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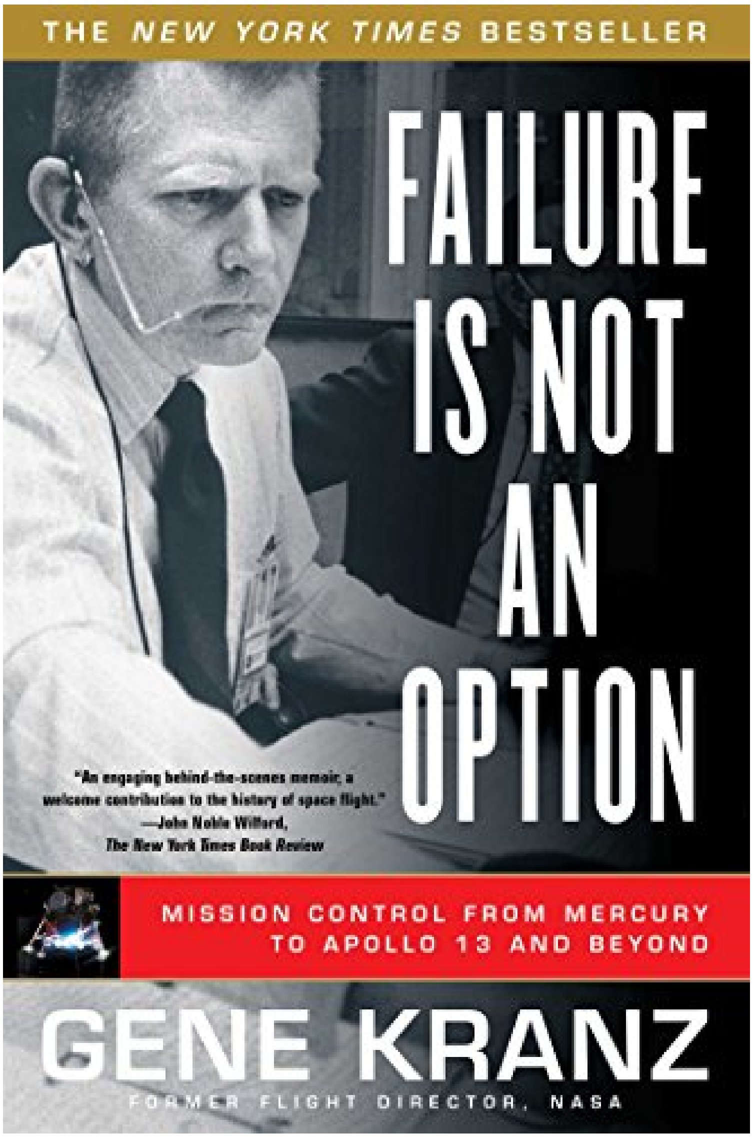
Failure Is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond (English Edition)



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Par Gene Kranz : Failure Is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond (English Edition) before purchasing it in order to gage whether or not it would be worth my time, and all praised Failure Is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond (English Edition):

Description : Description du produit Gene Kranz was present at the creation of America's manned space program and was a key player in it for three decades. As a flight director in NASA's Mission Control, Kranz witnessed firsthand the making of history. He participated in the space program from the early days of the Mercury program to the last Apollo mission, and beyond. He endured the disastrous first years when rockets blew up and the United States seemed to fall further behind the Soviet Union in the space race. He helped to launch Alan Shepard and John Glenn, then assumed the flight director's role in the Gemini program, which he guided to fruition. With his teammates, he accepted the challenge to carry out President John F. Kennedy's commitment to land a man on the Moon before the end of the 1960s. Kranz was flight director for both Apollo 11, the mission in which Neil Armstrong fulfilled President Kennedy's pledge, and Apollo 13. He headed the Tiger Team that had to figure out how to bring the three Apollo 13 astronauts safely back to Earth. (In the film Apollo 13, Kranz was played by the actor Ed Harris, who earned an Academy Award nomination for his performance.) In Failure Is Not an Option, Gene Kranz recounts these thrilling historic events and offers new information about the famous flights. What appeared as nearly flawless missions to the Moon were, in fact, a series of hair-raising near misses. When the space technology failed, as it sometimes did, the controllers' only recourse was to rely on their skills and those of their teammates. Kranz takes us inside Mission Control and introduces us to some of the whiz kids -- still in their twenties, only a few years out of college -- who had to figure it all out as they went along, creating a great and daring enterprise. He reveals behind-the-scenes details to demonstrate the leadership, discipline, trust, and teamwork that made the space program a success. Finally, Kranz reflects on what has happened to the space program and offers his own bold suggestions about what we ought to be doing in space now. This is a fascinating firsthand account written by a veteran mission controller of one of America's greatest achievements.

Prsentation de l'diteurThis memoir of a veteran NASA flight director tells riveting stories from the early days of the Mercury program through Apollo 11 (the moon landing) and Apollo 13, for both of which Kranz was flight director.Gene Kranz was present at the creation of Americas manned space program and was a key player in it for three decades. As a flight director in NASAs Mission Control, Kranz witnessed firsthand the making of history. He participated in the space program from the early days of the Mercury program to the last Apollo mission, and beyond. He endured the disastrous first years when rockets blew up and the United States seemed to fall further behind the Soviet Union in the space race. He helped to launch Alan Shepard and John Glenn, then assumed the flight directors role in the Gemini program, which he guided to fruition. With his teammates, he accepted the challenge to carry out President John F. Kennedys commitment to land a man on the Moon before the end of the 1960s. Kranz recounts these thrilling historic events and offers new information about the famous flights. What appeared as nearly flawless missions to the Moon were, in fact, a series of hair-raising near misses. When the space technology failed, as it sometimes did, the controllers only recourse was to rely on their skills and those of their teammates. He reveals behind-the-scenes details to demonstrate the leadership, discipline, trust, and teamwork that made the space program a success. A fascinating firsthand account by a veteran mission controller of one of Americas greatest achievements, Failure is Not an Option reflects on what has happened to the space program and offers his own bold suggestions about what we ought to be doing in space now..comIn 1957, the Russians launched Sputnik and the ensuing space race. Three years later, Gene Kranz left his aircraft testing job to join NASA and champion the American cause. What he found was an embryonic department run by whiz kids (such as himself), sharp engineers and technicians who had to create the Mercury mission rules and procedure from the ground up. As he says, "Since there were no books written on the actual methodology of space flight, we had to write them as we went along." Kranz was part of the mission control team that, in January 1961, launched a chimpanzee into space and successfully retrieved him, and made Alan Shepard the first American in space in May 1961. Just two months later they launched Gus Grissom for a space orbit, John Glenn orbited Earth three times in February 1962, and in May of 1963 Gordon Cooper completed the final Project Mercury launch with 22 Earth orbits. And through them all, and the many Apollo missions that followed, Gene Kranz was one of the integral inside men--one of those who bore the responsibility for the Apollo 1 tragedy, and the leader of the "tiger team" that saved the Apollo 13 astronauts. Moviegoers know Gene Kranz through Ed Harris's Oscar-nominated portrayal of him in Apollo 13, but Kranz provides a more detailed insider's perspective in his book Failure Is Not an Option. You see NASA through his eyes, from its primitive days when he first joined up, through the 1993 shuttle mission to repair the Hubble Space Telescope, his last mission control project. His memoir, however, is not high literature. Kranz has many accomplishments and honors to his credit, including the Presidential Medal of Freedom, but this is his first book, and he's not a polished author. There are, perhaps, more behind-the-scenes details and more paragraphs devoted to what Cape Canaveral looked like than the general public demands. If, however, you have a long-standing fascination with aeronautics, if you watched Apollo 13 and wanted more, Failure Is Not an Option will fill the bill. --Stephanie Gold ExtraitChapter One: The Four-Inch Flight"Houston, we have a problem."At some time in the hours that followed that terse announcement from Apollo 13, many of us in NASA's Mission Control Center wondered if we were going to lose the crew. Each of us had indelible memories of that awful day three years before when three other astronauts sat in an Apollo spacecraft firmly anchored to the ground. Running a systems test. Routine. In terms of the distances involved in spaceflight, we could almost reach out and touch them.Moments after the first intimation that something had gone terribly wrong, technicians were up in the gantry, desperately trying to open the hatch. It took only seconds for an electrical glitch to ignite the oxygen-rich atmosphere of the cabin, creating a fire that was virtually a contained explosion. In those few seconds, the men inside the capsule knew what was happening -- and they must have realized, at the last moment, that there was no escape. We simply could not reach them in time.Now, three equally brave men were far beyond us in distance, far out in the vast absolute zero world of space, the most deadly and unforgiving environment ever experienced by man. We could measure the distances in miles. But with so many miles, the number was an abstraction, albeit one we had become used to dealing with in matter-of-fact fashion.We could reach them only with our voices, and they could speak to us only through the tenuous link of radio signals from precisely directional radio antennas. This time they were truly beyond our reach. Time and distance. So close were we in the Apollo fire that claimed the first three Americans to be killed in a spacecraft.Now we were so far, so very far, away.Once again, technology had failed us. We had not anticipated what happened back then, on Earth. We had not anticipated what had happened this time. In fact, it would be hours before we really understood what had happened. There was one big difference in this case. We could buy time. What we could not accomplish through