Star Throwers of the Tularosa

THE EARLY COLD WAR LEGACY OF WHITE SANDS MISSILE RANGE

By
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Lisa M. Meyer,
and
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Contributions by
Sara Eidenbach,
John Hilley,
and
Michael Lawson

Prepared by Human Systems Research, Inc.
for
Environmental Services Division, WSMR

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Contract No. DAAD07-94-0104
Delivery Order No. 09

A DoD Legacy Project prepared for
Environmental Services Division
White Sands Missile Range, New Mexico

Prepared by
Human Systems Research, Inc.
Tularosa, New Mexico

September 1996

HSR Report No. 9422

WSMR Archaeological Report No. 9612

This report is dedicated to:

the early missile rangers and rocket men
whose efforts took us to the stars,
and their historians, who preserved that past—

Tom Starkweather, for years the unofficial WSMR historian,
PFC Burton Portnoy,
Bon Burt,
Benjamin Billups,
Eve Simmons,
Ruth A. Mabe,
R. B. Rypinski,
F. F. Gavaghn,
Gladys Thompson,
PFC Richard Smith,
M/Sgt. E. M. Houston,
V. Pearson Wosika,
Walter Cushman,
Col. E. W. Bradshaw, Jr.,
Jim Eckles,

and all those whose names may be forgotten,
but whose efforts made our work possible.

Library of Congress Cat. No. 97-74732
ISBN No. 1-887523-12-X

ABSTRACT

Star Throwers of the Tularosa is a study initiated to identify properties associated with the Cold War on White Sands Missile Range (WSMR) as part of a Department of Defense (DoD) Legacy Resource Management Program demonstration project. The properties investigated, constructed between 1942 and 1964, represent elements of an installation type essential to the Cold War historic theme at the national level of importance. They are diverse in structure and represent a range in function from launch and instrumentation facilities to barracks, laboratories, and missile-assembly buildings to administration buildings, and Army and Navy to NASA facilities.

Detailed historic contexts, a historical timeline, and a narrative history of WSMR and the vehicles tested at WSMR were developed as a foundation work for identifying historic properties associated with WSMR's role in the Cold War as a principal component in arms development in the United States. Historic contexts specific to individual properties were developed from a variety of sources, including synthetic WSMR histories and technical documents. Individual properties were documented in the field, and these field observations were compared to available design and "as-built" engineering drawings to define both the original and present condition and the architectural integrity with respect to the period of known historical significance.

This investigation represents only an initial phase in WSMR's historic preservation efforts for its Cold War legacy. It provides a synthesis of early Cold War historic contexts and significant properties, and begins the process for recognizing and preserving WSMR's rich military history and its place in the heritage of the nation.


WHITE SANDS PROVING GROUND
ARMY SERVICE FORCES
ORDNANCE DEPARTMENT
AUTHORIZED PERSONNEL ONLY

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ACKNOWLEDGEMENTS

A study such as *Star Throwers of the Tularosa* involving the Cold War has no precedent. Guidance for such an undertaking came from no published source, but was offered from a variety of people whose contributions to this project cannot be overstated. The authors gratefully acknowledge the contributions of those listed below and offer our sincere apologies to those we have overlooked.

The project was conceived and initially designed by Robert Burton of the WSMR Environmental Services Division (STEWS-NRES-E), who continued to provide valuable guidance throughout the project. Yolanda Romero and Michael Mallouf also provided valuable support from the Environmental Services Division. Discussions with Virge Temme of the Army Construction Engineering Research Laboratory and Ruthann Knudson of the Agate Fossil Beds National Park, as members of the Department of Defense Legacy Cold War Task Area team, greatly aided in the project design. Mary Ann Anders, architectural historian for the State Historic Preservation Division, assisted in developing the documentation standards for the Cold War era buildings.

The Master Plans Branch of the Directorate of Engineering and Housing provided information essential to identifying facilities, construction dates, and other facility data. Mary Lou Ayella, Samuel O. Sanches, and Joe Madrid were all particularly helpful. For the Navy facilities, Les W. Gibbs, facilities engineer, was most helpful in gaining access to the facilities and plans. Wade King, Vicente Romero, and John Diaz of the Civil Engineers Office provided access to the As-Built facility plans and engineering drawings. Nancy Serna, facilitator for the National Range, provided us with the first complete data on WSMR programs from 1945 through 1964, which was invaluable and a real eye-opener for the sheer breadth of missile-research support WSMR provided to the nation's defense industry. Robert Peters and his staff from the Safety Division provided safety information for the facilities targeted for documentation. The staff at C-Station, in particular Ken "Cowboy" Odom, was most helpful in navigating the maze of information for this facility.

Bruce D. Allen, director and curator of the White Sands Missile Range Museum, opened his museum and archives to our greedy eyes and his staff was most helpful. Jim Eckles, Don Montoya, and Debbie Bingham of the Public Affairs Office provided valuable information. Wayne Mattson and George House of the International Space Hall of Fame opened their files to our scrutiny. Jim, Bruce, and Wayne are to be personally thanked for the trust they placed in us by allowing us to borrow various treasures with only an IOU slip.

Finally, the Human Systems Research (HSR) project staff and support staff must be acknowledged for their contributions to this effort. They include:

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Karl Laumbach, Executive Director
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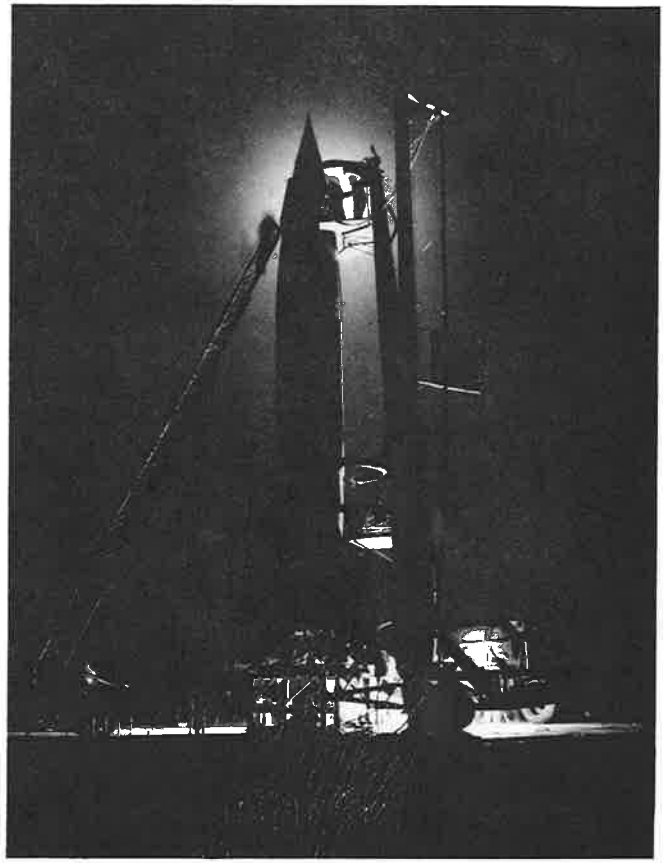
Peter Eidenbach and Rick Wessel served as principal investigators and are responsible for the data generated during this project and presented in this document. The views, opinions, and findings contained in this report are those of the authors and should not be construed as official Department of the Army positions, policies, or decisions, unless so designated by other documentation.

LIST OF ACRONYMS USED

AAAF	Alamogordo Army Air Field
AAM	air-to-air missile
ABRES	Advanced Ballistic Re-Entry Systems
ACC	Air Combat Command
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFMDC	Air Force Missile Development Center
AMS	Army Map Service
APL	Applied Physics Laboratory
ARDC	Air Research and Development Command
ASM	air-to-surface missile
AZON	Azimuth Only
BMA	Ballistic Missile Agency
BMD	Ballistic Missile Defense
BMEWS	Ballistic Missile Early Warning System
BRL	Ballistic Research Laboratory
CCC	Civilian Conservation Corps
CIA	Central Intelligence Agency
CIT	California Institute of Technology
DME	Distance-Measuring Equipment
DoD	Department of Defense
DOVAP	Doppler Velocity and Position System
EMRLD	Excimer Raman Shifted Laser Device
ENIAC	Electrical, Numerical Integrator and Computer
ETMWG	Electronic Trajectory Measurement Working Group
FDL	Flight Determination Laboratory
FIX	firing-in-extension
GAL	Guggenheim Aeronautical Laboratory
GALCIT	Guggenheim Aeronautical Laboratory-California Institute of Technology joint-venture
GAPA	ground-to-air pilotless aircraft
GE	General Electric
HABS	Historic American Buildings Survey
HADC	Holloman Air Development Center
HAER	Historic American Engineering Record
HAFB	Holloman Air Force Base
HELSTF	High Energy Laser System Test Facility
HSTS	horizontal static test stand
HTV	hypersonic test vehicle
HVAR	high-velocity aircraft rocket

ICBM	intercontinental ballistic missile
IGY	international geophysical year
IRIG	Inter-Range Instrumentation Group
IRBM	intermediate-range ballistic missile
ISHF	International Space Hall of Fame
ITS	Integrated Trajectory System
JATO	jet-assisted take-off
JB-2	Jet Bomb-2
JPL	Jet Propulsion Laboratory
LC	Launch Complex
LLS	Land Locked Ship
LRMP	Legacy Resource Management Program
LTH	Lethality and Target Hardening
MAR	Multifunction Array Radar
MDI	Miss-Distance Indicator
Mfac	Military facility
MIDOR	Miss-Distance Optical Recorder
MIRACL	Mid-Infra-Red Advanced Chemical Laser
MIS	Man in Space
MOU	Memorandum of Understanding
MTSA	Missile Test Stand Area
NAA	North American Aviation
NACA	(early NASA) National Advisory Committee for Aeronautics
NAMTC	Naval Air Missile Test Center
NARA	National Aeronautics Research Administration
NASA	National Aeronautics and Space Administration
NATIV	North American Test Instrument Vehicle
NATO	North Atlantic Treaty Organization
NMAMA	New Mexico College of Agriculture and Mechanic Arts
NRHP	National Register of Historic Places
NRL	Naval Research Laboratory
NSC	National Security Council
OCO	Office of the Chief of Ordnance
ORD	Army Ordnance Department
ORDCIT	joint-venture between ORD and CIT
OSWG	Optical Systems Working Group
PSL	Physical Science Laboratory, NMAMA
RAF	Royal Air Force
RAZON	Radio Control Azimuth Only Glide Bomb

RC	Range Camp
RCA	Radio Corporation of America
RCC	Range Commanders Conference
ROTI	Recording Optical Tracking Instrument
SAC	Strategic Air Command
SAM	surface-to-air missile
SCEL	Signal Corps Engineering Laboratory
SLED	Sea Lite Beam Director
SMT	Small Missile Telecamera
SOTIM	Sonic Observation of Trajectories and Impacts of Missiles
SRL	Schellenger Research Laboratories
SRP	Sounding Rockets Program
SSM	surface-to-surface missile
TAC	Tactical Air Command
TDU	Talos Defense Unit
TM	Tactical Missile
TNT	Trinitrotoluene
US	United States
USAAC	U.S. Army Air Corps
USAAF	U.S. Army Air Force
USAF	U.S. Air Force
USGS	United States Geological Survey
USN	U.S. Navy
USNOMTF	U.S. Naval Ordnance Missile Test Facility
USNR	U.S. Naval Reserve
USS	United States Ship
VB	Vertical Bomb
WAAC	Women's Army Air Corps
WAC	without altitude control
WDD	Western Development Division
WSMR	White Sands Missile Range
WSNM	White Sands National Monument
WSPG	White Sands Proving Ground
WSSCA	White Sands Signal Corps Agency
WWII	World War II
ZEL	Zero Length Launch



A V-2 prepares to light the night sky: star throwers in action, circa 1946 (photo by Martin Sauber).

INTRODUCTION

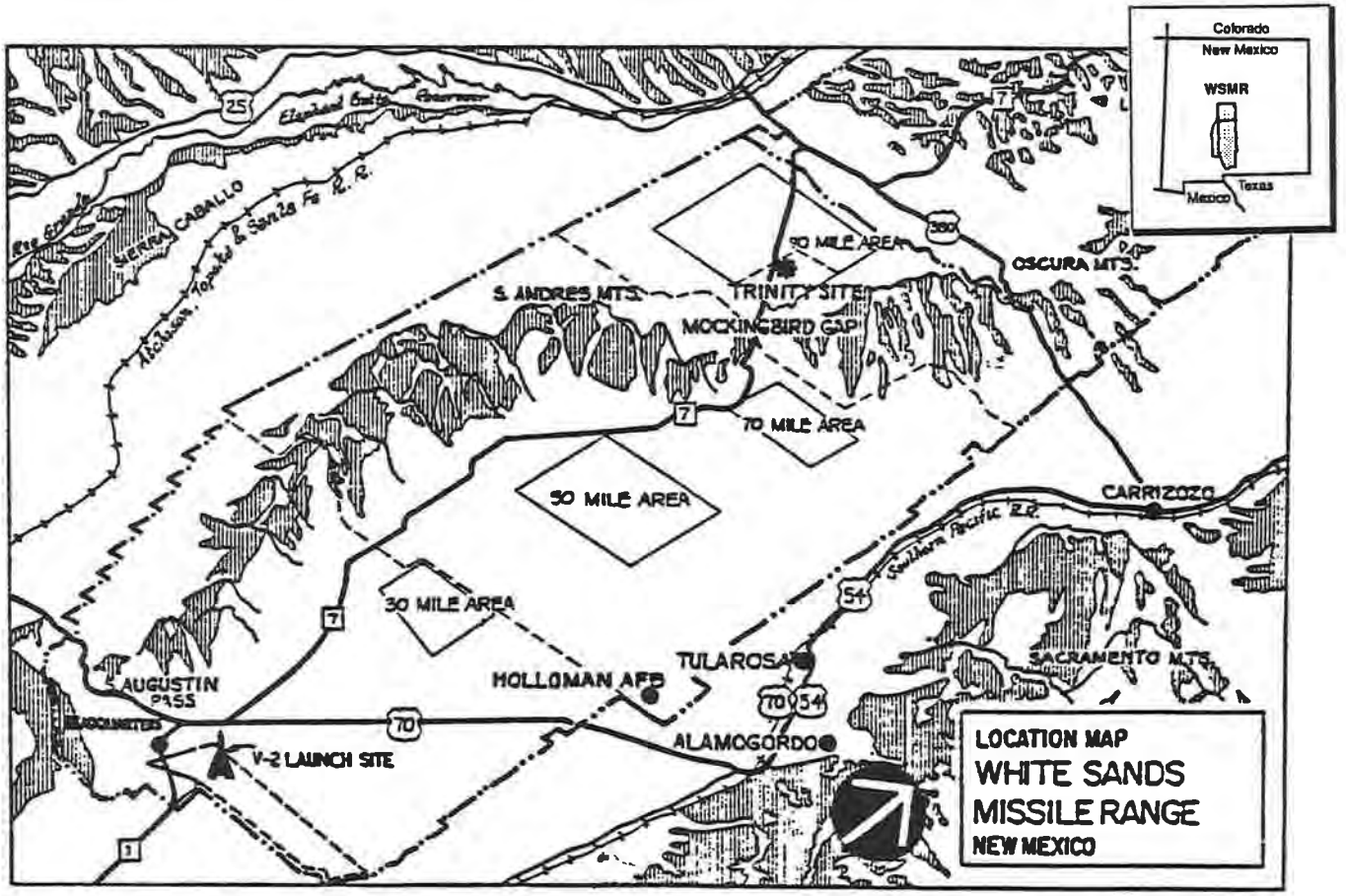
The U.S. Army White Sands Missile Range (WSMR) in south-central New Mexico initiated this study of the early Cold War in 1993 under the sponsorship of the Department of Defense (DoD) Legacy Resource Management Program. The Legacy Program was established by the U.S. Congress in 1991 to manage, study, and conserve natural and historic resources under the control of the DoD, and "protect...the physical and literary property and relics of the Department of Defense...connected with the origins and development of the Cold War" (Department of Defense 1991:2-3).

This study has documented the first 20 years of WSMR's history, identified some of that period's surviving architecture and industrial archaeology, and begun the documentation needed for nomination to the National Register of Historic Places (NRHP). This purpose conforms with the National Historic Preservation Act's Section 110 statutory and regulatory requirements to inventory historic properties under agency control that are listed on or eligible to the National Register. It provides identification, description, and examples of the Army and other military historic property types on WSMR and establishes their historic context to assist in formally assessing their eligibility for the National Register. Most of these military properties are less than 50 years in age and are considered eligible under National Register guidance contained in Bulletin 22: *Guidelines for Evaluating and Nominating Properties That Have Achieved Significance Within the Last Fifty Years* (Scherfy and Luce 1987).

Logo of the DoD Legacy Resource Management Program

INVESTIGATING YESTERDAY

WSMR (then known as White Sands Proving Ground) rose to early prominence as the site for research and development of the nation's first guided missiles, which responded to and fueled the growing tensions of the Cold War. From its onset, WSMR was a multiservice facility with an international flavor. Today's nearly 4,000-square-mile range was formed from earlier WWII bombing and gunnery ranges and subsumes several other agencies' properties within its boundaries. The material remains of the early Cold War era are scattered throughout the arid desert landscape at isolated launch pads, blockhouses, test sites, and instrumentation stations, and testify to the United States' earliest



WSMR in south-central New Mexico became the birthplace of the American missile program with the construction and use of V-2 rocket facilities from 1945 to 1952, now preserved as part of the Launch Complex 33 National Historic Landmark.

efforts on the road to space. In partnership with the U.S. Navy on post and neighboring Holloman Air Force Base (HAFB), WSMR was the scene of pioneering efforts in missile-systems testing, space biology, guidance, telemetry, meteorology, and atmospheric science, which allowed the United States to leap beyond the narrow constraints of the military arms race toward the stars.

