JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY

Explorer I

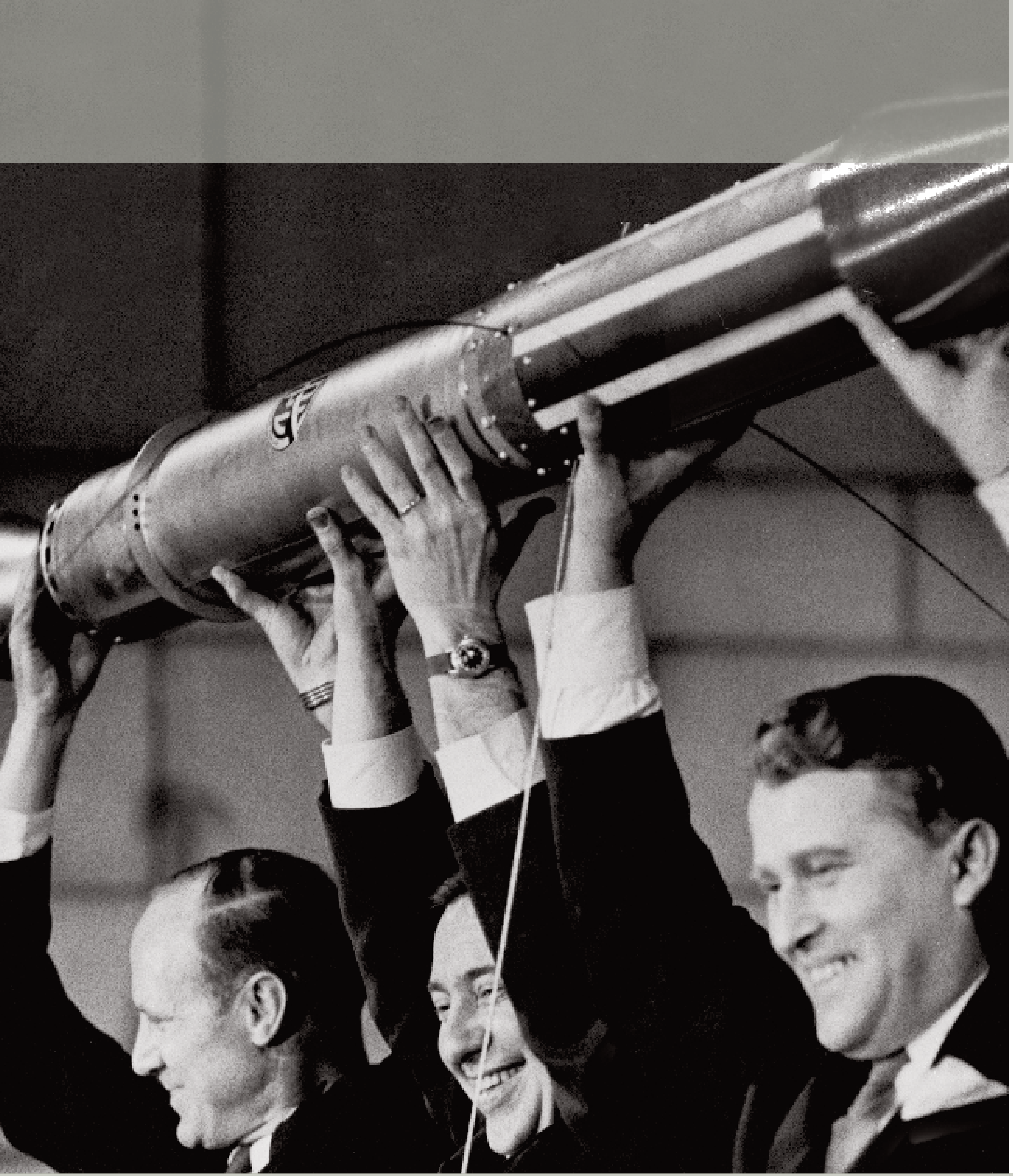
THE WORLD OF

Explorer 1

In 1957 and 1958, when Explorer 1 is imagined, built and launched, the United States is a nation of 48 states — Alaska and Hawaii were not to join the others until 1959. The Frisbee is introduced. Humphrey Bogart dies. President Dwight Eisenhower is inaugurated for a second four-year term. Dr. Seuss's *The Cat in the Hat* and Jack Kerouac's *On the Road* are published. John Lennon and Paul McCartney meet as teenagers three years before forming the Beatles. Ford introduces the Edsel car. The movie *Jailhouse Rock* starring Elvis Presley opens nationally. Fourteen-year-old Bobby Fischer wins the U.S. Chess Championship. Network television is on an Old West binge, with *Gunsmoke, Tales of Wells Fargo, Have Gun Will Travel, The Life and Legend of Wyatt Earp* and *The Restless Gun* among the Top 10 shows. Rebels under Fidel Castro attack Cuba's capital of Havana and the USS Nautilus becomes the first submarine to cross Earth's north pole underwater.

LAB EVOLUTION The progression of JPL from missiles to scientific spacecraft spanned (upper right, from left) 1936 rocket engine tests in the Arroyo Seco, 1950s flights of the Corporal missile and 1958's stunning launch of Explorer 1.

contents



Away

With a brilliant flash and billowing smoke one night over the windswept sands of Florida's Atlantic coast, America's aspirations in space were dramatically rescued. In the Cold War environment after World War II, the country had been humiliated when the Soviet Union put not one but two Sputnik satellites in orbit in the fall of 1957. The wound deepened when the United States' contender, a rocket called Vanguard, exploded on the launch pad a few weeks later.

So the nation was ecstatic when the California Institute of Technology's Jet Propulsion Laboratory joined with an Army unit that later became the Marshall Space Flight Center to launch Explorer 1 the night of January 31, 1958. As it looped around the planet, the bullet-shaped satellite not only salvaged national honor, but also yielded up the first major science finding of the infant space era: the discovery of the Van Allen radiation belts enwrapping Earth.

Once the satellite was in orbit, reporters gathered in the middle of a rainy night in Washington, D.C., for a news conference that gave the world an iconic image by which the launch will always be remembered. In the picture, a trio of men hoists a full-scale mockup of the satellite triumphantly over their heads. It showed William Pickering, JPL's director responsible for the satellite itself; James Van Allen, the scientist who designed the main instrument and for whom the radiation belts in time were named; and Wernher von Braun, a German whose team built the main-stage rocket that sent Explorer 1 aloft.

EXULTATION William Pickering of JPL, scientist James Van Allen and rocket engineer Wernher von Braun (from left) triumphantly hold aloft a model of Explorer 1 at the news conference announcing the successful launch.

Legend tells how JPL and the Army hustled into space, designing, building and launching Explorer 1 in less than 90 days after being granted permission to proceed. But the full story was neither that fast, nor that simple. How that trio and their teams came together is a story that stretched over many years — across wars, hot and cold, fierce rivalries between the branches of the American military and an only gradually developing public interest in space. One starting point for this story was the battle-ravaged landscape of Europe as World War II drew to a close.

Paper-clips

On May 2, 1945, two days after Adolf Hitler committed suicide in Berlin, a 26-year-old German on a bicycle rode up to an American infantry private in a village in the Bavarian Alps. In broken English, he called out, "My name is Magnus von Braun. My brother invented the V-2. We want to surrender."

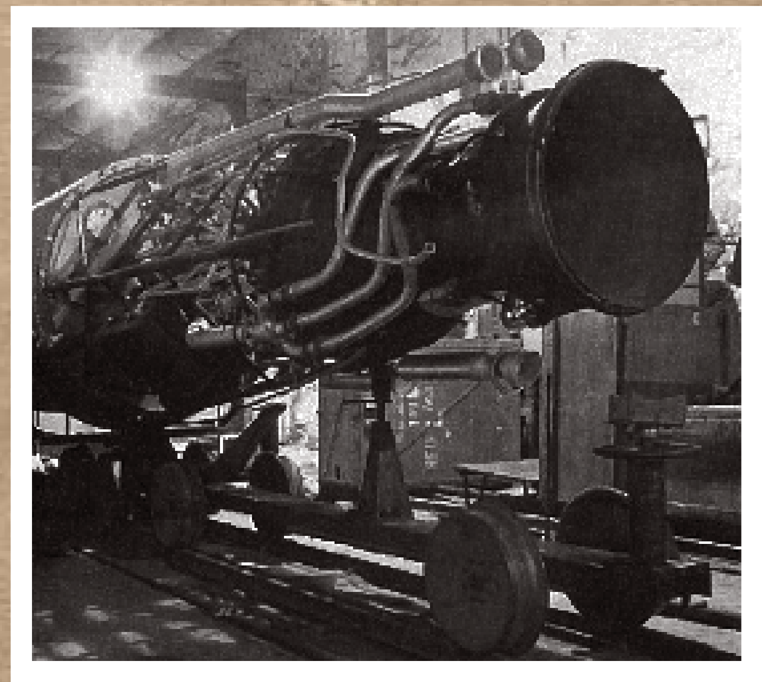
It was a lucky day for the U.S. Army. Von Braun's older brother Wernher, then only 33 years old, was the wünder-kind of German rocket science — and, as his brother noted, inventor of the missiles that the Nazis launched toward England in the final months of World War II. His transition to America not only made possible the rocket that launched Explorer 1, but also the vehicles that sent the Apollo astronauts to the moon.

Rocketry, in fact, seemed to be in Wernher von Braun's DNA. The son of parents from the Prussian nobility, von Braun received a telescope as a gift from his mother when he was confirmed into the Lutheran church as a youth. As a boy he read Jules Verne and H.G. Wells. But it was a key book by a German — Hermann Oberth's *The Rocket into Interplanetary Space* — that von Braun came across at age 16, inspiring him to dedicate his studies and career to space exploration. At university in Berlin, he was privileged to work with Oberth on tests of liquid-fuel rocket engines.

SURRENDER Wernher von Braun (here with a cast on his arm following an accident) went out of his way to turn his team over to the Americans at the end of World War II.

In 1933, while von Braun was working on his doctorate, Hitler's Nazi Party won power. Von Braun's thesis, in fact, was classified by the army, and soon he was pulled into Hitler's plans for military conquest. In 1937, at age 25, von Braun joined the Nazi Party. Three years later, he became an officer in the much-feared SS. The Nazis dedicated substantial funds to von Braun's rocketry work. When the military was scouting a location to establish a laboratory for rocket testing, von Braun's mother suggested the village of Peenemünde on the Baltic Sea in northern Germany, which she had remembered from her father's duck-hunting expeditions.

Developing rockets took time. In December 1942, Hitler approved production of a rocket designed by von Braun called the Aggregate 4, or A-4. The führer was so pleased with a movie von Braun showed in July 1943 of an A-4 taking off that he made the young researcher a professor. By the end of summer 1944 the rocket was ready to deploy — newly renamed Vengeance Weapon 2, or V-2.



After von Braun was arrested by the Gestapo, Hitler decided to free him — at least as long as he proved "indispensable" to the Nazi missile program.

COSMIC DREAMS Reared on Jules Verne and H.G. Wells, von Braun imagined rockets taking humans to the stars — but did not object to developing them for military uses.

WAR MACHINE More than 3,000 V-2 missiles were launched by the Nazis against Allied targets. The strikes killed 5,000, but at least another 10,000 died in the grim, dangerous factories in which the V-2s were built.

Towering by rocket standards of the day, the V-2 stood 14 meters (46 feet) tall and was 1.65 meters (5.4 feet) in diameter, and burned a mixture of alcohol and liquid oxygen. Onboard gyroscopes kept the rockets oriented as they flew. Lofted from mobile launchers, they had a range of about 320 kilometers (200 miles). The first were fired at the newly liberated Paris, while others were directed at Belgium and England. Von Braun is said to have remarked after hearing of the first V-2 reaching London, "The rocket worked perfectly, except for landing on the wrong planet."

Even so, not all of the rockets worked so well. It was estimated that overall only 60 percent of the V-2s launched successfully. The production process to create the missiles, which drew on slave labor, was notoriously deadly. At least 10,000 laborers died building the V-2s. The missiles killed approximately 5,000 in England and Belgium.

The rocketeer also faced other problems during the war. In 1944 he was denounced by a dentist who reported him for making remarks that sounded defeatist about the war effort, and von Braun spent two weeks in a Gestapo prison. He was only released when military leaders convinced Hitler that he was crucial; the Nazi dictator responded, "I will guarantee you that he will be exempt from persecution as long as he is indispensable for you, in spite of the difficult general consequences this will have."

It was clear to von Braun and his colleagues by the spring of 1945 that the war would soon be over — so they turned their attention to deciding to whom to surrender. Fearful of Russian cruelty to war prisoners, most of his team opted to join von Braun in trying for the Americans. The SS had other plans. With the Soviet army only 160 kilometers (100 miles) from Peenemünde, the SS moved the rocket team once to central Germany, and then to the Bavarian Alps. The SS guards had orders to kill the engineers and technicians if they were in danger of falling into enemy hands.

But with Hitler's death, von Braun's gambit to link up with the Americans paid off. The United States, too, knew that it had one of the great spoils of the war — von Braun had been at the top of a list of German scientists and engineers sought for immediate interrogation. By September 1945, the first of von Braun's group was in the United States. The effort was known in the American military as Operation Paperclip, a code name derived from paperclips used to mark the files of Germans picked to be transported to the United States.