technology, or procedures and operating manuals, we might be able to manage by drawing on a priceless fund of experience, accumulated over almost a decade of sending men into places far beyond the envelope of Earth's protective, nurturing atmosphere. All we had to work with was time and experience. The term we used was "workaround" -- options, other ways of doing things, solutions to problems that weren't to be found in manuals and schematics. These three astronauts were beyond our physical reach. But not beyond the reach of human imagination, inventiveness, and a creed that we all lived by: "Failure is not an option."That was not true in the beginning of the space program. There had been many early failures back then -- because we hadn't learned enough about the perilous business in which we were engaged.Would it happen again -- the loss of three men? We had failed our crew in Apollo 1. This time we had a few hours to do something. But did we have the wisdom? And could we somehow build not just on our own years of experience but the courage and resourcefulness of three astronauts far, far from home?Sociologists and engineers call it "the human factor." It's what we must depend on when all the glittering technology seems, suddenly, useless.For me, and others sitting safely in Mission Control in Houston, we could depend only on a learning curve that started at a place that wasn't more than a complex of sand, marsh, and new, raw concrete and asphalt. It wasn't even Kennedy Space Center then. But it was our first classroom and laboratory. And all we had learned since those first, uncertain years would be what we had to work with to figure out what had happened -- and what to do about it.November, 1960As a former Air Force fighter pilot, I am not usually a nervous passenger, constantly staring out the window to make sure a wing hasn't fallen off or monitoring the noise of the engines. But for once, on that fateful day, November 2, 1960, I couldn't wait to get on the ground.East Coast Airlines had only one flight a day from Langley Air Force Base in Virginia to South Florida, using creaky, old twin-engine Martins and Convairs. How long the flight took on one of those old prop aircraft on any given day depended on the size of the bugs that hit the windshield and slowed it down.This time my eagerness had nothing to do with the condition of the aircraft. This was my first trip to Cape Canaveral, Florida, the launching site for the infant American space program. During the brief flight on the shaky Convair, I was absorbed in thoughts about the new battle in which I had elected to play a part. As an American, I hated to see our nation second in anything -- and I had no doubt we were second in space. I had seen an example of what Soviet technology could do as I watched MiG aircraft making contrails high in the sky over the demilitarized zone in Korea, higher than our F-86 fighters could climb. Now the Russians had utterly surprised us by launching the space race. This was a race we had to win and I wanted to be part of it. In a matter of weeks, I had given up my exhilarating work in aircraft testing to take a job with the National Aeronautics and Space Administration (NASA), officially coming on board on October 17. Two weeks later I was on my way to the Cape, and my family -- my wife, Marta, and our two young daughters -- was camping out at a motel near Space Task Group headquarters at Langley. My instructions were pretty simple: get to Mercury Control and report for work.Well, I thought, here I am, looking around for launch towers and gantries -- but all I could see looked like a regular old Air Force base. It turned out that my knowledge of the local geography was just a little bit hazy. We had landed at Patrick AFB and I literally did not know whether we were north or south of my destination. After the plane rolled to a stop and a couple of guys from base operations rolled a metal stairway out to the aircraft's door, a shiny new Chevrolet convertible wheeled to a halt just beyond the wingtip. An Air Force enlisted man popped out, saluted, and held open the car's door for a curly-haired guy in civilian clothes, a fellow passenger who deplaned ahead of me. That was unusual -- a nonmilitary vehicle cruising around the ramp of a military base. As I stepped onto the tarmac, I looked around for the man my boss had said would meet me. I didn't see anyone who seemed to be looking for me, so I started searching for a taxi or any form of transportation. I felt like a foreigner in a strange land.The plane's baggage was being offloaded next to the operations building when the tall, thin, curly-haired guy now driving the Chevy yelled out, "C'mon, I bet you're going to the Cape." I suppose my military-style crew cut and ramrod-straight posture gave me away. As I nodded, he said, "Climb aboard."After clearing the plane, he peeled into a 180-degree turn and raced along the ramp for 100 yards, my neck snapping back as he floored the Chevy. I had never driven this fast on a military base in my life. I was thinking I had hitched a ride with a madman, or at least someone who apparently had no concern about being pulled over by the Air Police for speeding and breaking every regulation in the book. This feeling was reinforced as we took a few hard rights and lefts, then roared toward the gate, momentarily braking as an Air Force military policeman snapped a salute and waved us through. I took a closer look at the stranger behind the wheel. He was hatless, wearing a Ban-Lon shirt. There was no gold braid on him. I wasn't accustomed to seeing a guy in a Ban-Lon shirt rate salutes.Hitting the highway, he made a wide turn and a hard left, burning rubber. In no time, he had the needle quivering between eighty and ninety miles an hour. After a joyful cry of "Eeeee hah," he turned and offered his hand, saying, "Hi, I'm Gordo Cooper." I had just met my first Mercury astronaut. As I soon learned, if you saw someone wearing a short-sleeved Ban-Lon sport shirt and aviator sunglasses, you were looking at an astronaut. We humble ground-pounders wore ties and white shirts, and yes, those nerdy pencil-holding pocket protectors.I thought of that handshake often in the many years that followed. Mercury worked because of the raw courage of a handful of men like Cooper, who sat in heavy metal eggcups jammed on the top of rockets, and trusted those of us on the ground. That trust tied the entire team into a common effort.I took it as a good omen that Cooper, taking pity on a befuddled stranger, offered me a lift to the base. He was one of the seven former test pilots selected for the first class of astronauts. They had been introduced, unveiled like sculptures, in April of 1959. Instantly the media compared them to Christopher Columbus and Charles Lindbergh. Today, I wonder how many of them the average American could name. They were John Glenn, Alan Shepard, Virgil I. (Gus) Grissom, Wally Schirra, Donald K. (Deke) Slayton, Scott Carpenter, and Cooper. They were similar in size and build, partly because the design of the capsule ruled out anyone over five-foot-eleven.All of them were white, all from small towns, all middle-class, and all Protestant. This was not the result of deliberate discrimination, but because at the time that was the kind of man who became a military test pilot. At this period it was hard for Americans from any minority to get into flight training. But the military, like the rest of the country, grew up and lived up to its fundamental commitment to equality, thanks in large measure to the civil rights movement that, like the space program in the same era, demanded conviction and courage.That day when I arrived in Florida I stumbled into the future. I didn't have enough time even to learn the recently coined space jargon before the Mercury flight director, Chris Kraft, gave me the task of writing the operating procedures for Mercury flight controllers. Without knowing much about anything, I was telling people how to do everything, writing the rules for the control team that would support the Mercury-Redstone launch. Not only had I never laid eyes on the Mercury Control Center, I had never even seen, close up, any rocket big enough to carry a human payload.I did not really research the program before I joined. I knew that it was called the "man in space project." Lyndon Johnson, then the Senate majority leader, was given the job by President Dwight Eisenhower of determining how we should respond to the Soviets' launch of Sputnik on October 4, 1957. The impact of the first orbiting