallic thud. We all—except for Jim—cracked up.

"Wow! Well, I guess that's one way to get into orbit!" I observed, "Kinda hard on your payload, though!"

Larry grinned at Jim, shaking his head, "Good job! Guess you showed these punks a thing or two."

Roger said, "Well, now that you have that perfected, I think you should try burrowing underground. Maybe if we lifted off that manhole cover...."

We all laughed some more at Jim's expense, and he fumed and scrambled over the top to retrieve his misspent rocket. Art was squatting down by our arsenal, checking out the day's first rocket. "How's it look?" I asked. He glanced up at me, squinting into the sun, "Oh, pretty good. I think we can do better than Jim did, though. Why don't you light this one off?" and he handed up the first of our models to use the elongated fin harness. As I reached down to take it Art said, "This thing isn't going to sit very solidly on the launch pad. You'll have to be careful." He narrowed his eyes at me, "Don't screw up." I felt the pressure to succeed and not fall into the loser category with Jim Buss. I

took the correct length of fuse and stood waiting as Jim scrambled back up to our position. As he came over the wall he glanced at the rocket in my hands, but otherwise ignored me.

When I got to the bottom I looked around for the flattest part of our launching pad, inserted the fuse into the cartridge, then gingerly set the rocket upright. It swayed a little but looked like it would stand. I glanced up at the other guys. Except for Jim, who was nowhere to be seen, they were all watching me intently. I carefully uncoiled the fuse so it wouldn't curl back on itself and shorten the burn time. Everything looked ready so I reached into my shirt pocket and pulled out a wooden kitchen match, then looked both ways along the riverbed. Sometimes other kids played down there and I wanted to make sure we were alone. Everything looked OK. I took a deep breath and scraped the match on the concrete, then touched it to the fuse. Art and I had lit enough of these now to know pretty well what to expect, as well as how long it took to get back up to the observation area. I stayed for a couple of seconds to be sure the fuse was burning evenly, then hustled up the side and over the wall. Jim, who was refilling his first rocket using a little funnel, stopped and stood to watch. When the burning fuse got close to the CO2 cartridge we all started chanting in unison,

"*Five-four-three-two-one*!"

The little rocket hesitated for a second then gave out a diminutive *whoosh!* and shot straight up into the air! It worked! The burning time of the fuel was incredibly short, but the darned thing went vertical! We all let out a collective *"Aaaaaaaaaah,"* then cheered as it reached the peak of its parabola at about 200 feet and came plummeting back down, head first.

"YEAH! IT WORKED!"

"All right! This is great!"

"Wow! Look at it go!"

When it crashed into the ground Art and I looked at each other and grinned. Pure science (us) had won out over pure desire (Jim Buss). We bolted over the wall. On the way down I asked,

"What made you think that putting the fins lower would help?"

"I was looking through a book on Robert Goddard and one of his liquid–fuel rockets had the same configuration. It also makes good intuitive sense."

"Right! Great intuitive sense! I'm with you there!" I was so pumped up I thought I would explode. This was the most exciting thing I'd ever done, and this was just the start!

Art gingerly picked up our rocket by one of the fins as the cartridge was still too hot to touch. The fin harness was hardly damaged and we were able to use it again. This was an incredible success for Art. Every aspect of his design had worked. In the course of the day he and I set off three more rockets, and they all performed admirably. On one of them we bent the fins to try to get the rocket to spin. It was a whirling blur as it fell back out of the sky. Jim also managed to get his second rocket into the air. It was the last launch of the day because he had to work a long time to get the fuel to stay in the cartridge. Art and I were a little nervous watching him. He'd brought a little wooden dowel just smaller than the size of the exhaust hole, and he spent a lot of time tamping the fuel down so it wouldn't leak out as it had done before. He *really* jammed it in there. When he was finally

ready everyone remained silent, careful not to overstep Jim's limits of ribbing. It was hard, too, because he was such a good target. As he went down to light the fuse we all stood there, tight–lipped and wide–eyed, trying hard not to giggle. He got it going and ran back up. Four sets of eyes peered over the top of the wall, waiting as usual for Jim's incredibly long fuse to burn. Finally, Roger couldn't stand it anymore, and stood up.

"Holy shit, Jim! Why the *hell* do you use so much damned fuse? We're gonna be up here all *day* waiting for that thing, dammit!"

Larry reached up and pulled Roger by the arm, "Get down! It's going to go any second."

Just then the fuse reached the fuselage and, nearly too fast to see, Jim's rocket *SCREAMED* off the launching pad, made a quick 45° turn, *andbeforewecouldblinkaneyelash SLAMMED* into the concrete wall just inches below our heads! Concrete chips flew everywhere and the rocket ricocheted off the wall in a looping arc that sent it sailing back down to the launching pad! It hit the manhole cover with a *clang*, bounced once, and came to rest. We stood there for a second, stunned, then Roger jumped to his feet and yelled,

"Jim, you almighty jerk! What are you trying to do, kill us?"

Larry was more circumspect, "Way to go, Buss. Forget chemistry! You've got a future as a rocket scientist."

Jim looked at us guiltily but smiled sadistically, "Aw, relax. It didn't hit you."

We leaned over the wall to inspect the damage. The little rocket had torn a ragged chunk out of the wall's reinforced concrete an inch deep. If it had hit one of us we'd be dead for sure. For the first time it entered my thick skull that there might be some danger associated with this little hobby of ours. Art fingered the crater and said quietly to me,

"Looks like we should be packing the fuel more tightly, don't you think?"

"I'll say! That thing *took off!*"

This is as far as I got with the story of Art and me. We did go on to bigger, more complex and more dangerous rockets. The last rocket launch I was part of was out in the desert. Art had made a launch tower out of concrete and steel. As usual, I was there in a support capacity. Art attempted to launch two rockets that day, both about 5 feet tall. The first one performed beautifully, leaping off the pad with a roar amid great billows of smoke. It reached an altitude of 13,000 feet. The second rocket was equally spectacular, but in a different way. It blew up on the pad, destroying itself and the launching pad. We were about a mile and a half away when it went off. The rocket itself ended up a mangled mess.