This study focuses on historic military properties built and used from 1942 through 1964, while the range was under the control of the U.S. Army Office of the Chief of Ordnance (OCO). All surviving WSMR buildings built prior to or during 1964 have been reviewed. Selected properties dating from 1942 to 1964 that effectively illustrate the period are described in an abbreviated narrative, with accompanying photographs, plans, and documentation. The narrative format is based on draft guidance, dated May 1992, in the Historic American Buildings Survey (HABS) *Historian's Procedures Manual* (National Park Service 1992), adapted to the types of architecture and the military context (i.e., military projects are identified rather than owners/occupants). Detailed inventory documentation and specific recommendations for preservation have been furnished separately to WSMR to assist with Section 110 assessment needs.

Due to project constraints and security limitations, this report relies heavily on secondary historical sources, including various official and informal Army histories, as well as internal documents, monthly reports, etc., many of which exist only on microfilm or in almost illegible copies of original dittos. Despite its recent age, much of WSMR's history and thus its architectural context have been obscured through a combination of factors, including change in mission, destruction of property records, and the security classification of most project materials. Tom Starkweather, who acted as unofficial WSMR historian and had access to old top-security records, reviewed literally "hundreds of boxes of OCO files" at the National Archives, the Corps of Engineers History Office (Fort Belvoir, VA), the NARA Military Reference Branch (Suitland, MD), the Army Records Center (St. Louis), and the Corps of Engineers Documents Branch (Ft. Worth). He was particularly interested in materials concerned with the captured V-2 program and the Paperclip scientists who formed the core of the Proving Ground's research cadre. After an exhaustive search, he commented, "I never found a single reference to Operation Overcast, or Paperclip as it was later called. Strange isn't it?"

Insignia of the Ordnance Department, U. S. Army.

Figure 3. Austin L. Vick, former National Range Data Collection Chief, designed the WSMR logo in 1969. This logo, first used in 1970, is usually rendered in crimson, white, and blue, with a gold-braid border. Crimson, along with gold braid, was the official color of the Ordnance Branch of the U.S. Army. White represents the gypsum dunes at White Sands National Monument, from which WSMR takes its name. Blue symbolizes the clear southwestern skies essential to WSMR's mission (and perhaps, the U.S. Navy, which has been an integral part of WSMR since its birth). The large central star represents a significant birth in world history, and could also be interpreted as symbolic of the first atomic explosion at Trinity. The missile orbiting the birth star symbolizes the birth of America's missile and space activity, echoed in the logo's subtitle. The two star clusters of four and five stars, each, represent the year WSMR was founded, 1945. Added together, they total nine, commemorating the day WSMR (then WSPG) was officially established, July 9th.

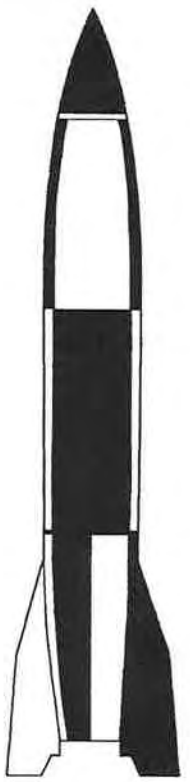
The new 50th-anniversary logo was designed by Joe Chavez, Materiel Test Directorate, WSMR.

Substantial effort was necessary to establish a detailed chronology (Appendix A) and associate specific missile test programs with architectural properties. Although many early site plans and building drawings are centrally archived in the Civil Engineer's Office, project files essential for establishing the context and details of the physical properties are either scattered in program-office libraries and files or remain unknown. Luckily, an increasing number of outdated, declassified files have been transferred to the WSMR Museum. Unfortunately, cataloging of these materials is just getting underway. But several "gems" essential to the success of this project were unearthed, including the history and status of the *Army Ordnance Department Guided Missile Program, 1 January 1948* (OCO 1948).

Genesis of the Star Throwers

The picture that has emerged of the setting for WSPG and the beginning of the missile program is tantalizing. WSPG's involvement with captured German V-2 rockets is well known. By July 1945, 640 tons of rocket equipment and materiel, including parts for 90-100 V-2s, had been captured at the production factories near Nordhausen, shipped to the United States, loaded into 300 freight cars, and were in transit to the Proving Ground. More than 100 Paperclippers were also enroute. Twelve tons of documents, representing 15 years of experimental research, had been recovered from a mine shaft at Dorten near Goslar, north of Nordhausen, where they had been carefully hidden by Wernher von Braun's staff.

The U.S. Military was interested in more than the V-2, however. In a cable to the Chief of Ordnance dated May 23, 1945, Eisenhower had recommended a high priority for materials relating to the *Wasserfall* antiaircraft rocket. American engineers had already reverse-engineered and tested a copy of the V-1 Buzz Bomb from parts recovered at impact sites, and at least two crashed V-2s had been recovered from Sweden and Poland in 1944. At the close of the war in Europe, the Germans reportedly had up to 138 different rocket projects underway. Several types of missiles in addition to the V-1 and V-2 were under development or nearing production in the Nordhausen area, including the *Wasserfall* (in production at Bleicherode) and *Schmetterling* surface-to-air missiles (SAMs). The Henschel Flugzeugwerke (or Aircraft Works), which had developed the *Zitteroschen* (the first winged, guided air-to-surface missile, canceled in 1944), was located in Kassel, only 60 miles east of Nordhausen and



Vergeltungswaffe 2
(vengence weapon 2)
German A-4 (V-2)
(Aggregate 4)
length: 46 feet
range: 190-200 miles

This map of Cold War Germany highlights significant locations in the German WWII missile program: Pennemünde, site of the V-1 and V-2 research facilities; major centers of missile production at the close of the war in Berlin, Kassel, Nordhausen, and Bleicherode, where the Allies captured German missile program personnel, documents, and materiel; and Oberammergau and Reutte, where the Paperclippers surrendered.

may have been producing the Hs 293 glider bomb and the Hs 298, the world's first air-to-air missile (AAM). The *Fliegende Jäger-Rakete* X–4 AAM had also been developed in Kassel, as had the Fieslerwerke *Natter* SAM, three of which had been captured near Kirscheim and transported to the United States.

Two other key missile-production locations had also been in American hands: Berlin (home of a subsidiary Henschel factory and Rheinmetall-Borsig) and Oberammergau (last retreat of the Peenemünde research team and home of Messerschmitt Werke). Rheinmetall-Borsig has produced the *Rheinbote* tactical SSM, the *Rheintochter*, *Feuerlilie*, and *Hecht* SAMs, and the *Fritz X* ASM.

Long before the war, scientists and engineers at CIT (California Institute of Technology) had become interested in the peaceful applications of rocketry. Led by Theodore von Karman, Frank J. Malina, and Edward S. Parsons, this group formed GALCIT (Guggenheim Aeronautical Laboratory, CIT). By 1939, GALCIT was engaged in designing JATO (Jet-Assisted-Take-Off) rocket boosters for the Army Air Corps. In 1941, Robert Goddard was invited to join the JATO project, leading to his relocation the following year from Roswell, NM, to Annapolis, VA. In 1943, von Karman, Hsue-shen Tsien, and Malina of GALCIT were asked to help evaluate British Intelligence reports on German rocket activities. Prior to this analysis, U.S. interest in rockets had focused exclusively on JATO and short-range, tactical solid-fuel rockets like Tiny Tim and Holy Moses. The August GALCIT report was alarming and included a recommendation that the United States begin development of a long-range ballistic missile. The report caught the interest of the Office of the Chief of Ordnance and led directly to the formation of the Jet Propulsion Laboratory. The missile design specifications in the resulting OCO contract were parallel to those written in 1936 for the German A–4 (V–2). The CIT project was redesignated ORDCIT, and its facility was renamed JPL-GALCIT. In November, Malina spent 10 days examining recently captured V–1 and V–2 launch facilities in France.

The original ORDCIT program envisioned three sequential and different developments: Private A, Private F, and Corporal. The first, Private A, used a composite solid fuel and launched a cylindrical, rear-finned missile with booster from an inclined-rail box launcher. Private F used the same engine and fuselage with rear wings and forward canard fins added, fired from a railed ramp. The third, Corporal E, used liquid propellant and was launched vertically from a raised platform. By the time captured German rocket materiel began to arrive at

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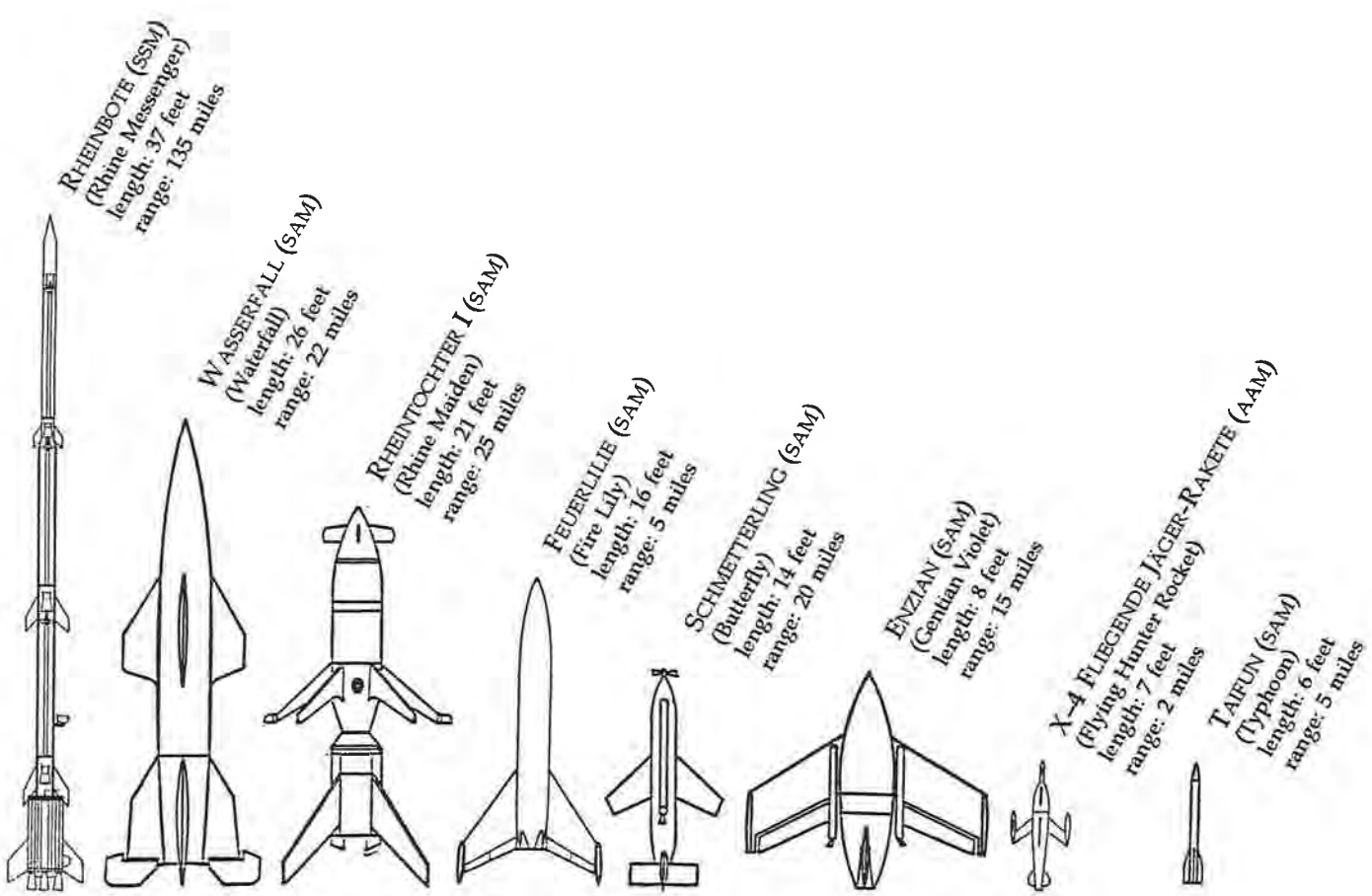

The great variety of Geman missile types and configurations is evident in this composite view of the major operational missiles produced during WWII, many of which never reached full production and deployment (dimensions approximate).

the Proving Ground, ORDCIT test firing had relocated to Camp Hueco, Fort Bliss, TX, and shortly thereafter, to WSPG. The OCO had also contracted with Bell for the Nike missile, which began testing at WSPG the following year.

The GALCIT report probably also influenced the April 1946 contract with Consolidated Vultee for Project MX-774, planned as a backup program for the Navaho I long-range ramjet. Project MX-774 pursued the feasibility of two different approaches toward long-range rocket-delivery systems. The first envisioned a subsonic winged ramjet cruise missile and was abandoned by December. The second approach, under the direction of Karel Bossart and known as Hi-Roc, led directly to the Atlas, America's first true ICBM. At the same time, the Army Air Force at Wendover, UT, had begun the Boeing GAPA (Ground to Air Pilotless Aircraft) and JB-2 programs.

The apparent influence of the German rocket program is striking. Until 1944, U.S. Military missile programs had concentrated on small, tactical air-to-ground rockets, rail- or tube-launched from the undersurface of aircraft wings. By 1945, the U.S. missile program included the full range of missile configurations developed by Germany. Propellants included both solid and liquid systems. Configurations included Oberth's now-classic, finned, cylindrical ballistic rocket, Max Valier's marriage of a jet engine to an aeroplane (first achieved practically in the V-1), and an intermediate form that added wings or large fins to a cylindrical rocket, often with canard surfaces forward, as seen in *Rheintochter, Zitteroschen, Fritz X,* and *X-4 Jäger-Rakete.*

Many early U.S. missiles are already recognized as derivatives of German systems. The V-1 resulted in the JB-2 (and Navy Loon); the Air Force Matador, Mace, Snark, and Navaho; and the Navy's Regulus. MX-774 Hi-Roc, Redstone, and Atlas were conceived from the V-2. The Loki AAM by JPL and Bendix Aviation was based on the German *Taifun*. The Talos, Terrier, GAPA, Rascal, and numerous slim, multistage sounding rockets resemble the German *Wasserfall* and *Rheinbote*, the first military multistage missile. And Nike bears a close resemblance in form and characteristics to *Rheintochter*. Even the early 1950s, streamlined "Buck Rogers" design for the WSPG post main gate sign shows a strong German influence, looking much like an *X-4 Jäger-Rakete* with its four wings removed.

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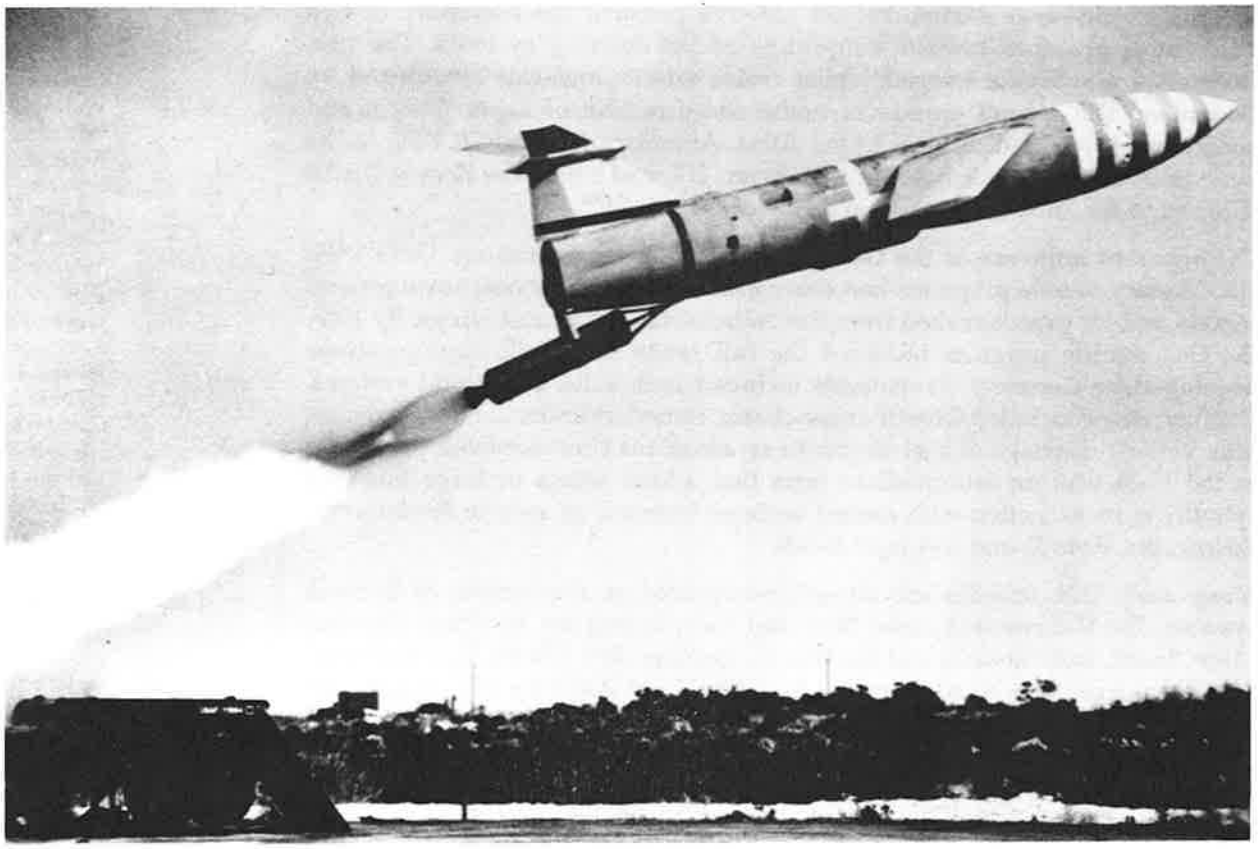

The B-61 Matador SSM resulted from a 1947 contract with Glenn L. Martin Company. Its predecessor, Snark, the Matador, itself, and its descendent, Mace, exemplify Max Valier's pre-WWII proposal to marry a jet engine to an aeroplane, which produced in the German V-1.