satellite, visible to the naked eye as it passed through the night sky over America, was profound. Sputnik was a shock to national pride -- Russian science had put the first object in outer space, giving Americans both an inferiority complex and a heightened sense of vulnerability in what was then the most intense phase of the Cold War. Out of this was born the "missile gap" between ourselves and the Soviet Union.Years later we would discover that this "gap" was an intelligence myth. But the Soviet Union was indeed ahead in a space race that this tiny, rather primitive satellite had effectively initiated. Our adversary had developed rockets with greater thrust and throw weight -- for the military this meant ballistic missiles that could "throw" a heavier warhead a greater distance than anything in our arsenal.The reverberations of that little sphere emitting its "beep-beep" radio signal as it sailed unrestricted through space were far reaching. Among other things, it would spark a massive federal education funding program, significantly called "The National Defense Education Act," to stimulate better teaching of math and science as well as foreign languages to more students throughout the country. A sleeping giant suddenly woke up.One of the other immediate results of Sputnik was the National Space Act of 1958 and the creation of the National Aeronautics and Space Administration. To me, our leap into space was the logical next step beyond the X-15 rocket-powered aircraft. The problem was that our first "leaps" would be some fairly short hops. All of these factors had influenced my decision to join this embryonic program. It had been cautiously funded, was working from a somewhat thin base -- and was also a crash effort for everyone involved in it. I don't think that at the time I realized just how caught up I was in the excitement and challenge of this race. Nor could I have anticipated just how thrilling and dangerous, frustrating and inspiring the first lap in it would be. All of those involved were obsessed by a driving dream, working with an intensity that fused NASA employees and contractors, launch and flight operations into one powerful organism.Cooper dropped me off at Mercury Control and I was greeted by the familiar face of the only person in the program I knew down at the Cape, Paul Johnson, a troubleshooter working for Western Electric, one of the subcontractors to Bendix in building the control center and the tracking network. Western Electric's responsibilities included radars, telemetry (radio signals to and from the rocket and spacecraft that told us how things were working -- and what wasn't) control consoles, and communications. These were the core systems. Western Electric quickly parlayed this into a responsibility for integrating operations, training, maintenance, and network communications. Paul was amazingly young for his responsibilities. He had an intuitive feel for this unprecedented development and deployment of technology, writing the specifications and testing procedures and doing everything that needed to be done to check out the largest "test range" in history, one that went around the globe."Kraft said you were coming down," he greeted me, smiling, "and I thought I'd give you a hand." During the next two days, Johnson gave me a master's degree in the art of mission control. He had been at the Cape for the preceding week and had been writing the manual on the team structure and operations. He handed it over to me to finish defining the standard operating procedures for Mercury Control, such as how to check out the console displays and communications, set the format for Teletype communications, and how specifically to request data from the technicians (politely but urgently).I soon began to think of Paul as my guardian angel. From the moment I came on the job it seemed that whatever I was doing, wherever I turned, he was there. He always appeared when the pressure was on and I was happy to see him.As I felt my way through a program inventing itself, Marta was moving from the motel into a new house in Hampton, Virginia. It was our fifth move in the four years since our marriage, setting up successive households in South Carolina, Texas, Missouri, New Mexico, and now Virginia. Carmen, our two-and-a-half-year-old daughter, had been born in Texas, and Lucy, fourteen months, in New Mexico. Like most service families they were ready for anything, anytime.The Space Task Group's launch team was permanently stationed at the Cape to support the test and checkout of the rocket and capsule. The flight team of which I was now a member, the astronauts, engineers, and program office operated from Langley Air Force Base and traveled to the Cape for each mission. I had been on the job in Virginia only two weeks, hardly long enough to figure out the pecking order, when Kraft walked up to my desk and said, "Everyone else is tied up. You're all I've got. We're coming up on our first Redstone launch. I'd like you to go down to the Cape, get with the test conductors and write a countdown. Then write some mission rules. When you finish give me a call and we'll come down and start training."The shock on my face must have registered as Kraft continued: "I'll tell Paul Johnson to meet you at Mercury Control to give you a hand." When Kraft talked, his eyes never left mine. I was given this assignment mainly because I was available. In this period of intensive development, jobs were open all over the place; NASA was forming organizations for mission planning, recovery operations, astronaut training, launch operations, and Mercury Control. Every new hire with the requisite technical and scientific credentials was put into a job slot the minute he came on board.Kraft was one of the original thirty-six members of the Space Task Group, most of whom stepped forward to do a job that had never been done. He recognized that someone had to be in charge of the ground effort and he volunteered to lead that effort. A graduate of Virginia Polytechnic Institute, Chris had worked at Langley in the aircraft stability and control laboratory. My senior by nine years, he did not immediately impress me as a leader, the way some of my early mentors had. Kraft led a step at a time, and each Mercury mission added a new dimension to his presence and style.My days as an observer were over, my chance to get up to speed ended. This was the first indication that my job slot would be in Mercury Control. Some people in Mercury Control had technical experience working on the tracking stations or at the Cape on the Vanguard, Explorer, and Pioneer missions. Others, like me, came from aircraft flight testing or were engineers from the pilotless aircraft research program at Langley. From my work, most recently at Holloman AFB in New Mexico, I knew about flying, systems, procedures, and checklists. I could figure out what a countdown should contain. Mission rules were different. There had never before been such a mission in U.S. history -- I would just have to give it a shot. Since there were no books written on the actual methodology of space flight, we had to write them as we went along.There was a relatively small group working down at Mercury Control, forty to fifty people. Some of them had grown up launching the early U.S. rockets derived from the German V-2 of the Second World War. Now, in a few months, we would attempt to send the first American into space. It was a scary thought, but not for anyone who had been around test pilots.I had flown supersonic F-100s, which needed at least a mile to get off the runway on a good day. When you took off at 230 miles per hour, if the engine crapped out or you lost the afterburner, it could quickly become a bad day. But when you punched through the sound barrier it was a jolt of pure adrenaline. The SuperSabre looked like it was more than capable of carrying out its air superiority mission. But you had better be ready when you strapped yourself in. No matter how skilled you were in handling it, you were never sure when the elements or the aircraft, in a perverse way, would decide to test you. Every time I climbed aboard I could feel the thrill of tension and anticipation.At Holloman AFB, where I had worked as a flight test engineer, we had been putting people into scary situations for years. It was not unusual for a guy to climb to an altitude of 100,000 feet in a balloon and then bail out in a parachute, falling 90,000 feet before his parachute opened. This was the environment of risk and these were the kinds of people who had been