How I helped NASA beat the Commies

By the time I reached my Junior year at the University of South Florida, it was becoming obvious that a lot of things in this world weren't going as well as we wanted them to. It was 1962 and John Kennedy was the president. Today we often hear about how everything was so idyllic in those days, but it did not seem that way at the time.

At a very early age I acquired the habit of reading the newspaper. My mom and dad were fairly well versed in current events and it was natural for me to try to keep up with whatever seemed to be going on. I had a few friends who were either trying to join or had been in the Peace Corps. From what I was hearing from them, and from many of the stories in the news, we Americans were kind of despised all over the world. We had instigated and supported an aborted invasion of Cuba in 1961. Our troops had been sent to Lebanon just a few years before that. Reports that we were trying to start a war in Vietnam were all over the campus of USF. Tampa still had a lot of fall out shelters and there was talk of nuclear war! B47's were taking off from MacDill AFB all the time. Where they were going, and with what on board, was anybody's guess. There was also a popular book named "The Ugly American" that made a case that we citizens of the USA were not the good people that I had been raised to believe we were. There really was a lot of dissension. I sometimes hear tales of how wonderful it was to be living in the "Era of Camelot" but I remember it differently.

The University of South Florida was a brand new school. It opened in September of 1960, just three months after I graduated from Plant High School. It was sort of a branch of the University of Florida. There were only three buildings, about 2,000 students, and a lot of sand there when I started. I was part of what they called the 3-2 program. USF didn't have a College of Engineering, so to get a BSEE degree, I would have to go there for three years, then automatically transfer to Gainesville to finish my last two. All of the Florida schools were under intense pressure to help the state deal with the spring break problem. The beaches on the east coast were attracting a very large number of college kids every spring. Each year the problem got a little worse. Students did a lot of drinking, fighting, and committed all sorts of mayhem in the spirit of having fun. About half of these kids came from the state of Florida. The schools in Florida adopted a scheduling scheme known as trimesters to keep Florida kids in school during the times that every one else was enjoying a week away from classes. It was structured to give us three, sixteen week semesters in a year. We started in late August and finished the fall term just before Christmas. Then in January the next trimester started. It went until mid-April. As soon as that one ended, we picked up the summer term.

I became aware of the Co-op program in late 1962. It allowed Engineering, Physics, and Math students to work for a semester then attend school for the next semester alternately, until a bachelor's degree was earned. I was about to run out of classes that could be taken at USF. I wanted to get a better summer job than the one I had the previous summer working on the railroad, so I signed up for the program. They sent me out to Honeywell in Clearwater for an interview along with eight or nine other USF students. For some reason Honeywell interviewed co-ops in groups like this and either accepted the whole batch or rejected them all. We were rejected. It was not surprising as there were only two of us that were engineering students. The rest were either art, history, or political science majors who had never heard of Honeywell.

Not long after that a notice was sent to all of the students who had signed up for the co-op program. A special meeting was being held for

those interested in going to work for NASA. The National Aeronautical and Space Administration had just been created to respond to all of the successes that the Soviet Union had been having with its space program. At that time, it was looking as if the Russians could do no wrong in space, and much of what we were trying to do, flopped. Instead of the Army, Navy, and Air Force all competing with each other, NASA was formed to launch men into space. There were to be three major programs (Mercury, Gemini, and Apollo) that would eventually culminate in a landing on the moon. In 1962, the Mercury program was underway. They had selected seven test pilots that they called Astronauts to fly the first missions. The seven were enjoying a degree of celebrity that was unprecedented in the US. The best selling book "Right Stuff" by Tom Wolfe describes major events of that time very well. As a college student it seemed incredible that I might actually be considered to work on such a prestigious project. I envisioned working at Cape Canaveral loading payloads onto rockets or helping the Astronauts or something.

When the time for the meeting finally came, I went to the specified room in the Administration building only to find it full. Several friends of mine got this far and did not attend because all of the seats were taken and students were standing in the back. For some reason I squeezed on in to see what it was all about. The head of the Co-op program and a couple of other professors were there. They introduced the representative from NASA and it turned out to be Dr. Wernher von Braun himself. I don't remember much about what he said, but I know that almost all of us were very impressed. Wernher von Braun was famous then. He was one of the scientists credited with creating the German V2 rockets in World War II. He was a Director of NASA and was often quoted in newspapers and magazines. Frequently he was seen on Walt Disney's TV show. He was sort of fat, wore a drab brown suit, and kind of slouched. I would have expected him to be more rigid, lean and crisp, more like a Nazi. Anyway whatever he said made me and everyone else in the room want to join NASA. When they passed out application forms, we all filled them out and turned them in on the spot. There were only to be ten or twelve openings for the whole school, so getting accepted did not seem likely. I was not too discouraged though because I knew that most of the kids in the room were political science and business administration majors. NASA would not seriously consider them. Not long after that, I got a letter with the distinctive NASA logo in the upper left hand corner. It offered me a Co-op job beginning in mid April 1963. The only problem was that they wanted me to work in Huntsville, Alabama rather than Cape Canaveral.

I went back to the Co-op office to find out what they could tell me about Huntsville. They had a list of other students that had been selected. I was able to get in touch with a few others from USF who were also starting at NASA at the same time. One was named Wayne Merriweather who was a Physics/Math major. Wayne had a car and offered to drive me to Huntsville if I'd split the gas expenses. It was about 600 miles from Tampa to Huntsville so once we got there, there would be no coming home until the end of the semester. We left Tampa on April 19, drove to Jacksonville to visit some of Wayne's friends, then went on to Huntsville the following day.

In 1963, Huntsville was a bustling town on the Tennessee river in far north Alabama. There was a big Army base called the Redstone Arsenal and the Marshall Space Fight Center. There was also a fairly significant housing shortage. We went to a house that was being rented by several USF and UF Co-ops. They didn't have room for any more, but let us sleep on the floor for one night. The next day Wayne and I went looking for a place to rent. We found more people looking for places than there were places to be found. Suitable apartments did not exist. A run down boarding house in one of the less desirable parts of town was the best we could do. We each had to pay $1.00 per night for a bed and the use

of the bathroom. There must have been about 15 beds in the three or four rooms in the house. They were full every night. Some of our fellow occupants appeared to be just barely socially acceptable, maybe not even that. We kept up our search and within a week, found a small, two bedroom, house. We also got James Farmer from Brandon, Fla. and a friend of Wayne's named Don Griner to join us in renting the house. James was majoring in EE at USF and Don was a U of F aerospace major from Niceville, Florida.