By the close of 1945, all the pieces, German as well as American, were in place at WSPG: the JPL ORDCIT, General Electric Hermes, and Bell Nike projects, 300 freight cars of captured rocket materiel and research documentation, and the first of 118 German scientists and engineers (initially housed at nearby Fort Bliss). Army Launch Area 1 (LC-33) was completed and a contract for the first static test stand (100-K) was awarded. The Star Throwers had arrived in the deserts of the Tularosa.

The results were unimaginable. By the end of 1945, JPL had completed a brief feasibility study for an artificial earth satellite. JPL concluded that the launch of a 4.5-kilogram payload would require a five-stage rocket weighing 1.4 million kilograms achieving a speed of 40,000 kilometers per hour. In just 12 years, the Russians (followed shortly by the American Explorer I) achieved the impossible—Sputnik I, weighing 83.5 kilograms. Satellite programs accelerated and in less than one year, Sputnik III, more than an order of magnitude heavier, was launched.

By the early 1960s, when the Office of the Chief of Ordnance was discontinued, the results of the Proving Ground's early programs were maturing and bearing impressive fruit. John Kennedy had committed America to landing on the moon in the next decade; we had entered orbital space on a routine basis with the Mercury program and reached another planet with Mariner. These and other programs (discussed separately in the Missile Programs chapter) evolved in tandem and as offshoots of the fledgling efforts begun in the New Mexico desert 50 years ago.

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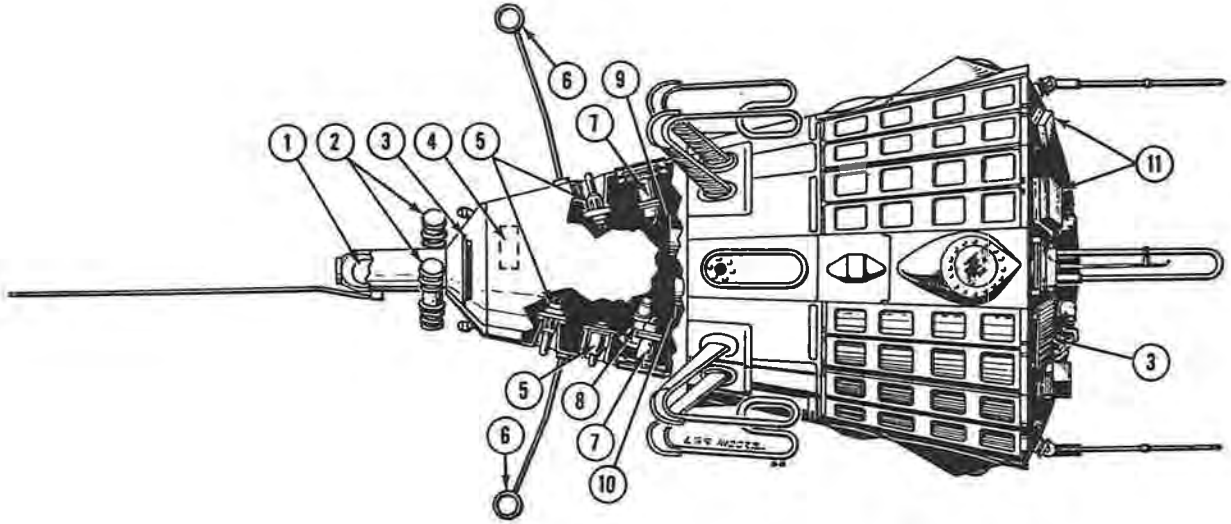
Werner G. Tiller
Dr. J. G. Tschinkel
Arthur Urbanski
Fritz A. Vancersee
Magnus von Braun
Dr. Wernher von Braun
Werner E. Voss
Theodor K. Vowe
Prof. Dr. Carl Wagner
Dr. Hermann K. Weidner
Walter Wiesman
Albin E. Wittmann
Hugo H. Woerdemann
Albert Zeiler
Helmut Zoike



Sputnik III

1. MAGNETOMETER
2. PHOTO-MULTIPLIERS FOR THE REGISTRATION OF THE CORPUSCULAR RADIATION OF THE SUN
3. SOLAR BATTERIES
4. DEVICE FOR THE REGISTRATION OF PHOTONS IN COSMIC RAYS
5. MAGNETIC AND IONIZATION MANOMETERS
6. ION CATCHERS
7. ELECTROSTATIC FLUXMETER
8. MASS SPECTROMETRIC TUBE
9. DEVICE FOR THE REGISTRATION OF HEAVY NUCLEI IN COSMIC RAYS
10. DEVICE FOR MEASURING THE INTENSITY OF PRIMARY COSMI RADIATION
11. PICK-UPS FOR THE REGISTRATION OF MICROMETERS

The Russian Sputnik III, launched May 15, 1958, weighed 2,925 pounds, the maximum payload for the SS–6 missile, and was 16 times heavier that the first successful sattelite, Sputnik I, launched less than one year earlier, on October 4, 1957.

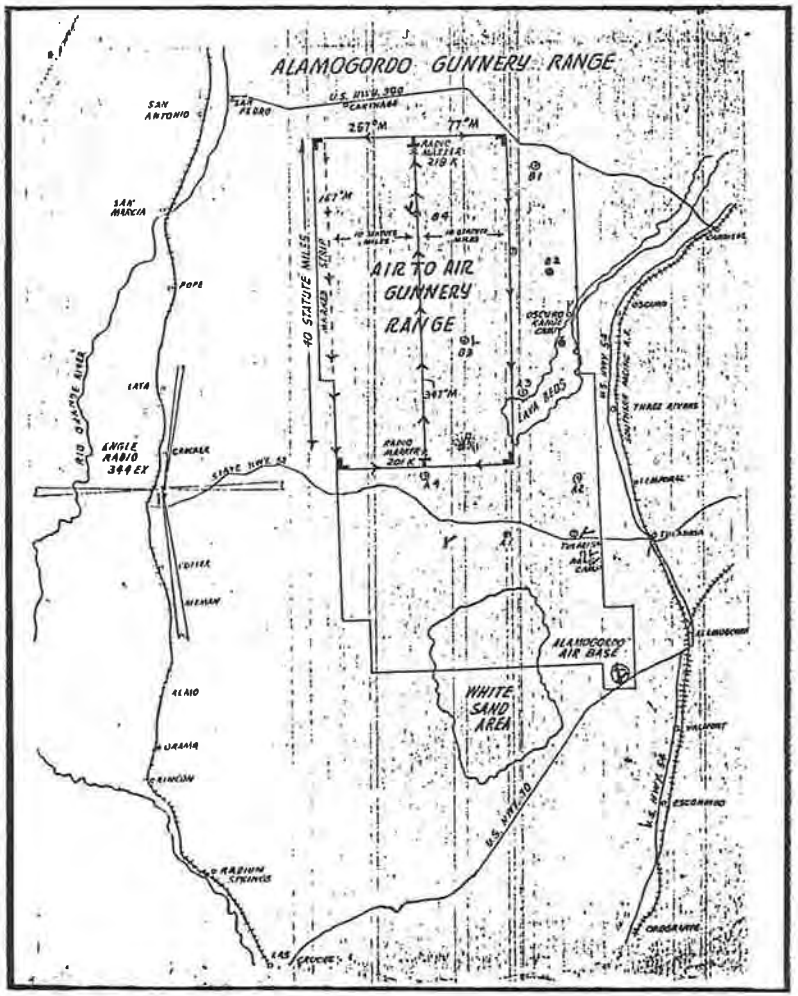
A BRIEF HISTORY OF WHITE SANDS PROVING GROUND

WORLD WAR II AND THE TULAROSA BASIN

1941 In 1941, the U.S. Army Air Force (USAAF; on June 20 of that year the name was changed from the USAA Corps) began planning for rapid expansion of existing training facilities throughout several western states. 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 (Couchman 1994). 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 Fort Bliss reservations. Construction began at Alamogordo Army Air Field on February 6, and the base was elevated to full status on June 1.

circa 1942



This map of the Alamogordo Bombing and Gunnery Range was issued by Headquarters, 16th Bombardment Operational Training Wing, (Biggs) Army Air Base, El Paso, TX, and distributed with a briefing memorandum (no. 50–39, dated November 11, 1943) to bomber crews in training (courtesy of Dan King).

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.

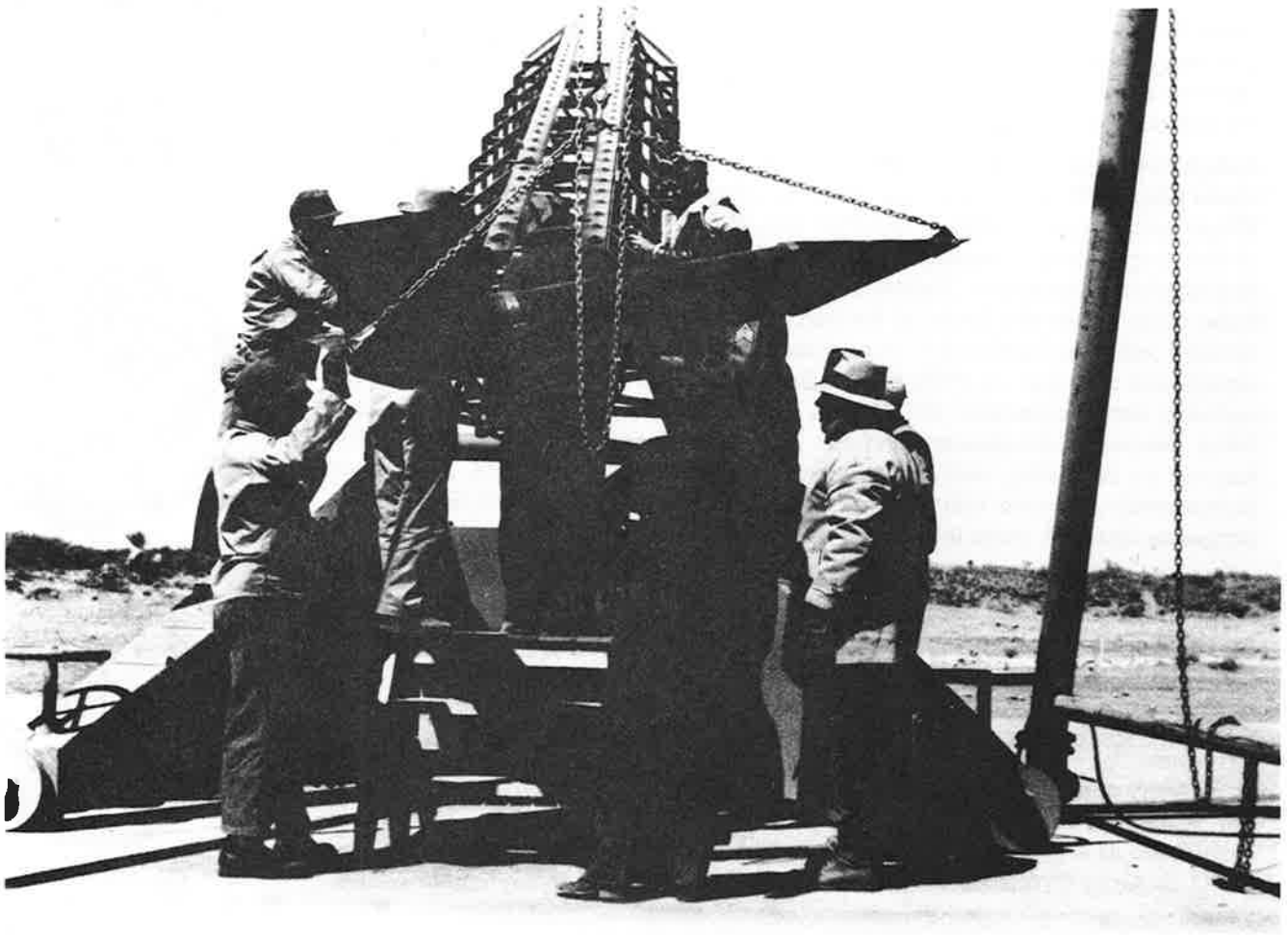
On October 3, 1942, Goddard's early rocketry research bore fruit in Peenemünde, Germany, with the first successful launch of an A-4 (V-2) missile for the German Army. This rocket was larger but almost identical to missiles Goddard tested years earlier at Roswell. In December, the German Air Force pulse-jet propelled V-1 was also successful in tests at Peenemünde, although this first flight only achieved a distance of 3,000 yards (Helfers 1954).

Ground Forces

Air Forces

Service Forces

1943 U. S. Army and Air Force histories suggest (but do not document) that by 1943, the Alamogordo Army Air Field (AAAF) was already being informally considered as a guided-missile development site. The Rocketry Branch, part of the U. S. Army Ordnance Corps, was officially established in September of that year.

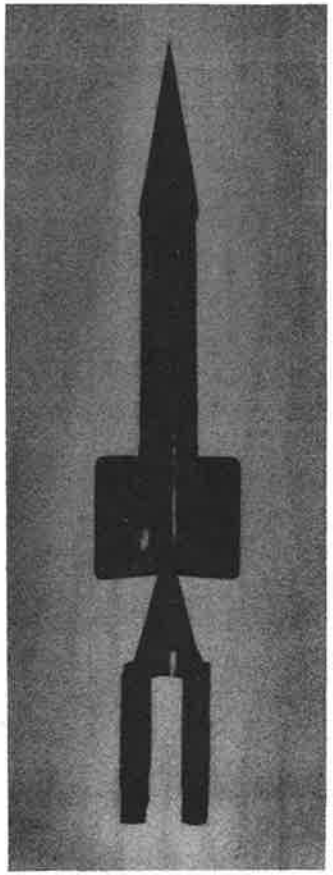


The ORDCIT Private F was tested from its inclined rail launcher in April 1945 on Hueco Range, Fort Bliss, TX.

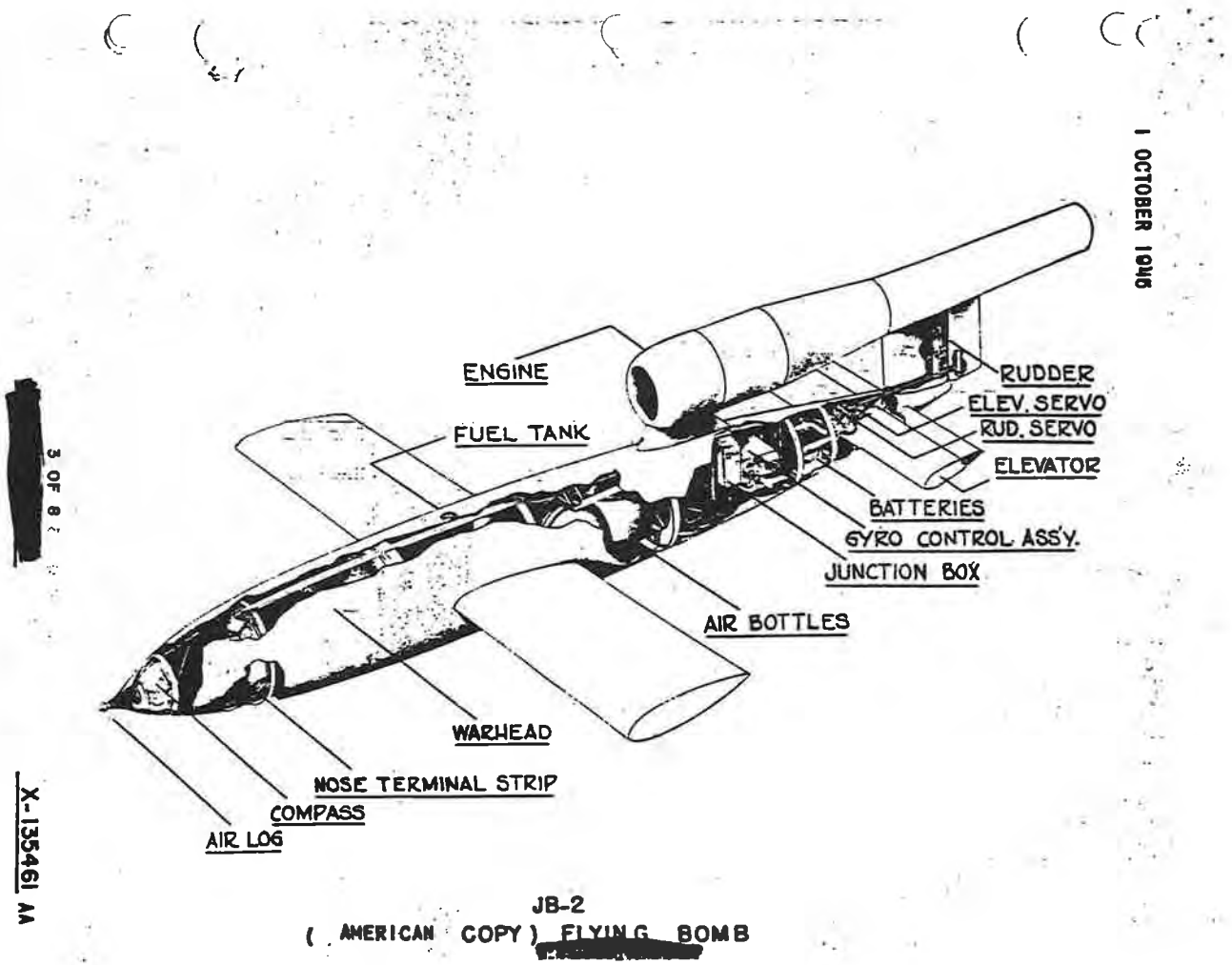
In August, the Luftwaffe in Italy began air attacks on allied combat ships with Fritz X, the first successful modern ASM. On September 9, 1943, a 1,400-kg armor-piercing Fritz X sank the battleship *Roma* and severely damaged the *Italia* in the Strait of Bonifacio. During the next week, Fritz X sank two cruisers, damaged two more cruisers 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, for the Army's first ballistic-missile program to "develop long range rocket missiles and ramjets and...associated guidance and launching equipment" (OCO 1948). 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. Burrows (1990:38) suggests an alternative explanation for the name WAC." 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 (Starkweather 1989). 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 (Starkweather 1989).



