A Brief History of White Sands Proving Ground 1941-1983

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based on materials which originally appeared in:
Star Throwers of the Tularosa:
The Early Cold War Legacy of
White Sands Missile Range
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World War II and the Tularosa Basin

1941 The U.S. Army Air Corps began planning for rapid expansion of existing aircraft training facilities throughout several western states in 1941. The Air Corps was rechristened the U.S. Army Air Force (USAAF) on June 20. Anticipating the inevitable fall of Europe to the Axis and direct American participation in World War II, military planners recognized the need for a fallback position for the Royal Air Force (RAF). In April, Major General H. H. "Hap" Arnold, USAAC, met with Vice Marshall Sir Guy Garrod, RAF, to establish the British Overseas Training Program, which would use new air bases built in the vast, open spaces of the American West. Alamogordo Army Air Field (AAAF) was officially established on Easter Sunday, April 13, 1941. By October, the government ordered local ranchers to begin disposing of livestock in anticipation of the establishment of the proposed bombing range. In December, following the air attack on Pearl Harbor, the United States declared war on Japan, Germany, and Italy, and ranchers in 55 townships in four New Mexico counties were rapidly notified that grazing leases on public lands had been canceled to accommodate the newly established Alamogordo Bombing and Gunnery Range.

1942 By early 1942, new construction was underway at the Alamogordo, Carlsbad, Deming, Clovis, and Roswell Army Air Fields, resulting in a massive increase in the military presence in southern New Mexico. Five of the 14 major bombardier training bases in the United States, designed to accommodate 45,000 trainees, were located in New Mexico. Five additional bases were located in Texas, and one was built in each of the states of California, Colorado, Arizona, and Louisiana. Ten practice ranges had also been established in the New Mexico-Texas Southwest. Most of these ranges lay within Doña Ana, Otero, and neighboring counties within or close to the current White Sands Missile Range (WSMR) and U. S. Army Fort Bliss reservations. Construction began at AAAF on February 6, and the base was elevated to full status on June 1.

In June, the Manhattan Project, initiated the previous year, was transferred from its original headquarters at the Manhattan, New York, Engineer District, to the U.S. Army, under the command of

(then) Colonel Leslie Groves, who supervised its relocation to the secret site of Los Alamos, New Mexico, the following year. Groves, promoted to Brigadier General on September 22, continued to command the Manhattan Project until its transfer, in March 1947, to the new Atomic Energy Commission.

Robert Goddard's rocket research group, the only such effort in the United States prior to World War II, had been operating in nearby Roswell, NM (about 200 miles northeast of WSMR and Fort Bliss), since 1930, under the sponsorship of the Guggenheim Foundation. Goddard's program relocated to the Naval Engineering Experiment Station in Annapolis, Maryland, in July 1942, just three years before the fruits of his early research arrived at the new Proving Ground with the captured V–2 program. Goddard, who had flown the first liquid-fueled rocket in 1926, had failed to interest the War Department in rocketry until September 1941, when he finally obtained contracts with the Navy Bureau of Aeronautics and the Army Air Corps. Ironically, Goddard's success in obtaining military sponsorship and the subsequent relocation permanently removed him from participation in the first major U.S. rocketry programs that took place in the western United States.

On October 3, 1942, Goddard's early rocketry research bore fruit in Peenemünde, Germany, with the first successful launch of an A–4 (V–2) missile for the German Army. This rocket was larger but almost identical to missiles Goddard tested years earlier at Roswell. In December, the German Air Force pulse-jet propelled V–1 was also successful in tests at Peenemünde, although this first flight only achieved a distance of 3,000 yards.

1943 U.S. Army and Air Force histories suggest that by 1943, the AAAF was already being informally considered as a guided-missile development site. The Rocketry Branch, called the U.S.Army Ordnance Corps, was officially established in September of that year.

In August, the Luftwaffe in Italy began attacks on allied combat ships with Fritz X, the first successful air-to-surface missile (ASM). On September 9, a 1,400-kilogram armor-piercing Fritz X sank the battleship *Roma* and severely damaged the *Italia* in the Strait of Bonifacio. The following week, Fritz X sank two cruisers, damaged two others and a battleship, and sank several merchant ships off Salerno.

1944 In May 1944, the USAAF, through the Office of the Chief of Ordnance (OCO), contracted with the Jet Propulsion Laboratory (JPL) of the Guggenheim Aeronautical Laboratory, California Institute of Technology (GALCIT), for the Army's first ballistic-missile program to "develop long-range rocket missiles and ramjets and...associated guidance and launching equipment." This project became known as ORDCIT, an acronym for Ordnance-California Institute of Technology, also used as the name of the original range. Between 1944 and circa 1960, the ORDCIT program produced the Private A and F, the WAC (Without Attitude Control) Corporal, Corporal E, Bumper-WAC (two-stage V–2/WAC combination to demonstrate launch and separation using available components), and Sergeant missile series. Historian William Burrows suggests an alternative explanation for the name. He states that WAC was "named after the Women's Army Corps because its developers thought of it as Corporal's little sister."

Also in May, the search began for a location to test the Manhattan Project's atomic bomb. Eight potential locations were originally identified: one in Colorado, one in South Texas, two in California, and four in New Mexico. The final choice was narrowed to three: the Grants, NM, Malpais (lava flow); the Rice, CA, Desert Training Area; and the Jornada del Muerto, NM. The Grants Malpais was eliminated because of the difficulty of moving Jumbo (the plutonium-containment vessel) across the lava. Groves refused to consider the California Desert Training Area because George Patton (whom he considered "the most disagreeable man I have ever met") had trained his Africa Corps troops there. The Jornada del Muerto (Journey of the Dead) was chosen. Col. Roscoe Wriston, Commander of the Alamogordo Bombing and Gunnery Range, turned over an 18-by-24 square mile area to the Manhattan Project, and construction began in November.

On June 13, one month after the ORDCIT project was initiated, German V–1 Buzz Bombs began to strike London. Within three weeks of the first impacts, American engineers had "reverse-engineering" a V–1 copy, JB–2 (Jet Bomb–2), from parts recovered at unexploded crash sites in occupied Europe and England. The JB–2 was tested between 1944 and 1946 at Muroc Army Air Field (later Edwards AFB) in California, Eglin AFB in Florida, and Wendover AAF in Utah. It was finally transferred to Holloman Air Force Base (HAFB) in 1948, when both HAFB and White Sands Proving Ground (WSPG) missile programs began to expand.

Birth of the White Sands Proving Ground

During the summer of 1944, less than one month after the Normandy D–Day invasion, the first Allied radio-controlled Aphrodite drone aircraft missile, carrying 20,000 pounds of TNT, struck German rocket launch-site targets in the Pas de Calais. During the fall, selection of a suitable missile test range began under the command of Major General G. M. Barnes, Chief of the Research and Development Service, OCO. The selection criteria required a large, level, uninhabited area within the continental United States—with clear skies and access to water, rail, and power facilities—near a permanent Army post. WSMR historian Tom Starkweather believes that initial alternatives were identified in Utah, Nevada, California, and Texas. A Corps of Engineers team, led by Colonel G. W. Trichel, Chief of the Rocket Development Division, OCO, visited the alternative locations. The selection team, under the command of Col. L. R. Skinner, OCO (coinventor of the bazooka), identified the Tularosa Basin in south-central New Mexico as the best of several available sites. The following February, the OCO directed the Corps of Engineers to acquire the lands necessary for establishing the ORDCIT Range, Area 3.