When I reported to work at the Marshall Space Flight Center, I was amazed at how big it was. I had become a Civil Servant in one of the biggest bureaucracies that the country had ever seen. First they sent us to the medical center at the Redstone Arsenal for a physical exam. It was not a very thorough exam, but it took 2 days to complete. Then there was a security indoctrination and training program they ran us through. It did not involve much more than a couple of half hour meetings and a few slide shows but they stretched it into two more days. We all learned what the phrase "hurry up and wait" really meant. It was Friday before I was taken to the group I was to work with. Neither myself nor the other three guys I was living with would be working in the same section of NASA. I was assigned to the Test Lab to work on Saturn Ground Support Equipment.

Before I got to NASA, I always thought that I knew what a lab was. The Test Lab at MSFC probably covered at least a hundred acres and I have no idea how many buildings. I soon learned the wide variety of things that had to be tested in order to get a rocket into space. It started by my boss giving me a task that I was totally unqualified to do. There was a big system concept review meeting. He gave me a "meeting document" and sent me off to take his place in the meeting. The document was a bound, 3 to 3½ inch thick, 8½ by 14 inch book of double spaced, typed design notes. There must have been six or seven hundred pages. It was all about the design of the barges that would be built and used to transport rockets from the factory in Louisiana, around the tip of Florida, to the Cape. Every conceivable thing about the design, construction and operation of this craft was in the manual. There were details of how it should be docked, how the rocket was to be loaded, the on board air conditioning systems, how the cargo was to be sealed and purged with dry nitrogen gas. There was a section on the exact route that the barge would be towed through with details on every bridge and every town it would intersect. The twenty or so people in the meeting each had one of these books. We all sat at a conference table and scrutinized every sentence of every page of the book. As each item was discussed we all took notes. It took us four full days to complete the task. A lot of discussing arguing and compromising took place. Some of the topics required the expertise of my boss. All I could do was take detailed notes and bring them back to the office with me. There were several complaints by the other meeting participants, who had to sit through the meeting, while my boss had sent a flunky in his place. The charges really were true. When I turned my book over to my boss, he seemed vacant and irritated that I had come back to bother him. In the next few days I met Co-op students from Auburn, LSU, and the Universities of Alabama, Georgia, Texas, Tennessee and Arkansas. They all seemed to think I was lucky because my job required me to do absolutely nothing. After about two weeks, my boss told me that the Lab was restructuring all of the student positions. He would no longer have a Co-op and I was to be reassigned. I couldn't have been more delighted!

The group that I was next assigned to was in charge of setting up exhaustive tests to "Man Rate" some of the thousands of sub assemblies needed to launch Saturn Rockets. Most of it was hot, sweaty work at various test sites scattered over the Lab. We had to bolt on, and wire up, new gadgets. To some it would have seemed tedious but I loved it. It seemed that I was really doing something that mattered. The term "man rated" is not something that I was familiar with.

There was a big difference in the degree of testing needed to qualify hardware used in manned and unmanned space launches. A lot of it is difficult to understand and to explain. Before a sub assembly or component could be trusted on a manned mission, it had to be exhaustively and repetitively tested in a simulation of the part of the launch that the component had to perform within. Often, a piece of equipment would have to be successfully tested at least 100 times before it could be cleared. Most of this was done out doors using simulations of parts of the gantry tower or block house that would service the rocket. They had different test areas all over the place. Some of it was really neat. Usually a test was repeated five to ten times, then the engineer on that project had to go write up the results. By the time one test was done two more would be waiting for our support.

The major goal for NASA in the sixties was to put a man on the moon. Everyone knew it would take many steps to reach that goal. We started out by sending a dinky Mercury capsule with one Astronaut on board on a 300 mile lob into the Atlantic ocean. That was with a Redstone rocket. Next we sent the same capsule into low earth orbit on an Atlas rocket. A bigger Gemini capsule held two Astronauts and was launched by a Titan II rocket. Next was the three Astronaut, Apollo. It would not get to the cape until 1966, but we were working on it in 1963. There were two main configurations of rockets that would be used to launch the Apollo capsule. For earth orbit missions, a Saturn 1B booster followed by an S-IVB second stage would be used. For anything to be sent to the vicinity of the moon, a Saturn V assembly, consisting of an S-IC booster, then an S-II second stage, and an S-IVB would be needed.

One of my jobs as a greenhorn Co-op student was traffic control for H-1 static firings. A static firing is where you fire a rocket, but hold it down and measure how much thrust it develops. The H-1 was a rocket engine that burned kerosene and liquid oxygen. It developed over 185,000 pounds of thrust and was supposed to burn for about three minutes. The first stage of the Saturn 1 consisted of eight of these tied together. With this much power there was always the chance of an explosion so certain roads in the Lab had to be blocked off during these tests. I was given a two way radio and sent out to one of the check points to stop all vehicles and pedestrians. The H-1 was positioned horizontally next to a muffler that was about the size and shape of a boxcar. The check points were all about a half mile from the test engine. When the countdown got to X minus five minutes, I had to move barricades onto the road. Then I reported in that my station was secure. When the test was made, I had a front row seat. As soon as it was over, I got an all clear on the radio and took down my roadblock. I liked having my NASA hard hat and two way radio and feeling like I was in control of something.

If the H-1 was impressive, something that was really awe inspiring was the static firing of the entire Saturn 1B booster. There was a special tower made that held two of these. Only one at a time was fired. I got to see a couple of these tests from a block house. This booster developed 1.5 million pounds of thrust; it was painted black and white and could only be called majestic. The rocket was held vertically next to the tower. All of the heat directed straight downward would melt anything left under it. A special huge, shaped deflector shield was held at a 45° angle under it, and millions of gallons of water were pumped into the “bucket” as the rocket was fired. The blast of the rocket and the extra load of steam shot sideways from the tower in a vivid display of color. The exhibition of raw energy and the intense very low frequency sound left its effects on you for several hours after a big static firing. When the test was over there was usually a white cloud forming over the tower. Often it would immediately start to rain as the test was ending. It’s hard to believe it but Saturn V and Shuttle tests must have been even more impressive.