Private A.



The JB-2 was a reverse-engineered, "chinese" copy of the German V-1 Buzz Bomb, with a maximum range of 150 miles at speeds of 400 miles per hour and a warhead filled with 1900 pounds of aluminized TNT. It was designed for ground-launch from ramps and trailers, and air-launch from B-17 and B-29 bombers.

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 were engaged in "reverse-engineering" a V-1 copy, known as the 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.

circa 1942

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 lbs 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 and rail and power facilities—near a permanent Army post. Starkweather (1989) 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 alternatives. 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. By December, OCO had decided to include the V-2 rocket within the Hermes Project and began planning for 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.

circa 1943

Commercial advertising during World War II.

The original WSPG cantonment, seen from the south, was photographed from a light aircraft in 1946 by WSPG Signal Corps Tech. Sgt. Martin Sauber, attached to the 1st Guided Missile Battalion, Fort Bliss, TX.

1945 Early in 1945, OCO contracted with Western Electric's Bell Telephone Laboratories to develop a supersonic surface-to-air guided missile to attack high-speed, high-altitude aircraft. Bell (which 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 by October of the following year. 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 Ft. 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 train of captured V-2 rocket components was underway 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 reerection of three barracks buildings

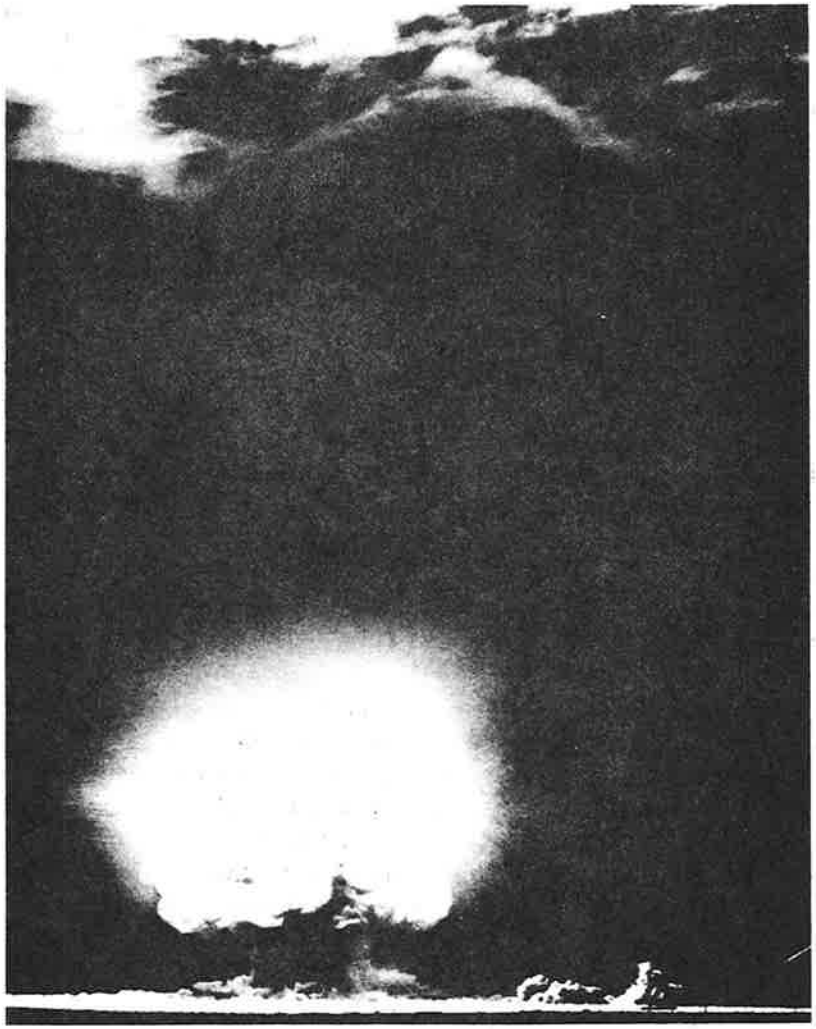
WAR CALLS COME FIRST

BELL TELEPHONE SYSTEM

circa 1943

circa 1944

Commercial advertising during World War II.



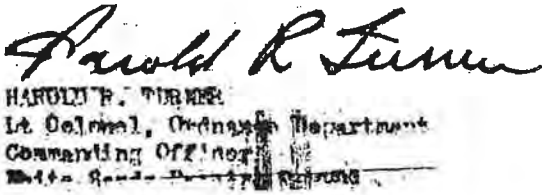
The Trinity Test, the world's first atomic explosion (ignited at 5:29:45 a.m. Mountain War Time on July 16, 1945), irrevocably changed history and set the stage for the nuclear arms race during the Cold War.

(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 reerected the three barracks moved from Sandia Air Base.

The new 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.

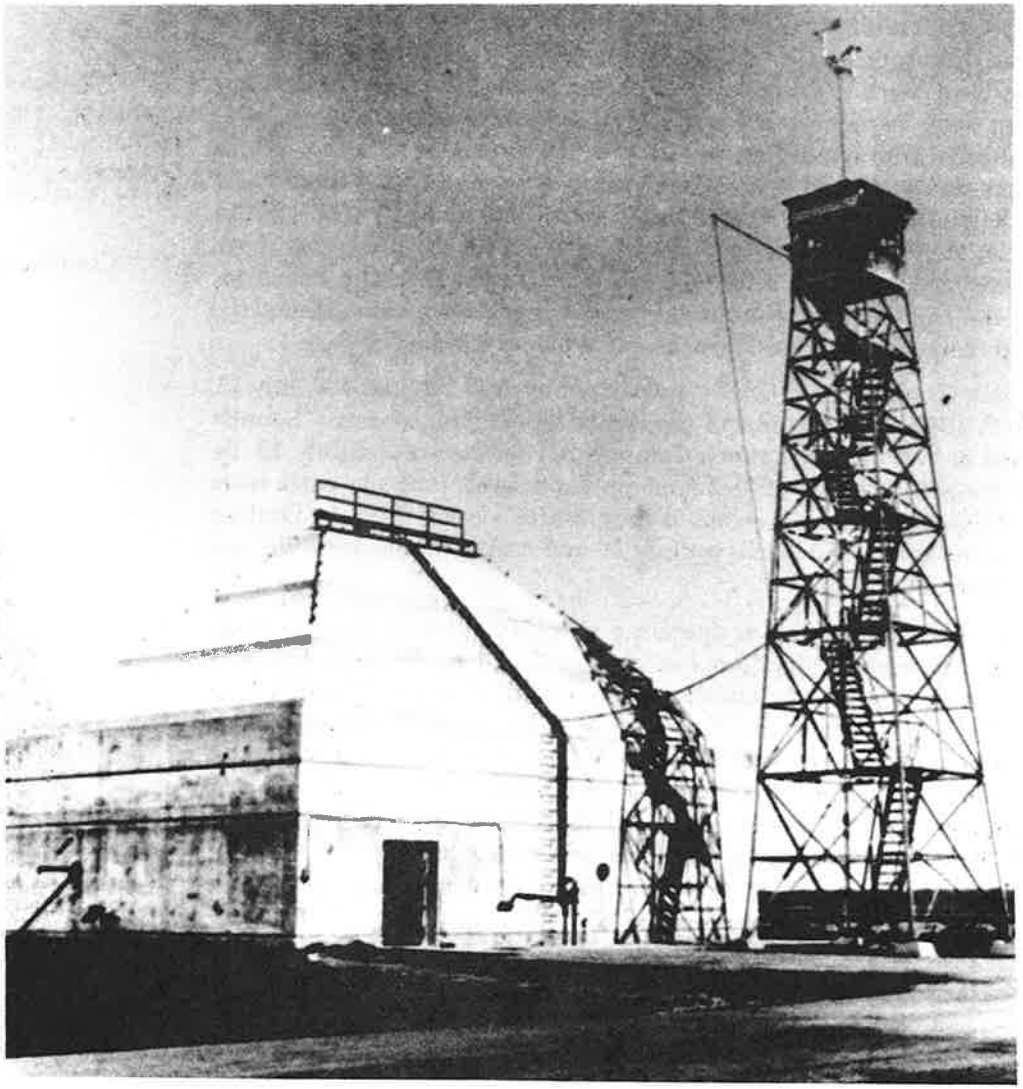
Meanwhile, the Manhattan Project, operating in secret at Site Y (Los Alamos, NM) under the command of Maj. Gen. Leslie Groves, had successfully designed the world's first atomic device. Unbeknownst to Col. Turner, WSMR's first commander, the Commander of the Alamogordo Bombing and Gunnery Range, Col. Roscoe Wilson, had reluctantly transferred control of the 432 square mile Trinity Site to the Manhattan Project (Powell and Scala 1994). 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 (Starkweather 1989). 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.



Commander, WSPG, 1945 to 1947.

The Trinity monument at Ground Zero.

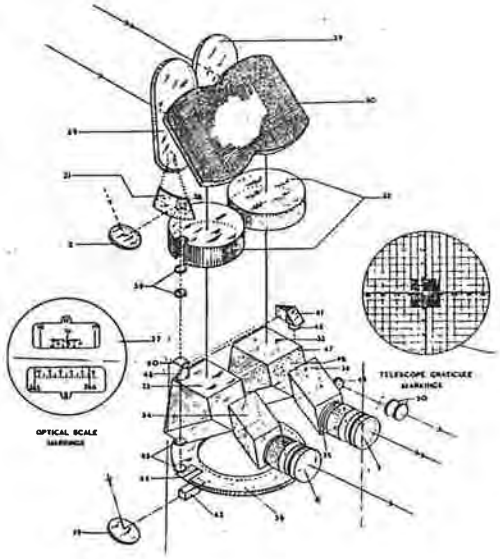


The Army blockhouse and an early observation tower (since removed) were part of the first launch complex at WSPG Army Launch Area No. 1, now a National Historic Landmark known as LC-33.

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 for construction of the first (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 also 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 General Electric employees at WSPG had begun to identify, sort, and reassemble V-2 components in the reerected hangar (Building 1538), designated as Assembly Building 1.

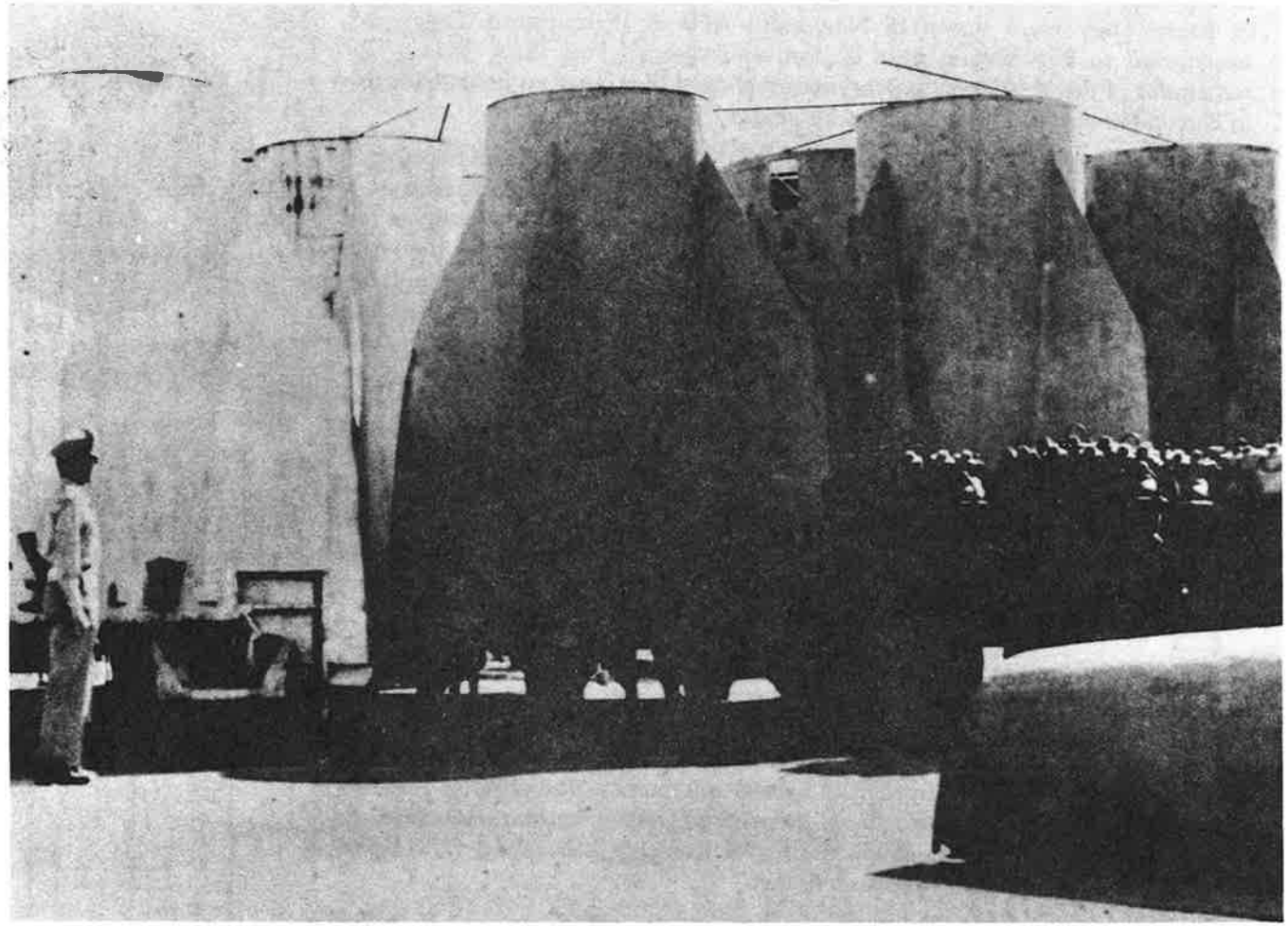
Insignia of the U.S. Army Ordnance Department.



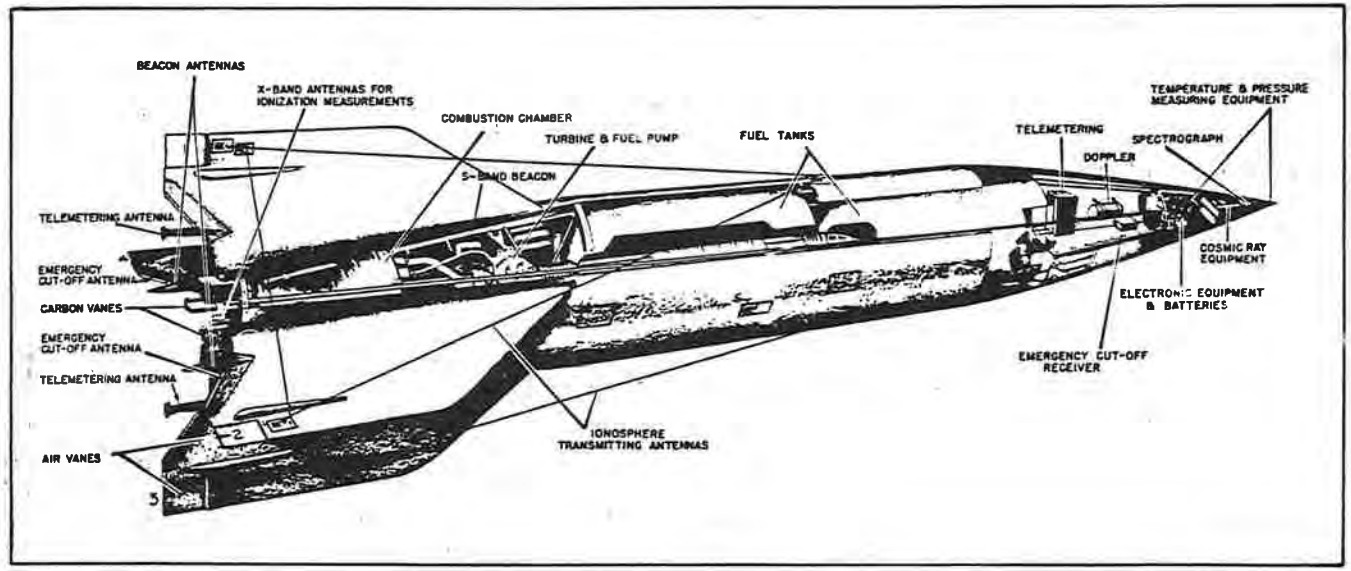
Optical system, German periscope flash-spotting theodolite, circa 1945.

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



These V-2 tail sections were a small part of the captured German missile materiel sent to WSMR in 1946.

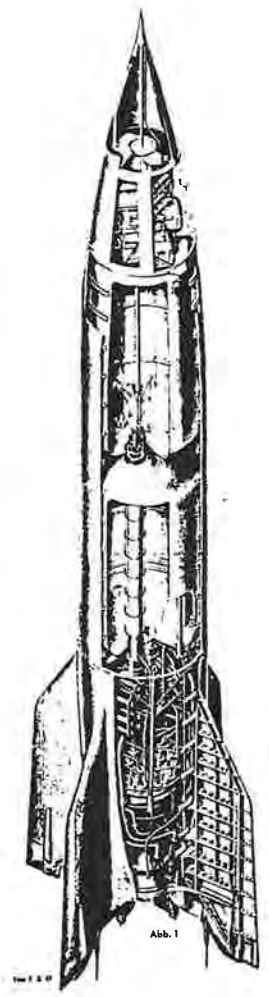


This July 1946 schematic illustrates a V-2 equipped for upper-atmospheric research.

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, among others (Brown, et al. 1959:71; Burrows 1990:43).