On November 20, OCO contracted with General Electric to undertake the Army's second missile program, the Hermes Project, to develop long-range surface-to-surface guided missiles (SSM). By December, OCO had decided to include the V–2 rocket within the Hermes Project and began planning the capture of 100 V–2 rockets after the liberation of Europe. That same December, the first of 24 JPL Private A missiles was fired at Camp Irwin, California.

1945 Early in 1945, OCO contracted with Western Electric's Bell Telephone Laboratories to develop a supersonic surface-to-air guided missile (SAM) to attack high-speed, high-altitude aircraft. By October 1946, Bell (which had tested the first U.S. jet aircraft three years earlier), with its subcontractors, Douglas Aircraft and Aerojet Engineering and Aberdeen's Ballistic Research Laboratory, produced the first successful Nike. Meanwhile, the Navy Bureau of Ordnance, concerned with the potential threat of kamikaze suicide attack, directed the Johns Hopkins University Applied Physics Laboratory (APL, established in 1942) to initiate the Bumblebee guided-missile and antiaircraft program, which led to the 3T missile family: Talos, Terrier, and Tartar.

The new WSPG site in the Tularosa Basin incorporated the Alamogordo Bombing Range, ORDCIT, and portions of the Fort Bliss Artillery Range. The site was approved by the Secretary of War on February 20, the day after the last V–2 was fired in Europe. Initially, the northern portion was under the jurisdiction of the Army Air Force (which became the Air Force in 1947); the central portion was under the jurisdiction of the Department of the Army, OCO; and the extreme southern portion, including the Fort Bliss Antiaircraft Firing Range, remained part of Fort Bliss. This split in jurisdiction lasted until Army consolidation in 1950. Beginning on April 1, the first of 17 JPL Private F missiles was fired from Hueco Range on Fort Bliss, Texas.

One month later, on May 2, Wernher von Braun and his rocket team fled the advancing Soviet Army and surrendered to American forces at Oberjoch, Germany. They had evacuated their Peenemünde rocket-research site and hidden their research documents in an old mine shaft near Dorten. U.S. Army Ordnance Technical Intelligence Special Mission V–2 captured the V–2 hardware at the underground Mittelwerk factory in Nordhausen, Germany. The 144th Ordnance Company secretly marshalled the Dorten documents, nearly 100 of some 400 Peenemünde personnel, and large quantities of V–2 hardware for transport to the United States.

By May 22, 1945, the first captured V–2 rocket components were being transported to Antwerp for shipment to the new Proving Ground. By June 30, evacuation of Peenemünde personnel to the United States was approved. Actual construction at WSPG began on June 25, with water-well drilling. Camp construction began on June 29, with the re-erection of three barracks buildings (referred to as CCC buildings in the 1959 WSMR history) moved from Sandia Air Base near Albuquerque or Camp Luna near Las Vegas, NM. These buildings had been sawn in half and transported to the new site with house-moving wheel sets. A relocated hangar, Dallas-type hutments, a missile-assembly building, and a building for the Fire Department were added. In correspondence to Starkweather, Col. E. W. Bradshaw, one of the three OCO officers who helped choose the WSPG site, recalls that (then) Lt. Col. Harold Turner, the first WSPG Commanding Officer, with the help of C Battery, 69th Antiaircraft Artillery Battalion, selected base camp and launch site locations, erected wood-floor squad tents, established generator and line power, drilled the first wells, and re-erected the three relocated barracks.

The Proving Ground was officially authorized by ASF Circular 269, July 13, effective July 9, 1945. Construction of the Army blockhouse at Army Launch Area 1 (the first at WSPG, now Launch Complex 33) commenced on July 10. By late July, 300 freight-car loads of V–2 (and probably other) missile parts were enroute to WSPG. Operation Overcast, a program to exploit German civilian scientific personnel, was established on July 19 and assumed responsibility for the captured Peenemünde staff.

Meanwhile, the Manhattan Project, operating in secret at Site Y (Los Alamos, NM) under the command of Maj. Gen. Leslie Groves, had successfully designed the world's first atomic device. Unbeknownst to Col. Turner, WSMR's first commander, the Commander of the Alamogordo Bombing and Gunnery Range, Col. Roscoe Wilson, had reluctantly transferred control of the 432 square-mile Trinity Site to the Manhattan Project. Construction at Trinity was underway by November 1944, and the Trinity test was ignited July 16, 1945, at 5:29:45 a.m., Mountain War Time. Less than one month later, atomic weapons were first used against Japan, just as the captured German V–2 materiel began to arrive at WSPG.

On August 6, 1945, the first atom bomb was dropped at Hiroshima, Japan, followed by another at Nagasaki on August 9. The following day, C Battery, 69th Antiaircraft Artillery Battalion, was officially assigned to WSPG, and 163 officers and enlisted troops from the 9393rd Technical Service Unit, OCO, arrived, followed later by elements of the 4119th Area Service Unit (formerly 4845th), 8th Service Command, 4th Army. Robert H. Goddard, the father of American rocketry, died the same day.

Post-World War II and the Early Cold War

In September 1945, von Braun and the first group of German scientists arrived in Paris. They were flown to Newcastle AFB in Wilmington, Delaware, transferred to Fort Strong near Boston, and then to Fort Bliss, Texas. The remainder of the 118 Paperclippers arrived aboard the transport liner *Argentina* in November and reached Fort Bliss by January 1946.

The Army Blockhouse at Launch Area 1 (LC-33) was completed in September 1945. On September 26, a modified Navy Tiny Tim rocket (configured as a booster for WAC Corporal) became the first missile launched by the Army at the new Proving Ground. The first full WAC Corporal A was fired less than one month later, on October 11, reaching an altitude of 44 miles. That same day, the 1st Guided

Missile Battalion was constituted and stationed at the Proving Ground. Later that month, a contract was awarded to construct the first (100,000 pound thrust; 100-K) static test stand, and the Chief of Ordnance invited the Navy to participate in the WSPG's new guided-missile program. The Air Force had initiated a guided-missile program of its own at Wendover AFB, Utah, and had begun construction of its first high-speed test tracks: K–2 at China Lake and the 2,000-foot track at Edwards AFB. By November 1945, troopers from the 1st Guided Missile Battalion were guarding captured German materiel at railway sidings near Las Cruces, and at WSPG, General Electric employees had begun to identify, sort, and reassemble V–2 components in the re-erected hangar (Building 1538), designated as Assembly Building 1.

1946 The Hermes project was assigned the task of assembling captured V–2 rockets (and, by 1947, supervising Bumper). (Between 1947 and 1954, Hermes utilized four modified German V–2 missiles [redesignated Hermes B–1], five Hermes A–1s [based on the German *Wasserfall* antiaircraft rocket], and 13 Hermes A–3s.) As the Project Hermes V–2 program neared readiness at the close of 1945, its scientific potential began to eclipse its original, purely military purpose. In December 1945 (or January 1946), the Naval Research Laboratory (NRL) had established a Rocket-Sonde Research Branch.