The group I was in had to support all kinds of special equipment including huge electric motors driving different kinds of pumps. One motor that helped pump water to cool the Saturn 1B static tower was 4½ or 5 feet in diameter. The copper wire that fed this monster was nearly an inch in diameter. We also had big motors like that which ran various hydraulic pumps. Huge hydraulic actuators were used to hold down the rocket just prior to launch. In the actual Saturn V launch sequence, the booster rocket was ignited at X minus 3 seconds. The rocket was held in place by special hold down arms while sensors measured several parameters. If everything was not going right, they might be able to shut off the booster or eject the capsule to save the crew. In 1963 we were testing the hold down arms for the Saturn V moon rocket. These things were huge, about ten or twelve feet tall. There were four of them and they could not be seen in the TV coverage of a real launch. When the arms worked, the top of each arm moved back about six inches and the rocket was released. In order to hold a system that weighed millions of pounds, and developed more millions of pounds of thrust, these had to be strong and reliable. They were that, but you couldn't see them do very much. The hold down arms test was done like you might defuse a large bomb. If everything went right, it was a big bore. If we ever had a system failure it could be devastating.

We spent a lot of time that summer setting up and running "Swing Arm tests." Swing Arms were used on all of the Saturn rockets to connect instrumentation and control signals in and out of the vehicle. They also carried liquid oxygen and liquid hydrogen to keep the tanks topped off prior to launch. They were the umbilical cords of the rocket system. The biggest rockets had about nine of them. They resembled the boom of a crane. They were made of welded tubular steel. All of them were strong enough for a man to hang, crawl, or stand on. The cross section area of a swing arm was from two to five feet square. They were from 20 to 30 feet long. The swing arms at the top of the gantry had to be longer than those at the bottom. They were called swing arms because they were designed to disengage the rocket and swing out of the way a few seconds before take off, so they wouldn't get burned up. All of the swing arms had numerous cables and some had cryogenic conduits, which could carry liquid oxygen or hydrogen.

Each swing arm had a bulkhead which was specifically designed to interface with a matching bulkhead on the rocket body. At the appropriate time, pneumatic actuators on the swing arm detached and pulled back the bulkhead. Then the arm pivoted out of the way as the rocket lifted off. Each swing arm was a magnificent machine. We were always having to make modifications to them. We added and deleted cables and connectors, re-routed cables, and tried different actuator and bulkhead detachment schemes. All of this had to be tested.

The test area for all except the "Crew Ingress Swing Arm" was in one spot. In the center was a tower about six feet square and maybe twenty-five feet high. Panels on all four sides were bolted on to a movable section that slid vertically on the tower. Its total travel distance was perhaps ten feet. This section simulated the rocket; it was powered by hydraulic actuators. Steel towers were also built on each of the four corners of the test stage. On each tower a different size swing arm was attached. Normally three of the four arms were tied back and only one at a time could be tested. A block house and equipment shack were located about fifty feet from the test area. The bottom of each arm was about four feet above the gravel that covered the test lot. I was considered a very welcome addition to this test crew because I was a skinny 140 pound kid who had grown up climbing trees and exploring caves in Florida. My ability to climb around on the swing arms was very appreciated when modifications had to be made. I'm sure that what I was doing would now be in conflict with many OSHA safety regulations, but then we were in a "Space Race" and it was

fun. “Man Rating” meant that every system had to have a back up or it had to “fail safe.” In the case of the swing arms we had to test what would happen if the bulkhead did not detach and the arm rotated anyway, and what would happen if the arm didn’t swing and the rocket lifted. In all cases, we had to prove that the swing arm would do its job and not impair the launch of the rocket.

I got along very well with the group of technicians and engineers that I was assigned to work with. I remember that I was the target of a lot of joking by the Alabama guys because I would be going to U of F which in ‘63 did not have the caliber of football team that U of A did. We did have fun on the job but there were times when things got deadly serious. I was never allowed to forget that there were many ways in the test lab to get badly hurt. With the swing arm testing, the force of the moving arm could easily kill a person. We often ran cryogenic liquids through the swing arms and bulkheads as part of the test. Some arms carried Liquid Oxygen or LOX. One of the arms carried both LOX and Liquid Hydrogen or LH_2. Tests were run first with no cryogenic liquids. Then we ran tests with Liquid Nitrogen or LN_2. Then we had to test with the real thing LOX or LH_2. The conduit that the cryogenic fluid was pumped through was 14 or 15 inches in diameter. Most of this was insulation. The duct in the center that carried the liquid was 2 to 3 inches in diameter. Tanker trucks, similar but a little larger than the kind that delivers gasoline to service stations, brought us the LOX, LH_2, or LN_2. There was a special pad for them to park on while they pumped the liquid. LH_2 was considered dangerous because if you got a leak it would burn, but the flame was invisible, and there could always be an explosion. LOX would saturate everything that it got close to, and whatever it got near became very flammable. All three were dangerous because they were very cold. We were conducting tests that pumped hundreds of gallons of this stuff through detachable bulkheads. Sometimes an arm under test would sling these dangerous liquids as it pivoted.

The outside surface of the cryogenic conduit was braided stainless steel. Even though the insulation layers were very efficient, and we were usually working under a hot summer sun, that surface would get very cold. Frost formed on it as soon as the truck started pumping. The layer of frost could get over ½ inch thick. There were a few times, when we had delays for one reason or another, that minor snowball fights broke out. There were also dewar flasks available and if we were in a wait state, we could get a few liters of LN_2 to play with. You could never get LOX or LH_2 because a safety officer was always around when these materials were on hand. It’s very interesting to actually watch what happens when you drop a cup of water into a flask of liquid nitrogen. One time I froze a dandelion. When I dropped it, it broke into so many pieces, you could only call it a powder.