In April, the Army Air Corps contracted with Consolidated Vultee (later General Dynamics) for a study of 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 which actually started at Trinity, but is usually marked by 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 (Brown et al. 1959:65). The following day, Operation Overcast was officially renamed Operation Paperclip. On March 21, Strategic Air Command (SAC) was created, 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 increasing 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.

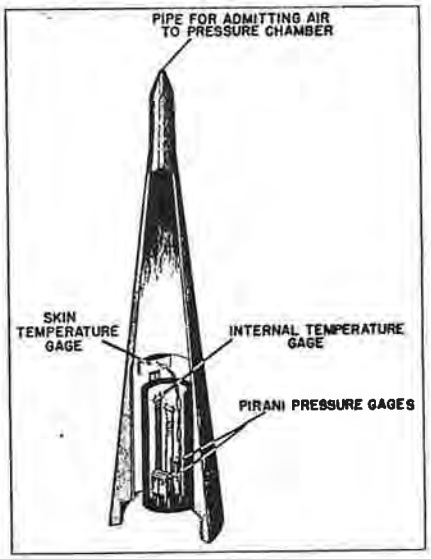


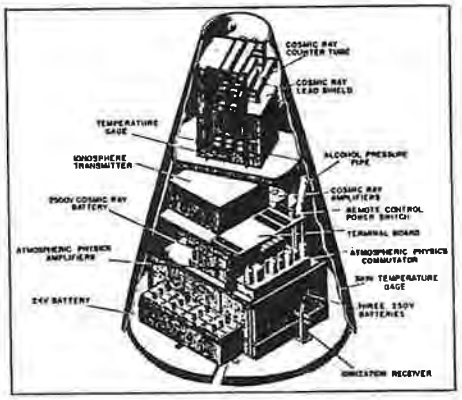
Cutaway of a V-2.

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.

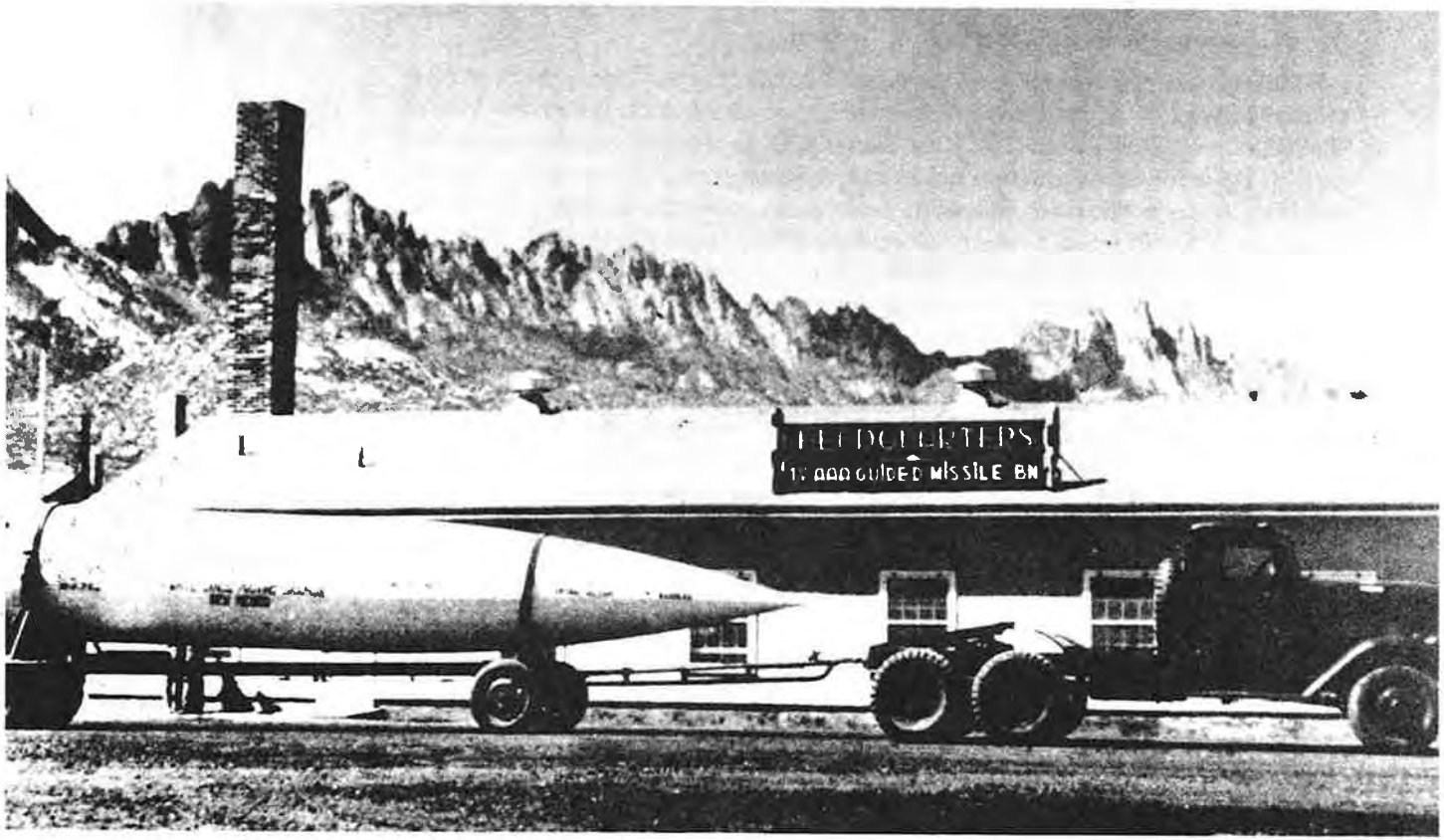
In January 1946, Dr. George Gardiner, head of the Physics Department at New Mexico College of Agriculture and Mechanic Arts (NMAMA, later New Mexico State University) met with Col. J. G. Bain, OCO, to discuss possibly providing student labor for data reduction of ballistic Askania films. The resulting contract with the Army's Ballistics Research Laboratory, effective in May, led to the founding of the Physical Science Laboratory (PSL, originally the Laboratory of Applied Science) by the Regents of the college 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 between Lewis Del Sasso and NMAMA's Harold Brown at the Amador Hotel in Las Cruces early in 1947, a third contract, this time with the Naval Research Laboratory, was undertaken (Starkweather 1989). PSL has continued since that time 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 (Billups 1959). On September 17, Bell engineers static-test fired the first Nike surface-to-air missile (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 reached a size of approximately 200 before mid-year 1947.





Detail of V-2 nose cone and warhead instrumentation for atmospheric research.



This reconfigured V-2, parked in front of the 1st Guided Missile Battalion Headquarters at WSPG, is ready for transport on a Vidalwagen to the launch area.

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, three damaged Zeiss theodolites, shipped to WSPG with the loads of V-2 missile parts, were cannibalized and adapted into two usable instruments by local personnel.

The original ORDCIT WAC Corporal program was nearly complete by early 1947. On February 24, 1947, 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

Fourth Army

Eighth Service Command

Ninth Service Command

28 July 1947

To: Whom It May Concern

From: Commanding Officer, Alamogordo Army Air Field and AAF Special Range, Alamogordo, New Mexico

Commanding Officer, White Sands Proving Ground, Las Cruces, New Mexico

1. Following is a proposed operating agreement for the cooparative use of the White Sands - Alamogordo missile testing facility. This proposal was jointly composed by the Commanding Officers, White Sands Proving Ground and Alamogordo Army Air Field and is submitted as a working arrangement as seen from this level.

2. For such consideration or action as higher authority may consider desirable.

(signed)
PAUL F. HELMICK
Colonel, Air Corps
Alamogordo Army Air Field

(signed)
HAROLD R. TURNER
Lt. Colonel, Ordnance Department
Commanding Officer
White Sands Proving Ground

P-R-O-P-O-S-A-L

"NEW MEXICO GUIDED MISSILES RANGE"

A. DEFINITION: The New Mexico Guided Missiles Test Range will consist of the following areas and facilities:

1. White Sands Army Ordnance Proving Ground, and its associated range area under control of the Chief of Ordnance.

2. Alamogordo Army Air Field and the Alamogordo AAF Special Range under the control of the Commanding General, Air Materiel Command.

3. The Navy installations at the White Sands Proving Ground such Navy facilities to be under the technical direction of Chief, BU ORD, Navy.

B. PURPOSE: The purpose of establishment of the New Mexico Guided MissilesTest Range is to provide a common range to be used by the Army Air Forces, Ordnance Department, other War Department establishments and the Navy activities in the development and proof firing of guided missiles. Firings will normally be conducted by personnel of the developing agency primarily interested.

C. ORGANIZATION AND RESPONSIBILITY OF COMMAND OF NEW MEXICO GUIDED MISSILES TEST RANGE:

1. The Commanding Officers of the White Sands Army Ordnance Proving Ground and the Alamogordo Army Air Field will constitute a board for coordinating the mutual use of all facilities and areas in the New Mexico Guided Missiles Test Range, and will coordinate all operations, both for Army Air Forces and Ordnance projects as well as for the projects of any other agency authorized the use of the New Mexico Guided Missiles Test Range.

D. SECURITY:

1. Will rest with the Commanding Officers of the White Sand Proving Ground and the Alamogordo Army Air Field. Where joint interest exists, security measures will be coordinated between the two Commanding Officers.

2. The release of information relative to test firings will be by the Commanding Officer concerned under the provisions of regulations set forth by the Commanding General, Air Materiel Command, and the Chief of Ordnance, respectively.

E. SAFETY:

1. Launching Sites:

a. Safety precautions around the launching sites and within the fixed installations will be the responsibility of the Commanding Officer concerned.

2. Range Areas:

a. The safety measures required to protect range and instrumentation parties will be coordinated between the Commanding Officers, White Sands Proving Ground and Alamogordo Army Air Field.

3. Missile Recovery:

a. Missile recovery parties will be under the supervision of the developing agency concerned. Joint use of personnel and equipment will be coordinated between the Commanding Officer, White Sands Proving Ground and Alamogordo Army Air Field.

F. SIGNALS COORDINATION:

1. Purpose:

a. To coordinate and assign the use of all radio frequencies in order to prevent interference by duplication or by harmonics. To assist the projects operating in the New Mexico Guided Missiles Test Range to overcome difficulties encountered in the fields of radio, radio-telephony, radar, and related electronic forms of signal generation.

2. Personnel:

a. To be appointed by the Chief Signal Officer as requested by the Commanding Officers, White Sands Proving Ground and Alamogordo Army Air Field, and to be responsible to these Commanding Officers for the functions outlined above.

G. MISCELLANEOUS:

1. Real Estate:

a. The Commanding Officers of the White Sands Provir Ground and the Alamogordo Army Air Field will be responsible for administering real estate matters of the lands under their control.

Facsimile of the original July 1947 integration agreement between WSPG and AAAF establishing the New Mexico Guided Missiles Range.

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.

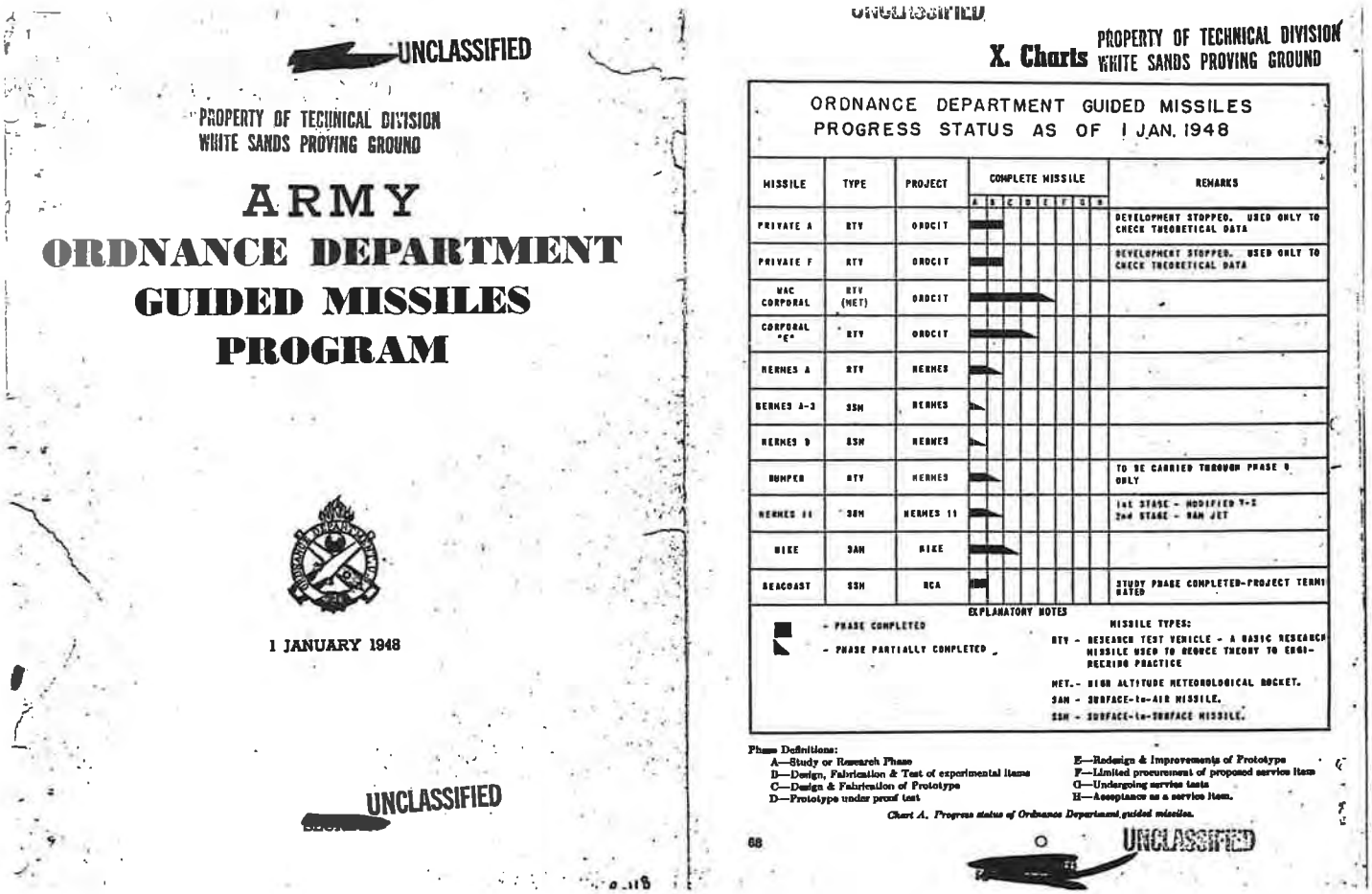
Signal Corps

In October, Air Force Captain Chuck Yeager flew the Bell X-1 beyond the sound barrier. Two months later, Major John Stapp made the first two rocket-sled runs at Edwards AFB Test Track in California.

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 surface-to-surface missile (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 onto 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 (known as Hermes II) impacted outside Juarez, Mexico.



UNCLASSIFIED

PROPERTY OF TECHNICAL DIVISION
WHITE SANDS PROVING GROUND

ARMY
ORDNANCE DEPARTMENT
GUIDED MISSILES
PROGRAM

1 JANUARY 1948

UNCLASSIFIED

UNCLASSIFIED

X. Charts

PROPERTY OF TECHNICAL DIVISION
WHITE SANDS PROVING GROUND

ORDNANCE DEPARTMENT GUIDED MISSILES
PROGRESS STATUS AS OF 1 JAN. 1948

MISSILE	TYPE	PROJECT	COMPLETE MISSILE (A B C D E F G H)	REMARKS
PRIVATE A	RTV	ORDCIT		DEVELOPMENT STOPPED. USED ONLY TO CHECK THEORETICAL DATA
PRIVATE F	RTV	ORDCIT		DEVELOPMENT STOPPED. USED ONLY TO CHECK THEORETICAL DATA
WAC CORPORAL	RTV (MET)	ORDCIT		
CORPORAL "C"	RTV	ORDCIT		
HERMES A	RTV	HERMES		
HERMES A-3	SSM	HERMES		
HERMES B	SSM	HERMES		
BUMPER	RTV	HERMES		TO BE CARRIED THROUGH PHASE B ONLY
HERMES II	SSM	HERMES II		1st STAGE - MODIFIED V-2 2nd STAGE - RAM JET
NIKE	SAM	NIKE		
BEACOAST	SSM	RCA		STUDY PHASE COMPLETED-PROJECT TERMINATED

EXPLANATORY NOTES

- PHASE COMPLETED
- PHASE PARTIALLY COMPLETED

MISSILE TYPES:

RTV - RESEARCH TEST VEHICLE - A BASIC RESEARCH MISSILE USED TO REDUCE THEORY TO ENGINEERING PRACTICE
MET. - HIGH ALTITUDE METEOROLOGICAL ROCKET.
SAM - SURFACE-to-AIR MISSILE.
SSM - SURFACE-to-SURFACE MISSILE.

Phase Definitions:
A—Study or Research Phase
B—Design, Fabrication & Test of experimental items
C—Design & Fabrication of Prototype
D—Prototype under proof test
E—Redesign & Improvements of Prototype
F—Limited procurement of proposed service item
G—Undergoing service tests
H—Acceptance as a service item.

Chart A. Progress status of Ordnance Department guided missiles.

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Cover and chart from the 1948 OCO report describing the ORDCIT, Hermes, and Nike missile programs.

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, reported on 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*). Loki was contracted to Bendix Aviation and JPL after initial feasibility studies were completed in 1948–1949 and 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 (King 1963:3).

GE launched the first successful, electronically controlled missile, V-2 no. 36, on February 6. 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.

In addition to the three original Wendover programs (GAPA, JB-2, and Tarzon) transferred in 1947, the Air Force at Holloman had initiated 11 new missile and drone test programs between 1947 and 1948. The first of four North American Test Instrument Vehicle (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 atop a V-2 stood 58 feet in height. The first flight successfully 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.