picked as the Mercury Seven astronauts.Looking back, I can see now how minimal, even primitive, our facilities were at the time, both in the control center and in the blockhouse -- a massively reinforced structure placed as close as prudently possible to the launch pad where the guys who were responsible for the actual functioning of the rocket manned their posts. We tended to talk about "the Germans in the blockhouse" largely because Wernher von Braun and his cohorts, who had worked on the rocket programs, came to the United States after Germany's defeat in World War II. They were originally stationed near El Paso, Texas, and tested captured V-2 rockets for the military at the White Sands, New Mexico, test range. Later they were moved to permanent facilities at Huntsville, Alabama, and worked for the Army Redstone Arsenal. Most of the Germans became American citizens, adopting Huntsville as their home. In 1960 rocket development at the Redstone Arsenal was transferred to the newly formed Marshall Space Flight Center (MSFC), and von Braun, along with nearly 100 other German scientists and technicians, began work on a powerful series of rockets called Saturn I.At this point in the space program, our communications network was actually run out of NASA's Goddard Space Flight Center in Greenbelt, Maryland. It had been named after Dr. Robert Goddard, the American pioneer in rocketry, who had developed rocket engine and guidance technology in the 1930s equal, if not superior in some respects, to what von Braun and his colleagues were working on as late as 1945. Goddard, one of my boyhood heroes, had had the backing of Charles Lindbergh, which enabled him to test his rockets in New Mexico, not far from the site where von Braun and his Germans would fire the first captured V-2 rockets in the late 1940s and test those that evolved from V-2 technology in the years that followed.The German scientists and technicians would come back to the Cape occasionally for selected launches (particularly high-profile manned missions), but they had their hands full at Marshall developing a new generation of rockets. By the time NASA launch operations were forming up, American engineers were well acquainted with rockets, building on the experience of the Germans, as were the contractors producing the Redstone and Atlas missiles. While the new generation of American scientists and engineers was now doing the job, the first boosters in the manned spaceflight effort were barely adequate, as events would demonstrate. In many ways this technology was as "out on a limb" as Charles Lindbergh's Ryan monoplane. He didn't have any manuals either, and his facilities were primitive. Roosevelt Field in 1927 and Canaveral in 1960 had a few things in common. The massive Cape facility that would grow up in the next decade and soon become the Kennedy Space Center (which would include the largest enclosed space in the world, the vertical assembly building) was beyond our wildest dreams at the time.In 1960 the Cape looked like an oil field, with towering structures, dirt, and asphalt roads newly carved out of the palmetto scrub. The alligators were reluctantly surrendering to the onslaught of newly arrived civilization. If you didn't have a good sense of direction you were in trouble. There were few directional signs and once you got off the road visibility narrowed. At night you could easily imagine the gators and snakes taking their revenge on any intruder foolish enough to be wandering around on foot, lost in the boondocks.The man in space program was simple in concept, difficult in execution. Every mission was a first, a new chapter in the book. Many, if not most, of the components in both rockets and capsules had to be invented and handmade as we went along, adapting what we could from existing aviation and rocket engine technology. Before putting a man on top of a rocket, we would first fly one or two tests with a "mechanical man," a box full of electronics weighing about as much as an astronaut to simulate the conditions that would be present when an astronaut was on board the capsule. The capsule would send back some prerecorded messages to test our communications. Then we graduated to spider monkeys -- and then to chimpanzees, working our way up the evolutionary ladder, so to speak. The missions were initially to be twenty-minute lob shots, using the Army's Redstone rocket; then we would go into orbit with the Air Force's first-generation Atlas intercontinental missiles. The military boosters were barely ready for operational use. Here the missile gap was indeed real -- except the gap was between what the hardware was supposed to do and what it had shown it could do.The day after I arrived Paul Johnson and I went to the launch pad. I was shocked when I first saw the Redstone rocket. It was stark, awkward, and crude, a large black-and-white stovepipe atop a simple cradle. It had none of the obvious coiled power and distinctive personality of an airplane; it was not graceful in form, not something you could come to love and rely on. The Mercury capsule squatted atop the rocket, black in color and seemingly constructed of corrugated sheet metal. With its tall red escape tower it looked more like a buoy in a harbor than a rocket ship from a science fiction novel. Given the oil field-like setting in the wilderness and the crude appearance of the rocket, I felt more like a drilling rig roughneck than a rocket scientist when I made my way into the bar of the Holiday Inn that evening.Putting any reservations aside, I plunged into working with Paul on defining the joint tests of control and communications systems, as well as the Go NoGo points for telemetry display, command, and communications in Mercury Control. My next step was to synchronize the Mercury Control Center (MCC) countdown with the capsule and booster countdowns. Paul Johnson returned to Langley to deal with a set of problems in the tracking network while I completed the work down at the Cape. To this day I feel enormous gratitude to Paul for giving me a running start. This was one of the critical moments in my life when someone stepped in and pointed me in the right direction.I had left behind a world where airplanes were flying at roughly five miles a minute. In this new, virtually uncharted world we would be moving at five miles per second. During a mission countdown, or even a flight test, so many things would be happening so fast that you did not have any time for second thoughts or arguments. You wanted the debate behind you. So before the mission, you held meetings to decide what to do if anything went wrong.You wrote down on paper the outcome of these meetings and this became what you needed for a launch, your personal list of Go NoGo's. There was no room in the process for emotion, no space for fear or doubt, no time to stop and think things over. A launch is an existential moment, much like combat. With no time to think about anything, you had to be prepared to respond to any contingency -- and those contingencies had to be as fully anticipated as possible before you pushed the button. You also had to be thoroughly knowledgeable about the responsibilities of launch control and range safety. During a launch the only mission alternative to save the capsule was an abort, and we had to pick the points to act before the range safety officer (RSO) stepped in to blow up the rocket and the capsule after launch if things went to hell.By the end of the first week we had just finished the initial paperwork for the countdown procedures and mission rules, but had yet to run a simulated countdown. I was finally breathing easier. Johnson had taken me from Kraft's few words on what he wanted done to a point where I finally knew what he was talking about. It was only some six days after my "rocket ride" with Gordo Cooper, but my job was starting to seem real to me. The few days of hands-on familiarity with MCC systems now tied into the concept of the MCC team. The MCC was coming together as a working reality. My newfound knowledge, while only paper thin, was as good as anyone else's. It was now time to put it to the test. I called Kraft and said the countdown and the operational rules were ready.Shortly before the rest of the team that would be involved in the first launch arrived from Langley, I made a thoughtful walk-through inspection of the relatively small -- in comparison to later control centers -- space that contained the operating elements of Mercury Control.When a fighter pilot arrives at a base the first thing he does