There was a fire control system we worked on, that was really difficult to forget. It was a remote controlled fire hose mounted about thirty feet up on a tall scaffold. I understand that several of these were mounted on the gantry at Cape Canaveral. We did not have any pumps for the water supply. This was just connected up to a regular fire hydrant. The tower or scaffold and a small block house were located on the edge of a meadow perhaps twice the size of a football field. The nozzle had gear motors that moved it up or down and left or right. Another motor controlled the nozzle from off, to fine spray, to a full jet. The controls in the block house consisted of just three, two position, center off, bat handle toggle switches. You could easily direct a column of water fifty yards from the tower, but from the block house it was difficult to tell exactly where it was going.

Another system that was undergoing testing while I worked for NASA was the crew escape slide. I didn’t get to do much with it. The three Astronauts in an Apollo capsule depended

primarily on special escape rockets if a launch abort was necessary. Three small rockets mounted on the nose would shoot the capsule several hundred feet in the air. A parachute would then lower the capsule back to the ground, hopefully not right on top of the gantry. As a back up they left the Crew Ingress Arm parked right next to the capsule until the last possible second before lift off. If an imminent explosion of the rocket were detected, and for some reason the escape rocket could not fire, then an alternate plan was needed to get the crew away from the rocket. A sturdy cable was strung from the back side of the gantry to the ground about 400 feet below. A very small cage was suspended on pulleys from this cable. In a dire emergency, the crew might be able to get in this cage and slide down to safety. I always wanted to get to try this but they never tested it while I was working there.

Another interesting item that we tested was called the Q-Ball. As the Apollo rocket was being assembled (in an indoor hanger called the vertical assembly building) there was no exposure to the elements. A huge carriage moved it to the launch pad where it could get rained on, and gather dust, for several days before the launch. There was a big problem keeping the sensors at the very tip of the nose of the escape rockets clean. Sea Gulls and other birds that liked to roost there tried to keep this part of the rocket well fertilized. The Q-Ball sat on the tip of the rocket until just prior to lift off. It looked like and was about the size of a football helmet. It was white plastic and someone must have thought it looked more like a big pool Que Ball. There were three ways for it to work. A heavy duty balloon was deflated and put in the open side of the Q-Ball before it was placed on the rocket. Just before launch, the balloon was inflated until the Q-Ball fell off its perch. A cable was attached which reeled it in as it fell away from the ascending rocket. If the balloon did not work, the cable pulled the Q-Ball off of the nose cone anyway. If the cable withdrawing mechanism did not work, the rocket would jerk the Q-Ball off as it rose above the launch pad. We had to test all of this over and over again to insure that there would be no problem with it.

At the end of the summer term Wayne Merriweather and James Farmer returned to USF. I moved to Gainesville and became a Resident Assistant in one of the dorms at the University of Florida. I was able to get Don Griner as a room mate. The fall term went very smoothly. While I was in school several memorable things happened in world news. The Soviets kept putting up bigger satellites while our Mercury program had ended. George Wallace, the Governor of Alabama, was making a lot of news resisting integration. There were several bombings and church burnings in the South. President Kennedy and the leader of South Vietnam had a well-publicized grudge with each other. When Diem, the president of Vietnam was killed, it was frequently suggested JFK got him and that the head of Cuba would be next. Everyone was surprised when JFK was assassinated, rather than Castro. This was an amazing time in history, but nothing seemed to affect our space program.

The four of us returned to Huntsville in the first week of 1964. We found a different house to rent that was actually closer to work. There was a 17 inch snow fall that paralyzed Huntsville and really made an impression on the four of us from Florida. I was given a new assignment working for a group in charge of the design of equipment that would eventually be used to test the big Saturn V rockets. I was able to visit my old group a couple of times and gloat over the fact the Florida Gators had beat the mighty Crimson Tide in their football game the previous fall, but my new duties would keep me in the office almost all of the time.

My new job was with the engineers that were to staff the new NASA test facility then being built in far south Mississippi. They would be responsible for static testing the super sized boosters that were being designed for the moon launches. Our big boosters were built in a

special factory at Michoud, Louisiana. S-IVB rockets could be taken anywhere on a specially designed jet plane called the "Pregnant Guppy." But Saturn 1B boosters could only be moved by the biggest trucks or rail cars, and with greatest difficulty. Saturn V had two boosters that could only be shipped by barge. Factories and test facilities had to be situated so hardware could be fabricated, tested, moved to the cape, assembled, and launched. New facilities had to be located on navigable waterways. The recent death of JFK had transformed his image across the country. His promise to "send a man to the moon in this decade" was now taken very seriously by the whole nation. At NASA they were actually arguing over the semantics of the term "decade." Some MSFC honchos were saying that the decade would end December 31, 1970 not 1969.

I believe that I must have made a favorable impression on several of the people working on the Mississippi Test Facility (MTF.) As I was growing up, anything about space was interesting to me. I was reading a lot of science fiction at the time and I devoured any information on our space program. I knew the length, diameter, gross weight, and thrust of all of the NASA rockets. I also had a clear memory of my first week at Huntsville when I struggled over the myriad of facts on barges that would be used for transport of the big Saturn rockets. Because I was interested, I still remembered most of that stuff. There were several occasions when I was able to supply useful information that others on the job did not anticipate that I would know. Another thing that made an impression was my drafting. I took drafting in Jr. High School and as a college freshman. It was something that came very naturally to me, I was good at it. By far, the shortfall that my new work group had, was in the drafting department.

The MTF group was a mixture of NASA Civil Servants and contractors. Key engineers and managers were all NASA workers. Many of the support functions were contracted out to companies such as Boeing, and General Dynamics whose employees worked along side NASA personnel. The non architectural drafting was farmed out an engineering support company. They hired "per diem" contract workers and had a couple of portable buildings next to the main lab building for them to work in. There were six to eight drafting tables in each "trailer." We had five or six draftsmen assigned to our group, but it was just about impossible to get any of them to work. We had a lot of equipment identified that was to be installed in 19 inch racks. This was all identified in engineering drawings. These were 22 by 34 or 34 by 44 inches in size and drawn on vellum paper. The originals were stored in flat file cabinets in a special document room. Copies were made by something called the blue line or Ozlid process. I started out by having to fold drawings. There was actually a Military Specification that dictated exactly how drawings were to be folded. These copies were then used by engineers who found reasons to modify or revise the design. During the course of their work, or in meetings, their copies would get "red lined" which would mark the errors to be corrected or the changes that had to be made. A draftsman would then check out the original vellum, make the revision, and check it back in.