WSPG Instrumentation - 1948

Tracing the history of instrumentation on the early WSPG presents many more difficulties than following missile program histories. WSPG's primary mission has always been "firing and...testing of guided missiles and long range rockets" (WSPG 1950). Development of the instruments that made testing possible was a secondary task: "...maintain ...scientific, technical...and facilities for the purpose of performing functions in these fields" (ibid.).

At the onset of WWII, America lacked the technology to support such missions. By the close of the war, two sources of new technology emerged. The first represented the spoils of war: some equipment, tons of documents, and the Paperclip personnel. A second source, American and German technological creativity, needed only support and recognition. The greats of the U. S. missile and space program—von Karman, Van Allen, Tombaugh, and Steinhoff, as well as von Braun—applied their know-how to unprecedented problems in optics, electronics, and mathematics. Sadly, little of that history survives, due to an understandable bias toward missiles, themselves, which ignored significant achievements in the instruments that made them possible.

By the end of 1944, Ordnance Technical Intelligence was producing detailed reports on German missiles and instruments. By late 1945, Col. Holgar Toftoy was receiving design data on German sighting telescopes and theodolites from the British Military College of Science. In addition, a profusion of materiel, including Askania cinetheodolites, were shipped to the new range.

Periodically, WSPG or nearby AAAF prepared profiles of technical capabilities and studies of instrumentation facilities. These, technical documents, and operational manuals offer a glimpse of instrumentation evolution. Unfortunately, no history of milestones has been located. Therefore, this history of range instrumentation is provided only at intervals where documentation exists. The first of these profiles dates to 1948.

Some of the earliest instrumentation at WSPG consisted of little more than sighting poles for observing missile trajectory, azimuth, altitude, and climb angle. By 1948, Sky Screens had been developed to visually predict when a missile flight would continue beyond the range safety zone. Sky Screens were typical of early range instrumentation —low-tech, local solutions based on sophisticated (but manually computed) physical models.

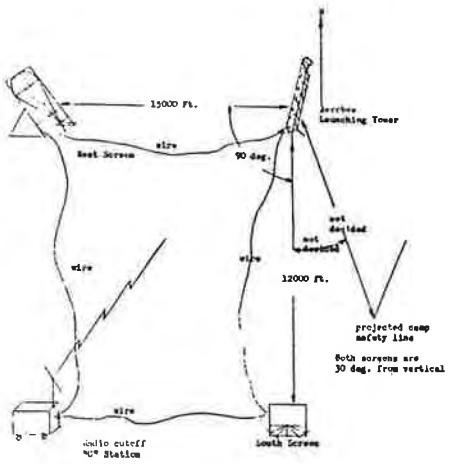
In 1948, Operations Section, 1st Battalion, 1st Guided Missile Regiment, compiled an "Instructor's Manuscript" on range instrumentation. WSPG's first tracking instruments were two Mitchell phototheodolites (at Stations C and E). Trajectory and acceleration were measured by three Bowen-Knapp cameras (at Stations U, V, and W). The five German Askania cinetheodolites (at Stations F, G, N, O, and P) were superior to American instruments because they photographed directly over azimuth and elevation circles, reducing errors. Two Ballistic

At Holloman, planning for the High Speed Test Track was initiated with Northrup and Hughes 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" (Department of the 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 I, into space less than a decade later.

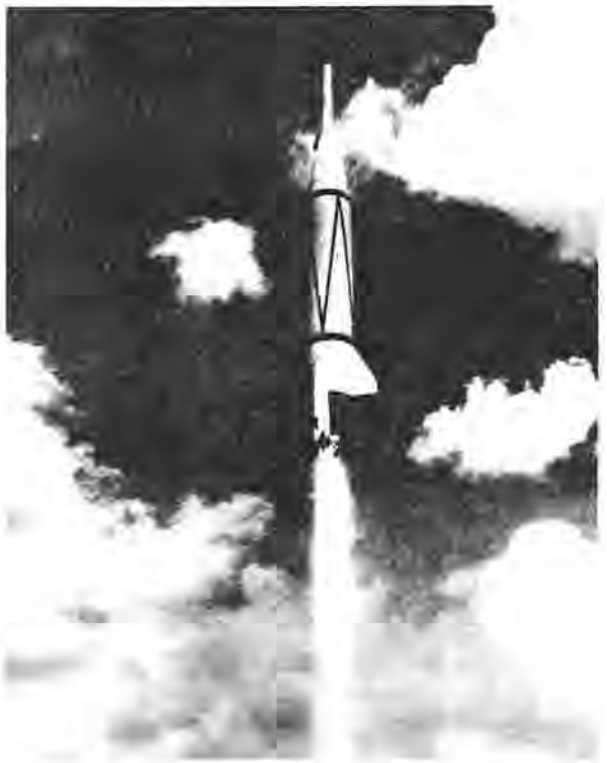
1949 On January 4, 1949, Army General Order 2.II designated the Signal Corps Engineering Laboratory at WSPG (which had been temporary since April 1946) as the 9577th Technical Service Unit, SCEL Field Station No. 1, at Fort Bliss. On October 26, an additional Signal Corps unit was added to the WSPG complement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

WSPG's second Commanding Officer, Brigadier General Phillip Blackmore, 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 (Redmond 1957). 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



Sky Screen setup for Aerobee rocket, WSPG.

cameras (at Stations D and R), developed for recording bomb ballistics by Aberdeen Proving Ground, were undergoing feasibility tests, and a third station was planned. Two tracking telescopes, a 4.5- and a 10-in., with focal lengths of 200 and 280 in., were also being tested to measure yaw, pitch, and roll. A 16-in. telescope, with variable focal lengths from 400 to 1,000 in., had just been completed. Two S-band and two X-band SCR-584 radars with optical trackers were operating at C Station central telemetry facility. The DOVAP System transmitted continuous radio to missile receivers which doubled the frequency and retransmitted to three or more ground receivers. These signals were relayed by wire to C station for analysis by ENIAC (Electrical, Numerical Integrator and Computer). Five Doppler stations were in operation by 1948, at Stations B, F, G, K, and an unidentified station north of D. A general-purpose time signal (a 2-sec, pulse superimposed on a 100-cycle sine wave) was continuously transmitted over telephone lines to all instrument stations and broadcast on two radio frequencies. The resulting signal sent a millisecond pulse with an accuracy of 1-in-1-million for timing instrumentation.



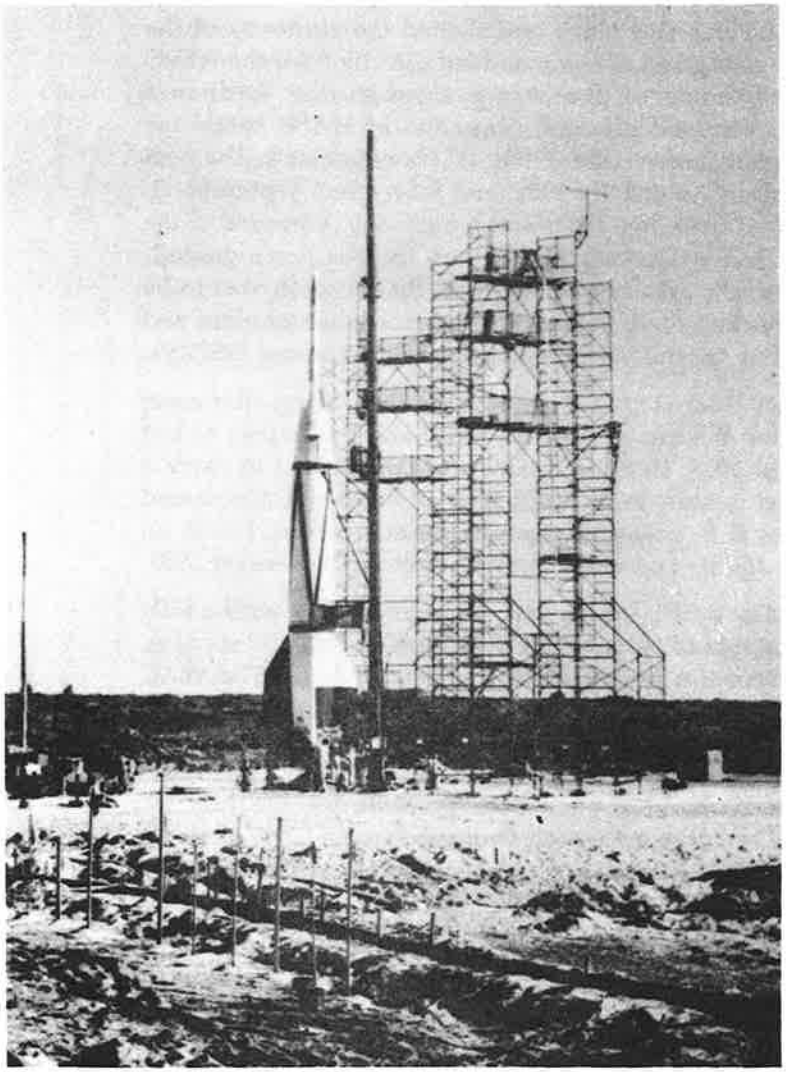
This Bumper-WAC was one of six fired from WSPG between May 1948 and April 1949.

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 title and administrative control 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 Holloman 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 (Redmond 1957:19).

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 and achieving the highest altitude ever reached to date by a man-made object. 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 and reached 2,039 miles per hour, the highest sustained speed ever reached to date 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), 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 air-to-surface missile, had begun with dummy drops of the Shrike re-entry vehicle.



The Bumper program used a two-stage rocket with a WAC Corporal mounted on the nose of a V-2, reaching an altitude of 244 miles and penetrating outer space for the first time in 1949.

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, and an additional 168,000 acres were transferred from Fort Bliss to WSPG in August.

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.

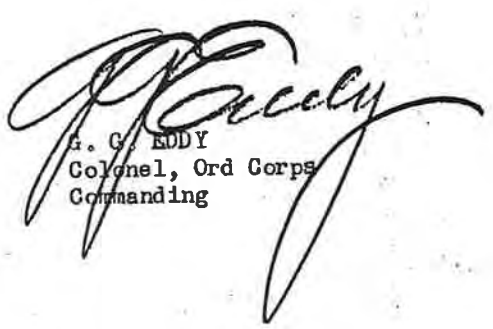
Korean War

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 that 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 Holloman 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 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, Captain Vincent



Signature of WSMR's 3rd commander.

WSPG Instrumentation - 1950

By 1950, WSPG had deployed two above-ground wire transmission systems on 270 miles of pole lines, and approximately 750 miles of multiconductor cable for voice communications, most of which was buried underground. The "close-in" wire system covered 30 miles north, and the "up-range" system extended 85 miles north and 35 miles east and west. These two systems carried Doppler and timing signals, camera pulses, and other instrument data from instrumentation stations to C Station and the Army and Navy Blockhouses at WSPG, and to the Holloman Central Control Building and Blockhouses 1 through 4.

BRL White Sands Annex, and SCEL Field Station No. 1 were responsible for data collection and tracking instrumentation. BRL operated ballistics, telemetry, standard-time base, and data reduction components. BRL's optical instrumentation included five Bowen-Knapp cameras, three wide-field, fixed Ballistic cameras, five Askania cinetheodolites, five long-focus Askanias teletheodolites, three Mitchell theodolites, and five tracking telescopes. Holloman also operated similar instrumentation independently of WSPG. The two systems were combined in the early 1950s.

Electronic instruments included C Station's four tracking radars, three types of missile-borne radar beacons, and 14 DOVAP stations. BRL supported five telemetry systems: the 30-channel FM Hermes System; the 30-channel, pulse-time-modulated NRL System; the 16-channel DOVAP radar; the 6-audio-band FM APL System, and the 35-channel FM JPL System. BRL provided two timing signals on wire and radio: the O Time Base (100-cycle pulsed square wave) and the 10-second binary Coded Time Base.

Data reduction was rapid by the standards of the time —two days for radar data, 10 days for Bowen-Knapp and telescope film. Trajectory and Doppler data required up to six weeks. Data reduction was labor intensive —Askania data took one hour per data point. Until 1951, when electronic computers were introduced, such work was done at Aberdeen PG, NM College of A&MA, and WSPG.

The hub of the early instrumentation network was C Station where two SCR-584 S-band and two AN/MPG-2 X-band radars provided continuous trajectory azimuth and elevation. A variety of plotting boards were used to track missile coordinates, compute velocity, evaluate safety, and predict impact. A black room held data displays of azimuth, elevation, range, and two clocks, one traveling 1 rps and the other at 1 rpm. These clocks and displays were continuously filmed by 16-mm or 35-mm movie cameras to produce a synthetic record of each tracked flight.

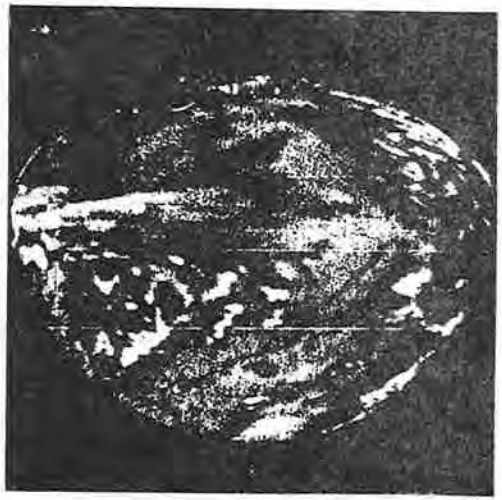
A Chain Radar System was planned for operation by January 1951. The initial system would include three radars, one at C Station and two at HAFB. All three could be controlled from any facility, allowing precise triangulation. A Sound Ranging system was also operating, consisting of six microphones in two groups on a 7 mi, east-west baseline 14 mi north of the Army Blockhouse, and capable of predicting impact with an accuracy of 1.5 mi.

Mazza set a new altitude record of 42,176 feet, parachuting from a balloon. This record was surpassed three weeks later by Captain Richard Wheeler, who parachuted from 42,449 feet above Holloman. That same day, HAFB personnel launched the first Wright Field AeroMedical Laboratory high-altitude cosmic radiation balloon from WSNM. On November 21, the Navy Viking V launched from LC-33 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 in 1951. 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 antiaircraft interception by destroying a B-17 drone over WSPG.

circa 1950

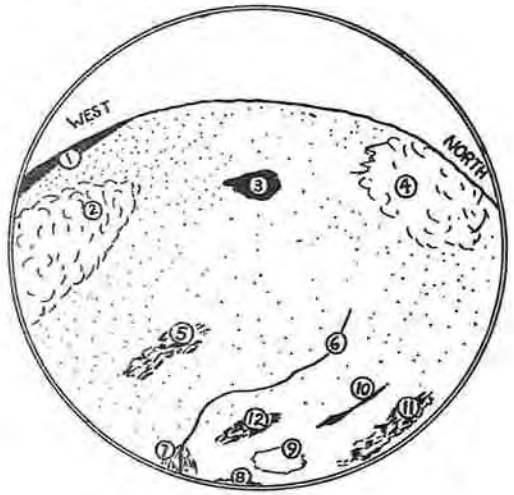


View of Earth

135 Miles

The above sketch shown at right was made from a single photograph taken at an altitude of 135 miles, which is the highest photo ever taken from above the earth's surface. It was taken from the Navy's record - breaking rocket, the "Viking" No. 7, fired from White Sands Proving Ground on 7 August, 1951. The photograph caught and covered portions of New Mexico, Arizona, California, Utah, Colorado, Nevada, Oregon, Montana, Wyoming, and Idaho.

The numbered geographic localities listed below were easily identified from the photograph:



1. Pacific Ocean
2. Cloud coverage over Rocky Mountains
3. The Great Salt Lake
4. Cloud coverage
5. Black Range Mountains
6. Rio Grande River
7. Mesilla Valley
8. Organ Mountains
9. White Sands National Monument
10. Lava beds
11. Sacramento Mountains
12. San Andres Mountains

14

This early photo of earth from space, taken from Viking no. 7, appeared in a circa-1952 WSPG General Information booklet.

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 laid 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 for exclusive military use, and additional Fort Bliss acreage was transferred in August. 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. Late the following month, the newly integrated range broadened its mission to an international scale with the announcement the Swiss Oerlikon missile was to be tested from Tularosa Range Camp.

This hand-lettered report cover is from collections being transferred from the WSMR Technical Library to the Museum.

This circa-1952, and other WSPG General Information booklets, provided a wealth of detail on the architecture, organization, and daily life at the post.

Integration of Army's WSPG and the Air Force HAFB Special Test Range in 1952–53 led to a major reassessment of combined range instrumentation. Early in 1952, Aberdeen PG transferred the WSPG Ballistic Research Laboratory facilities to the new Flight Determination Laboratory at White Sands. Shortly after integration, SCEL operations, which included operation of Chain Radar, meteorological monitoring, and communications, was merged into the White Sands Signal Corps Agency. Within its first several years, the Chain Radar included five linked radar sites (C Station, HAFB, Oscura Range, Oscura Peak, and Red Butte, near Stallion Range Center), linked by microwave through receiver/transmitters on Alamo Lookout in the Sacramento Mountains.