Before long, von Braun and a group of 120 colleagues were settled at Texas' Fort Bliss, near El Paso on the Mexican border. They brought with them from Europe blueprints and hardware for about 100 V-2 rockets, which they began launching at White Sands in nearby New Mexico.

Although the United States' first interest in the rockets was for their military use — now that the Cold War was in full swing, and missiles seemed likely vehicles for atomic bombs — von Braun as ever had his eyes to the stars. Not long after settling in Texas, he booked himself as guest speaker at the local Rotary Club, where he enthusiastically described in great detail an array of rockets, satellites, orbiting space stations, flights to the moon and even expeditions to Mars. He received a standing ovation.

ON NEW SOIL Arriving at Ft. Bliss, Texas, in 1945, the 120 members of the German rocket team that came to America posed for a group photo. Later the group relocated to Huntsville, Alabama.

The Lab

While Nazi Germany was lofting V-2 missiles, on the other side of the Atlantic the staff of the just-created Jet Propulsion Laboratory was busy with rocket work of their own. They did not get as early a start as the Germans, but made significant advances in rocket technology during the wartime years.

Modern rocketry had in fact begun with the New Englander Robert Goddard, who wrote just after World War I of rockets that could reach the moon, and who conducted his own experiments with liquid-fuel rockets in the 1920s. His ideas were ridiculed in a New York Times editorial, and it soured Goddard on sharing his ideas with the public at large. He relocated to New Mexico, where he worked in virtual seclusion.

One day in 1936, a pair of hobbyists approached Theodore von Kármán, a professor at the California Institute of Technology, requesting his help in building rockets. The professor steered them toward one of his graduate students, Frank Malina. Malina and the hobbyists — Jack Parsons and Ed Forman — hit it off, assembling a group to carry out a test of a small rocket engine on Halloween 1936 in the Arroyo Seco, a dry canyon wash outside Pasadena, California.

Those tests eventually turned into an ongoing program, with Parsons, Malina and their colleagues working to refine fuel mixtures and motor designs. They made overtures to Goddard in New Mexico to compare notes or even work together, but were rebuffed.

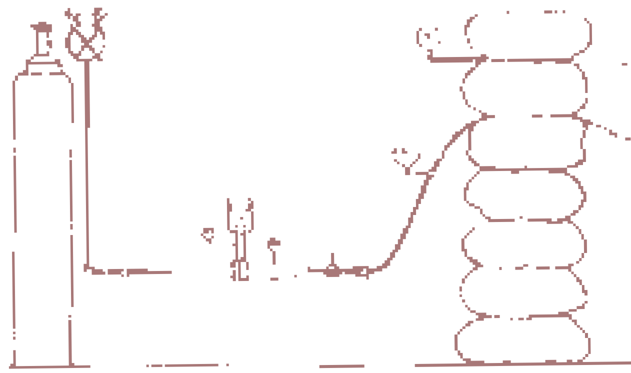
In 1938, the Caltech rocketry group was recruited by the U.S. Army Air Corps to work on technologies that the military would find useful as war loomed. Picking from an Army wish-list, the Caltechers chose to work on strap-on rockets that could help heavy bombers take off from short runways on islands in places like the South Pacific. A representative of another university ridiculed it as a "Buck Rogers job."

GUIDING THE LAB Military missiles were a necessary evil for JPL director Frank Malina, who later went to work for the United Nations and ultimately turned to a career as a studio artist.

But the strap-on rockets worked. After the United States entered World War II, the Caltech group sent a proposal to the Army to develop missiles in response to the rumored V-2. For the first time, they referred to themselves as the "Jet Propulsion Laboratory."

The JPL crew envisaged designing a series of progressively larger and more capable rockets, naming them for Army ranks — Private, Corporal, Sergeant. The finale would be one called Colonel — for, as von Kármán joked to an Army general, that is "the highest rank that works."

Just a few months after the effort got underway, in December 1944 JPL launched the first in the series, the Private A. An unguided rocket about 2.3 meters (8 feet) long that burned solid fuel and had a range of some 18 kilometers (11 miles),



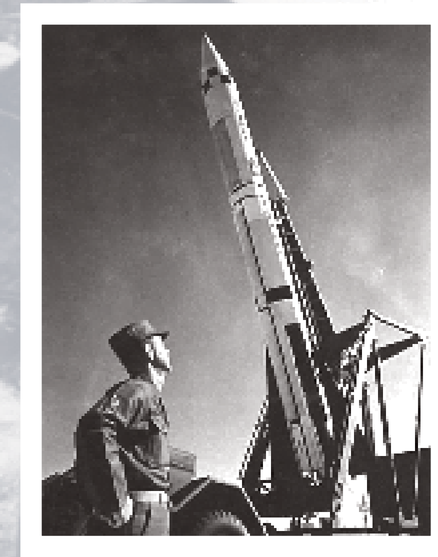
the Private was very simple. But positioned atop a booster adapted from the strap-on jets that JPL designed for airplanes, it was America's first multistage rocket. By 1945, the team managed to fly a Private A to an altitude of 60 kilometers (37 miles).

The next rank up from the Private was the Corporal, and this was to be a much larger, liquid-fuel rocket. As an intermediary step Malina, who had become JPL's director, called for a smaller test version, which the JPL team called the "WAC Corporal." There are two explanations for the name "WAC." For the record, it referred to the lack of a guidance system, or "Without Attitude Control." But the original inspiration most likely was from the Women's Army Corps, since the rocket was considered the "little sister" of the Corporal missile the JPL team intended to build eventually. Though the concept was sold as a military rocket, this 5-meter (16-foot) model was designed to also be a sounding rocket, lofting scientific instruments to high altitudes. The WAC Corporal crowned Frank Malina's career leading JPL.

After their initial tests in the California desert, JPL's engineers realized that they needed a more extensive, better equipped range where they could test the rockets they were developing. Soon they found themselves traveling across the Southwest to the White Sands Proving Ground in southern New Mexico.

JPL's first tests in New Mexico took place in October 1945, just as the German team was in transit to nearby El Paso. The first WAC Corporal leaped skyward from its launch tower, reaching an altitude of 70 kilometers (43.5 miles) — the first liquid-fueled rocket financed by the U.S. government. JPL launched a dozen of the rockets, then redesigned them to make them lighter. Eventually the WAC Corporal inspired other rockets, such as one called the Aerobee designed by a company called Aerojet spun off from JPL by its founders. Ironically, JPL would find itself competing against the Aerobee a decade later in the contest to pick the rocket to launch America's first satellite.

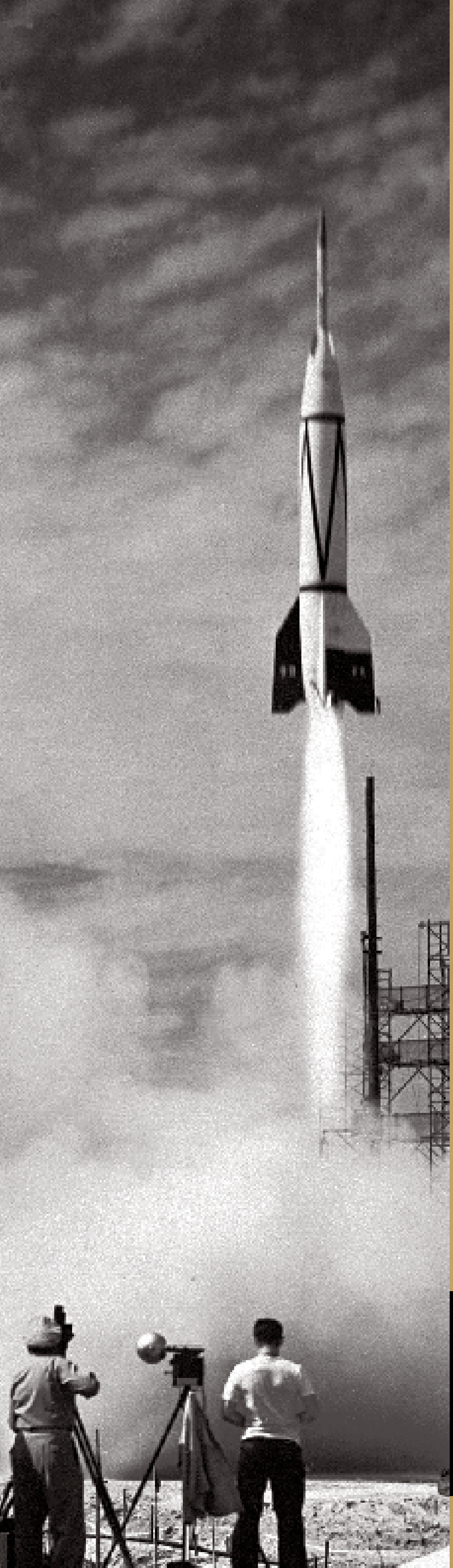
Eventually JPL turned its attention to the full-sized rocket intended as the larger sibling to the WAC Corporal. Known as the Corporal E, this liquid-fueled rocket was designed to climb 100 kilometers (62.5 miles). The first one was launched at White Sands in May 1947, exceeding expectations. But the next two failed, making the first appear to be a lucky fluke. The later missiles rose up, tilted and zigzagged along the ground before blowing up. They attracted the humorous nickname "Rabbit Killer." Engineers spent a year and a half redesigning the Corporal's engine, finally testing an improved model in June 1949 that launched with success.

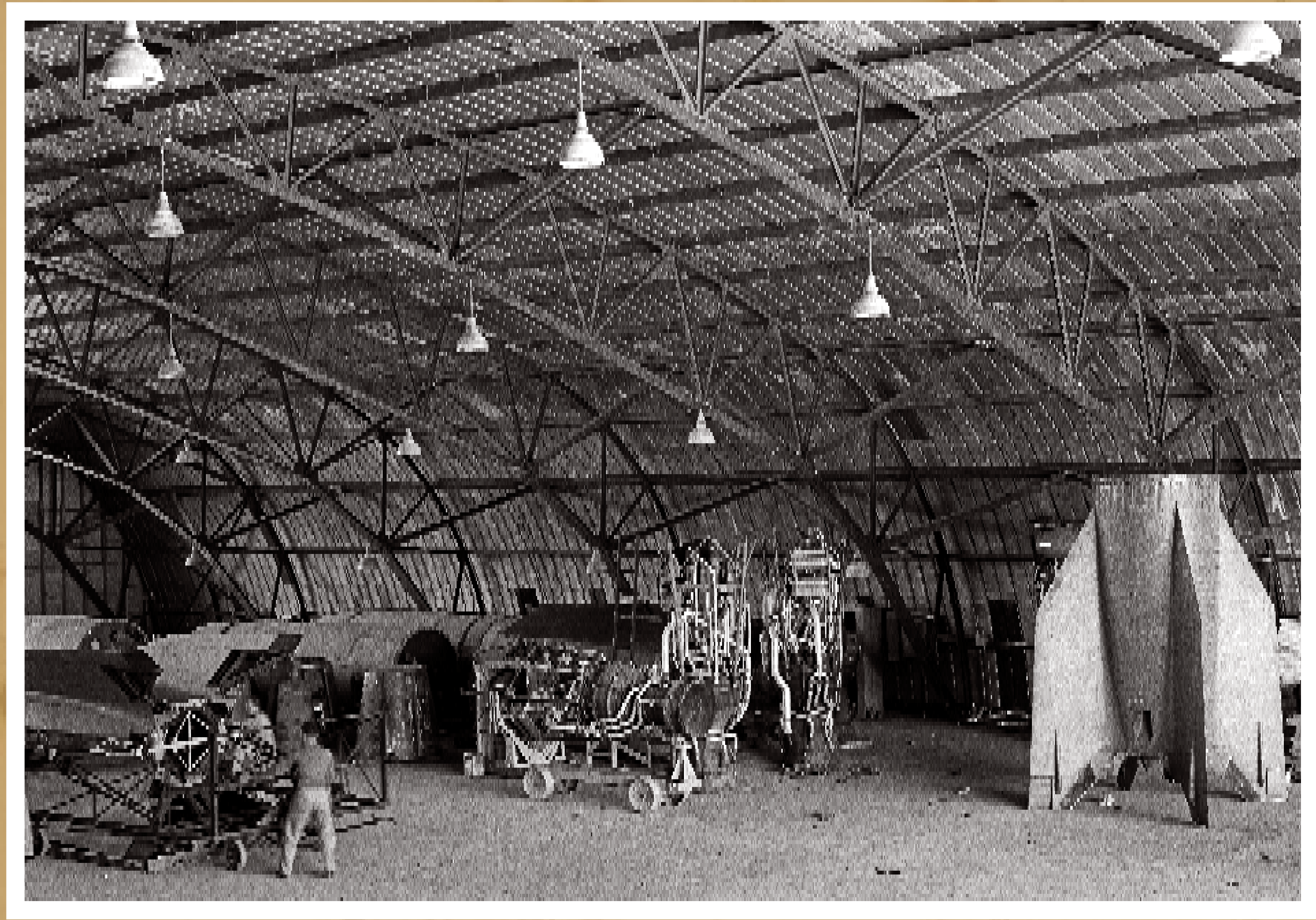


"NATIVITY SCENE" JPL's roots go back to tests of rudimentary rocket engines in the Arroyo Seco near Pasadena, California, in the fall of 1936 — resulting in the lab's iconic scene of young researchers taking a break (top left).