In early January 1946, after OCO offered the NRL use of captured V–2s for research, NRL invited other military and university programs to join the V–2 Upper Atmosphere Research Panel (originally the V–2 Panel; later the Rocket and Satellite Research Panel), chaired by Dr. James A. VanAllen, APL (who later directed the Aerobee program). The panel membership included Ernest H. Krause, NRL; W. G. Dow, University of Michigan; M. H. Nichols, Princeton; Fred Whipple, Harvard; Col. James G. Bain, OCO; Col. Holger N. Toftoy, the Army Ground Forces; and representatives of the Air Materiel Command, the Army Signal Corps, Cal Tech's Jet Propulsion Laboratory (JPL), and General Electric.

In April, the Army Air Corps contracted with Consolidated Vultee (later General Dynamics) to study a long-range ballistic missile (known as MX–774) as a back-up program for the Navaho I missile, which was to succeed the Hermes B–1. The program was canceled the following year, but three launches of the MX–774 Hi-Roc took place in 1948 at LC–33.

The V–2 program began in earnest with the full onset of the Cold War, an era that actually started at Trinity, but is usually marked by Winston Churchill's Iron Curtain speech on March 5, 1946. Assembly Building II (Building 1558; a *Mills* building, later known as "The Mill") was erected in 1946. On March 15, the first V–2 was static-test fired on the new 100-K Test Stand, which had been designed by the German rocket team, based on earlier examples in Germany. The following day, Operation Overcast was officially renamed Operation Paperclip. The Strategic Air Command (SAC) was created on March 21, and the Air Materiel Command began developing the XB–63 Rascal, a subsonic air-to-ground pilotless parasite bomber, under contract with Bell Aircraft. Rascal was used in the first off-range firing at WSPG 10 years later. Aberdeen Proving Ground's Ballistic Research Laboratory (BRL) organized a permanent White Sands Annex the same month. On April 2, the Signal Corps Engineering Laboratories (SCEL) in Fort Monmouth, New Jersey, dispatched personnel to establish Field Station No. 1 at WSPG. Alamogordo Army Air Field, temporarily deactivated since February, was reactivated in April to support the increased missile-firing schedule. OCO established the Ordnance Research and Development Division Suboffice (Rocket) at Fort Bliss to provide facilities for a select group of German scientists who were engaged in the new Hermes II project to develop a two-stage missile based on a modified V–2.

After one unsuccessful launch attempt on April 16, the first successful V–2 firing took place on May 10, 1946, reaching an altitude of 70 miles. On May 17, the Naval Bureau of Ordnance, already envisioning the need to replace its small supply of V–2s, contracted through the Applied Physics Laboratory at Johns Hopkins University with Aerojet for 20 XASR–1 Aerobee sounding rockets (originally called Venus) and established the U.S. Naval Ordnance Missile Test Facility at WSPG. In July, the USN Bureau of Ordnance began constructing the Navy Cantonment Area at the Proving Ground.

Dr. George Gardiner, head of the Physics Department at New Mexico College of Agriculture and Mechanic Arts (NMAMA, later New Mexico State University) had met with Col. J. G. Bain, OCO, in January 1946 to discuss the possibility of providing student labor for data reduction of ballistic Askania films. The resulting contract with the Army's Ballistics Research Laboratory, effective in May, led to the Regents of the College to found the Physical Science Laboratory (PSL, originally the Laboratory of Applied Science) in September. A

second contract for similar services with the Johns Hopkins Applied Sciences Laboratory, acting for the Navy Bureau of Ordnance, was negotiated that fall. After a historic meeting in early 1947, between Lewis Del Sasso and NMAMA's Harold Brown at the Amador Hotel in Las Cruces, a third contract was undertaken, this time with the Naval Research Laboratory. PSL has continued to supply support, research, data reduction, and a wide range of other services to WSMR and its tenant organizations.

During the summer and fall of 1946, PSL student crews began surveying baseline instrumentation stations A through Z to provide position data for missile test firings. On September 17, Bell engineers static-test fired the first Nike SAM at LC-33. By October, the Bell Nike no. 1 was successfully fired to an altitude of 28 miles. The same month, von Braun's German rocket team had arrived at WSPG to assist General Electric engineers with V–2 testing. Several sources indicate that 39 scientists led by von Braun spent six months as WSPG, billeted in Building H (which may have been the H-shaped, single-story Officer's Quarters fronting B Street, shown on the June 1945 cantonment map). Starkweather notes that members of the team used Army buses for weekend trips to Ruidoso and Cloudcroft in the Sacramento Mountains. The German team apparently numbered approximately 200 before mid-year 1947.

The first motion pictures of the earth from space were taken from V–2 no. 13, which reached an altitude of 65 miles on October 24, 1946. Construction at LC-33 continued, and the gantry tower was completed in November. On December 17, V–2 no. 17 made the first American night rocket flight.

1947 By 1947, the need for an accurate, three-dimensional coordinate system became apparent. The requirements for measuring vertical angles were unprecedented, and eventually a modified transverse-mercator projection was developed and anchored to the U.S. Coast and Geodetic Survey Texas-California Arc at Kent Peak in the San Andres Mountains and Elephant Mountain near Orogrande. Because no suitable survey equipment was then available, local personnel cannibalized three damaged Zeiss theodolites, shipped to WSPG with the loads of V–2 missile parts, and built two usable instruments .

The original ORDCIT WAC Corporal program was nearly complete by early 1947. On February 24, WAC Corporal B no. 17 reached a record altitude of 45.5 miles. The final WAC launch took place on

June 12. Blossom, another V–2 program, began firing in February under the auspices of the Air Force Cambridge Research Center. Blossom's mission was to study ionospheric conditions and develop an instrument-package parachute-recovery system. The Blossom program continued through 1951. Five Blossom experiments, carrying four rhesus monkeys all named Albert and a mouse, were conducted for the Wright-Patterson AFB Aero-Medical Laboratory. However, only the first of a total of 11 Blossom launches was fully successful. Blossom I (V–2 no. 20), fired February 20, carried a canister containing fruit flies and various seeds to an altitude of 68 miles and returned safely to Earth by parachute.

In February, shortly after the first Blossom flight, AAAF was transferred to the Air Materiel Command in return for transfer of Wendover AFB to the new Strategic Air Command. In March, the Air Force guided-missile program—including Boeing's GAPA (Ground to Air Pilotless Aircraft), North American's NATIV (North American Test Instrument Vehicle), and the Tarzon Vertical Bomb—was moved from Wendover to AAAF, which was rechristened Holloman AFB the following year. On July 26, the National Security Act created the Department of Defense with three separate departments, and the U.S. Air Force was established as an independent service. The Act also set up the National Security Council (NSC), the Central Intelligence Agency (CIA), and the Joint Chiefs of Staff. The following day, Lt. Col. Turner, WSPG, and Col. Paul F. Helmick, AAAF, executed a cooperative-use agreement locally integrating the *New Mexico Guided Missiles Range*. The new Air Force missile program at AAAF expanded rapidly—in its first year, AAAF fired the first GAPA, three early Falcon AAMs, and the first Firebird AAM; launched the first OQ–19 drones; began the first high-altitude balloon operations; and started the first dummy missile drop tests for the Snark ICBM.