I started doing some of the drafting revisions when I had been on the job about a month. Co-op students did not normally do this type of work. It came about because my boss was desperate. He had an off site meeting about a large contract for test equipment. The drafting group was trying to enlarge its staff at Marshal Space Flight Center. They said they were overloaded and would be unable to get the drawings revised for several weeks. They wanted six more draftsmen to be hired. My boss had me do the work; it was only five or maybe six drawings. It couldn't have taken more than a couple of days and I was being very deliberate and careful. My boss was delighted and I was "persona non grata" in the drafting trailers. That didn't matter to me. I was not fully aware of the all turmoil that I was causing. There were obviously big problems brewing in this area

long before I got involved. Much of the difficulty was my non-union status. To me it was obvious that these contractors were trying to milk NASA for every nickel they could get. I was glad to help keep that from happening if it was possible.

During the next few months I made minor revisions to quite a few of the engineering prints. My boss did not allow me to check prints out of, or back into, the document room. He always got one of the engineers to do that. He probably was afraid someone would accuse me of losing or damaging a print. He was very protective, but liked to brag that I could do more than a trailer full of draftsmen. It wasn't really all that great. I don't think I ever did more than two prints a day. They sort of kept a limit on how much I could do. When I'd encounter any of the draftsmen they would be pretty cold but I do not remember any overt threats. From what I could tell, the MTF people were kind of at war with a few of the contractors. I was on the MTF team and had a lot more friends around than the contractors did. Some of the contractors talked about striking, but it did not seem as if that was likely. They could have all gone out on strike and it wouldn't have affected the total work output very much. Public pressure would have come down very harshly on anyone who appeared to be trying to prevent us from winning the space race. These guys were sabotaging the space program for their own profiteering interests. A strike would have probably put them out of business, maybe into jail.

As the semester proceeded I became more familiar with my evolving responsibilities at NASA. I now know that I must have been very idealistic, but to me it was up to us all to do everything possible to beat the Russians to the moon. I was able to learn a lot about the space program and the politics that surrounded it. Many of the details never came out in the national press. Most of the experienced people in my group were holdovers from the old ABMA or Army Ballistic Missile Agency. They had adopted the German V2 program after WWII and developed the Juno, Jupiter, and Redstone rockets. They were uncomfortable with me knowing anything about the Atlas and Titan rockets that were really the work horses of the Mercury and Gemini programs. To them, these systems didn't exist. Some of them probably would really have preferred that the Soviets get to the moon first rather than have an Air Force or Navy rocket do it. I had to learn when to keep my mouth shut about the relative strong points of some of our own vehicles. This was especially true about the Titan II which was to be used to launch all of the Gemini series of NASA space craft.

The problem that we had with the first rockets was that they had been developed as military ballistic missiles. Their sole purpose was to deliver a nuclear payload to some spot half way around the world. They initially used kerosene as a fuel and compressed oxygen to burn it. Then we developed rockets that used LOX. These were OK for preemptive strikes, but it was difficult to keep them fueled up on stand by for long periods of time, waiting for someone else to start a fight. Kerosene/LOX rockets were also fairly difficult to start. There had to be a device called a "squib" mounted in the combustion chamber. It worked like a match. You started the pumps pouring fuel and LOX into the chamber, hit the squib, and watched it go. I began to understand the reasons for the Hold Down Arms, and for all of the H-1 static firings that I was involved in during my first semester. NASA's idea to get a man on the moon was to build a heavy lifter by tying eight rockets together. But they were relatively hard to start rockets. All eight had to be going full throttle before the rocket could be let go. If even one of the eight failed to light, it would not get off the pad. The ignition sequence had to be very very reliable.

Furthermore, once the rocket motor stopped, you could not re-start it. LH_2/LOX rockets had to be created to start on demand. There was another kind of rocket they were talking about

that used hypergolic fuel. This stuff was liquid at room temperature. It consisted of two materials. If they were mixed, they blew up with incredible energy. These two liquids could be pumped right into a combustion chamber. These materials had their own problems. They were very reactive. They tried to rust or corrode everything they came in contact with. They were also highly classified. The pentagon was developing ICBM's with hypergolic fuels and I never was sure whether I was supposed to know about them or not. Actually some of the squibs that we were considering to light the second stage of the Saturn V, were really small reliable hypergolic containers that made big enough blasts that they were sure to light the rocket engines.

When our "Man on the Moon" program was being formed, ABMA people tried to get the top NASA brass to use Saturn 1 as the launch vehicle for Gemini. But the Air Force was way ahead of them with the development of the Titan ICBM. A lot of people in NASA questioned whether eight rockets could ever be made to work as one. Our people knew that the Russians were launching big rockets with multiple engines, but they were not supposed to know that. Their sources were probably friends that they had in the Military. Aerospace people had all kinds of contacts and information sources they wouldn't talk about. For what ever reason, they had a lot of confidence that it would work, but it was decided to use Titan II for Gemini. There was a possibility that Apollo might be launched with a bigger Titan called the Titan IIIC. But its booster required multiple engines and the ABMA faction was way ahead on that.

While one group at NASA was getting Titan ready for Gemini, another group was squeezing more thrust out of the Saturn 1, which became the Saturn 1B. It all worked out to our advantage because the extra lift capacity was needed to get more Apollo hardware in orbit to work out docking problems. There were some skeptics who questioned whether we would be able to dock the Apollo capsule with the Lunar Excursion Module. The extra time also allowed us to learn how to make the eight engines of the Saturn 1B and the five engines of the Saturn V work together perfectly. We also worked on plans for the testing of an even bigger set of rockets called the "Nova Series." The first Nova rocket was to be twice the size of the Saturn V. NASA was planning on getting its people on the moon in the sixties, then going right ahead with a permanent colony there in the seventies. It took really ambitious people to contemplate journeys to the moon.