LAST OF THE LINE The Sergeant (top right) was the last and largest missile developed by JPL.

LAUNCHER Missiles developed by JPL included the large Corporal (above), overshadowing a model of the much smaller Private underneath it.





SPACE-BOUND The "Bumper WAC" — a JPL WAC Corporal missile atop a German V-2 — became the first human-made object to enter space in 1949.

NEW MEXICO In a hangar at White Sands, parts of JPL's Corporal missiles are dwarfed by the tail segment of a German V-2.

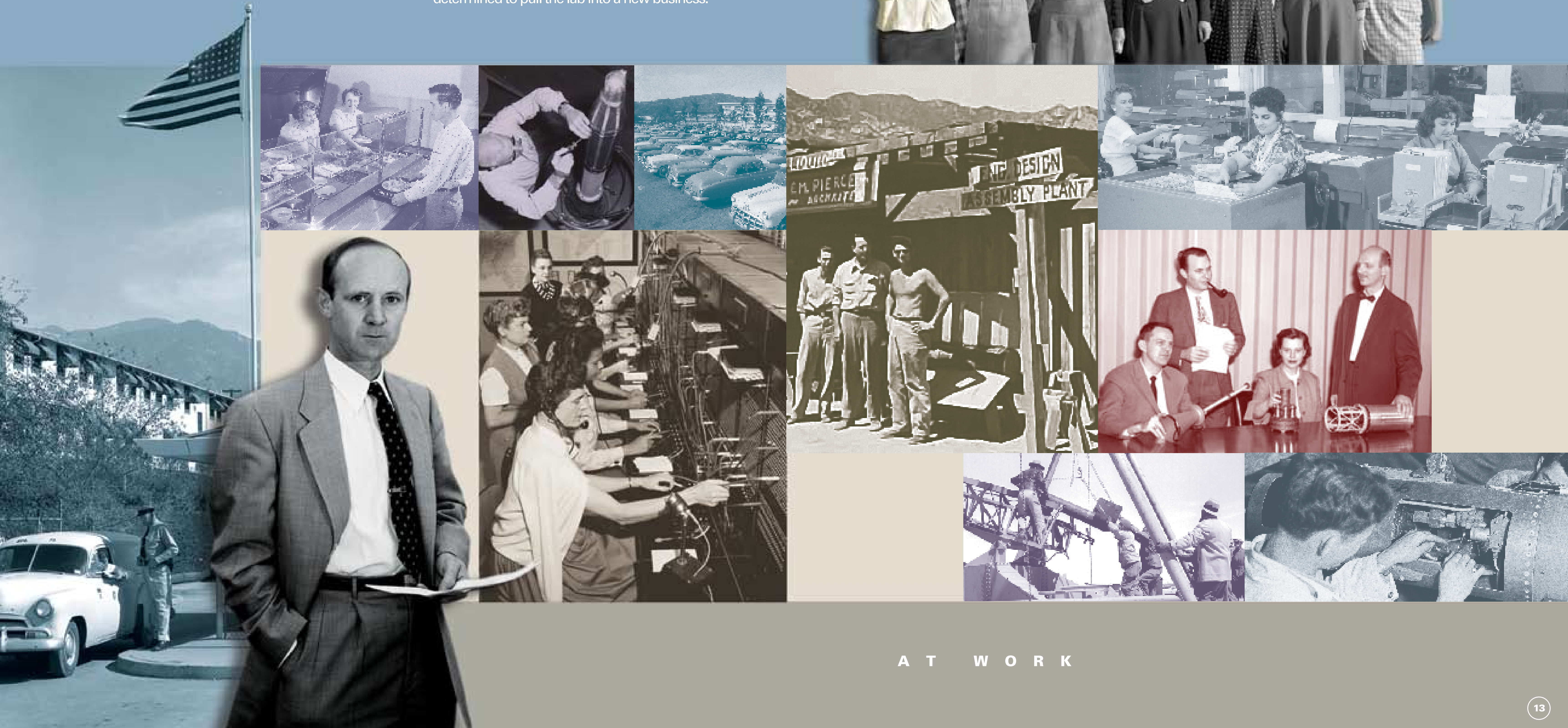
It was inevitable that, at White Sands, the JPL team and Wernher von Braun's Germans would rub shoulders. In fact, some of them already knew each other; JPL researchers such as the Chinese-born Qian Xue-sen had taken part in interrogation of the German team soon after their surrender.

And it was inevitable that the respective teams would look at JPL's rockets and the Germans' V-2s and imagine putting them together. That became reality on February 24, 1949, when a WAC Corporal was placed atop a V-2 as the German rocket's upper stage. The JPL rocket, which bore the nickname "Bumper WAC," became the first human-made object to enter space when it climbed to an altitude of 393 kilometers (244 miles).

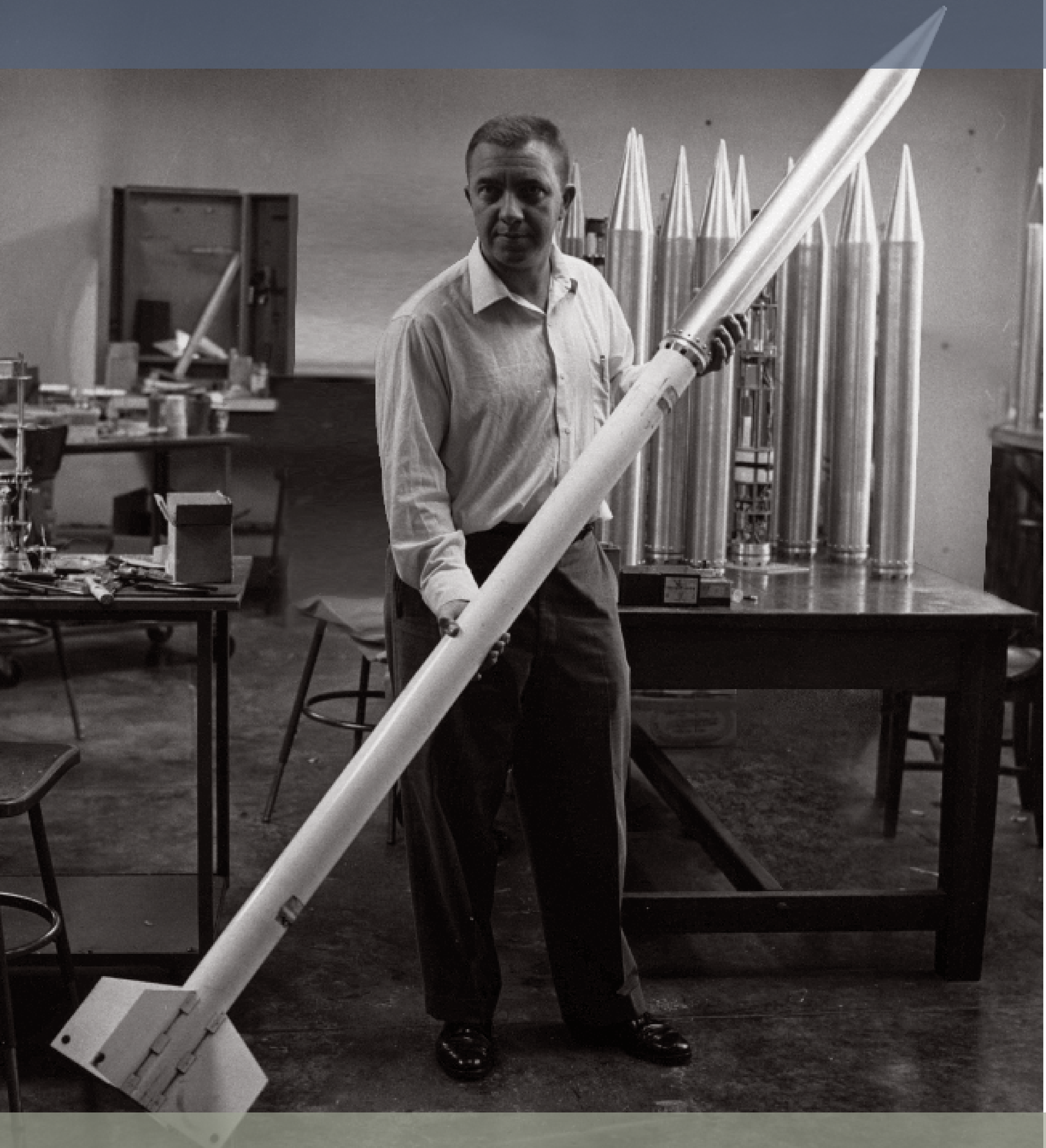
Eight months later, in October 1949, the Army decided to move von Braun's group to the Redstone Arsenal in northern Alabama. As JPL and the Germans continued testing the Bumper WACs, they started launching some of them at a newly established test range on a desolate spit of sand on Florida's Atlantic Coast known as Cape Canaveral. The first-ever rocket launch there, the eighth Bumper WAC, took place July 24, 1950.

Just a month before that launch, war broke out between North and South Korea, soon dragging American soldiers to the battlefield and intensifying the Cold War. Von Braun's team at the Redstone Arsenal received approval to expand their V-2 into a larger missile with a range of about 800 kilometers (500 miles). Three years later, the first launch of the missile — now known as the Redstone — took place at Cape Canaveral. It had to be destroyed less than two minutes into flight due to an engine failure, but in time the Redstone would become a reliable launch vehicle. Combined with the upper stages created by JPL, all of the major pieces required to propel a satellite into orbit now existed. It only remained for the United States to resolve to make it happen.

As it moved from creating missiles to scientific spacecraft, JPL also matured as an institution. Over the 1950s, the lab's workforce grew from about 600 employees to 2,500, and new buildings were added at a similar pace. Though JPL experimented with analog computers, all of the truly critical calculating responsibilities fell to a team of young women (top right) recruited out of high school to do all the math by hand required to plot satellite trajectories and the like. While JPLers still traveled to the desert environs of New Mexico to test missiles like the Sergeant, director William Pickering (below left) was determined to pull the lab into a new business.



AT WORK



COSMIC Rays

Some time after rockets began firing into orbit on a regular basis, Time magazine ventured the thought that the space race may have begun one evening in 1950 in the living room of a small brick home in the Washington, D.C. suburb of Silver Spring, Maryland.

A 35-year-old physicist from Iowa named James Van Allen was hosting a visitor from England who had expressed interest in meeting other scientists in the Washington area — prompting Van Allen to invite eight or 10 colleagues over for what he called "a pedigreed bull session." They talked that evening about how a number of countries had organized an International Polar Year in 1882, sending a dozen expeditions to the Arctic and three to the Antarctic. The time seemed ripe, the gathering of scientists agreed, for yet another polar year. But this time, they had larger ambitions. They proposed calling the event the International Geophysical Year — in honor of a wider net that scientists hoped to cast in understanding the entire planet. And given the active efforts to develop rockets and missiles in both the United States and the Soviet Union, it would be a good idea, the scientists decided, to cap the year by sending satellites into orbit with instruments to conduct science.

SOUNDING ROCKETS Iowa scientist James Van Allen used small rockets to loft scientific instruments into the upper atmosphere, but dreamed of sending them even farther into space. (Courtesy University of Iowa.)

The collected personalities in Van Allen's home had enough sway in the science world and with the government that the concept soon began to become a reality. It was fortunate for the scientists that their desires dovetailed with President Dwight Eisenhower's interest in establishing the right to fly over other nations for national defense purposes. The International Geophysical Year was scheduled to take place a few years later — in fact running for 18 months, from July 1957 to December 1958. The dates were picked because the 11-year cycle of sunspots would be at its maximum.

Taking science into space was a natural idea for Van Allen. Ever since his youth, the Iowa native had been finding ways to carry scientific detectors ever higher on balloons and small rockets. The son of a three-generation family of lawyers, Van Allen preferred Popular Mechanics and Popular Science and his Erector set. One of his college professors had been chief scientist for Admiral Richard Byrd's second expedition to Antarctica in 1933–35, which whetted his appetite for studying Earth's environment.

And then there were cosmic rays. After radioactivity was discovered around the turn of the century, a German scientist named Hans Geiger invented a tube — the Geiger counter — that could detect radiation. Scientists suspected that some of it came from outer space; Robert Millikan, a Nobel laureate and Caltech's president, dubbed it "cosmic rays." In the end, Millikan's instincts were not quite correct; rather than rays, the energy proved to arrive in the form of particles.

All of this fascinated the young Van Allen, who set about launching Geiger counters and other instruments on whatever means of ascending from the ground he could find. At first this meant balloons. After Wernher von Braun's rocket team was installed in Texas, the Army invited scientists to come to White Sands to put payloads on V-2s as they were lofted during engineering tests. Van Allen wasted no time in taking advantage of the offer. He also lofted his instruments on small sounding rockets from Navy and Coast Guard ships in various remote parts of the world.