The Navy guided-missile program began construction of two tiltable, 140-foot Aerobee launch towers and the Navy Blockhouse at Launch Complex 35 in May. On November 24, the Navy launched the first fully configured Aerobee sounding rocket (no. A–4), which carried cosmic-ray instruments to an altitude of 36.7 miles. Earlier in May, Douglas Aircraft launched a Corporal E, the first American-designed, engineered, and fabricated SSM, and the first ORDCIT test vehicle with command guidance. This first Corporal E reached an altitude of 24.4 miles, impacting 62.5 miles downrange within 2 miles of its target, after receiving and executing a radar course-correction signal. In September, the Navy tested the V–2 at sea

during Project Sandy, successfully launching from the *Midway's* carrier deck in the Atlantic Ocean. At WSPG, in Operation Pushover, the Navy intentionally toppled and exploded a fully fueled V–2 on a segment of carrier flight deck.

The OCO approved the Bumper V–2 program in June 1947. Under the direction of JPL, Bumper was the first multistage rocket system, wedding a WAC Corporal to a V–2, an idea originally suggested prior to July 1946 by Col. Holger Toftoy, who had organized Special Mission V–2 to acquire captured missiles for testing at the Proving Ground. (The first Bumper flight took place in May 1948. Less than one year later, Bumper no. 5 penetrated outer space.)

Following two near-mishaps with off-course missile impacts, steps were taken to increase range safety. On May 15, steering trouble developed in V–2 no. 26, causing an off-range impact near Alamogordo. Two weeks later, on May 29, the first Hermes B–1 (Hermes II) impacted outside Juarez, Mexico.

In October, Air Force Cpt. Chuck Yeager broke the sound barrier in the Bell X–1. Two months later, Maj. John Stapp made the first two rocket-sled runs at the Edwards AFB Test Track.

In August, efforts to secure a more permanent test range had resulted in 52 co-use and full-use agreements with local landowners. In November, the Army Corps of Engineers, Albuquerque District, prepared the first feasibility study for a northern Range expansion. In December, plans were approved for a new Loki antiaircraft free-flight rocket (based on the German *Taifun*). Bendix Aviation and JPL contracted for Loki to after initial feasibility studies were completed in 1948–1949. Loki was first test fired at WSPG in June 1951.

1948 The AAAF was redesignated Holloman Air Force Base in January, effective the following month, with a formal dedication in September. Missile programs continued to expand at both WSPG and HAFB. Between 1946 and 1950, the Army and Navy launched 235 missiles and the Air Force launched 329, in addition to 604 drone flights, 111 parachute-recovery drop tests, 157 bomb drops, and 52 miscellaneous missions.

On February 6, GE launched the first successful, electronically controlled missile, V–2 no. 36. On June 11, USAF Blossom III (V–2 no. 37) carried the first rhesus monkey, Albert I, to a height of 39 miles, but failed to reach recovery altitude.

By the end of 1948, the Air Force at Holloman had initiated 11 new missile and drone test programs, in addition to the three original Wendover programs (GAPA, JB–2, and Tarzon) transferred in 1947. The first of four NATIV flights was launched in May. In July, USAF Project MX–774 commenced with the first Consolidated Vultee Hi–Roc launch from LC-33. Project MX-774 led to the Atlas rocket, the first intercontinental ballistic missile (ICBM). By December, the first fully powered Ryan Firebird air-to-air missile, which used plastic in the nose, fore-, and aft fins, was launched.

Bumper, designed to demonstrate the feasibility of multistage rockets, began the first of six WSPG test firings on May 13. Bumper's WAC Corporal/V–2 stood 58 feet in height. The first successful flight demonstrated stage separation and reached an altitude of 70 miles. The WAC Corporals for this and the second test (where the V–2 booster failed), contained only a separation charge. Bumper no. 3 achieved 93 miles with its first stage, but its WAC exploded before separation. A fully successful multistage flight was not achieved until the following year.

Development of the Integrated Range

At Holloman, planning for the High Speed Test Track was initiated with Northrup and Hughes Aircraft in October, and by December, HAFB had been reorganized under the Air Materiel Command. All three services now had successful missile programs in place—the Army and Navy at WSPG and the Air Force at HAFB. In September, WSPG was "declared a Class II activity under the control of the Chief of Ordnance at Fort Bliss, Texas" (Dept. of Army, General Order 59, 8 September 1948).

Late in the year, two developments occurred that would greatly expand the WSPG mission. During August and September, the two Koreas were established, setting the stage for the conflict that would begin in less than two years. On December 29, 1948, Secretary of Defense James Forrestal announced the establishment of the U.S. earth satellite vehicle program, which would launch the first U.S. satellite, Explorer 1, into space less than a decade later.

1949 On January 4, 1949, Army General Order 2.II designated the Signal Corps Engineering Laboratory at WSPG (which had been temporary since April 1946) as the 9577th Technical Service Unit, SCEL Field Station No. 1, at Fort Bliss. On October 26, an additional Signal Corps unit was added to the WSPG complement with the arrival of

six officers and 210 enlisted men from the 169th Signal Construction Company at Camp Gordon, Georgia. In March, USAF control of WSPG's local support airfield, Condron Field, was transferred from Biggs Army Air Field at Fort Bliss to Holloman.

Brig. Gen. Phillip Blackmore, WSPG's second Commanding Officer, established a Joint Range Coordination Committee on January 7, composed of the WSPG Commanding General, the HAFB Commanding Officer, and the WSPG Naval Officer-in-Charge, to resolve problems of cooperation and jurisdiction at a local level. The Committee's authority was challenged within a month by the Commanding General at Fort Bliss, who asserted his command authority over WSPG, based on the General Order establishing the Proving Ground as a permanent Class II activity under his command. The Air Force and Navy vehemently opposed this action —more than three years of negotiations took place before the Secretary of Defense's final decision, on July 18, 1952, resolved the dispute by centralizing range operational authority under the Commander, WSPG. The decision recognized advise by deputies from both the Air Force and Navy and denied the authority of the Commander, Fort Bliss. The new chain of command led directly from the WSPG Commander to the Department of the Army through the Ordnance Department. The Air Force retained title and command of HAFB, while the Navy retained administrative control and title over all Navy facilities. The final integration plan was issued on August 19, 1952, and took effect September 1. The dispute concerning use of the range for training purposes continued at the departmental level, which had a detrimental effect on the Air Force guided-missile program at HAFB by creating a belief that the program was to be taken over by the Army. This belief led, in turn, to the cancellation of plans and monies, seriously jeopardizing the guided-missile program.

In early January, the Hermes II (or B-1) program resumed test firing after more than a year's delay following the loss of course control and the impact of test vehicle no. 0 near Juarez in 1947. Hermes II used a modified V–2 to carry a smaller, second-stage ramjet missile, known officially as RAM and nicknamed Organ. The second Hermes II B–1 was successfully launched from LC-33 on January 3, followed by two additional tests in October 1949 and November 1950.

The GE Bumper no. 5, fired at WSPG on February 24, was the first with a fully fueled second stage and the first to be completely

successful. After 30 seconds, the first-stage V–2 had attained a speed of 3,600 miles per hour. The WAC separated and continued upward to a distance of 250 miles into outer space, reaching a speed of 5,150 miles per hour, achieving a new altitude record. This was the first time radio equipment had ever been operated at such extreme altitudes. On July 29, Bumper no. 7, fired at the Long Range Proving Ground, Florida (as was no. 8), attained Mach 9, reaching 2,039 miles per hour, a new record for sustained speed in the earth's atmosphere.