is go down to the flight line and look at the new airplane he is going to fly. You walk around it, feel the skin, climb up on the wing, and look in the cockpit, knowing that soon this airplane is going to be yours. It is a time when you feel a bit cocky, knowing that you are one of the few who will be privileged to live in this highly charged new world of high-speed flight.I felt the same way on my solitary walk around the Mercury control room; I felt like I was meeting an airplane. I was, at long last, feeling at home. The telemetry, communications, and display areas were like the facilities at Holloman, but there was no counterpart for the control room itself. The room was square, about sixty feet on each side, dominated by a world map in the front. The map contained a series of circles, bull's-eyes centered on the worldwide network of tracking stations. Below each were boxes containing many different and, for the uninitiated, unintelligible symbols. A toylike spacecraft model, suspended by wires, moved across the map to trace the orbit. On each side of the map were boards, where sixteen critical measurements were plotted by sliding beads, like those on an abacus, up and down wires as the capsule circled the world. In less than four years much of this technology would be obsolete -- only the concept of Mission Control would remain. The meters and console displays would eventually be replaced by television displays driven by computers, which provided the controllers virtually instantaneous access to every bit (or byte) of the spacecraft's data. Digital systems would enable ground control of the space systems. This would make it possible for controllers on the ground to work in partnership with a spacecraft's crew to achieve the objectives of any flight. But this was yet to come; now we had to control the missions with fragile communications, a first-generation solid-state computer, slide rules, and guts. We were in the Lindbergh stage of spaceflight.Given my aircraft test flight background, the control room felt vaguely familiar, with the exception of the three rows of consoles on elevated platforms. Each console was configured differently. Consoles on the top row were flat pedestals with communications boxes on top. When I first arrived at the Cape, Paul Johnson had taken me on a tour of the control room and pointed out the procedures console. I sat at the console, staring at the flat gray face and writing desk. The only instruments were a clock and an intercom panel with a rotary (!) phone at the top. This was the state-of-the-art work station that Paul and his colleagues from Western Electric had designed from scratch. It was on the left, in the middle row, and closest to the Teletype room. As I sat down at my console, two people came over and introduced themselves.Andy Anderson, tall and skinny with long, sandy hair, was the boss of the communications center. His hotshot Teletype operator, a short redhead with a brush cut, was simply "Eshelman." No one called him anything else. During a launch, I reeled off a running account of key data on the sequence of events to Eshelman, who typed them out and transmitted them by landline and radio links to remote tracking stations in Bermuda, Africa, Australia, and distant islands and ships in the Atlantic and Pacific. Eshelman had the skill and grace of a concert pianist as he stood, intently bent over the Teletype keyboard, interacting in real time with the Bermuda Teletype operator, just as if they were having a conversation. The tools we used in Mercury were primitive, but the dedication of highly trained people offset the limitations of the equipment available to us in these early days and kept the very real risks under control. But at a price; this was high-sweat, high-risk activity, demanding a degree of coordination between the ground and the capsule exceeding what I had experienced even in the testing of experimental aircraft.During the next two years, Anderson, Eshelman, and I controlled virtually all the Teletype message traffic originating from Mercury Control at the Cape. This was the heart of the ground control system, tied to that tenuously linked chain of tracking stations and manned remote sites by a variety of communications systems. Low-speed Teletype provided the backbone, and the controllers became adept at moving messages rapidly between the tracking sites as the spacecraft passed overhead.The tracking network voice system used a massive manual switchboard up at Goddard; its operator plugged cables into a bewildering assortment of jacks as he performed a frenetic ballet. He carried a thick bundle of cables wrapped around his arm, darting from one part of the big switchboard to another, making connections manually so we could talk to tracking sites and working around bad circuits to provide alternative connections. This remarkable guy, known as "Goddard voice," was another guardian angel.Since we never knew whether every link had heard the voice exchanges, as a cross-check I transcribed every major communication into a Teletype message. We didn't have computers in Mercury Control. So the radar information from the launch, orbit, and reentry was transmitted by tracking sites around the world to the computers at Goddard for processing, and then sent down to drive the plot boards in Mercury Control. Advanced as they were at the time, and filling whole large rooms, those computers had a speed and processing capacity easily exceeded by desktop PCs today. So our margins for error were made even thinner by the limitations of these resources.While waiting for Kraft's full team to arrive from Langley I explored everything from the launch pad to Hangar S, where they checked out the spacecraft prior to launch. I was welcomed everywhere by engineers and technicians who were as new to their jobs as I was. All of them were eager to discuss their work, trade ideas, and figure out how each of us fit into the total picture. I felt that I was not alone, that virtually everyone was writing their game plan as they went along. I felt an undercurrent of organization that was emerging from a leadership structure still solidifying.By the time Kraft and the rest arrived at the Cape, I was no longer feeling like a rookie. I had spent every available moment in

Mercury Control, prowling through the room and listening to the check-out, observing how the technicians handled communications with "Goddard voice," the tracking stations, and the blockhouse.Project Mercury was literally having trouble getting off the ground. In August of 1960, after the first Mercury-Atlas exploded in flight, the major journal in the aerospace business, Missiles and Rockets, stated: "NASA's Mercury manned satellite program appears to be plummeting the United States toward a new humiliating disaster in the East-West space race. The program is more than one year behind the original schedule and is expected to slip to two. It no longer offers any realistic hope of beating Russia in launching the first man into orbit, much less to serve as an early stepping-stone for reaching the Moon."The testing of the Mercury capsule escape system was carried out at the Wallops Island Station just below the Maryland-Virginia border. This was a Langley test facility for all sorts of "sounding," or high-altitude research rockets. The tests of the escape system were about 50 percent successful. While we were getting ready at the Cape, one of the Mercury tests at Wallops failed spectacularly on November 8. Sixteen seconds after launch the escape and jettison rockets fired prematurely, thus leaving the capsule attached to the booster rocket, which reached a ten-mile apex and then came screaming back to Earth, destroying the capsule at impact.The Mercury program used two booster rockets -- the Redstone and the Atlas. Both were derivatives of military systems but with vastly different capabilities. The Redstone was an Army battlefield rocket. It would be used to start the capsule systems qualification test flight and, if that was successful, for two ballistic manned missions. The ballistic missions were to be about twenty minutes in duration, reaching a maximum altitude of about 130 miles and providing a short weightless period before reentry. The Atlas was an Air Force intercontinental missile and was to be used for both ballistic and orbital Mercury missions. The first three missions were ballistic, to continue the booster and capsule qualification, test the tracking network, and provide experience for the MCC team. The orbital testing would continue the