During his time working with V-2s at White Sands, Van Allen had gotten to know a project manager from JPL who was working on rockets there — William Pickering. Born in New Zealand, Pickering grew up fascinated with the technology of radio, and came to America to earn bachelor's and doctoral degrees in electrical engineering at Caltech. His specialty became telemetry — how ground controllers use radio to track and control guided rockets. Joining the Caltech faculty, Pickering eventually moved to the staff of JPL. Pickering was put in charge of the Corporal missile — a sign of the increasing importance that electronics and radio would play as engineers worked to refine their control of guided missiles.

Van Allen, meanwhile, was offered a job as head of the physics department at the University of Iowa, and moved back from Maryland to his home state a year after the gathering of scientists in his living room.

Through Pickering at JPL, Van Allen got access to small, cheap rockets such as the Loki, a solid-fuel anti-aircraft rocket that JPL had designed for the Army. By putting together a balloon and small rocket — a combination that became known as a "rockoon" — Van Allen found he could lift an eight-pound instrument payload to an altitude of about 120 kilometers (75 miles) for only $750, a great bargain. Taking several aboard an American icebreaker bound for Greenland, Van Allen was bemused when the first two balloon-assisted rockets didn't fire. Hitting on the idea that the extreme cold at the altitude reached by the balloons could have stopped the clock mechanism controlling the rocket, Van Allen packed heated cans of orange juice wrapped in blankets around the third rocket when he prepared it for launch — it worked like a charm.

But as successful as the rockoons proved to be, there were other realms beckoning. The real gold mine for studying cosmic rays would be to put a Geiger counter into orbit.

The problem with launching a satellites was not a lack of ideas, but rather that too many competing teams wanted to lead the way into space. In the years following World War II, the Army, Navy and newly independent Air Force squabbled over which service branch was to be in charge of long-range missiles and, by extension, vehicles that could put payloads into orbit.

In 1954, von Braun's Army group got together with colleagues at the Navy to talk about a joint effort to put a satellite into orbit. Dubbed Project Orbiter, the plan called for one of the basic V-2–derived Redstone rockets as the first stage, topped with clusters of Lokis — one of the sounding rockets that Van Allen had used to probe the upper atmosphere. The team projected they could put a payload in orbit in September 1956 at the earliest. Von Braun sent a copy of the plan to JPL, suggesting that the laboratory get in on the collaboration. Pickering suggested replacing the Loki rockets with scaled-down versions of JPL's Sergeant missile, and adding a state-of-the-art radio transmitter that JPL had been developing.

For his part, scientist Van Allen later recalled himself as an outspoken advocate of the plan. "I made rather a pest of myself around Washington" about the rocket, he said.

But there was competition from other units of the military. The Naval Research Laboratory proposed a project called Vanguard that used as its second stage, ironically, a rocket called the Aerobee that JPL's commercial spinoff Aerojet had developed as a sounding rocket. The Air Force floated a third proposal that would make use of its Atlas rocket.

JPL's Project Orbiter was killed, and the Army was forbidden to try launching satellites. The Soviets, meanwhile, moved quietly forward.

It fell to the Defense Department's R&D chief to pick between the competing plans. He, in turn, set up a committee — with two members each picked by the Army, Navy and Air Force, and two members he appointed himself.

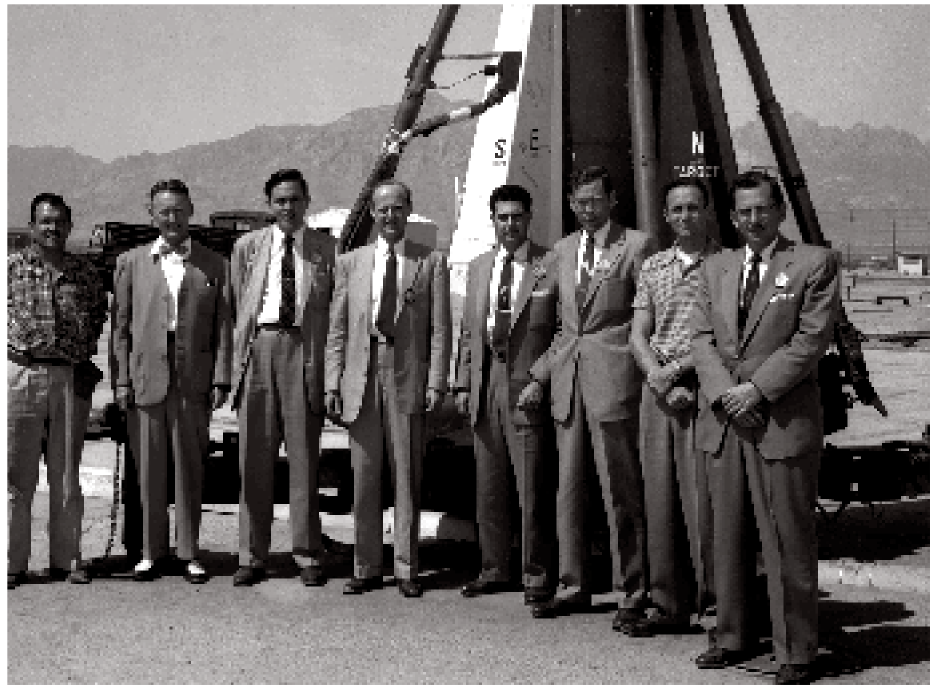
One of the Army's picks was a Caltech professor named Homer Stewart who also headed a division at JPL. He ended up as the committee's chairman. The Air Force proposal seemed the most farfetched, since the Atlas rocket did not actually exist at that point — and the Air Force wouldn't guarantee it could do the launch by the end of the International Geophysical Year. By contrast, the Army's Redstone was a proven missile, so Project Orbiter seemed the most mature of the three competing concepts.

But there were politics involved. Eisenhower was widely known to be troubled by what he perceived as the expanding power of the military-industrial complex (a phrase, in fact, that he coined a few years later when he warned of the same trend in his farewell speech as outgoing U.S. president). Although all three proposals to orbit a satellite were sponsored by branches of the military, it would be important to the president for the undertaking to have as civilian and scientific a flavor as possible. From this point of view, Vanguard — which would use rockets designed from the outset as carriers of scientific payloads — had an edge over Redstone, which was being actively developed as a military missile.

In August 1955, Homer Stewart's committee voted. He and one other member voted for Project Orbiter, but five other members went in together in support of Vanguard. Overruled by his own committee, Stewart reportedly said to von Braun, "We have pulled a great boner!" The vote even surprised the head of the Vanguard project at the time. "I thought they'd win too," he recalled. "They had a rocket, and we didn't."

Twelve days later, the Army demanded a second hearing on Project Orbiter. Its backers said that issues with the proposal could be easily fixed, and they criticized the Vanguard plan. It fell on deaf ears: By September 1955, all of the branches of the military were formally notified of the selection of Vanguard as the United States' satellite project. Project Orbiter was killed, and the Army was forbidden to try launching satellites.

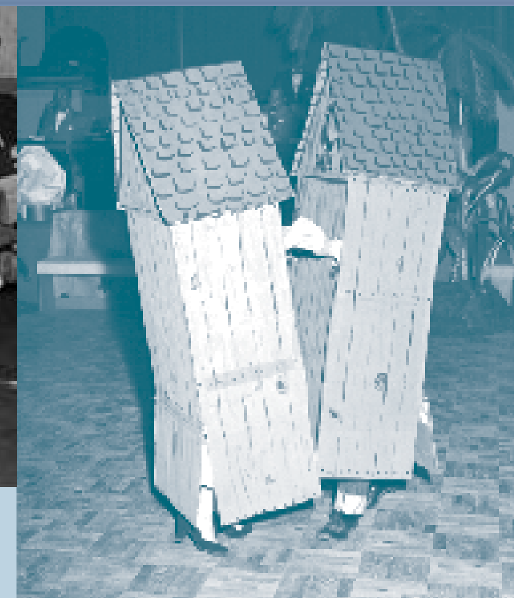
The Soviets, meanwhile, moved quietly forward with plans of their own. At an astronautics symposium in Copenhagen that year, the Russian space program's chief scientist was asked whether the first astronaut would be a Russian or an American. "Neither one," he replied coolly. "The first astronaut will be a dog. A Russian dog, of course."

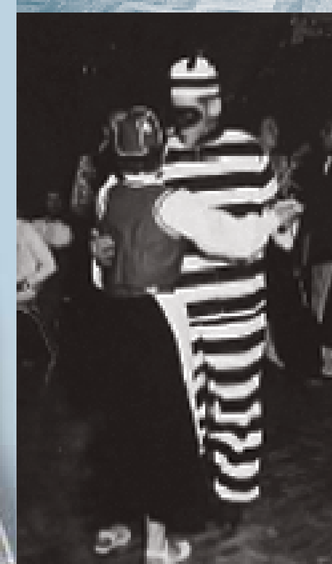


LAUNCH DAY William Pickering (fourth from left) and senior engineer Clifford Cummings (third from left) of JPL host a group at a Corporal missile firing.

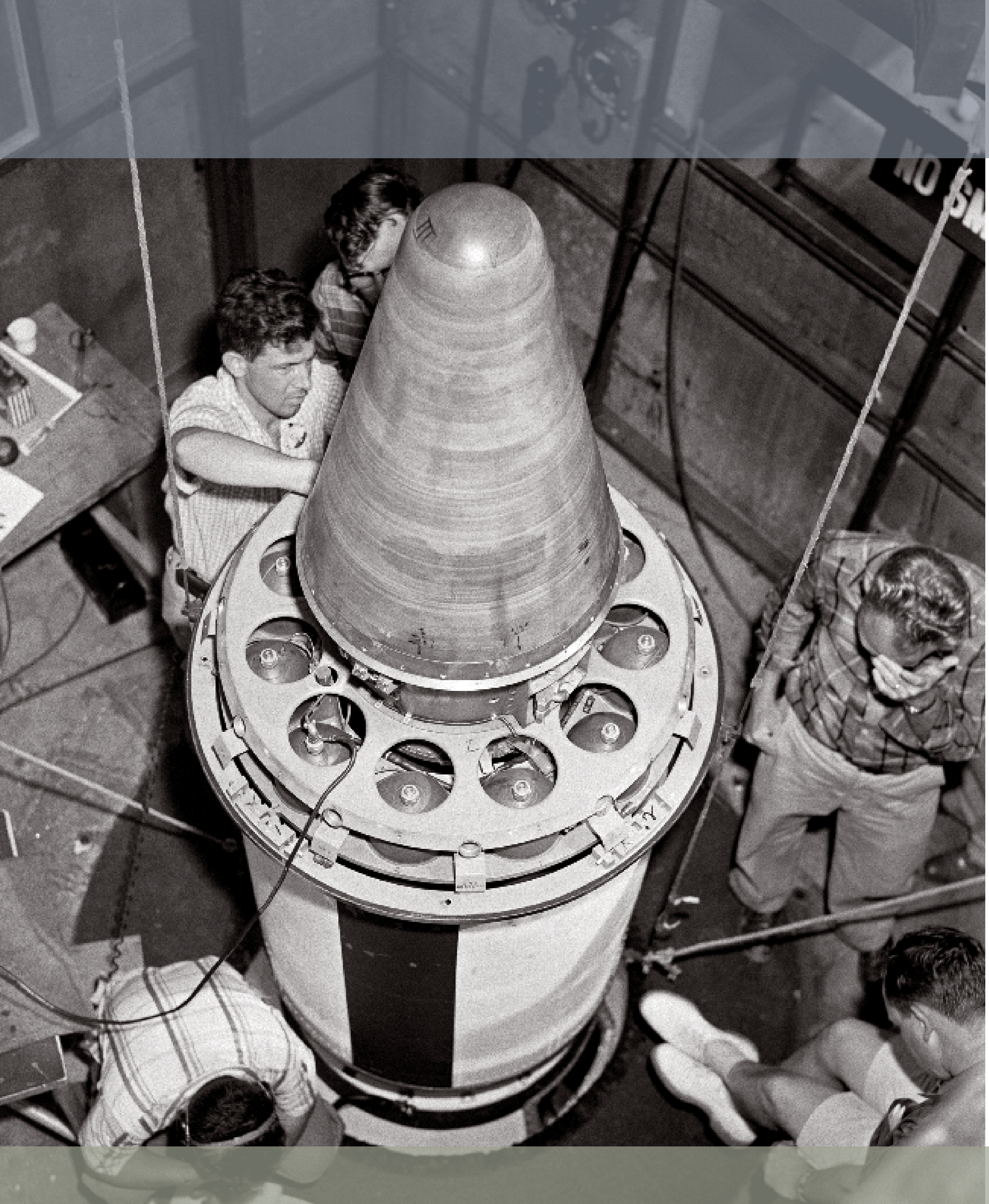
Then as now, in the 1950s JPLers worked hard — and played hard. Against the atmosphere of a smaller, more closely knit laboratory, employees enjoyed a year-round schedule of social outings to take the edge off the rigors of work.

The biggest bashes were lab-wide dances — one each in spring, fall and at Christmas. Musical tastes of the era ran to jazz orchestras. Sometimes there were costume parties. In addition to the holiday dance, in December the lab put on a Christmas party for employees' children. In summer employees enjoyed a lab-wide picnic. Many work units threw their own parties — some sections invited their people to the coast for beach parties, while the male staff of the Plumbers, Heavy Duty Mechanics and Refrigeration Group opted for a "stag social."