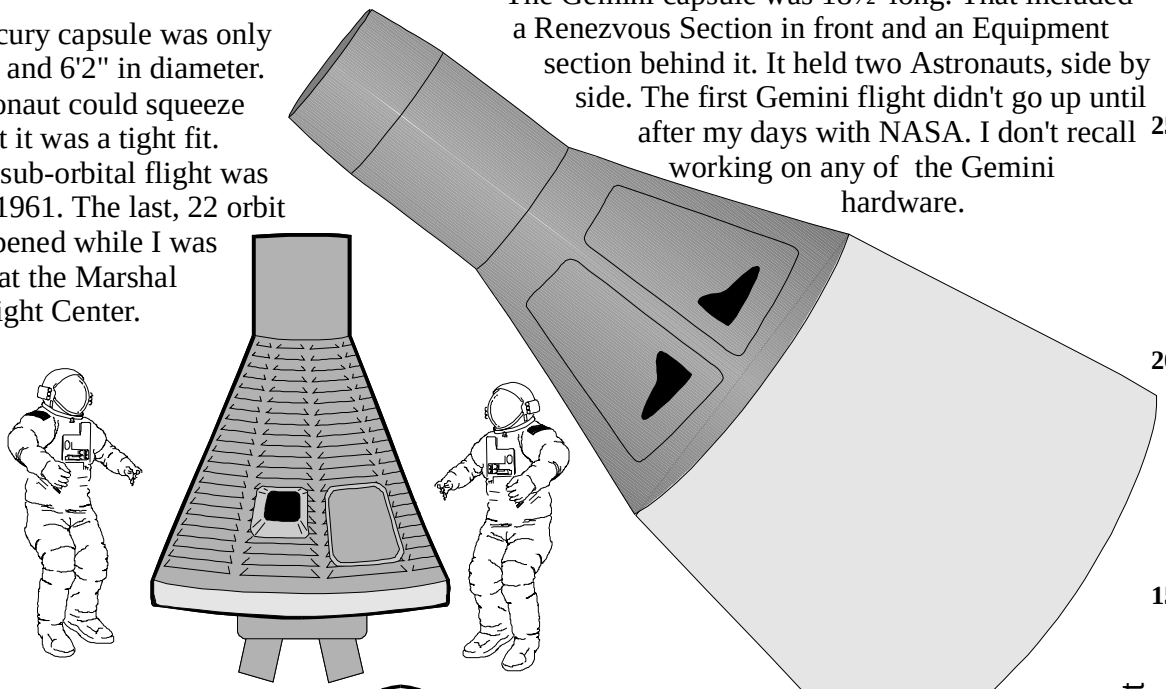
I was, and still am, proud of my own little part in the space race. There I became familiar with details of the program that were far too trivial to ever get into any books that were published. I met a lot of really good, talented people that knew how to work hard. I also saw some that took every thing they could get, and offered nothing in return. I got exposed to some of the excesses of defense spending. I learned about the value of a strong organization that can get tens of thousands of diverse people, efficiently working toward one goal. I also experienced a strong prevalent optimistic attitude that seems to be lacking now. We were just going to keep on doing what needed to be done, until we had an Astronaut on the moon. If the Russians beat us then, they beat us, but we would do everything possible to get there first. I paid a lot more attention than most people did to the space launches, even though I decided to not return to NASA after my second work term. The Gemini series started in March of 1965. We kept launching those until November of 1966. We lost three astronauts before the first Apollo flight in October of 1968. All of the Apollo flights except for one, were very successful. Even that one, Apollo 13, had a happy ending. I do not recall hearing of any failures or delays caused by any of the equipment that I worked on. The new Saturn rockets and the ground support equipment that help launch them, all worked magnificently. We beat the Russians to the moon and like thousands of others, I can say "I helped."