On May 3, 1949, the Navy's new American-designed Martin Viking research rocket (originally called Neptune) was first launched from LC-33, reaching an altitude of 50 miles. At Holloman, the Hughes Falcon (the world's first operational, guided air-to-air missile, or AAM), the first Martin Matador surface-to-surface pilotless bomber, and the first USAF X–8 Aerobee had been launched. Preliminary development testing for the Bell Rascal program, the world's first supersonic strategic ASM, had begun with dummy drops of the Shrike re-entry vehicle.

Meanwhile, the range co-use and full-use agreements with landowners were found to be unworkable and were terminated in March 1949. In May 1952, Public Land Order 833 withdrew range lands for exclusive military use. In August 1952, 168,000 acres were transferred from Fort Bliss to WSPG.

On May 11, 1949, President Harry S. Truman signed legislation authorizing development of a 3,000-mile guided missile test range. That July, the public and press were first allowed to visit Trinity Site. The following month, the Soviet Union exploded its first atomic bomb.

Korean War

1950 International events taking place in 1950 had a major impact on the U.S. military establishment and operations at WSPG. In January, President Truman approved development of the hydrogen bomb. By April, the National Security Council had prepared NSC 68, which redefined the Cold War in military terms, calling for the buildup of a nuclear arsenal and expansion of conventional weapons to counter the Soviet threat. The nuclear arms race had begun.

On June 25, North Korean troops crossed into South Korea and President Truman committed U.S. forces to its defense. Late in the year, the United States and South Vietnam signed a Mutual Defense

Assistance Agreement. Together, these events dramatically spurred guided-missile development programs in the defense agencies.

In February, the Navy announced the tests of Mighty Mouse, the first successful air-to-air rocket. The Air Force established nearby Sacramento Peak Observatory to study solar radiation. The first HAFB 3,550-foot High Speed Test Track was completed on June 15, and the first unloaded Snark launch-sled test took place on June 23, reaching a top speed of 101 miles per hour. The new Army Ordnance Missile Center was established at the Redstone Arsenal in Huntsville, and von Braun's scientific team, composed of more than 100 captured German scientists stationed at Fort Bliss and WSPG since 1946, was transferred in November.

On May 19, 1950, the Army unsuccessfully launched the first Hermes A–1 antiaircraft missile (based on the German *Wasserfall*). In August, attention shifted to the Air Force high-altitude balloon program. On August 8, Capt. Vincent Mazza set a new altitude record of 42,176 feet, parachuting from a balloon. This record was surpassed three weeks later by Capt. Richard Wheeler, who parachuted from 42,449 feet above Holloman. That same day, HAFB personnel launched the first Wright Field Aero-Medical Laboratory high-altitude cosmic radiation balloon from WSNM. On November 21, the Navy Viking V was launched from LC-33 and set a new single-stage altitude record of 107 miles. The first flight-test of Snark on December 21 proved unsuccessful when the missile disengaged from its sled below flight separation speed and was destroyed.

1951 During 1951, the interservice debate about the Proving Ground chain of command continued. WSPG completed construction of its new headquarters, the Post Administration Building No. 100, in January. The Air Force reorganized its missile program, including Holloman, under an independent command, the Air Research and Development Command (ARDC). On March 29, an Aerobee launch from HAFB was broadcast on nationwide radio. Run no. 15 at the Test Track produced the first successful Snark launch and uprange test flight on April 16. Two days later, the first Aerobee flight carrying a monkey took place.

Meanwhile, in March and June, the final two Air Force Cambridge Research Center Blossom tests, IV–E and IV–F, suffered tail explosions shortly after launch. Another American redesign of a German antiaircraft concept, Loki (based on *Taifun*), was launched from the new Small Missile Range. The Douglas Honest John SSM,

which became the first post-war operational American missile, was also test fired at the Proving Ground. In August, the Navy's Viking set another single-stage altitude and speed record of 135 miles at 4,100 miles per hour. On September 20, Aerobee carried a monkey and 11 mice (the first living creatures to survive outer space) to an altitude of 236,000 feet. This flight provided the first successful recovery of animals from a rocket flight. In November, a Nike–Ajax achieved the free world's first successful anti-aircraft interception by destroying a B-17 drone over WSPG.

The Navy Talos program, an outgrowth of the original 1945 Bumblebee Project's experiments in ramjet propulsion, had progressed at the Naval Ordnance Test Station in China Lake, CA, to the point that it needed an extended range. Talos was transferred to the Navy Launch Area at LC-35 on WSPG.

1952 The year 1952 marked a continued expansion of test programs and further integration of the range. Another phase of the Cold War began with the first hydrogen bomb test on November 1, at Enewetok Island in the Pacific, and President Truman officially lay the keel of the world's first atomic-powered naval vessel, *U.S.S. Nautilus*. In February, the Aberdeen BRL transferred range instrumentation responsibilities to the new WSPG Flight Determination Laboratory. In May, Public Land Order 833 withdrew on-range public lands from the public domain, and additional Fort Bliss acreage was transferred. On August 19, the Secretary of Defense established WSPG as a permanent Class IV activity under the command of the Chief of Ordnance. On September 1, HAFB and WSPG ranges were consolidated by order of the Secretary of Defense. On September 22, the WSPG Commanding General issued General Order 30, *Plan for the Operation of the Integrated Range*, just three days after the 73rd and final V–2 was fired at the range.

In July 1952, WSPG Commander, Brig. Gen. G. G. Eddy, and Dr. J. W. Branson, NMAMA, initiated the College Student Cooperative Program. The first launch of the Type 1 tactical version of Corporal took place in August, and the first Navy Talos at WSPG was fired in October. At Holloman, the 33rd and final Snark Test Track flight took place on March 28. Snark was immediately succeeded at the Test Track by Sandia Corporation's Project Sleighride, which tested the effects of impact, deceleration, and rainfall on a "free rocket special warhead" for the Atomic Energy Commission on behalf of the Ordnance Corps, U.S. Army. On September 20, the first Rascal ASM was launched at Holloman. In late October, the newly

integrated range broadened its mission to an international scale with the announcement that the Swiss Oerlikon missile was to be tested from Tularosa Range Camp.

After Korea and the Death of Stalin

1953 On August 14, five months after the death of Josef Stalin and less than one month after the Korean Armistice was signed, the Soviet Union tested its first hydrogen bomb. Local research and logistic support for the WSPG expanded. Texas Western College (later the University of Texas at El Paso) founded the Schellenger Research Laboratories (SRL) and gradually began to undertake research and development contracts for the Army Signal Corps, OCO, and other military organizations. Sometime during the late 1950s, SRL developed the SOTIM (Sonic Observation of Trajectories and Impacts of Missiles) System for WSPG, an array of sensitive, ground-positioned microphones capable of precisely triangulating impact sites to supplement radar-tracking systems.

In April, Lt. Col. John Paul Stapp was reassigned to Holloman from Edwards AFB to undertake a new test program on the Biophysics of Abrupt Deceleration, the first of several innovative AeroMedical programs concerned with the problems of aircraft escape and bailout from high-speed aircraft, which provided the basis for the new field of space medicine.

The Desert Navy at WSPG completed the *L.L.S.–1 U.S.S. Desert Ship* in June. The *Desert Ship's* concrete-blockhouse complex provided assembly and launch facilities simulating shipboard conditions.