AT PLAY



Plan B

The fall of 1955 didn't bring entirely bad news to the Army–JPL team. Just days after their satellite proposal was killed off, they were given a new assignment with a more military bent. As they started, however, it was obvious that many of the team still had their eyes on outer space.

Instead of using the rocket stack that the Army and JPL had proposed for Project Orbiter to launch a satellite, they were assigned to use it to test heat shields for intercontinental missile warheads. As the warheads reentered Earth's atmosphere they would heat up enormously, which could either destroy or cause a major deviation in the flight path. One possible solution to the problem was to create a nose cone made of glass fibers that would simply burn away as the missiles came down toward Earth. Von Braun's team was assigned the job of finding out whether such nose cones would actually work.

By now the base in Huntsville was being reorganized, with all of the rocket group going into a new organization called the Army Ballistic Missile Agency. Their new boss was a 53-year-old major general from Ohio named John Medaris. Like von Braun, he saw himself as a futurist, and his ambitions for the rocket for military purposes would merge with von Braun's enthusiasm to keep ideas of reaching outer space very much in the public eye.

REENTRY SHIELD Spurned in their bid to launch a scientific satellite, the JPL–Army team turned their attention to testing a heat shield for reentering missile warheads.

Besides contributing the rocket's upper stages, JPL was called upon to provide the radio system to track the missiles. An engineer at the lab named Eberhardt Rechtin came up with a system JPL called "Microlock" that was able to transmit an effective signal using extremely low power.

The new system had its first test on September 20, 1956, when one of the rockets lifted off from Cape Canaveral. The team decided that since they had done much of the design work for Project Orbiter, they would first test out an upper-stage rocket nearly identical to the one designed to carry a satellite — except that its fourth-stage motor carried sand instead of fuel. The rocket shattered previous altitude records, reaching a height of 1,098 kilometers (682 miles) above Earth — far above the atmosphere — and logging a total of 5,391 kilometers (3,350 miles) in flight.

"I recall someone suggesting that we deliberately have a failure," JPL engineer Al Hibbs recalled much later. "That is, the object we were firing into space would fail to reenter and just stay up there. It was a nice idea!"

The success may have threatened the other branches of the military. Two months later, the secretary of defense issued a "roles and missions" memo that stripped the Army of all missiles with a range of more than 320 kilometers (200 miles).

Undeterred, in April 1957 Medaris and von Braun rolled out a follow-up proposal to Project Orbiter that would launch a half-dozen instrumented satellites on a new four-stage rocket based on Redstone called Jupiter C. The first, they projected, could be launched within five months. The proposal was rejected.

While the Army and JPL continued heat-shield tests, in the summer of 1957 another hint came from Moscow of what lay ahead. The leadership of the Soviet space program announced that preparations were underway to launch a satellite, and that they would do so within a few months.

The Army group in Huntsville had launched three of a planned dozen of the new Jupiter C. The rest were put in storage. With rumors of problems surrounding the Navy's Vanguard effort, Medaris wanted to be ready to leap in with a backup in the event Vanguard went astray. He ordered two Jupiter C rockets stored so that they could quickly be readied for launch if the opportunity presented itself. He also stored a supply of JPL's upper-stage rockets under a supposed "long-term life test" to see how long they would last on the shelf.

JPL's Pickering, meanwhile, had his own vision for a future in space. Designing sophisticated electronics such as satellite payloads — or even space probes to other worlds — was clearly more promising than the laboratory's bread-and-butter business of rocket engines. In fact, shortly after he was named JPL's director three years before, Pickering and the president of Caltech agreed that the Sergeant missile then under development would be JPL's last venture on that end of the launch vehicle.

As a sign of his determination to put JPL on a new course, Pickering floated a proposal for JPL to fly a satellite on one of the Navy's Vanguard rockets. Writing in a summer 1957 issue of a Caltech magazine, the JPL director described how the lab could "completely instrument one of the vehicles" with a cosmic ray experiment developed by a Caltech professor and another instrument from a Palomar Observatory astronomer. The proposal never went any further.

And then — a colossal shock. After alerting in mid-September that a launch was imminent, the Soviet Union launched Sputnik 1 on October 4, 1957. Pickering, who was in Washington to attend International Geophysical Year meetings, heard the news from a reporter at a party at the Soviet embassy. Pickering took part in a toast, then slipped away to see what he could learn about Sputnik.

"We were very disappointed," Pickering recalled later, "because we knew darn well that the Vanguard was in trouble, and we knew darn well that we could launch a satellite anytime we were told to." In Huntsville, Medaris and von Braun were entertaining the newly designated secretary of defense. Von Braun pleaded for approval to proceed.

The defense chief was noncommittal as he left, but Medaris saw an opportunity. "I stuck my neck out," he later recalled — secretly instructing von Braun to take Jupiter C rockets out of storage while the details of approval to launch were worked out.

A week after Sputnik, Eisenhower held a news conference in which he said that the Soviet success "does not raise my apprehension, not one iota." Though Vanguard hadn't scheduled its first full-up satellite launch until the following spring — planning only rocket tests in between — the president announced that a launch would be made before the end of the year.

On November 3, the Soviets launched yet another Sputnik — this one a much larger vehicle that, as predicted years before, contained a living passenger — the dog Laika. The same week, Eisenhower went on national television to show the nose cone retrieved from the Army–JPL launch that summer. The display did little to comfort the public.

The day after Eisenhower's television appearance, the Army–JPL team was authorized to prepare a satellite launch. This led to a delicate battle of words. The authorization was to "prepare" a launch,

TAKING A GAMBLE Army General John Medaris ordered a supply of V-2–derived Redstone rockets and JPL upper stages stored as a supposed test of their shelf life — but also wanted them ready to go into space.

"I stuck my neck out," said Medaris — who secretly instructed von Braun to take Jupiter C rockets out of storage while the details of approval to launch were worked out.

not actually to proceed; if Vanguard succeeded, the Army–JPL project would be shelved. Medaris sent off a wire to the Army's R&D chief threatening that he, von Braun and Pickering would resign unless they were given approval to proceed with launch, regardless of the outcome of Vanguard. That blessing was promptly given.

With the way cleared, Pickering went to Huntsville the following day for a meeting with Medaris and von Braun to clarify assignments in getting their rocket and a satellite into space.

Going into this meeting, von Braun's assumption was that JPL would contribute the upper stages and perhaps the radio system, whereas his own team in Huntsville would be responsible for the rocket and, presumably, the satellite itself. In fact, when the team had previously proposed Project Orbiter, an engineer in Huntsville named Josef Boehm had worked out a bullet-shaped satellite that could fit on one of JPL's upper stages. Von Braun's team had also contacted James Van Allen, the scientist preparing a cosmic ray experiment for the Navy's Vanguard, about adapting his package for an Army vehicle.

Pickering asked for a few minutes in private with Medaris after he arrived. The JPL director and the Army general then joined the combined planning meeting, where Medaris announced that JPL would be responsible for the satellite. Von Braun swallowed hard, but did not protest.

Pickering and other JPL managers in fact had already laid the groundwork for JPL to pursue developing the satellite. Weeks before the meeting with Medaris and von Braun, JPL had sent a group to Iowa to give an overview for Van Allen's team of students of the radio system that the lab had developed. The JPL group went on to describe a satellite they hoped to develop, and how Van Allen's cosmic ray experiment could be adapted to it. At the time, JPL had no mandate to design a satellite.

Meanwhile, the Navy's Vanguard team was preparing to launch. Originally they had intended the December 1957 event as merely a rocket test, but keen public interest and pressure on the White House ratcheted up expectations — and the 22-meter (72-foot) rocket was in fact outfitted with a functioning satellite in the form of a cantaloupe-sized metal sphere.

After postponements due to high winds, the launch at Cape Canaveral went forward on December 6. Moments before 11:45 a.m., the rocket ignited, rose a few feet for two seconds, then settled back onto the launch pad, fell over and burst into flames. The satellite was thrown clear and continued beeping away over its radio transmitter; it had to be opened up to be turned off.

Vanguard's director, John Hagen, was in Washington, receiving play-by-play reports on the countdown from his deputy over the phone. As the disappointing news was announced, he said quietly, "Oh." Then, turning to colleagues, he added, "It blew up." Then he muttered."Nuts."

Hagen tried to put the best face on things in a news conference. All missile programs experience early failures, he argued; it was the keen public scrutiny that had ratcheted up expectations for the December launch. His eye was set on what he regarded as the truly important test of Vanguard in a launch planned the following March.

But the American public was appalled. The stock market plunged — most notably the stock of the company that had built Vanguard's Viking first stage.

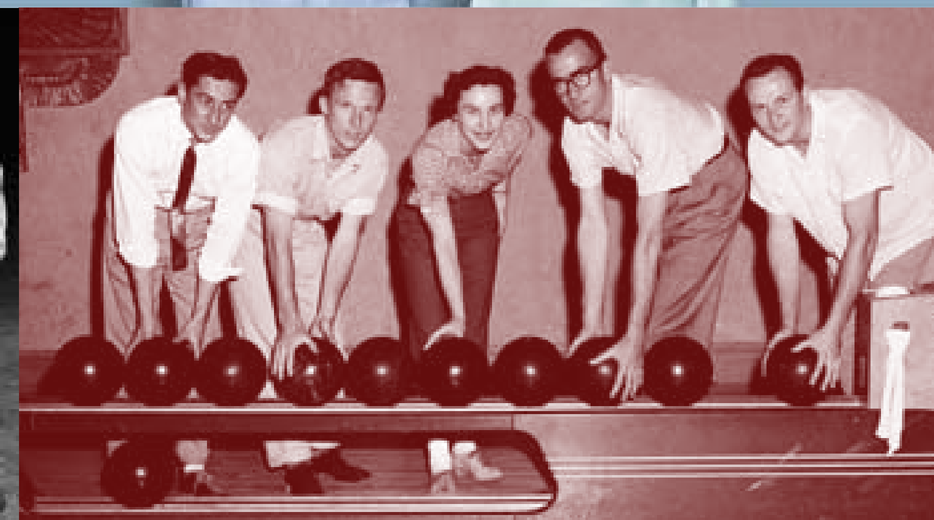
One JPL engineer, Henry Richter, was blunt when a Los Angeles wire service reporter called him for his reaction to Vanguard. "The launch failure," Richter told the journalist, was a "black day for the United States." He added that the misfiring was not unexpected in scientific circles, "because something wrong commonly happens when complete tests have not been run on a project of this sort."

The JPL–Army team, already deeply engaged in their own satellite program, continued pushing forward. Given the Vanguard experience, Medaris wanted to keep preparations wrapped in as much secrecy as possible. The rocket they were readying was known only by the name "Missile 29."

LAUNCH DEBACLE The fiery launch-pad failure of Vanguard in December 1957 severely shook the American public, already on edge from the Soviets' successful launch of Sputnik 1 and 2 that fall. The spherical Vanguard satellite (inset) was thrown clear and continued beeping away.

Like many other Americans of the 1950s, JPLers found camaraderie in the form of clubs. During the years that the lab put its first satellites into space, employees could choose from a diverse array of recreational groups spanning interests from fishing and hunting to motor sports, photography, archery, scuba diving and amateur radio. And then there were the sports teams — softball, basketball, golf and badminton, as well as others. Among the most popular was a slate of very active bowling teams (where losers after a night at the lanes might be obliged to don a "Crying Shirt").

Over the years, many clubs fell victim to changing lifestyles, as employees got busier at work and endured longer commutes. Today, softball remains very active at the lab, with more than 20 teams participating in local spring, summer and fall leagues. Other clubs devoted to such interests as golf, hiking, astronomy, guns and stamps also remain.



TO THE Pad

The weekend of November 15, 1957, a black and white sedan passed through Denver over the Rocky Mountains, taking a young graduate student, his six-months-pregnant wife and two preschool daughters on a long driving journey from Iowa to California. With the trunk and back seat crammed to the brim with wires and transistors and parts and papers, the two girls each had only a small "cockpit" carved out to sit in. They were heading west with the electronic brains for America's first satellite.

Or more precisely, the satellite's key science instrument. The 30-year-old student was George Ludwig, who was studying under James Van Allen at the University of Iowa. Van Allen himself was still on his way home from a trip to the Antarctic.

The Army–JPL team had promised the government they could build and launch a satellite in less than 90 days. In order to do that, JPL took over the job of building the final flight version of Van Allen's science instrument, based on mockups that Ludwig was bringing west. He and his family moved to Pasadena for several months while he shepherded the creation of instruments for the first launch and a follow-on.