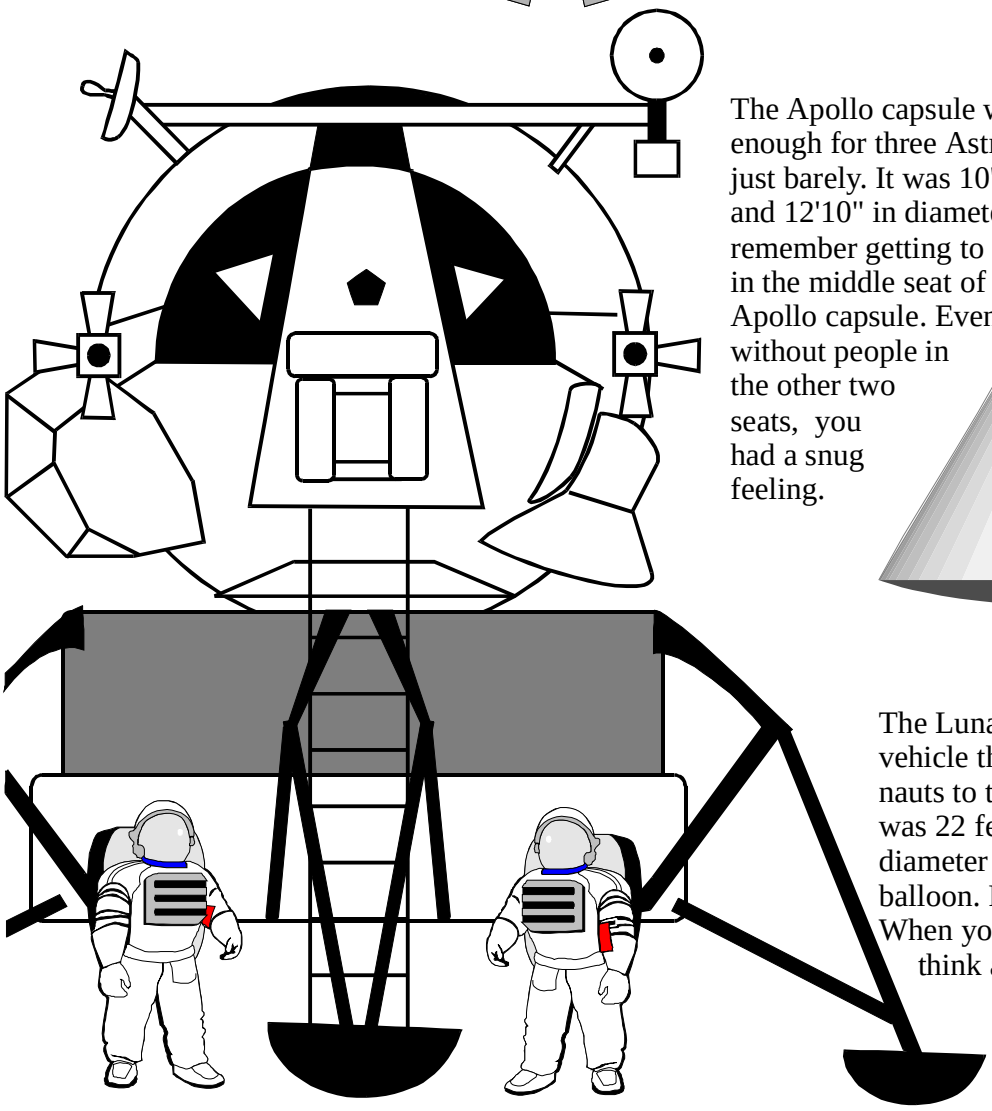
JWM - May 1997

Space Capsules

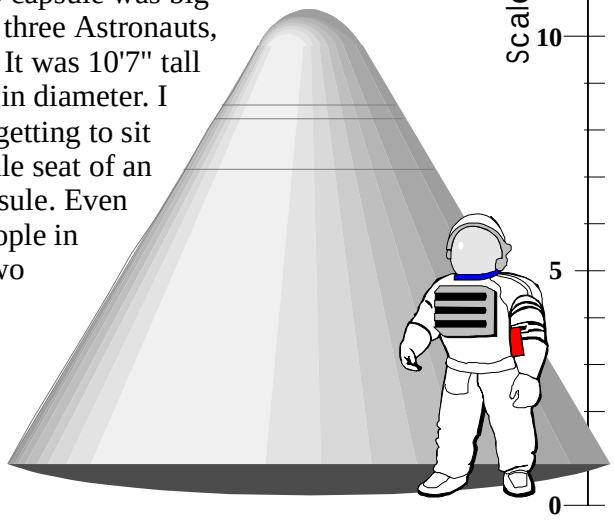
The Mercury capsule was only 9'7" long and 6'2" in diameter. One astronaut could squeeze into it but it was a tight fit. The first sub-orbital flight was made in 1961. The last, 22 orbit shot happened while I was working at the Marshal Space Flight Center.

The Gemini capsule was 18½' long. That included a Renezvous Section in front and an Equipment section behind it. It held two Astronauts, side by side. The first Gemini flight didn't go up until after my days with NASA. I don't recall working on any of the Gemini hardware.



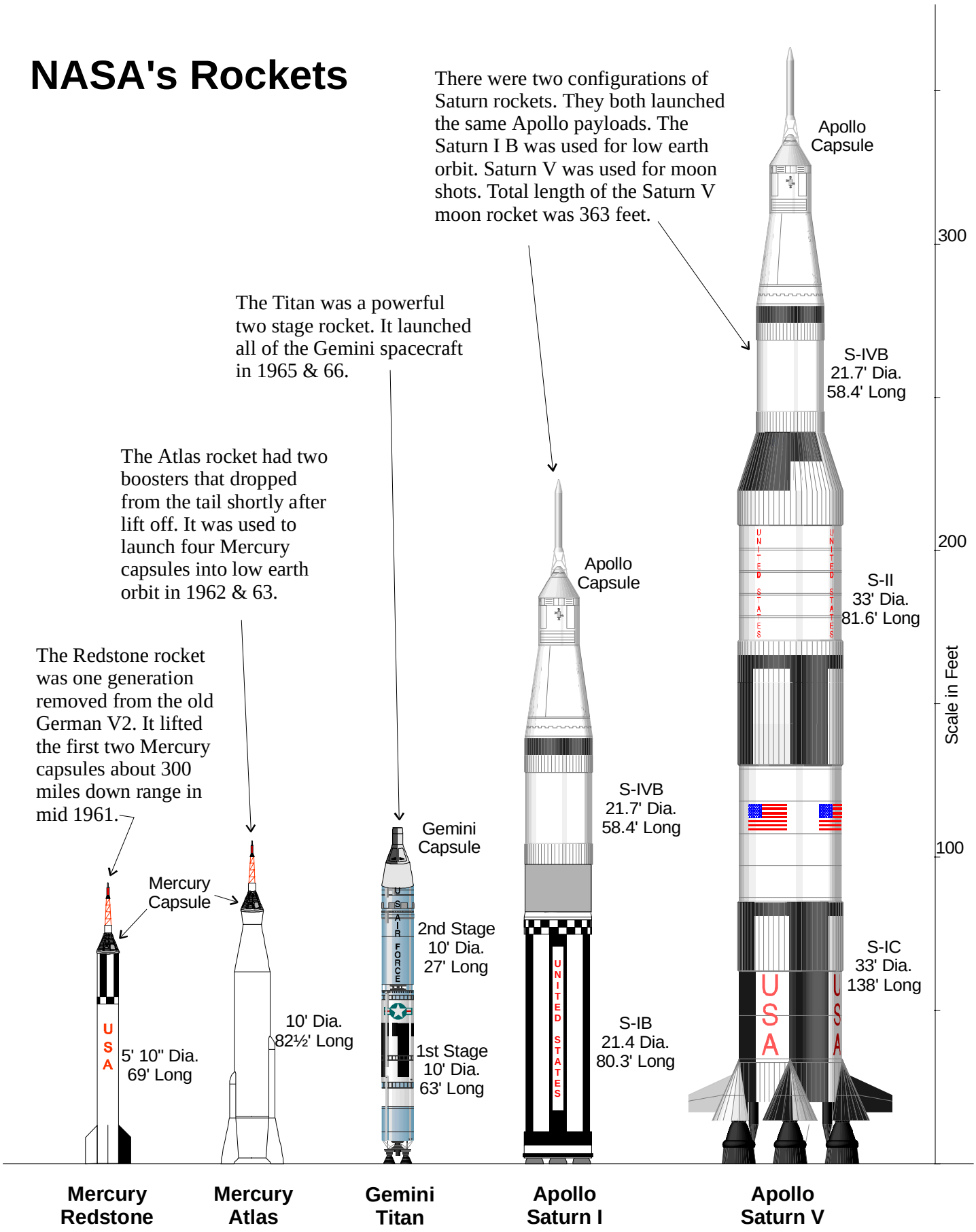


The Apollo capsule was big enough for three Astronauts, just barely. It was 10'7" tall and 12'10" in diameter. I remember getting to sit in the middle seat of an Apollo capsule. Even without people in the other two seats, you had a snug feeling.