qualification testing using the mechanical man and a chimpanzee before the manned orbital flights.When Mercury-Atlas 1 exploded in flight, we fell about one year behind in the schedule, so a lot was riding on the first Mercury-Redstone flight, MR-1. Kraft's team arrived on November 13 for the MR-1 launch, now only eight days away. Once again my guardian angel, Johnson, arrived to save my bacon. He took a place to the right of the console and punched up the buttons of the intercom during our simulation dress rehearsal.Immediately, a half dozen different conversations flooded through my headset. It reminded me of the cool, almost casual but terse and clear voice chatter that came up on the tactical frequency when things heated up during the time I was in Korea directing air strikes on ground targets. As I listened, I picked up the voices of the test conductors. Johnson broke out some thick documents and advised Kraft of the page and sequence of the countdown. It was fortunate that this was just a test. It gave Johnson a chance to brief me on the countdown process, get to know the people talking on the loops and Mercury Control's role in the test.At intervals, Johnson encouraged me as the MCC procedures controller to make suggestions to Kraft or one of the other controllers. Throughout the test, he glanced around the room and made mental notes about what people at the various console positions should be doing or doing in a different way. Periodically, I would print out a message and call the ground communications controller. Eshelman would rush into the room to pick up the message, put it on the Teletype line, and then rush back with a confirming copy of the transmitted text. After several hours, I picked up the routine of the count and felt comfortable, as long as all was going well.This first mission in which I would play a role was a ballistic test of a Redstone booster rocket and a Mercury capsule. The Redstone's engine was scheduled to burn for two and one half minutes. After the booster engine cut off, the escape tower separated from the capsule by firing the tower ring attachment bolts and igniting the tower escape rocket. Then after the booster thrust had decayed, explosive bolts would fire, followed by the firing of three small posigrade solid rockets, to separate the capsule from the booster. ("Posigrade" is the term used for adding velocity in the direction of flight, in this instance the small rockets used to separate the Mercury capsule from the booster. Retrograde rockets fire opposite to the direction of flight.) The Redstone boosted the spacecraft to an altitude of 130 miles before it started to arc downward.At 20,000 feet, the capsule's drogue parachutes would deploy, stabilize its motion, and slow it down sufficiently to allow the main parachutes to deploy safely. Then the landing sequence would begin. The entire mission was planned to last only sixteen minutes. After the countdown simulation test we began training for the brief actual flight of the Redstone. For three days we rehearsed, calling out events and issuing backup commands to the automatic sequences.During the simulation run-through our instructors sat watching us from their vantage point at the top row of the consoles and played magnetic tapes into the telemetry and radar systems, which in turn drove the controller's meters and plot board displays. If all else failed, we would be handed a written question, like a pop quiz in school. You had to stand up in front of the entire Mission Control Center team and say, "Flight! A new problem has shown up and this is what I am going to do about it." You took it seriously. God help you if you couldn't come up with an answer -- instantly.The launch complex from which we would fire the Redstone consisted of the launch pad, service tower, and a blockhouse for launch site command and control. Servicing the pad was a network of power and communications cables, and pipes carrying fuel and other fluids. The blockhouses were igloolike structures that sat about 230 meters from the pad and looked somewhat like squat World War II pillboxes. Atlas blockhouses were a bit different -- twelve-sided concrete bunkers with walls three meters thick and domed tops, embedded in thirteen meters of sand. Earlier blockhouses used a viewing slit with a thick quartz/glass window. Later on periscopes were added; they afforded a view of such things as the fuel tanks and cable trenches. The blockhouses had to be close enough for direct viewing and far enough from the booster to survive an explosion. (Five percent of the early boosters exploded shortly after liftoff.)The blockhouse team was a mixture of German rocket scientists, former Army technicians, and booster contractors. The Germans were most often found talking in their native language, huddled over their displays and praying for things to go right. In addition to von Braun's colleagues, the blockhouse capsule engineers were drawn from a broad talent pool, mostly from aircraft (soon to be called aerospace) contractors. Kraft's team was made up of engineers who came from all sorts of backgrounds, put together like a pickup softball team. The capsule engineers came from the NASA Space Task Group, network controllers from the Air Force, facility technicians from Bendix, and the Mercury Control Center CapComs from the initial group of seven astronauts. Three-man operations teams were deployed to the thirteen Project Mercury manned tracking stations to provide global tracking, data, and voice communications data coverage. The leader of the three-man team was the CapCom, and he was responsible for site mission readiness, real-time mission support, and status reporting to the Mercury Control flight director. During the manned missions he provided the communications with the astronaut in the capsule, hence the term "CapCom."The teams at the thirteen manned tracking stations were provided by Kraft's operations organization. With high-risk time-critical decisions, the astronaut corps believed that only astronauts should talk to the astronaut in the capsule. In the Mercury Control Center and at the blockhouse, CapComs were selected from the Mercury astronauts and they were often sent to tracking stations designated as mission critical.During this period, the American space program drew on some military resources as well as those of NASA. By contrast, the Russian program was part of their military. Soviet hardware, software, and personnel were military, albeit with some modification -- spacecraft instead of warheads sitting on top of boosters that, like our Atlas, originated in military programs developed for strategic warfare. Over time the Russian effort would become somewhat more civilian in nature, but from inception, NASA's operations would be separated by a kind of firewall from military operations and personnel.In the first decades of the race into space the Russians enjoyed the advantages of running a program powered by the virtually unrestricted resources and funding of a military that, in a command economy, came first in economic priority. We were on a somewhat more modest footing in the early days. That would change dramatically thanks to President John F. Kennedy and Vice President Johnson pushing for the funding and resources that would enable an explicitly civilian space program to succeed.In Mercury Control the only controllers reporting administratively to Chris Kraft were the trajectory operators, Tecwyn (Tec) Roberts, and Carl Huss, whom I had yet to meet; Howard Kyle, who doubled for Kraft at the flight director console; Paul Johnson; and myself. The capsule engineers assigned to work with the MCC team understandably focused on hardware rather than flight operations and had their hands full checking out the spacecraft in Hangar S, and they looked at training in the Mercury Control Center as a waste of their time. The core of the engineering staff was based at Space Task Group headquarters at Langley Research Center. When McDonnell Aircraft sent a capsule to the Cape the engineers would come down and check it out in Hangar S.Despite a certain amount of confusion about who should be doing what, since we were inventing it all as we went along, we were moving quickly to the crunch point. To my dismay, two days before launch at the readiness review, Johnson took me aside and said he would not be there. He had to go to the Canary Islands to work out a tracking site problem. He wished me good luck.November 21, 1960, Mercury-Redstone 10 Only one month and four days after I was hired, I was at the