On June 13, the Hermes A–3 series, larger and more powerful than the *Wasserfall*-based A–1 (a modified V–2 Hermes B–1), reached the testing stage with the first successful Hermes A–3A launch. The following month, WSPG officially assumed maintenance and operation responsibility for all instrumentation within the integrated range. In October, the Office of the Adjutant General, Fourth Army, finally clarified the WSPG-Fort Bliss boundary by.

In December, the Nike-Ajax was deployed around Washington D.C., becoming the first guided SAM defense system in the world. Within four years, more than 16,000 rounds had been produced. By 1957, Ajax had been deployed throughout the United States and in Europe and Asia.

1954 In 1954, WSPG began a survey of potential range extensions that finally led to the addition of the FIX (Firing-in-Extension) in 1960, to the north of the existing range. It also investigated test-flight corridors for Matador and Redstone, from WSPG into British Columbia and Alaska, with ranges of 1,500 and 2,000 nautical miles, respectively. In May, the Navy Viking no. 11, launched from the new *Desert Ship* facilities, set another single-stage altitude record of 158 miles, and the Army Hermes A–3B flew for the first time under radar guidance. Testing at White Sands had grown from a total of 14 launches in 1945 to 656 in 1954, supporting 11 separate programs, including Aerobee, Corporal, Dart, Hermes, Honest John, Lacrosse, Nike, Papa John, Pogo–Hi, Talos, and Viking. The nearby Air Force Aero-Medical Laboratory High Speed Test Track programs also expanded and, on March 19, Lt. Col. Stapp rode the first human rocket-sled test into history, reaching a top speed of 615 feet per second and enduring a peak deceleration of 22 G (gravities).

Post-Stalin Cold War: Expanded Conflict and New Frontiers

During 1954-1955, the Cold War began to escalate. In 1954, the French suffered a catastrophic defeat at Dienbienphu, and Vietnam was divided along the 17th parallel into North and South. On May 1, the Soviets revealed the M–4, their first jet-propelled, long-range bomber. At the end of May, the first Nike-Ajax battery became operational at Fort Meade, Maryland. In August, President Dwight D. Eisenhower signed the Communist Control Act, and the Communist party was outlawed in the United States.

1955 In 1955, the Warsaw Pact was signed, calling for mutual defense among the Communist Bloc. In June, the United States held its first nationwide civil-defense exercise, and the first SAC nuclear B–52 bombers were deployed. On July 29, Eisenhower's press secretary announced the U.S. artificial-satellite program, and the United States officially entered the space race. Exaggerated reaction to Soviet air-show bomber displays raised the specter of a "bomber gap," adding fuel to the missile race.

During September 1954, Wernher von Braun, in a secret report entitled *The Minimum Satellite Vehicle Based Upon Components Available from Missile Development of the Army Ordnance Corps*, had predicted that other countries in addition to the United States already had the capability to assemble and launch an earth satellite within a few years. He concluded, "it would be a blow to U.S.

prestige if we did not do it first." In the spring of 1955, the CIA informed President Eisenhower that the Soviets were already engaged in such a satellite program. At the President's direction, DoD convened the Ad Hoc Committee on Special Capabilities to consider proposals for a satellite system from the three services, for a launch coinciding with the International Geophysical Year (IGY), 1957–1958. The Army, under von Braun's direction, proposed launching a 15-pound payload by 1956, using Redstone as the first stage topped by a cluster of 37 Loki rockets as upper stages. The Navy, in *A Scientific Satellite Programme* dated July 5, 1955, proposed a 40-pound satellite using a three-stage system based on Viking and Aerobee. The Air Force promised it could launch an even heavier payload using the proposed Atlas ICBM, whose development had just been contracted to Convair that January. The committee chose the Navy's proposal, naming the project Vanguard. In July, Eisenhower announced the intention to launch the first earth-orbiting satellite during the IGY.

In March 1955, the first on-range firing of a USAF Matador took place. Shortly thereafter, Matador became the Air Force's first operational missile. Similar in size and shape to a jet fighter and loosely based on the German V–1, Matador could carry a 3,000-pound nuclear or conventional warhead while flying up to 35,000 feet over a range of 500-650 miles. This and other advanced long-range tactical missiles demanded longer test ranges. Despite their test advantages, especially the ease of payload and vehicle recovery, overland ranges were limited in size. Numerous plans for a variety of possible WSPG range extension firing corridors of 100, 140, and 200 miles were proposed. In December, the WSPG Acting Commander proposed the acquisition of 216 square miles for a northern range extension.

1956 In 1956, war broke out in the Middle East following Egyptian nationalization of the Suez Canal. Hungary revolted, and Nikita Khrushchev promised "We will bury you." WSPG and Holloman Air Development Center (HADC) had finalized their Joint-Use Tenancy Agreement, completing the process of range integration. In February, the U.S. Army Ballistic Missile Agency (BMA) was established at Huntsville Arsenal to develop the Jupiter IRBM and assume the lead role in Army long-range missile weaponry, including the Redstone. By June, detailed plans for WSPG's long-range flight corridors and impact areas had been prepared for distances of 250, 500, 750, 925, and 1,500 miles. However, in

November, a directive from the Secretary of Defense curtailed the original BMA mission, limiting Army missiles to a range of less than 200 miles. Longer-range programs became the purview of the Air Force. That same month, a Rascal fired from Orogrande marked the beginning of off-range testing at WSPG. Toward the end of the year, the Navy (on behalf of the Air Force) had contracted with RCA for a land-based Talos Defense Unit, which was successfully tested one year later at WSPG. By December, the Navy/Martin team had successfully launched the first modified Viking Vanguard test vehicle, with inert second and third stages.

1957 Holloman's Capt. Joseph Kittenger, Jr., and Lt. Col. David Simons made record-breaking Man-High I and II balloon ascents to 96,000 and 102,000 feet (respectively, in June and August). These were eclipsed on October 4, 1957, when the Russians achieved the first satellite earth orbit with Sputnik I, followed in November by the 1,120-pound Sputnik II, carrying the dog, Laika. Both Sputniks were launched aboard the massive Soviet 32-engine SS–6 Sapwood, the first Soviet ICBM, initially tested just months before in August.

The competing Vanguard program, based on the Navy's Viking and Aerobee, successfully launched the second modified Viking test vehicle from Cape Canaveral in May, but the results still trailed behind. Then in December, under mounting pressure following Sputnik I and II, a third test vehicle using a new first stage was hurriedly readied to launch a 4-pound satellite. Faulty ignition in the new first stage caused the Vanguard to explode, and the launch failed.

In early November, von Braun's Army Redstone team at Huntsville was directed to undertake satellite-launch attempts. In just under three months, on January 29, 1958, they succeeded with America's Explorer I, boosted by a massive Jupiter C, modified from the older Redstone.

The Navy at WSPG continued to set new single-stage, high-altitude records with Aerobee–Hi, which reached an altitude of 190 miles in April. The Deckhouse was added to *Desert Ship* at LC-35, and missile assembly was relocated from the Navy Headquarters area. The first land-based TDU (Talos Defense Unit) just west of Desert Ship was completed in September, and the first launch of a TDU-directed Talos scored a direct hit on a drone in December. APL began formulating the basic concepts for the first radar-guided integrated missile weapon system for the Navy, named Typhon. In

September, the first long-range Air Force Matador flight from WSPG impacted at the inactive Wendover Bombing Range, Utah, and the first underground nuclear test took place near Las Vegas, Nevada.