The Lunar Excursion Module or LEM, was the vehicle that took two of the three Apollo astronauts to the moon's surface. The complete LEM was 22 feet tall. The crew stayed in a 12' diameter sphere. It was kind of like a tin foil balloon. Framework and equipment were inside. When you saw this thing up close, all you could think about was how flimsy it was.

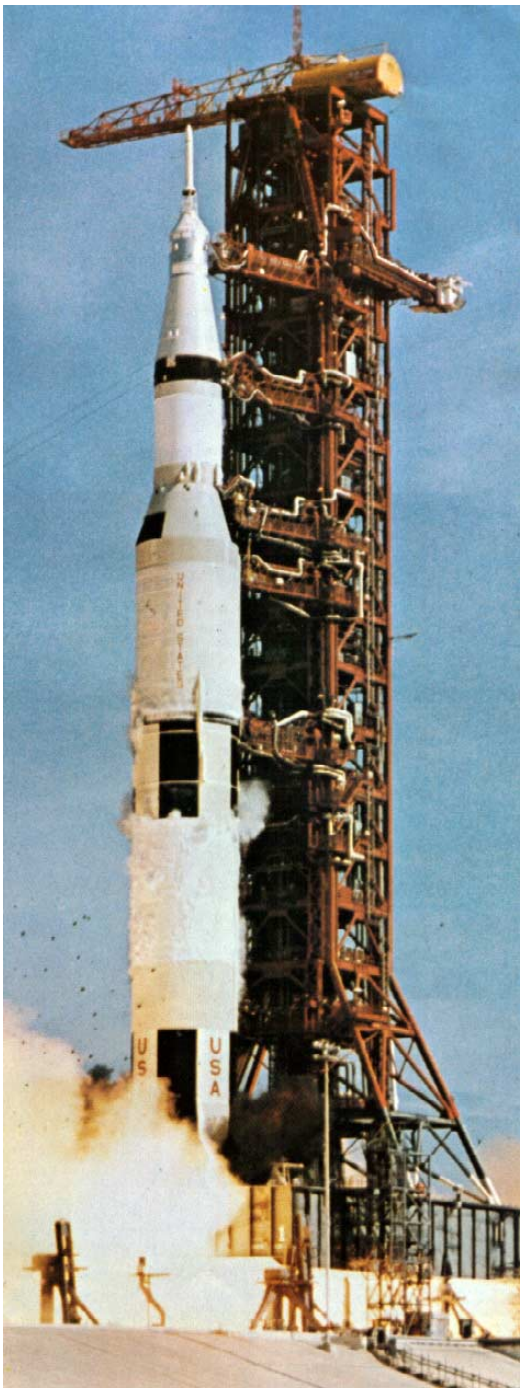
NASA's Rockets

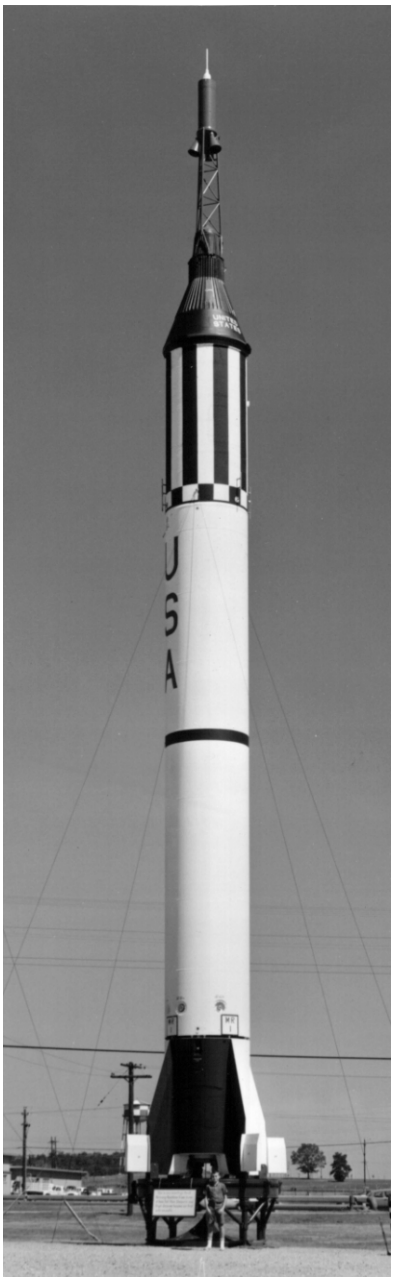


In 1963, NASA didn't have their Space Museum yet. They had a display of capsules and satellites in an un-airconditioned corrugated steel building. Outside they set up several of their rockets. You could drive right up to them. Here is a picture of my dad's 1961 Plymouth station wagon next to an S-1B booster. The Saturn had a much higher maximum speed, but the Plymouth could easily out drag it in a ¼ mile, and got much better mileage. →

This picture was taken in the spring of 1964. That's me standing next to an honest to goodness Mercury capsule. I think we have forgotten how much of a big deal the space race was in the sixties. Just like we've forgotten how cool it was to wear narrow ties, tab front collars and pocket protectors. →

This picture of the Apollo 11 launch shows some of the GSE (Ground Support Equipment) that I worked on. It catches our first trip to the moon in the critical three second period after the ignition of the five booster engines. The Hold Down Arms are still clamping the rocket in place. The Swing Arms are disengaging from the rocket body. The top arm has already rotated. The Q-Ball had been pulled earlier in the countdown. You can just barely see the two crew escape cables strung from the left side of the gantry. →





← Here is a picture of my twelve year old brother, Rick, standing in front of a Redstone - Mercury rocket. This configuration was our first and smallest manned (sub-orbital) space shot.