procedures console. Thanks to Johnson's unflagging coaching and the training we had done, I had no problems and felt comfortable with the mechanics. But I had a long way to go before I would have that sense of "being ahead of the airplane" or "ahead of the power curve" as pilots put it -- having the experience to anticipate what could happen rather than just reacting to what was happening at the moment.As the countdown proceeded, I noticed a change in the intensity of the atmosphere in the control room. I had felt that before when I signed off my aircraft -- accepted it as ready for flight -- at Holloman. Although the job was different, the emotional content was the same. Controllers were going through the same gut churning as we had had prior to a B-52 test flight. During a hold in the countdown to fix a leak in the Redstone's hydrogen peroxide system that fueled the control thrusters, Kraft turned to me and said, "How about getting me a couple of cartons of milk from the roach coach?" (Mercury Control, like all the other Cape facilities, was out in a vast palmetto swamp, about half a mile off the main road. A lunch wagon, known as the roach coach, pulled by a pickup truck, made its rounds to the test stands, camera trackers, and other stations. The loudspeakers would announce its arrival when it stopped at Mercury Control three times each day. The menu was pretty limited -- but it did offer milk.) For the first time I realized that behind Kraft's calm exterior he had the same sensations I felt -- of squirrels running around in my stomach -- as we approached launch.The launch countdown progressed without any major incident. As liftoff approached, I leaned back and peered at the video image on Kraft's console coming from a camera focused on the Redstone standing on the launch pad. Precisely at zero on the clock, there was a great cloud of smoke. Kraft looked startled, and then he leaned forward intently. The TV cameraman momentarily lost track as he panned the camera upward, and, for a few seconds, there was nothing on the screen but a smoky sky. From my position, it looked much like the rockets I had launched from aircraft. I was surprised at how quickly the Redstone had accelerated and moved out of sight.Then after a few seconds the camera panned down. Although smoke still obscured the launch pad, the vague outline of the Redstone was still there. Kraft's face was incredulous. He stammered for a few seconds, then called out, "Booster, what the hell happened?"Our booster engineer in the control room came from the Marshall Redstone team. After liftoff he was responsible for reporting booster status -- engine and guidance -- to Kraft's team. If something was wrong he was supposed to give us a heads-up so the trajectory people in Mercury Control could better assess what they were seeing on their radar plot boards. Now he reverted to his native German as he tried to figure out what happened and, more importantly, what the blockhouse team should do about it. All hell broke loose. The Redstone had lifted a few inches off the launch pad and then the engine shut down. By some miracle, the rocket had landed back on the launcher cradle.When the escape tower cut loose, unguided and spewing flame, it corkscrewed to an altitude of about 4,000 feet. As it plummeted back to Earth, loudspeakers around the facility blared out warnings to the astronauts, engineers, and VIPs in the viewing area to take cover. The escape tower ultimately landed some 1,200 feet from the launch pad.The launch team in the blockhouse was as stunned as Mercury Control. Booster continued talking in German to his counterparts in the blockhouse, oblivious to Kraft's repeated calls. Television cameras showed the events on the pad as the main and reserve landing parachutes popped out of their stowage compartment at the nose of the capsule, ejected upward and partially opened up. Initially, they hung limply, then they slowly inflated and caught the sea breeze. At the same time strips of tinfoil were ejected from the capsule and spilled over the sides of the booster and capsule. (The strips, or chaff, were used to help radar track the capsule as it was slowed down by the parachute and headed for splashdown, or water landing, in the Atlantic Ocean.) Every controller held his breath, afraid the parachute would topple the rocket and cause an explosion.The intercom that had been quiet was now busily filled with directions, observations, and opinions. Everything that happened, although it had taken only seconds, passed before me in slow motion. Then it finally clicked. We had launched the escape tower.The Redstone rocket, surrounded by smoke, was armed and fueled but still sitting on the launch pad. Kraft told everyone to calm down, but Booster was still on the hot line, interrogating the blockhouse in German. We all could see the anger glowing in Kraft's eyes as he walked over and yanked Booster's headset cord loose from the console, saying, "Speak to me, dammit!"Chaos continued for several minutes until Booster, in halting English, told us that the Redstone engines had fired and the rocket had lifted off the pad enough to drop the umbilical, the bundle of cables that connected launch control with the booster and that normally fell away right after liftoff. Then the engine inexplicably shut down. The Mercury capsule, sensing the booster's engine shutdown, acted as if it were in orbit and sent the command to jettison the escape tower. The capsule, not sensing any further acceleration, acted as if it were in the recovery phase and so deployed the parachutes. We now had a live rocket on the pad, a fully pressurized Redstone; and, since the umbilicals had disconnected, we had no control of it. The booster's destruct system was armed and there was no way to secure the system. No one had any idea what to do next.Kraft walked over to me, eyes blazing. Pointing at Booster he snapped, "The damn Germans still haven't learned who they work for. Everyone in this control room must work for me." We sat stunned, helpless in Mercury Control. We had no technical data on the spacecraft or the launch system beyond a simple manual, the equivalent of an owner's manual for a new car. All of us were still thinking in aircraft, not rocket, terms -- and we were definitely behind the power curve. We had no data to work with because we weren't smart enough to know what we really needed. We were dealing with a new control room, a new network, new procedures, and entirely new jobs, doing something that we had never done before, something almost alien to our nature.A tentative proposal came from the blockhouse to reconnect the umbilical. The chances of people getting killed doing this were discussed and we decided that it could not be done safely. The next, and equally desperate, suggestion was to get a cherry picker (a kind of crane or boom with a man-holding bucket on the end of it, like those used by telephone and utility line repair crews) and cut the nylon parachute risers. This would at least eliminate the threat of wind filling the parachute and toppling the Redstone, but this idea was also discarded because of the risk to personnel. All the while we were apprehensively watching a partially inflated parachute and praying that the sea breeze did not pick up, fill the parachute, and topple the whole damn rocket over.After impatiently listening to a pretty far-out proposal to depressurize the rocket by using a rifle to shoot holes in the fuel and oxidizer tanks, Kraft sputtered and growled, "Dammit, that's no way to do it! They sound like a bunch that just started spring training!" Even to a rookie like me, shooting a hole in the tanks did not seem to be a sound plan.Kraft listened intently as each of the crazy schemes came across the loops, everybody desperately searching for a way out. Then one of the test conductors came up with a plan that made sense. "The winds are forecast to remain calm, so if we wait until tomorrow morning, the batteries will deplete, the relays and valves will go to the normally open condition. As the oxidizer warms up, the tank vents will open, removing the flight pressure. With the booster depressurized and batteries depleted, it will then be safe to approach the rocket."Kraft nodded and growled at his controllers, "That is the first rule of flight control. If you don't know what to do, don't do anything!" We secured Mercury Control and the blockhouse gang got saddled with the unenviable job of nervously watching over the Redstone throughout the night. "Doing nothing" worked: by early the next