In August 1957, Russia announced its first successful ICBM launch, followed in December by the first U.S. Atlas ICBM. Although Atlas was only four months behind the Soviet program and represented the largest and one of the fastest missile development programs, the apparent lag led to a broad perception of a missile gap between the two countries. That December, the Gaither Report to the National Security Council concluded that the Soviets had achieved superiority in long-range ballistic missiles. Late that year, a Columbia graduate student first conceived of an idea that would revolutionize both military and civilian technology as the millennium closed—the laser.

1958 In 1958, Khrushchev became the Soviet Premier as well as First Secretary of the Communist Party. Both the United States and the Soviets now had parallel ICBM and space programs. First the Soviet Union, and then the United States and Britain, suspended atmospheric nuclear testing. Later in the year, Khrushchev demanded talks about German reunification. In January, the Army's Anti-ICBM Nike-Zeus had been chosen over its Air Force competitor, the Wizard, as the basis for ballistic missile defense (BMD). (The first Zeus was successfully fired on December 16, 1959, at WSMR and tested against Atlas at Ascension Island, a British Colony in the South Atlantic, in 1960.) The November 1956 Wilson Memorandum prohibition on long-range Army missile programs was rescinded, and the Army contracted with Martin Company for Missile D, which became known as Pershing, a two-stage, surface-to-surface tactical nuclear missile with a range of 100-460 miles.

On March 17, the Vanguard program finally succeeded with its fifth test vehicle (TV–4), which became the first multistage launch platform, delivering a 5-pound payload, including a 4-pound satellite, into an elliptical 406-mile orbit. This Vanguard's orbit was used to demonstrate the true, pear-shaped, bulged form of Earth. The first Vanguard success was followed the next year by six more failures and two successes (SLV–4, SLV–7), completing the original program.

The Navy constructed Army Launch Area 3 (LC-36), and the WSMR Flight Determination Laboratory was renamed the Integrated Range Mission, reflecting implementation of the formal joint-use

agreements developed during the previous six years. A USAF Mace (successor to Matador) was launched along the Wendover corridor in February, becoming the first inertially guided missile flown over a populated area in the United States. In May, WSPG was officially renamed White Sands Missile Range. In June, WSMR launched its first Redstone ICBM from the new Launch Area 3 (LC-36). In July, President Eisenhower established the National Aeronautics and Space Administration (NASA) to consolidate and direct American efforts in the newly established space race, transferring the remaining Paperclip personnel who would become the nucleus of the Marshall Space Flight Center. In December, the new agency established Project Mercury, the first human space program.

The original 3,550-foot High Speed Test Track at HAFB, operational since 1950, began its last year of testing before being extended to 35,000 feet. A Horizontal Test Stand designed for Atlas engine tests was approved as part of the new track's instrumentation, but was never fully equipped or used for Atlas. On March 21, a world-record monorail sled run on the old track achieved a speed of 2,704 miles per hour. At the companion Daisy Track, Capt. E. I. Beeding Jr., became the first human to absorb 83 G. In October, Lt. Clinton McClure III reached 99,900 feet aboard the Man-High III balloon gondola. The 400th successful Firebee launch took place in November.

1959 The year 1959 opened explosively with the Cuban Revolution on New Year's Day. In May, President Eisenhower decided against deploying the Nike-Zeus, still in the testing stage. In July, Vice President Richard Nixon visited Khrushchev in the Soviet Union. September was eventful: the Atlas D became operational, a Soviet Lunik II spacecraft crashed on the moon, and Khrushchev visited the United States to meet with President Eisenhower at Camp David. In October, Lunik III passed around the far side of the Moon, returning the first photographs of the Moon's hidden surface.

In April, WSMR received the OCO Legislative Liaison and Public Relations Plans of its proposed Northern Extension. The Acting Secretary of the Army approved the Northern Extension Plan in August, and WSMR also assumed operational control of the Fort Churchill, Manitoba, Rocket Research Facility. At Holloman, the new, longer High Speed Test Track became operational, the 100th Aerobee–Hi reached 140 miles as the program closed down at HAFB, and testing was completed on the Sidewinder AAM. In November, Capt. Joseph Kittenger, Jr., parachuted from an open

balloon gondola at 76,400 feet. The same year, APL began developing the Typhon Weapons System for testing at *Desert Ship*. (Typhon was first fired in March 1961. After 10 successful test flights, the Typhon System was terminated in 1963, because of its high cost.)

1960 By January 1, 1960, all co-use agreements for the Northern Extension had been completed. Six weeks later, France joined the nuclear group with the explosion of her first atomic bomb. Weightlessness training for Project Mercury astronauts began over HAFB in March, using a modified C–131.

Nike-Hercules, successor to Ajax since 1958, acquired enhanced guidance. Early in the year, Hercules, equipped with the new High-Power Acquisition Radar, successfully intercepted an oncoming Corporal over WSMR. But by 1960, the concept of a Ballistic Missile Defense system had become problematic and both the USAF and the Navy had abandoned their BMD programs. Nike-Zeus, the first anti-ICBM, was already outdated and would shortly be replaced by the Nike X (later Safeguard) program starting in 1963.

In 1960, the U.S. satellite program began in earnest. In April, balloon drops began to test the re-entry system of the Discoverer satellite. In May, the United States launched the Midas II military reconnaissance satellite; Tiros I, the first weather satellite; and Echo, the first passive communications satellite.

In May, just over two weeks after Gary Powers was shot down in a U–2 spy plane, the Commander of Army Ordnance Missile Command officially requested WSMR's support for an off-range launch of Redstone, proposing Fort Wingate as a launch site.

On July 20, the 1,000th rocket sled reached a speed of 2,660 miles per hour at the HAFB High Speed Test Track. In August, Capt. Joseph Kittenger, Jr., again broke records with a balloon flight and parachute jump from 102,800 feet, free-falling 82,300 feet and reaching a speed of 614 miles per hour.

That November, John F. Kennedy was elected President of the United States.

1961 On January 31, after Kennedy's inauguration, HAM became the first Holloman Aero-Medical chimpanzee to go into space on a 16-minute suborbital flight. On February 1, the first Ballistic Missile Early Warning System (BMEWS) became operational. By midmonth,

the Army Ordnance Missile Command's earlier request for a Redstone launch from Fort Wingate to WSMR was denied. In March, the Navy conducted the first test launch of the Typhon integrated weapon system.

Once again, the Soviet Union preempted the United States in the space race with the successful Vostok I mission on April 12, which placed the first human being, Yuri Gargarin, in orbit around the Earth. Five days later, the ill-fated, U.S.-backed Bay of Pigs invasion of Cuba escalated existing tensions, already heated by the January break in diplomatic relations with Fidel Castro's government. Russia also launched its first Venus mission that year, but lost contact with the probe.

On May 5, less than one month after Gargarin's historic orbital flight, Alan B. Shepard, Jr., became the first U.S. astronaut in space. Shepard, aboard the Mercury Freedom 7 boosted by the Army's Redstone, completed a 15-minute suborbital flight. Virgil Grissom followed on July 21, aboard Liberty Bell 7, for a 16-minute suborbital flight. Then, on August 6, Soviet cosmonaut G. Titov dwarfed all previous efforts, achieving a 17-orbit, 25.6-hour flight.