In 1951, the Commander, Naval Air Missile Test Center, proposed the Range Commanders Conference (RCC). The first RCC meeting was held at WSPG on August 29–30, 1951, and included the Commanders of WSPG, NAMTC (Pt. Mugu, CA), and Air Force Missile Test Center, Patrick AFB, FL. The Conference expanded the following year, and an Inter-Range Instrumentation Group (IRIG) was formed to advise Range Commanders on information exchange and standardizing range instrumentation. As the Conference and IRIG expanded, so did the range of systems being investigated. IRIG quickly broke into more specialized working groups devoted to specific sectors of the IRIG mission. The July 1953 Minutes of the 2nd Meeting of the Electronic Trajectory Measurement Working Group (ETMWG), for example, list reports delivered on 16 different instrument systems. The 5th ETMWG meeting, in December 1955, heard a briefing by Dudley Cottler, WSSCA, summarizing the overall progress and direction of range instrumentation. The MPQ-18 radar was undergoing tests to determine its suitability as a replacement for long-range bore-sight cameras. The IGOR optical system remained the best device available for indicating miss-distance. Digital equipment used with MIRAN was reducing errors to about 3 yds until signal attenuation interfered. Technical modifications were improving velocimeters. Plans to procure Miss-Distance Indicator (MDI) devices were under consideration. DOVAP data handling was being improved by implementing automatic digitizing into an 1103 computer, and an acoustical impact prediction system (probably the SOTIM system) had been developed to locate impact points to within 150 ft at ranges up to 40 mi. Several optical tracking systems were also being investigated by WSPG. Recording Optical Tracking Instrument (ROTI), for example, would employ twin telescopes, with phased cameras, slaved to tracking radars and mounted on a modified Navy 5-in. 38-gun mount. A free-running pulsed light source, with telemetering of pulse time, was being developed for WSMR by BRL to fit very small missiles such as Loki.

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 soon-to-emerge field of space medicine.

The Desert Navy at WSPG completed the LLS–1 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 and, in October, the WSPG-Fort Bliss boundary was finally clarified by the Office of the Adjutant General, Fourth Army.

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.

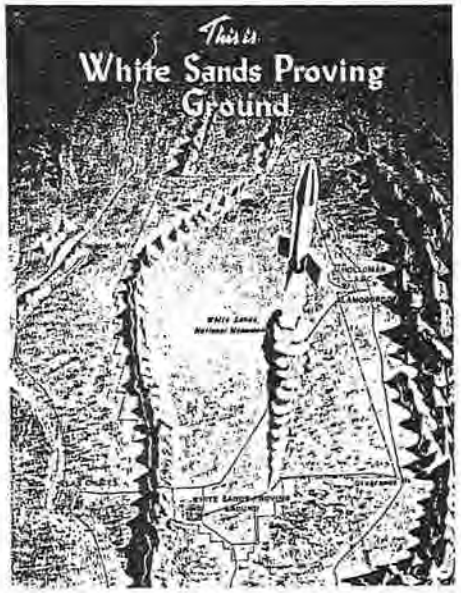
1954 In 1954, WSPG began a survey of potential range extensions that finally led to the addition of the FIX (Firing-in-Extension) in 1960 to the north of the existing range. It also investigated test-flight corridors for Matador and Redstone, from

By the mid-1950s, the integrated range (and many of the other test ranges) was engaged in expansion of conventional instrumentation facilities in addition to development of new systems. In 1956, Ernst Steinhoff completed "A Study of the Range Instrumentation and Instrumentation Facilities at Holloman Air Force Base." Steinhoff recommended standardizing and upgrading all sites (including placing all instruments on towers) integrating WSPG, HAFB, and contractor-operated systems, and developing common repair and procurement systems. Many of Steinhoff's recommendations were adopted. The distinctive, pyramidal Askania towers had already been designed in 1954, and the IRIG Optical Systems Working Group had coordinated a joint procurement contract with Askania Werke on behalf of several test ranges prior to 1957, when OSWG reported that new designs for an open aperture conversion kit had been turned over to that firm for production. In its October 1957 report to IRIG, the OSWG also reported on jointly developed specifications for a new tracking telescope and recommendations for standardization to 243-in. pitch, 70-mm film for optical instrument recording.

By 1958, T-33 Radars were being modified by Sandia Corporation for WSPG to replace the original SCR-584s that were still in use. Long-term replacement of DOVAP components was underway to completely renew the system over five years. Similar upgrades of velocimeters were also in progress. Tests of the new Miss-Distance Indicator had been successful and plans were being contracted to build receiver stations. A new Trajectory Measuring System (renamed Integrated Trajectory System, ITS, by 1960) was ready for installation and would combine four angle-measuring equipment (AME) stations and three distance-measuring equipment (DME) stations. By 1960, a new Small Missile Telecamera (SMT) had been developed and work had started on MIDOR (Miss-Distance Optical Recorder) for high-altitude, high-velocity, extremely small vehicles and multiple targets. In October 1961, Maj. Gen. John Shinkle, Commander, WSMR, briefed the Range Commanders Conference on the status of range instrumentation. Citing the rapid expansion of the range during the 1950s, from less than 100 hot firings per year in the early 1950s to more than 2,000 by 1961, Shinkle noted that the range now had more than 1,000 instrumentation sites. He singled out the 75 existing and 19 planned cinetheodolite stations that still formed the core of the system until the dawn of the electronic age during the next decade.

Askania-Werke logo, circa 1958.

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 more than 12 separate programs, including Aerobee, Corporal, Crossbow, Hermes, Honest John, Lacrosse, Nike, Papa John, Pogo-Hi, Talos, and Viking. The nearby Air Force AeroMedical Laboratory High Speed Test Track programs also expanded and, on March 19, Lt. Col. John Paul 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's (gravities).



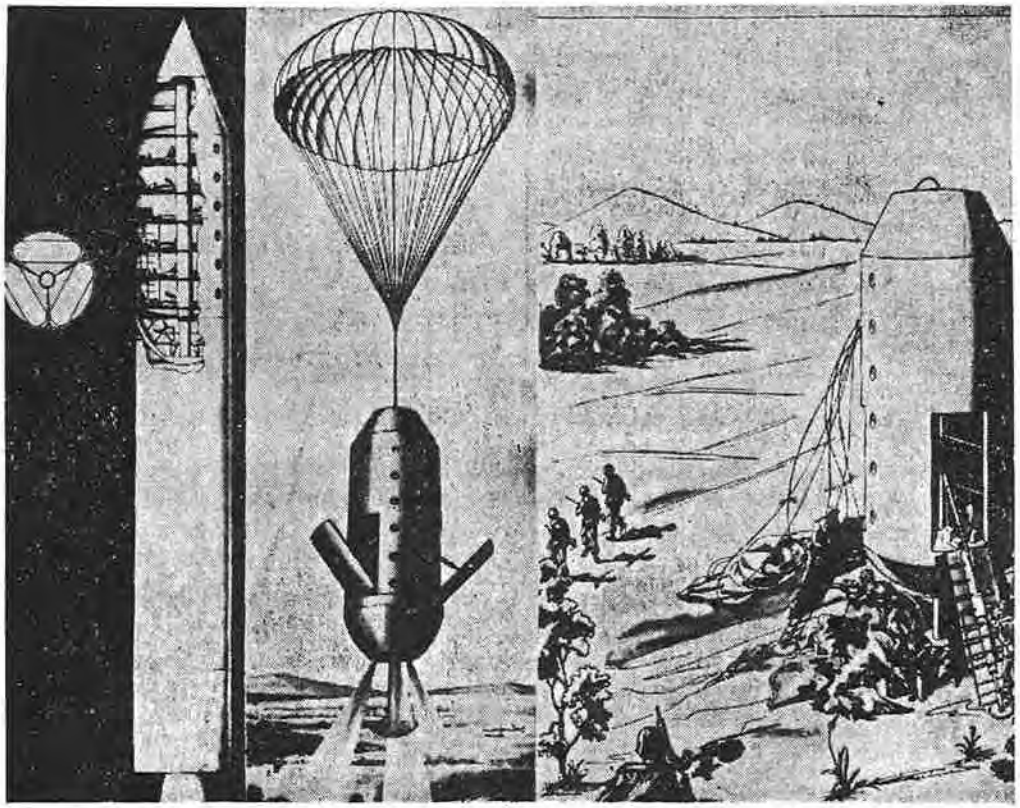
General Information Booklet, 1955.

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*, 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.



MISSILE TROOPS ENVISAGED BY ARMY — *The possibility of employing ballistic guided missiles for transportation of troops, weapons and supplies has been advanced by Maj. Gen. J. B. Medaris, commanding the Army ballistic missile agency at Huntsville, Ala. These drawings show how the project would work. Left photo: A cutaway drawing shows how 18 soldiers with equipment could be moved 500 nautical miles in less than 30 minutes. Insert shows the layout of bunks arranged in groups of three around the missile center. Center photo: The payload compartment carrying troops, weapons or supplies, is automatically guided to land in vertical position via parachute. Rocket power is used to brake its speed of descent. Right: The missile-transport troops are ready for combat after their journey through outer space.* —*(INP Soundphoto)*

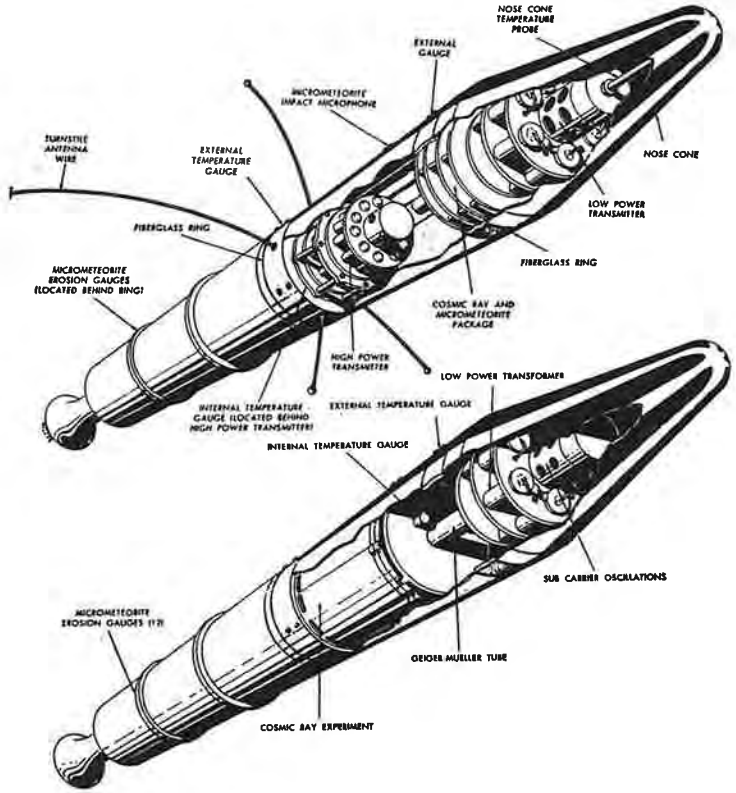
This news clipping, dated November 4, 1956, describes a futuristic proposal by Major General John B. Medaris, Commanding General, Army Ballistic Missile Agency, the Proving Ground's higher headquarters.

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 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 at 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.

USNOMTF entrance signage, 1956.

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 long-range flight corridors and impact areas had been prepared for distances of 250, 500, 750, 925, and 1,500 miles. However, the original BMA mission was curtailed in November by a directive from the



Cutaway views of the Explorers I and III, which were lifted into orbit by the massive Jupiter-C. Explorer I, launched in January 1958, became the first successfully launched U.S. satellite.

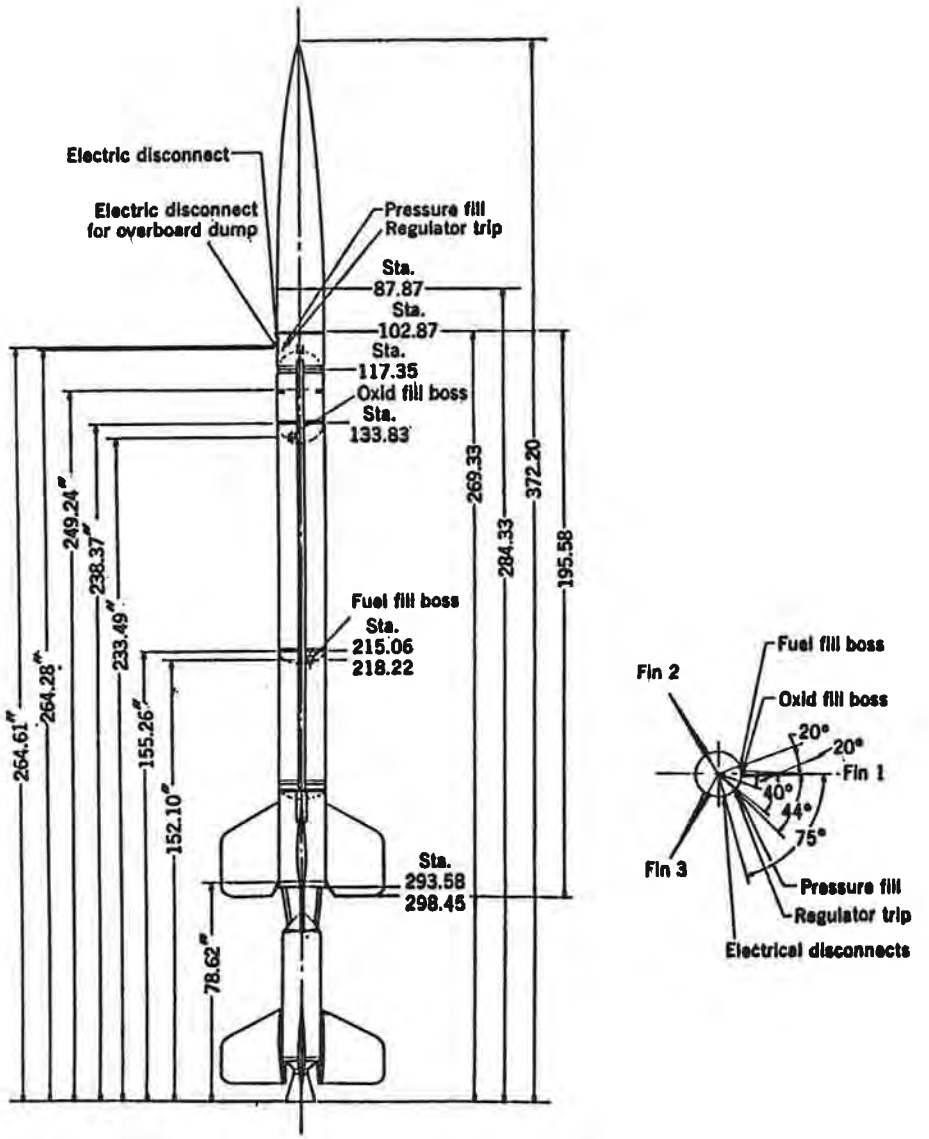
Secretary of Defense that limited Army missile programs to those with a range of less than 200 miles. Longer-range programs became the purview of the Air Force. That same month, a Rascal fired from Orogrande marked the beginning of off-range testing at WSPG. Toward the end of the year, the Navy (on behalf 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 2, carrying the dog, Laika. Both Sputniks were launched aboard the massive Soviet 32-engine SS-6 Sapwood, the first Soviet ICBM, initially tested (successfully) 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 Deck House was added to Desert Ship at LC-35, and missile assembly was relocated from the Navy Headquarters area. The first land-based 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



The Aerobee-H, known as the Aerobee-Hi (and later improved as the Aerobee 150), succeeded the original Aerobee in 1955, when both the Air Force at HAFB and the Navy at WSPG began firing.

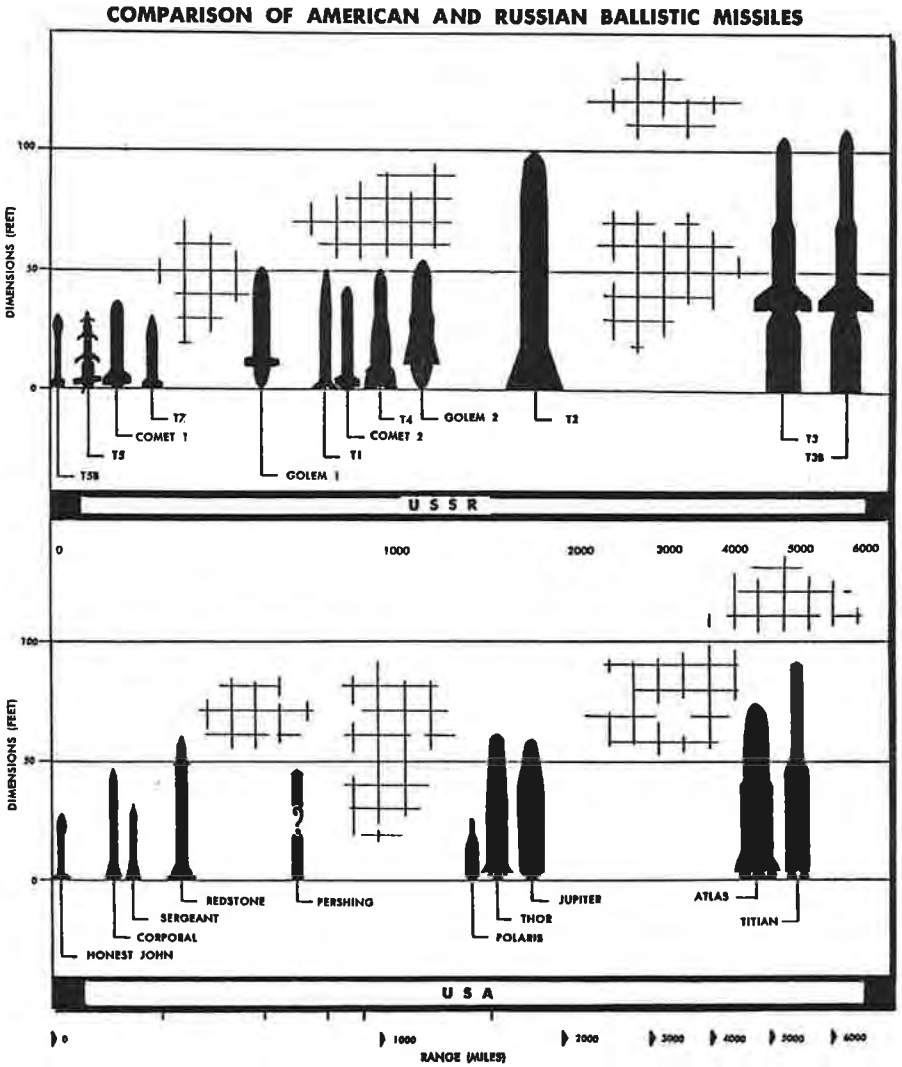
flight from WSPG impacted at the inactive Wendover Bombing Range, Utah, and the first underground nuclear test took place near Las Vegas, Nevada.