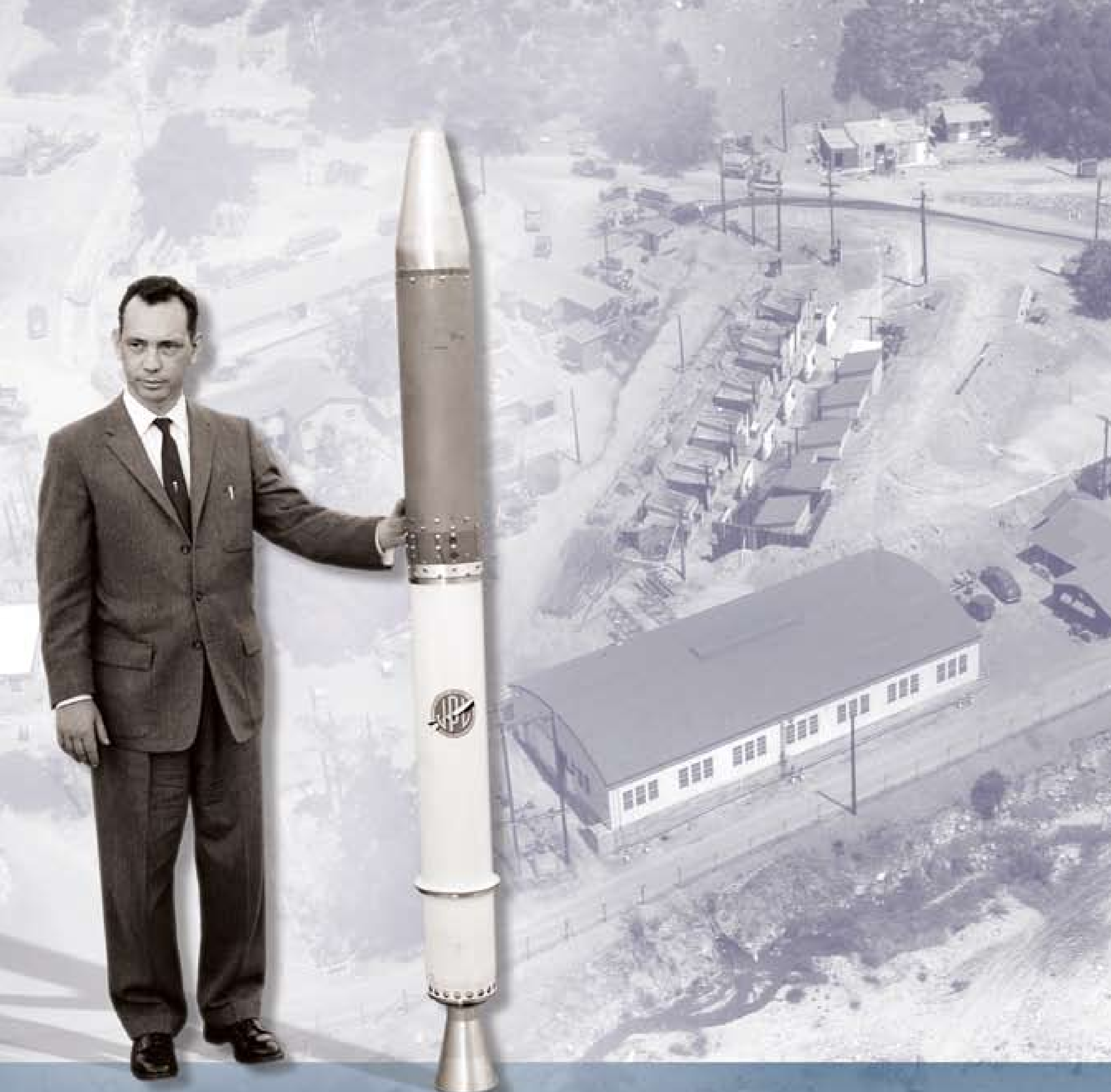
JPL of that era, Ludwig recalled, was "a closely packed maze of wooden, one-storied, barracks-like structures, plus a few permanent laboratory buildings, all arrayed along the hillside beside the Arroyo Seco." He was given a desk and a phone, and told to report to Henry Richter, one of JPL's electronics gurus.

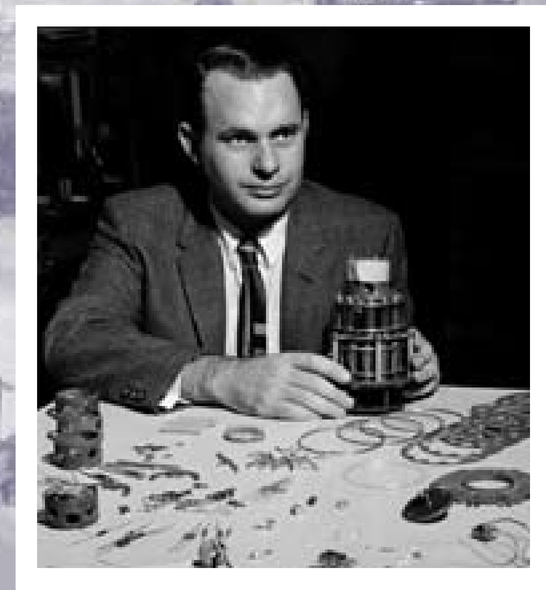
SATELLITE PREP Explorer 1 is test-mated before launch by engineers (from left) John Small, Gene Hendricks and Dee Trimble.

While the Huntsville team called their campaign Missile 29, at JPL the undertaking became known as Project Deal. Various stories floated around later about where the name came from, although they were all linked to playing cards. One version held that Jack Froehlich, the engineer who Pickering appointed as the satellite's project manager at JPL, was a formidable poker player. It was said that he remarked after Sputnik, "When a big pot is won, the winner sits around and cracks bad jokes, and the loser cries, 'Deal!'"

JPL and Huntsville were in the game, but now it was a race against the clock. Von Braun's team had to fit the rocket with an attitude-control system that would reorient it during its coasting period, so that when the upper stages fired they would send the satellite into a proper orbit. "Actually, we didn't have much to do," von Braun later wrote. "Our Jupiter C's were practically ready to go. The big job … was out in Pasadena at the JPL."

At JPL, various teams pursued the complex pieces required to bring the project together. One group worked on expanding the network of ground stations needed to track the satellite. Others tackled refinements to the rocket's upper stages, including work to add a single fourth-stage rocket, which, like the other upper stages, was a cut-down version of JPL's Sergeant missile.





PROJECT LEADER Jack Froehlich (left) served as JPL's project manager for Explorer 1 — known during the development process as Project Deal.

ANOTHER ERA In the late 1950s JPL was "a closely packed maze of wooden, one-storied, barracks-like structures, plus a few permanent laboratory buildings."

ELECTRONICS GURU Engineer Henry Richter (above right) supervised key electronics for Explorer 1 at JPL and served as the lab point of contact for George Ludwig (below right), who moved to JPL for several months to finalize the satellite's science instruments.

Perhaps the plum job was designing the satellite itself. The team rejected going with a sphere shape like the Vanguard satellite. The Jupiter C's upper stages sat on a rotating carousel that was spun up to 750 rpm — more than a dozen rotations per second — just before launch in order to stabilize the flight path. The bullet-shaped design was much like the concept sketched out by von Braun's engineer Boehm at Huntsville.

Aware of the shapes for the satellite concepts that had been proposed in the previous years, Van Allen had thoughtfully designed his science instrument so that it could fit into either Vanguard's spherical satellite or a bullet-shaped design from the Army–JPL team. At its heart, it featured a Geiger counter that would click away as it detected cosmic rays. The version that Van Allen really wanted to fly also included a tape recorder to store the instrument's data when it was out of range of ground stations. However, there wasn't time to adapt the more complex payload to the simple satellite that JPL proposed for the first foray into space. Instead, engineers worked out a clever way for the satellite to summarize the cosmic ray hits the instrument detected during each orbit.

Besides cosmic rays, there were two other science experiments on the satellite. One was designed to detect hits from micrometeorites. This was accomplished by two different kinds of measurements. The satellite contained a microphone, which would register the vibration of any impacts on the spacecraft's body from the smallest dust particles. In addition, a dozen grids of fine wires were mounted on a retainer ring that girded the lower part of the satellite's body. A hit by a larger micrometeorite (large is relative — even these were in the realm of 10 microns, or 1/2,500th of an inch, in diameter) might fracture one of the wires, causing a change in the circuits connected to the grids.

The final experiment was a set of temperature sensors that JPL placed inside and on the outer surface of the satellite. Temperatures were of keen interest to the satellite's designers, who had to keep the payload from getting too hot or too cold in order to continue to function. One way they did this was by painting a

Van Allen had thoughtfully created a science instrument that could fit on either Vanguard or a bullet-shaped Army–JPL design.

series of "zebra stripes" — actually stripes of white aluminum oxide paint — all along the satellite's stainless-steel body. As the satellite spun a dozen times a second, the width of the stripes had been calculated precisely to reflect just enough sunlight to maintain the desired temperature.

To communicate with the ground, the satellite used two different transmitters. One, which operated at higher power, was similar to a design that Van Allen had worked with when he prepared his payload for the Navy's Vanguard satellite. The other was JPL's innovative, extremely low-power Microlock transmitter. Two antennas were built into the satellite's body; another four took the form of wires with beaded weights on the ends that whipped out like an ice skater's arms as the satellite spun. Relying on internal batteries, the transmitters were expected to work for two to three months.

A week after getting official approval in November 1957 to proceed with the satellite, JPL's Pickering took the risky step of calling a news conference in Pasadena to show off the laboratory's new assignment. He posed for photos with a prototype of the payload for the as-yet unnamed satellite. The launch was vaguely described as being in "early 1958."

After the Vanguard failure in December, however, Medaris put the Army–JPL project strictly under wraps. Movements of the project's key personnel were worked out according to elaborate decoy plans. Work at the launch site at Cape Canaveral — visible from public beaches — was hidden with scaffolding and canvas tarps. "I cannot overemphasize the importance of these decoy plans and the absolute necessity of covering this launching as a normal test of a Redstone missile," Medaris wrote in a memo, "and I desire it well understood that the individual who violates these instructions will be handled severely."

On December 20, 1957, the large first-stage booster for the Jupiter C rocket — shipped in two pieces — arrived at Cape Canaveral from Huntsville. Wrapped in secrecy, it was moved to a hangar in the Cape's industrial area.

By January 11, 1958 — just two months after the formal assignment to proceed — the Explorer 1 satellite was assembled and tested. Not counting the fourth-stage rocket motor, the spacecraft weighed 8.4 kilograms (18.5 pounds).

Four days later, the Jupiter C's first stage was transported to the Cape's launch pad 26A. The next day it was hoisted to a vertical position; over the following week, engineers tested its power plant, tank pressurization, gyros and radio.

The rocket's upper stages from JPL arrived at the launch pad on January 24, and were hoisted atop the Jupiter C inside a shroud to keep the preparations from public eyes. On Monday, January 27, a dress rehearsal of the countdown went smoothly.

By the following day, it was clear that the weather outlook was poor for the planned launch date, January 29. The southern tip of the northern hemisphere's jet stream was forecast to reach down into Florida, producing high-altitude winds of 165 to 175 knots — which would be unacceptable. The morning of Wednesday, January 29, the Army scrubbed the launch attempt planned for that day before the countdown started.

Early on Thursday, January 30, the high-altitude winds were looking marginal, so the team began its countdown for the evening launch on schedule. About an hour before the planned 10:30 p.m. launch, controllers concluded that the winds were still too high, so they scrubbed for the night. If they couldn't get off the pad soon, however, the team would have to stand down and let the Navy's Vanguard have the range for another launch attempt.

That left the final day of the month — Friday, January 31. All signs were that the high-altitude winds had abated. The team pressed on for their late-night launch.

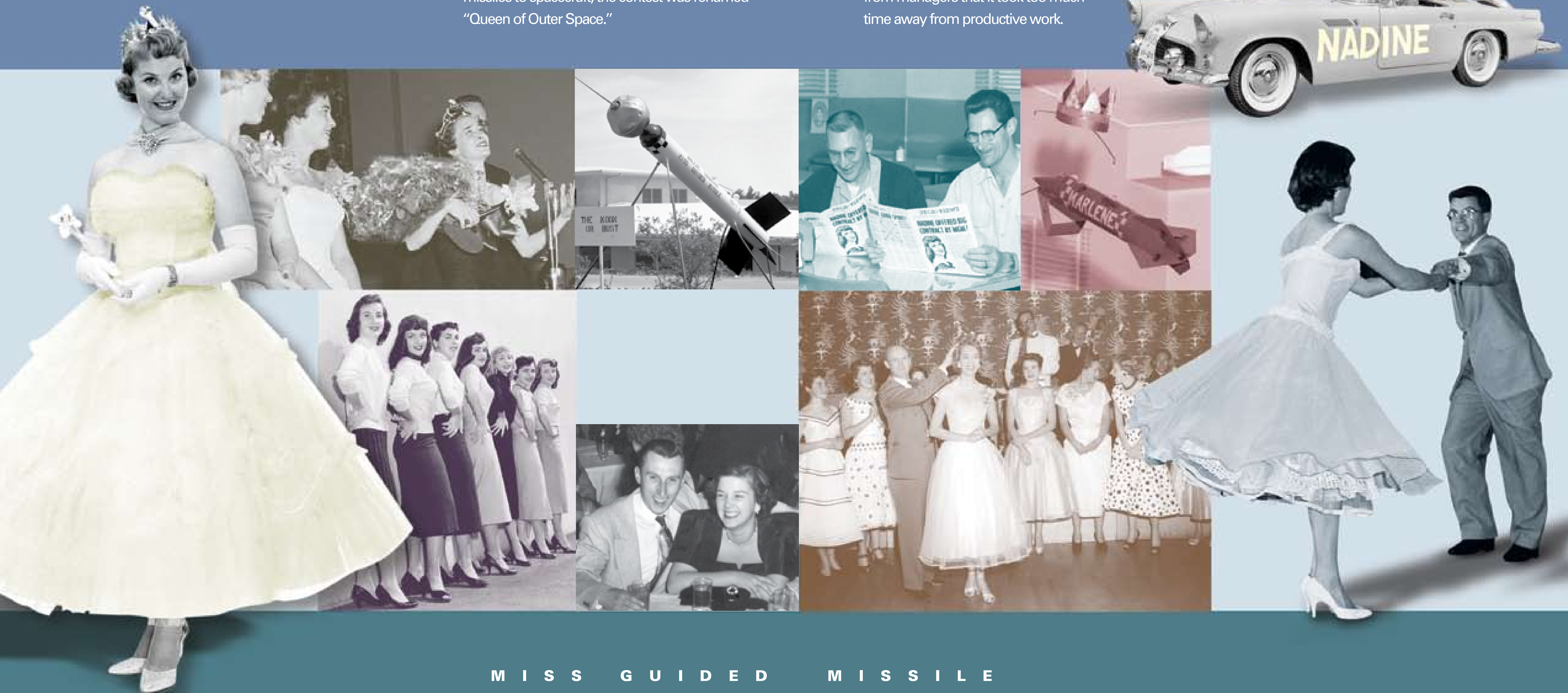
RESOLVE It was a sign of William Pickering's determination to move JPL's business out of missiles and into spacecraft that he pursued other proposals in addition to Explorer 1 (pictured).