Meanwhile, the Cold War heated up on several fronts. On May 11, just two weeks before his pledge to put a human on the moon in the next decade, Kennedy committed U.S. advisors to Vietnam. In June, Khrushchev repeated his ongoing demands for German reunification talks within six months. Kennedy responded with a rapid military buildup and another civil-defense program. By August, East Germany had closed the Brandenburg Gate, sealing the border in preparation for constructing the Berlin Wall. By September, both the Soviet Union and the United States had resumed underground nuclear testing.

Late in 1961, Gen. Schriever, Commander of the Air Force Systems Command, commissioned a white paper on the concept of re-entry systems for ballistic missiles. The clear practicality of ballistic missile-defense systems such as Nike-Zeus indicated that the deployment of BMD systems created an actual defensive combat zone and that the offensive-delivery system, exclusive of the re-entry vehicle, constituted a logistic and not a weapons element. This study resulted in the ABRES, or Advanced Ballistic Re-Entry Systems program, to study ways of increasing the penetrability of offensive re-entry systems. In July, WSMR had installed an integrated real-time data system, primarily for the ARPAT program,

to provide ground guidance for hyper-velocity targets. WSMR was chosen for subscale tests of ABRES in a program called Athena, which further upgraded range instrumentation.

1962 At the end of January, nuclear test-ban talks in Geneva finally broke down. The U.S. Mercury space program began to achieve impressive results, orbiting three astronauts during the year: John Glenn in February, Scott Carpenter in June, and Wally Shirra in October. The U.S. Mariner 2 became the first man-made object to reach another planet, Venus. Telstar, launched in July, became the first active communications satellite. Meanwhile, the Soviet Mars probe failed when contact was lost. In April, the United States resumed atmospheric testing of nuclear weapons. By October, the same time the first flight of 10 silo-protected Minuteman I ICBMs became operational, Soviet missile bases under construction in Cuba were detected, precipitating a U.S. blockade.

In May 1962, the U.S. Army discontinued the OCO, parent organization for America's earliest space and missile efforts. The WSMR Integrated Range Mission, which had started as the BRL White Sands Annex, became the Range Operation Directorate, and WSMR was transferred to the Army Materiel Command.

During 1962, WSMR also tested the Lockheed Pegasus, fired from the original Redstone pad at LC-36, for launching the SAMOS spy satellite. In September, the Air Force's Green River, Utah, launch site for the Athena subscale tests of ABRES was approved, and land acquisition was initiated by the Sacramento District Corps of Engineers in late December. Pershing, which had been in the test phase at the Atlantic Missile Range since 1960, became operational in July and was widely deployed during the next two years in both the United States and West Germany.

The first successful firing of the North American Aviation/Air Force Hound Dog, a forerunner of the modern cruise missile based on the canceled Navaho, took place on October 11. The Hound Dog air-to-surface missile was designed for launch from a B-52 bomber, carrying a 1-megaton nuclear warhead. The first off-range test firing of Hound Dog was launched from Del Rio, Texas, but failed to reach the range and impacted into Guadalupe Peak.

1963 The U. S. and Soviet space programs continued to compete as L. Gordon Cooper completed 22 orbits in May, followed by Valentina Tereshkova-Nikolayeva, first woman in space, who reached 48 orbits in June. The Soviets also achieved two vehicles in simultaneous orbital flight. In February, Syncom 2 became the first artificial satellite placed in geosynchronous orbit.

The U.S.S.R. and the United States began exploring ways to moderate tensions. In a June 10 speech, Kennedy questioned the wisdom of the so-called holy war that had developed and suggested a mutual interest on both sides in peace and a halt to the arms race. Ten days later, the White House-Kremlin Hot Line was established. The first Minuteman ICBM wing, consisting of three 50-missile squadrons, became operational during the same period that IRBM Thor and Jupiter missiles in Britain, Italy, and Turkey were being removed from service.

In July, Cuba seized the American Embassy in Havana. By October, Kennedy had signed the trilateral Limited Test Ban Treaty. Unfortunately, other tensions continued to escalate in the Caribbean, Southeast Asia, and at home. Civil-rights demonstrations in Birmingham and the arrest of Martin Luther King required the intervention of federal troops under Presidential order, and 200,000 Freedom Marchers demonstrated in Washington. In November, South Vietnamese President Diem was assassinated. Three weeks later, John Kennedy suffered the same fate in Dallas.

Earlier in the year, the new Nike X BMD program was authorized, and Martin Marietta was chosen to develop the high-acceleration Sprint SAM. At WSMR, the fully operational Pershing began off-range test firings from Fort Wingate, NM.

1964 In February, the U.S. Ranger VI space probe took the first good closeup pictures of the Moon. President Johnson announced the War on Poverty and signed the Civil Rights Act, while urban riots continued to erupt. In August, Johnson ordered immediate retaliation against the North Vietnamese after the attack on the U.S. destroyers *Maddox* and *C.Turner Joy.* Congress immediately passed the Gulf of Tonkin Resolution, marking the official beginning of the Vietnam War, granting the president power to take "all necessary measures to repel any armed attack against the forces of the United States." China detonated its first atomic bomb October 16, the day after Khrushchev was ousted as Prime Minister and Secretary of the Communist Party, replaced by Kosygin and Brezhnev, respectively.

At WSMR, the Athena program began firing and the Multi-function Array Radar (MAR) developed for the Nike X program began testing. The General Dynamics' Nike-Hercules continued with 12 firings of various tactical and scientific configurations.

1965 In March, the first U.S. Marines waded ashore at Da Nang, Vietnam. By May, U.S. troops had been sent to the Dominican Republic to defeat the emergence of a new Communist state in the Western Hemisphere. In November, U.S. forces engaged the North Vietnamese at Ia Drang Valley. On the home front, civil rights conflicts in the south continued to escalate, culminating with Ku Klux Klan murders in Selma, Alabama. Student demonstrations against the U.S. bombing of North Vietnam began, and during the summer, Watts, in Los Angeles, exploded in race riots that left 35 dead.

The competing Soviet and U.S. space programs continued to achieve new milestones. On March 18, A. Leonov conducted the first space walk, spending 20 minutes outside his spacecraft. On March 23, America's first two-person space crew, Virgil Grissom and John Young, orbited three times in a Gemini spacecraft. They were followed in early June by McDivitt and White, who completed 62 orbits, including extravehicular activity. On July 15, the Mariner IV passed within 7,500 miles of Mars. In August, Cooper and Conrad achieved a 120-orbit Gemini flight, demonstrating the feasibility of a lunar mission. In December, Schirra and Stafford, in Gemini 6, successfully rendezvoused in space with Gemini 7, manned by Borman and Lovell.

The year 1965 marked the end of an era in the missile race. Lance missile firings began at WSMR in March. The Vought Lance SSM, a 45-75 mile tactical fire-support system, eventually replaced Honest John and Sergeant. SAC had deactivated all its first-generation ICBMs—including 18 Atlas Ds, 27 Atlas Es, 68 Atlas Fs, 54 Titan Is, and 54 Titan IIs—all of which had been superseded by 600 Minuteman missiles carrying 1.3 megaton nuclear warheads with a range of over 6,000 miles.