morning, the batteries were depleted, the destruct system disarmed, and the pressure relieved. The capsule and the Redstone rocket had survived with only minor damages to the tail fins.This fiasco was the most embarrassing episode yet for the young engineers of the Mercury program. The history books call this mission, sardonically but accurately, "The Four-Inch Flight." While the badly shaken booster engineers frantically worked on finding out just what had happened, I promised myself that when I returned to Langley I would use the same technique that had worked for me flying airplanes or flight-testing at Holloman. I would get to know as many technicians, designers, testers, and planners as possible and find out what data they had that would be useful to me. I would then compile a book that contained essential, carefully organized, and easily accessible information so in future emergencies we would have what we needed to know right at our fingertips. The engineers at Langley were tremendously cooperative and even gave me a drafting board where I could study blueprints. The learning curve of my first mission had been steep. But I had gained something precious. I now knew how much I didn't know.We went back to Langley and regrouped. The launch team debriefed, fixed the launch umbilical circuit problem that had caused the premature engine shutdown, and a month later we sent the rocket aloft. Project Mercury closed out 1960 with its first successful Redstone launch.In January of 1961, our second mission gave the chimpanzee Ham a hell of a ride. The Redstone failed to shut down when commanded and went to fuel depletion, landing almost 120 miles downrange from the recovery forces. We wrote our reports and classified the mission a success; after all, Ham survived and the rocket had not blown up.In these early months, we were plain lucky that America understood there was no achievement without risk, and there were no guarantees in this new business called spaceflight.To hurl a man into space and bring him back alive, we needed to wire the world. This meant stringing communications across three continents and oceans, building tracking stations, installing the most powerful computers we could lay our hands on, and learning the business of real-time spaceflight with our teams.We established the thirteen manned network stations, which provided optimal coverage only during the initial three orbits. Cable connections from the United States stretched to switching centers in London, Hawaii, and Australia. The Mercury voice and Teletype communications were controlled by Jim McDowell from the central switching center at Goddard. After logging thousands of hours at his end of the lines, McDowell had an instinctive feel for each of his communications links and was able to predict and anticipate problems to an uncanny degree, bringing alternate circuits on line moments before the prime circuits failed. It was common to lose communications because of construction workers severing cables, or cranes knocking down power lines, sunspot activity, or even fog.After only a few weeks of training, in March 1961 the controllers went to the most remote outposts, installations connected to Mercury Control by a communications system best described as brittle. Text messages were prepared by Teletype operators at machines that punched holes into a narrow paper tape. When the message was completed, the tape was fed into a machine and transmitted to the tracking stations. This took at least twenty times longer to transmit a data packet than a present-day $100 fax machine would take to transmit the same amount of information. The constant chattering of the Teletype machines provided the audible backdrop for virtually all of the work at a site.The CapCom was the remote site team boss and handled all air-to-ground communications. His systems monitor assessed the capsule status with a bank of twenty-one meters and a couple of eight-pen recorders, like those used on lie detector, or polygraph, machines. The team flight surgeon had even fewer displays, thirteen meters, a scope to monitor the astronaut's electrocardiogram, and an eight-pen recorder. Each three-man remote site team, with their brief contacts of eight minutes or less with the capsule during each orbit, provided the global coverage for early spaceflight. They were our eyes and ears as the spacecraft passed overhead. Their charge was simple: stay out of trouble, keep the mission on track, and provide any needed assistance to the crew. Easier said than done.The Mercury remote site CapComs were all fresh college graduates; this was their first job. They were paired with systems monitors, also young, who worked for Philco, a high-technology (in those days) electronics company. The systems monitors had no more than two years' experience working at the early global satellite tracking stations. Only the very young seemed to have the guts to volunteer for these assignments, living on their own in distant and remote places.The tracking stations were often fairly primitive corrugated steel buildings like the hootches I lived in while in Korea, housing the electronic equipment and consoles. The sites were easily identified by their myriad of antennas. Primary site communications were provided by sixty-word-per-minute Teletype and a radio voice link from relay stations at London, Honolulu, and Sydney. The system was a daily crapshoot, susceptible to a variety of problems. When communications failed, the remote site teams were on their own, improvising and taking any action necessary during the period the capsule was in view to restore contact.The key sites were located at the points for the major Go NoGo decisions, and the locations of the deorbit maneuver. These included Bermuda; Australia; Hawaii; Guaymas, Mexico; and the California coast. These sites were usually designated as critical, and the team was augmented with an astronaut CapCom. The more remote facilities were the Canary Islands, Nigeria, Zanzibar, Canton Island, and ships sailing the Atlantic, Pacific, and Indian oceans. World War II cargo vessels had been converted into floating sites to track satellites. They were the length of a football field, manned by a makeshift crew recruited from the hiring halls at the local ports. Since the ships carried no cargo, a foot of concrete was poured on the top deck to make them ride lower, and the superstructure was filled with antennas and electronics.Chris Kraft developed the concept of Mercury Control and taught the first generation of controllers. Like everyone else, he was drinking from a fire hose and needed every bit of help he could get. I was the operations and procedures officer. The job description consisted of keeping anything from falling through the cracks before or during the mission. I wrote the countdowns, prepared all message traffic, made sure the communications were working, briefed the tracking stations on the mission, and gave Kraft any assistance he needed. In effect, I was the flight director's wingman.I became the scribe of Mercury Control, originating and approving every outgoing Teletype message and most voice communications. Within weeks after I had come on the job in 1960, my relationship with Kraft was solid enough for me to take on responsibility to clear virtually all of the messages without having to bother him. On the first Mercury deployment this got me into big trouble with the U.S. State Department and President Kennedy's Peace Corps. I sent out a message to one of our controllers requesting information on the health conditions at one of our sites in Nigeria. The controller replied that "a hospital of doubtful cleanliness is nearby" and noted that the local people were "extremely poor, local government performance rather feeble. There are no nightclubs or bars. Temperatures are as high as 115 with frequent dust storms." The bad news? "When the rainy season begins it will get worse."The Nigerian government intercepted the message and threatened to remove the Peace Corps unless the U.S. government apologized. The flap filtered down through the NASA chain of command until it got to me. The message from Kraft was clear: "You screwed up. Next time you're gone." The U.S. apology kept the lid on the issue. The teams stayed on site and I got my first lesson in international diplomacy.On the last day of March 1961, five months after my arrival, the tracking network was declared operational. We had twenty-one sites, thirteen of which were manned. The total cost of the network, built in one year, was $60 million.