A week after getting approval to proceed with the satellite, Pickering took the risky step of calling a news conference to show off the laboratory's new assignment.

No question about it — the world of the 1950s was a far cry from current-day America. JPL's engineering staff was overwhelmingly male; women primarily worked in clerical positions, though there was a sprinkling in a few other support jobs such as technical illustrators.

One way in which the different sensibility of the 1950s was most evident was in JPL's annual Miss Guided Missile contest. In 1952, the laboratory began a tradition of holding a spring dance that climaxed with the announcement of a queen. In 1959, as JPL transitioned from missiles to spacecraft, the contest was renamed "Queen of Outer Space."

The competition continued for another decade, with lavish campaigns including a parade around the lab in decorated convertibles and a luncheon. It was eventually discontinued around 1970, due both to changing times and complaints from managers that it took too much time away from productive work.



M I S S   G U I D E D   M I S S I L E

Launch Night

As preparations proceeded at the launch pad during January 1958, the veil of secrecy gradually faded from the project. Early in the launch week, newspaper reporters were briefed on the pending plans; the New York Times ran an advance story sketching a fairly detailed overview of the enterprise on January 29. It would be the first time journalists were allowed onto the Cape to cover a launch in person. The chamber of commerce in neighboring Cocoa, Florida, printed up 5,000 moon flight tickets as a publicity gag. Technically the launch was still supposedly classified — but not very classified.

Pickering, von Braun and Van Allen — unhappily, at least for the German rocketeer — had been ordered to stand by in the nation's capital. Army general Medaris and JPL's project manager Jack Froehlich were the senior people from the rocket and satellite team on site at Cape Canaveral. They were among 57 jammed into a blockhouse a hundred yards from the launch pad, which they could see through green-tinted, bulletproof glass.

LAUNCH SUCCESS After waiting out high winds for two days, Explorer 1 roared off the launch pad on the last night of January 1958.

At 8:30 p.m., technicians began fueling the Jupiter C rocket's massive first stage. The rocket's destruct system was armed, platforms surrounding the vehicle were removed and the gantry rolled backward on tracks. Medaris later colorfully remembered, "Floodlights were turned on, and the missile stood like a great finger pointing to Heaven — stark, white and alone on its launching pad." More than two dozen film and still camera units clustered outdoors at one vantage point — the most elaborate array of cameras, claimed the Los Angeles Times, that had ever been assembled for a single news event up to that point.

The countdown was halted when the team noticed what appeared to be a leak at the base of the rocket. One technician bravely ran over and looked up underneath the rocket's nozzle — the liquid was an old spill left over from loading the hydrogen peroxide used to drive the rocket engine's turbopumps.

This pushed them a few minutes past their 10:30 p.m. launch target. By 10:48, there was no further reason to delay. On a signal from Medaris, the head of the launch crew said, "Firing command." A member of his team pulled out a metal ring on a console and gave it a twist. An electric motor at the top of the first stage kicked into life, whirring the three upper stages around and around.

Thirteen seconds later, the massive engine on the Jupiter C's first stage roared into life. It built up thrust for three seconds, gradually climbing into the night sky. The team in the blockhouse listened with rapt attention to a whining signal transmitted from the satellite — until it abruptly stopped. "I've lost my signal!" Medaris yelled. The team phoned a larger hangar three miles away where most of the tracking and support team was based. Forty seconds later, Medaris was told that ground stations still had a signal.

Two minutes and 37 seconds after launch, the massive first stage burned out as the rocket sped southeast toward the Caribbean. Explosive bolts fired, and springs pushed the rocket's upper section away from the spent booster. Jets of compressed air nudged the remaining rocket from its flight angle, pointing 40 degrees skyward, into a horizontal path pointing toward the horizon.

The next step in the launch sequence took a Rube Goldbergian twist calling for a key piece of human judgment. In order for the satellite to reach orbit, it was critical for the second stage to fire precisely when the vehicle reached the peak of its flight path with the rocket parallel to Earth's surface. In a modern launch, that would all be handled by onboard computers, or perhaps by automated systems on the ground. For the 1958 launch, it fell to Ernst Stuhlinger, one of von Braun's group directors who came with him to America from Germany, to make the call on exactly when to command the second stage to fire. He was stationed in the hangar a few miles from the launch pad.

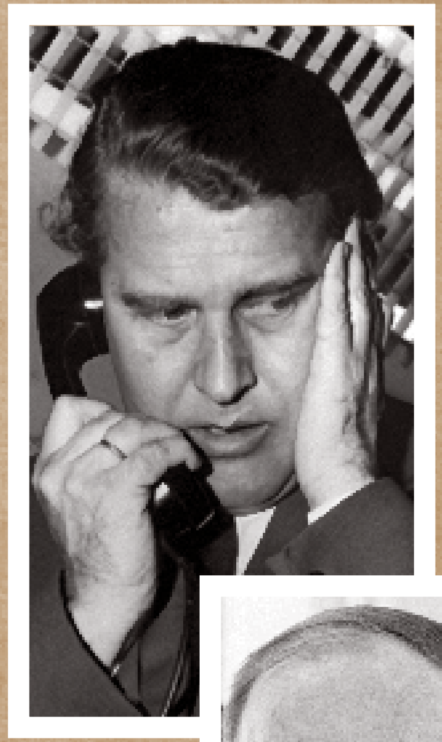
Stuhlinger consulted telemetry from an onboard accelerometer, along with radar and radio data, and used a special analog computer that he had designed to work this out. Four minutes and 20 seconds after the big first stage had burned out, he sent a signal commanding the first cluster of JPL's upper stages to fire. Firing of the third and fourth stages was controlled by timers. In its story on the launch, the Los Angeles Times noted that Stuhlinger had only recently become a father. His friends said his wife told him, "Okay, I had my little satellite. Now you have yours."

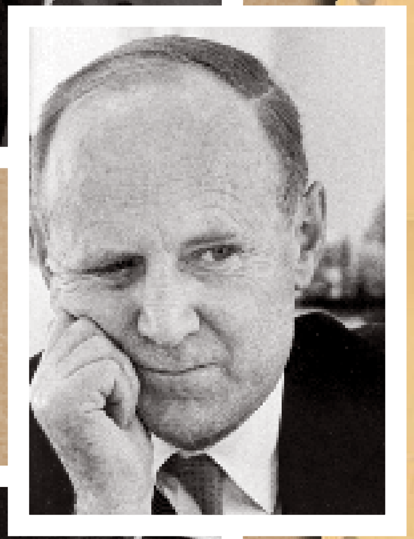
As the rocket disappeared from view, back in the blockhouse Medaris' attention shifted to JPL's Al Hibbs. It was Hibbs' job to synthesize all the information coming in about the progress of the launch to make a statement about the satellite's predicted state. Being a good engineer, Hibbs spoke not in black and white certainties, but in the language of statistics. A half-hour after launch, Hibbs told the Army general that he could conclude "with 95 percent confidence" that there was "a 60 percent probability" the satellite was in orbit. "Don't give me any of this probability crap, Hibbs," Medaris snapped. "Is the thing up there or not?" Hibbs replied, "It's up."

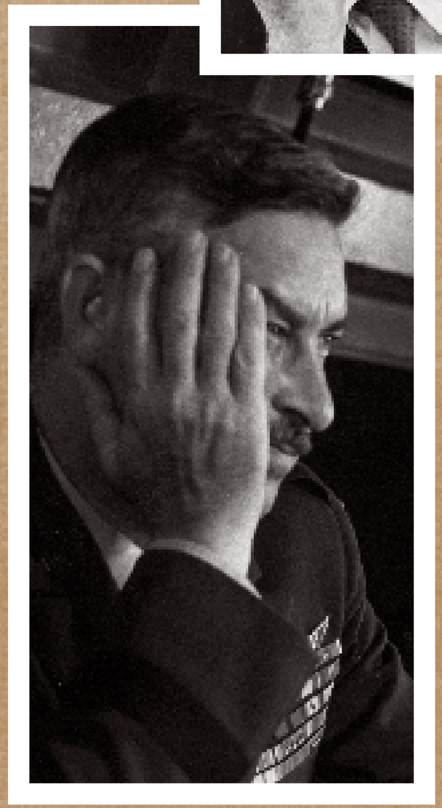
But for some time it wasn't really clear. The greatest proof-positive of the satellite's fate would be the steady beeping of its radio signal as it passed over ground stations. In those days, this was a rag-tag collection of outposts far from today's multi-continent Deep Space Network.

In 1958, the first ground station after Cape Canaveral was a Navy facility on the island of Antigua in the eastern Caribbean. Following that, the satellite would pass over British bases in Nigeria and Singapore. Finally it would reach a temporary ground station that JPL had set up in the Earthquake Valley area of the Anza-Borrego wilderness northeast of San Diego in Southern California. Then there would be nothing until, once again, it flew over the launch site in Florida.

In another twist to the story of interservice rivalry, the Navy allowed JPL's tracking team to place a radio receiver at its base on Antigua, but JPL could not deploy its own antenna — it would have to use an existing one at the Navy site, and no opportunity was provided to test it. Shortly before launch, a switch was thrown to connect the antenna to JPL's receiver. The switch was badly weathered, and as a result the antenna didn't work — no signal was received on Antigua.







AGONIZING WAIT The unexpected delay to acquire a signal from the orbiting Explorer 1 was incredibly tense for (from top) rocket engineer Wernher von Braun, JPL's William Pickering and the Army's General John Medaris.

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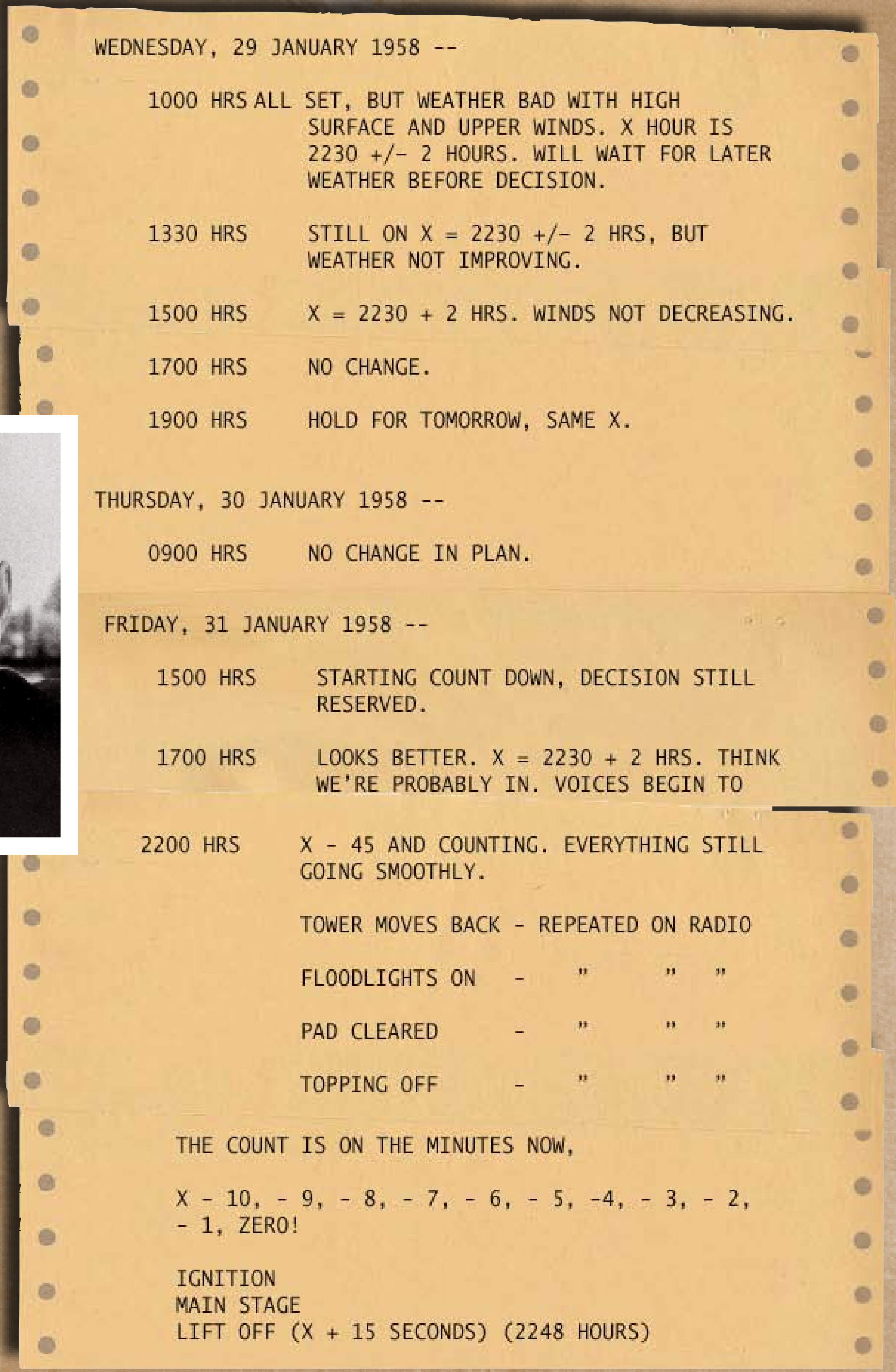

WEDNESDAY, 29 JANUARY 1958 --

1000 HRS ALL SET, BUT WEATHER BAD WITH HIGH SURFACE AND UPPER WINDS. X HOUR IS 2230 +/- 2 HOURS. WILL WAIT FOR LATER WEATHER BEFORE DECISION.

1330 HRS STILL ON X = 2230 +/- 2 HRS, BUT WEATHER NOT IMPROVING.

1500 HRS X = 2230 + 2 HRS. WINDS NOT DECREASING.

1700 HRS NO CHANGE.

1900 HRS HOLD FOR TOMORROW, SAME X.

THURSDAY, 30 JANUARY 1958 --

0900 HRS NO CHANGE IN PLAN.

FRIDAY, 31 JANUARY 1958 --

1500 HRS STARTING COUNT DOWN, DECISION STILL RESERVED.

1700 HRS LOOKS BETTER. X = 2230 + 2 HRS. THINK WE'RE PROBABLY IN. VOICES BEGIN TO

2200 HRS X - 45 AND COUNTING. EVERYTHING STILL GOING SMOOTHLY.

TOWER MOVES BACK - REPEATED ON RADIO

FLOODLIGHTS ON - " " "

PAD CLEARED - " " "

TOPPING OFF - " " "

THE COUNT IS ON THE MINUTES NOW,

X - 10, - 9, - 8, - 7, - 6, - 5, -4, - 3, - 2, - 1, ZERO!

IGNITION
MAIN STAGE
LIFT OFF (X + 15 SECONDS) (2248 HOURS)

As for Nigeria and Singapore, the receiving equipment there worked well enough. But in that age before communication satellites and the global Internet, there was no telephone or telegraph link from those outposts to the United States.

So the first definitive chance to hear from the satellite in orbit was when it would pass over California. In addition to the station in Earthquake Valley, a backup receiver was established at an amateur radio club in Temple City, a few miles southeast of JPL in Pasadena. Exactly when the California stations would pick up the satellite was a matter of conjecture. The team estimated it would fly over the west coast around 12:30 a.m. Eastern time, about an hour and three quarters after launch. But based on how the rocket's speed shifted the pitch of the satellite's radio signal, Hibbs had reason to believe that the launch sent the satellite into a higher orbit than planned, which would make the wait longer.

Meanwhile, Hibbs recalled later, JPL project manager Froehlich and Army general Medaris "were having kittens across the hall from my crew." In an effort to cut the tension, Medaris sent a teletype to JPL in California suggesting that the staff there "have a cigarette and relax." With trademark California humor, the JPL team joked that they were "being nonchalant and lighting up a marijuana."

Another reason for the tension was that, in Washington, Pickering, von Braun and Van Allen would soon be on their way through a rainy night from the Pentagon to the National Academy of Sciences, where they would be expected to pronounce the launch a success or failure. Pickering kept a phone line open for the word from California.

In Washington, spirits were deflated as the 12:30 a.m. milestone came and went with no signal. "We were miserable," von Braun recalled later. "The Explorer had never really gone into orbit." Someone walked over to Pickering and said, "Well, better luck next time, Bill, I guess you didn't quite make it, chuckle, chuckle." Pickering responded quietly, "I'll wait 'til my boys tell me that."

Finally, three minutes shy of two hours after launch, the word was in — California "had the bird." Von Braun exulted to the press conference in Washington, " We have firmly established our foothold in space. We will never give it up again." He, Pickering and Van Allen held the satellite model over their heads for the cameras, and the image passed into history.

In Georgia, President Eisenhower was at his vacation home in Augusta on his first golf getaway since suffering a slight stroke around Thanksgiving. He interrupted an evening of bridge and his usual dinner hour for a briefing on launch preparations as they proceeded. The president was awakened when the rocket launched; he said cautiously, "Let's not make too great a hullabaloo." Later, when it was confirmed that the satellite was in orbit, the president added, "That's wonderful. I sure feel a lot better now." The next day, he took to radio to announce the achievement.

There was one other piece of business to finish. Even as the rocket climbed into the night, the satellite and the mission didn't have an officially announced public name. "Missile 29" and "Project Deal" were uninspiring. Medaris in Huntsville liked the name "Highball," whereas the secretary of the Army suggested "Topkick." In the end, President Eisenhower approved the name Explorer, and that is what the Defense Department announced when the satellite achieved orbit.

With the launch, America was now in space.

FAMOUS SHOT A jubilant William Pickering, James Van Allen and Wernher von Braun (from left) hoisted a model of Explorer 1 for the cameras at a post-launch news conference.

THE Space Age

With the dawn came a new month, and yet more proof that Explorer 1 was indeed in orbit. Scribbling calculations, JPL's Al Hibbs concluded that his hunch was correct that it was in a looping orbit around Earth slightly higher than planned, taking it as high as 2,565 kilometers (1,594 miles) and as low as 362 kilometers (225 miles) above Earth. It went once around the planet every 114 minutes. The country was ecstatic.

Over a period of days, long strips of paper started arriving in Van Allen's Iowa laboratory. At first with return addresses from around the country, they were joined later with similar mailings from other continents. The tick marks on the strips were recordings from ground stations of what Explorer 1 was telling them about the cosmic rays that were hitting its Geiger counter.

THE TEAM Explorer 1 surrounded by several of the JPL engineers who made it happen: (from left) John Small, Jack Froehlich, Al Hibbs, Karl Linnes and Walt Victor.

Van Allen was baffled by the results. As might be expected, cosmic ray hits climbed gradually at greater altitudes, reaching a high at around 1,100 kilometers (684 miles). Then, something odd happened. As the satellite passed higher above Earth in the outer portion of its orbit, Explorer 1 fell silent and reported no rays at all. This was an oddity, as Van Allen was sure that a radiation-free belt above Earth wasn't possible.

He was therefore looking forward to seeing what the next Explorer satellite would report. But first, the Navy was to have another shot at launching a Vanguard. On February 5, 1958 — just five days after the Explorer 1 launch — a Vanguard sailed beautifully away from the pad in a middle-of-the-night launch. All went well for 57 seconds, but then a guidance failure caused the rocket to veer suddenly — subjecting it to such great forces that the rocket broke in two. A range safety officer sent a command to blow up what remained of it.

The Navy finally had its first success on March 17, when it successfully launched Vanguard 1. The satellite remains in orbit today, the oldest human-made object in space. It was originally expected to last 2,000 years in orbit, but engineers later determined that the pressure of solar radiation and atmospheric drag will limit its flight to about 240 years. The success was followed by four Vanguard failures in 1958. In 1959, two more Vanguards, 2 and 3, made it to orbit, peppered with two more launch failures.

Along the way the Army–JPL team had its own run of wins and losses. On March 5, 1958, Explorer 2 went to the launch pad with an enhanced cosmic ray instrument. The first three stages of the Jupiter C rocket performed admirably, but the fourth stage — one of JPL's cut-down Sergeant missiles — never fired. The satellite ended up splashing into the Atlantic.

Three weeks later, the team had better luck with Explorer 3, which managed to carry the improved science payload into orbit. Four months later it was joined by Explorer 4, which got into space well enough but unexpectedly showed signs that it was tumbling as it orbited, making interpretation of its science results difficult. A final launch in the Army–JPL series, Explorer 5, failed when the Jupiter C's booster collided with the vehicle's second stage after separation, sending it off course.

But with Explorer 1 and 3 sending back good data on cosmic rays, Van Allen had what he needed to start drawing conclusions. Like its earlier sibling, Explorer 3 also exhibited a mysterious silence in cosmic ray hits at the highest altitudes. Van Allen hit on the idea that perhaps cosmic rays in that zone were so intense that they overwhelmed the Geiger counter. He tried this out with a spare tube in his lab, and found that indeed radiation saturation would cause the science instrument to fall silent.

Van Allen saw this layer of intense cosmic rays as a doughnut-shaped radiation belt wrapped around Earth. A later JPL mission turned up evidence of a second, and higher, high-intensity layer. In time these went down in history as the Van Allen radiation belts — a staple of schoolchildren's science textbooks of the 1960s.

As for Explorer's other science experiments, the micrometeorite detector revealed that near space was not as cluttered with rubble as some had feared. The only significant hits detected were during a meteor shower in May 1958. The thermal sensors showed that the satellites' temperature environments were controlled perfectly.

President Eisenhower's uneasiness about the military flavor of the missions, meanwhile, bore other fruit. In July 1958, Congress passed a bill called the Space Act creating a new civilian agency to lead America's scientific exploration of space. The president soon signed it, and on October 1, the National Aeronautics and Space Administration was created.

The core facilities of the new agency would be a collection of existing aerospace research centers around the country that had previously been under the aegis of another government body, the National Advisory Council for Aeronautics. In addition, NASA's administrator-designate, Keith Glennan, had his eye on the Army's two jewels, JPL and von Braun's group in Huntsville. The Army howled loudly. As a compromise, President Eisenhower decided that NASA would get JPL right away — on December 1, 1958 — whereas von Braun's team would stay with the Army for another year before migrating to NASA as well.

JPL's Pickering certainly didn't mind. He saw the Caltech lab logically as the premier space laboratory of the new agency. NASA agreed to a contract that gave JPL considerable leeway in running itself as a government-funded unit of a university, much as it had enjoyed under the Army.

In 1959, the von Braun team was folded into the new agency, becoming the Marshall Space Flight Center. That same year, 160 scientists and engineers from the Naval Research Laboratory's Vanguard team were transferred to become the nucleus of a new NASA facility set up at an agricultural station in Maryland outside of Washington. That became known as the Goddard Space Flight Center.

Before long, Wernher von Braun began designing an enormous new rocket, Saturn, that would be powerful enough to take astronauts to the moon. In 1969 it did just that, with Apollo 11. He nursed a dream that Saturn rockets would carry astronauts to Mars in the 1980s. However, the Nixon administration decided to cancel the Saturns in favor of a new, allegedly cost-saving vehicle called the space shuttle. After serving as Marshall Space Flight Center's first director, von Braun went

President Eisenhower decided that NASA would get JPL right away — on December 1, 1958.

BUSY NIGHT The control room during the Explorer 1 launch at Cape Canaveral.

to NASA Headquarters in a planning job for two years, then retired to take a job in industry. He died in 1977 at the age of 65.

John Medaris, the Army general whose ambition and risk-taking made Explorer 1 possible, won a promotion soon after the launch to become the commanding general of a higher umbrella unit called the Army Ordnance Missile Command. He retired from the Army in 1960. A decade later, he had moved to North Carolina and was ordained an Episcopal priest. He died in 1990 at the age of 88.

With newsmaking science from Explorer in hand, James Van Allen went on to participate in numerous other NASA missions, all the while remaining on the faculty of the University of Iowa. He investigated the energetic environments of every planet except Mercury as a member of the science teams on the Pioneer, Mariner, Voyager and Galileo missions. He died in 2006 at the age of 91.

JPL's William Pickering successfully guided the laboratory to a role as NASA's lead center for robotic exploration of other planets. During his long tenure as JPL director from 1954 to 1976, the lab launched or made preparations for missions that would visit all of the solar system's planets from Mercury to Neptune. After retiring on the eve of the Viking arrivals at Mars, Pickering established a research institute in Saudi Arabia, conducted a consulting business and formed a company to manufacture wood pellets for use as fuel. He died at age 93 in 2004.

As for the satellite that started it all, Explorer 1 stopped transmitting when its batteries ran out on May 23, 1958, after more than four months in space. It stayed in orbit for a dozen years, making a fiery reentry over the Pacific Ocean on March 31, 1970.

But while Explorer 1 is gone, its impact on JPL was permanent. Never again would the laboratory be an obscure Army facility laboring away on classified projects. Explorer 1 opened the doorway to space, and JPL would never be the same.

AFTERGLOW The celebratory atmosphere following the successful launch brought out JPLers' wit.

Explorer I

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