In August 1957, Russia had 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 one of the fastest (exceeded only by the contemporary USAF Thor IRBM) and certainly the largest development program, 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 Soviet Union, and then the United States and Britain, suspended atmospheric nuclear testing. Late in the year, Khrushchev demanded talks over German reunification. In January, the Army's Anti-ICBM Nike-Zeus was 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 prohibition on long-range Army missile programs, known as the Wilson Memorandum, 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



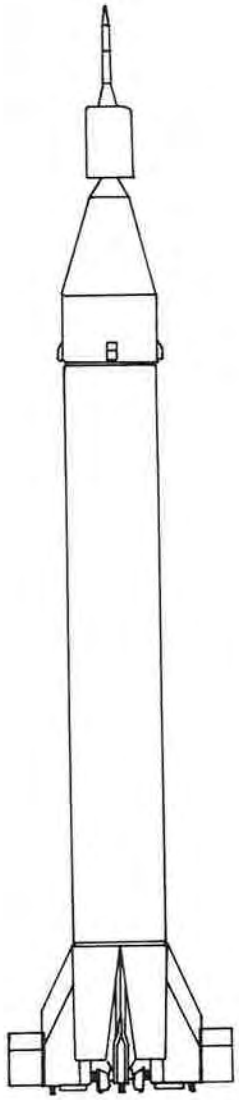
This comparison of American and Russian missiles (circa 1958) illustrates the parallels characteristic of the "arms race" at the dawn of the space age.

the previous six years. A USAF Mace, successor to Matador, launched along the Wendover corridor in February became the first inertially guided missile flown over a populated area in the United States. In May, WSPG was officially renamed White Sands Missile Range (WSMR). 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 manned 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 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 May, Eisenhower decided against deploying the Nike-Zeus, still in the testing stage.

In April, the Northern Extension Plan moved ahead with delivery of the OCO Legislative Liaison and Public Relations Plans to WSMR. The Northern Extension Plan was approved in August by the Acting Secretary of the Army, 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



Explorer I satellite atop the Jupiter C.

This 1958 Douglas advertisement reflects American confidence despite the NSC's conclusion that the Soviets had achieved ballistic missile superiority.

November, Capt. Joseph Kittenger, Jr. parachuted from 76,400 feet out of an open balloon gondola. The same year, APL began development of 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.

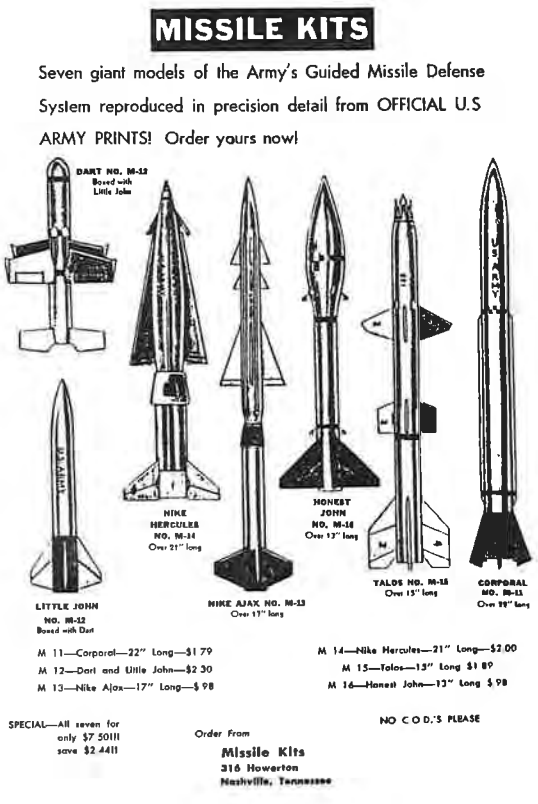
1960 By January 1, 1960, all co-use agreements for the Northern Extension had been completed. Six weeks later, France joined the nuclear group with the explosion of her first atomic bomb. Weightlessness training for Project Mercury astronauts began over the range in March, using a modified C-131 based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

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 (BMD) system had become problematic. By that time, both the USAF and the Navy had abandoned their BMD programs. Nike-Zeus, the first anti-ICBM, was already outdated and was shortly to 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.

On July 20, the 1,000th rocket sled (weighing 2.5 tons) 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.

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 to support an off-range launch of Redstone, proposing Fort Wingate as a launch site. That November, John F. Kennedy was elected President of the United States.



Commercial advertisement, 1959.

On the left, above, is the huge cylinder of steel and aluminum known as REDSTONE (built by Chrysler Corporation) the largest ballistic missile in full industrial production. Perfected in an all-important project at Huntsville, Alabama, by the Army, Redstone is more than a weapon. It is a milestone of immense proportions.

On the right—and going into production under a new Army contract with Chrysler Corporation—is JUPITER—the first offspring of Redstone. It's an intermediate range missile capable of traveling 1500 miles. Without Redstone, Jupiter would never have come into being with the astonishing rapidity that has marked its growth from experimental idea to production status. Many of the principles used in Jupiter—propulsion, guidance and control, measuring systems and flight controls—have been proved in successful Redstone firings.

Chrysler Corporation is proud of its role in helping to create two generations of guided missiles. Along with the men who have made the Army Ballistic Missile Agency the most successful missile headquarters in America, we are now continuing this program of progress.

This, too, is

THE *FORWARD* LOOK **CHRYSLER CORPORATION**

PLYMOUTH • DODGE • DE SOTO • CHRYSLER • IMPERIAL

Two of the most significant missiles resulting from the efforts and expertise of von Braun's team at Huntsville are shown in Chrysler's 1958 advertisement.

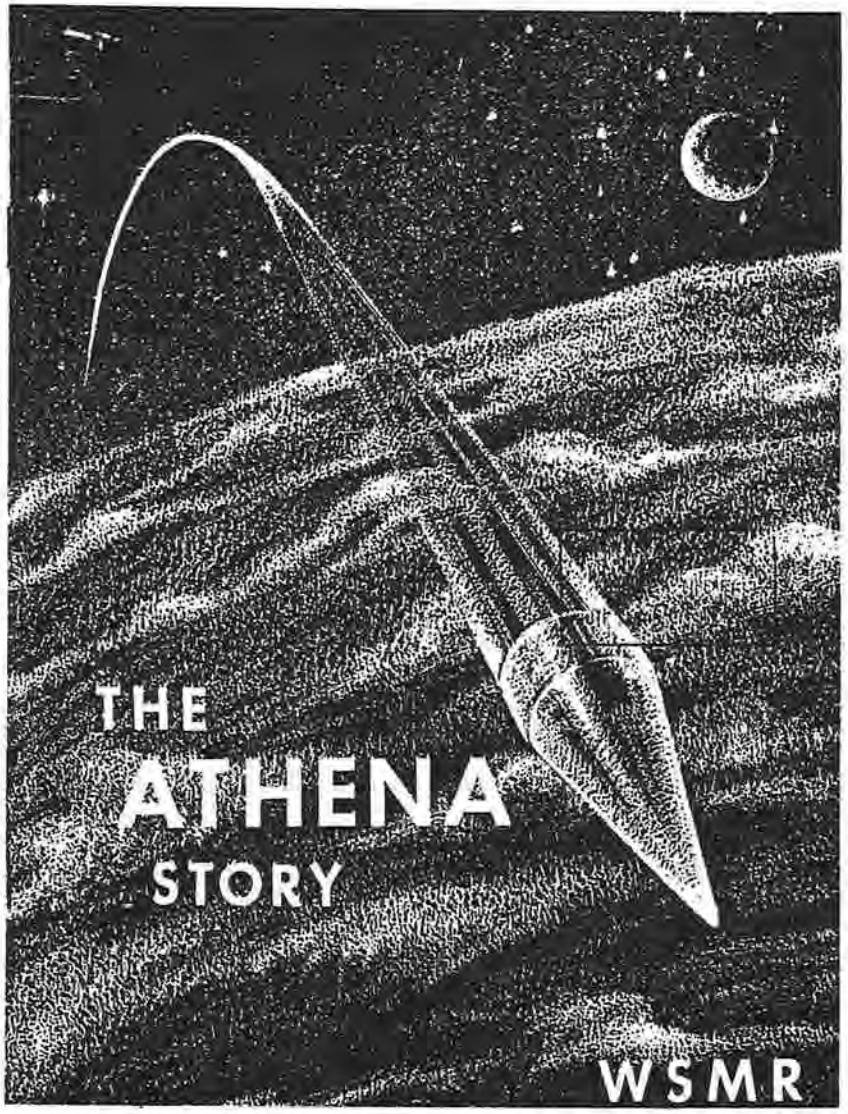
1961 On January 31, after Kennedy's inauguration, HAM became the first Holloman AeroMedical chimpanzee to go into space on a 16-minute suborbital flight. On February 1, the first Ballistic Missile Early Warning System (BMEWS) became operational. In midmonth, the Army Ordnance Missile Command's earlier 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 man on the moon in the next decade, John F. Kennedy committed U.S. advisors to Vietnam. In June, Khrushchev repeated his ongoing demands for talks on German reunification within six months. Kennedy responded with a rapid military buildup and the beginning of 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, General 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 creates an actual defensive combat zone and that the offensive-delivery system, exclusive of the



Cover from the WSMR Athena Program brochure, circa 1963.

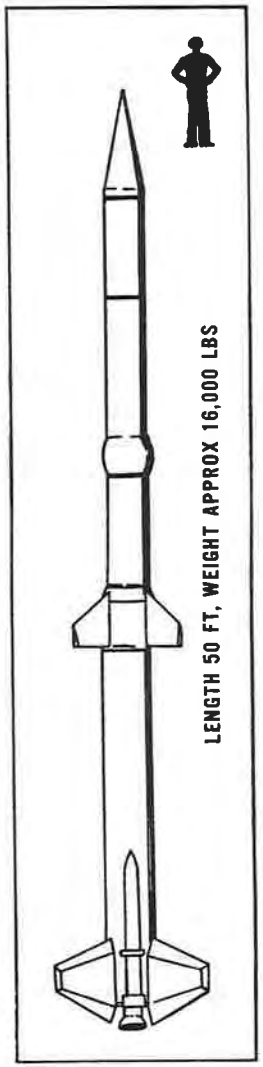
re-entry vehicle, constitutes a logistic not a weapons element. This study resulted in the ABRES, or Advanced Ballistic Re-Entry Systems program, to study ways of increasing the penetrability of offensive re-entry systems. In July, WSMR had installed an integrated real-time data system, primarily for 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, and 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 and the threat of invasion.

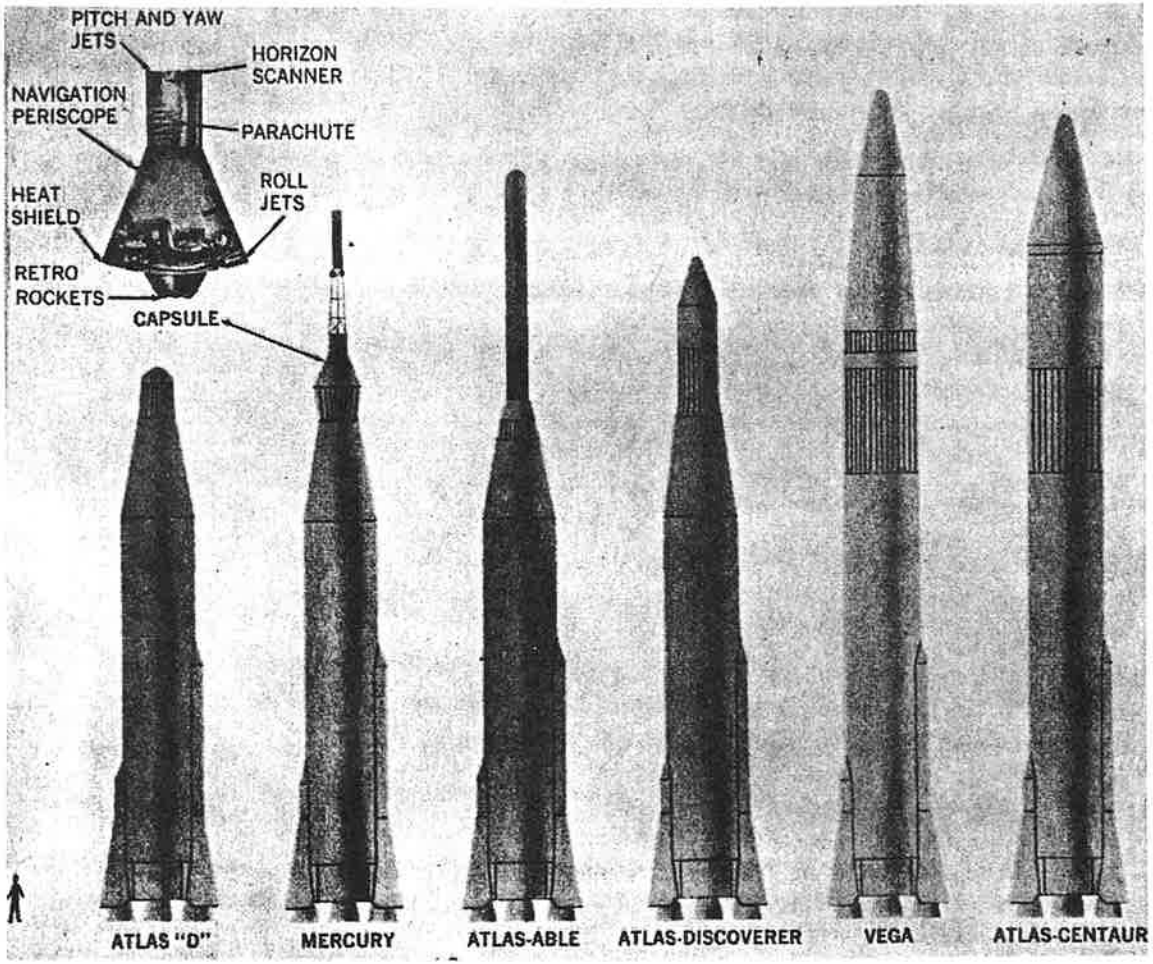
In May 1962, the U.S. Army discontinued the OCO, the parent organization for America's earliest space and missile efforts. The WSMR Integrated Range Mission, which had started as the BRL White Sands Annex, became the Range Operation Directorate, and operation of WSMR was transferred to the Army Materiel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



Athena test vehicle.



The Atlas missile family, workhorse of the American space program.

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 Both the United States and Soviet space programs continued to compete as L. Gordon Cooper completed 22 orbits in May, followed by Valentina Tereshkova-Nikolayeva, the 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.

Following the Cuban Missile Crisis, both the U.S.S.R. and the United States began to explore ways to moderate tensions. In a June 10 speech at American University, Kennedy questioned the wisdom of the so-called holy war that had developed and suggested, in mutual interest of both sides in peace, to halt the arms race. Ten days later, the White House-Kremlin Hot Line was established. The first complete 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.

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 July, Cuba seized the American Embassy in Havana. In November, South Vietnamese President Diem was assassinated. Three weeks later, John Kennedy suffered the same fate in Dallas.

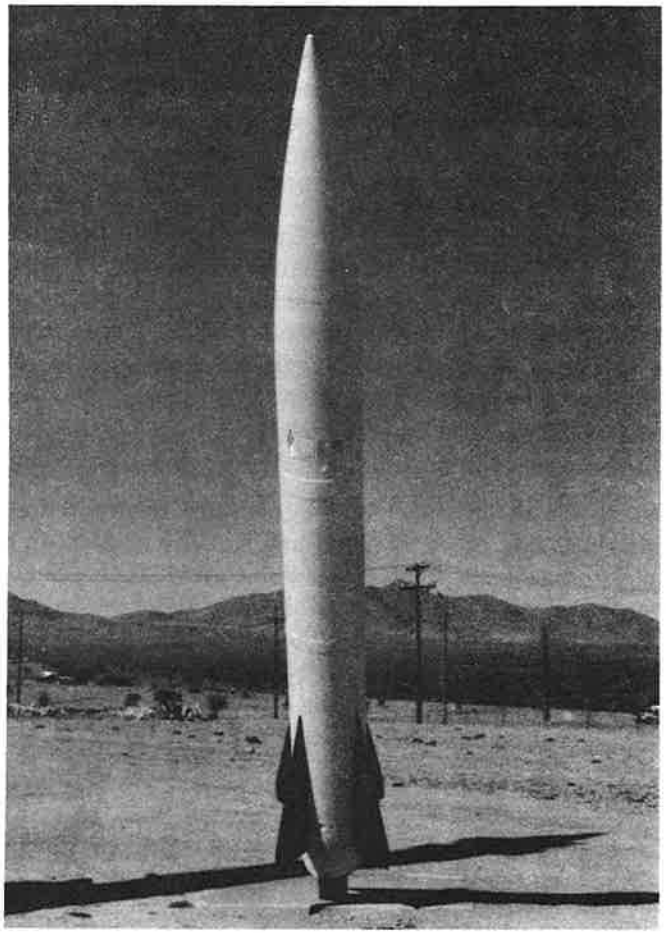
Earlier in the year, a new BMD program known as Nike X was authorized, and Martin Marietta was chosen to develop the system's high-acceleration Sprint SAM. At WSMR, the fully operational Pershing began additional off-range test firings from Fort Wingate, New Mexico.

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,

J. F. THORLIN
Major General, USA
Commanding

Commander WSMR, assumed command June 1962.

This Lance SSM, which began testing at WSMR in 1965, marked a new era in missile technology. Lance, the first Army missile to use prepackaged storable liquid propellant, could carry nuclear as well as conventional warheads fired from a self-propelled launcher and operated in all types of weather.



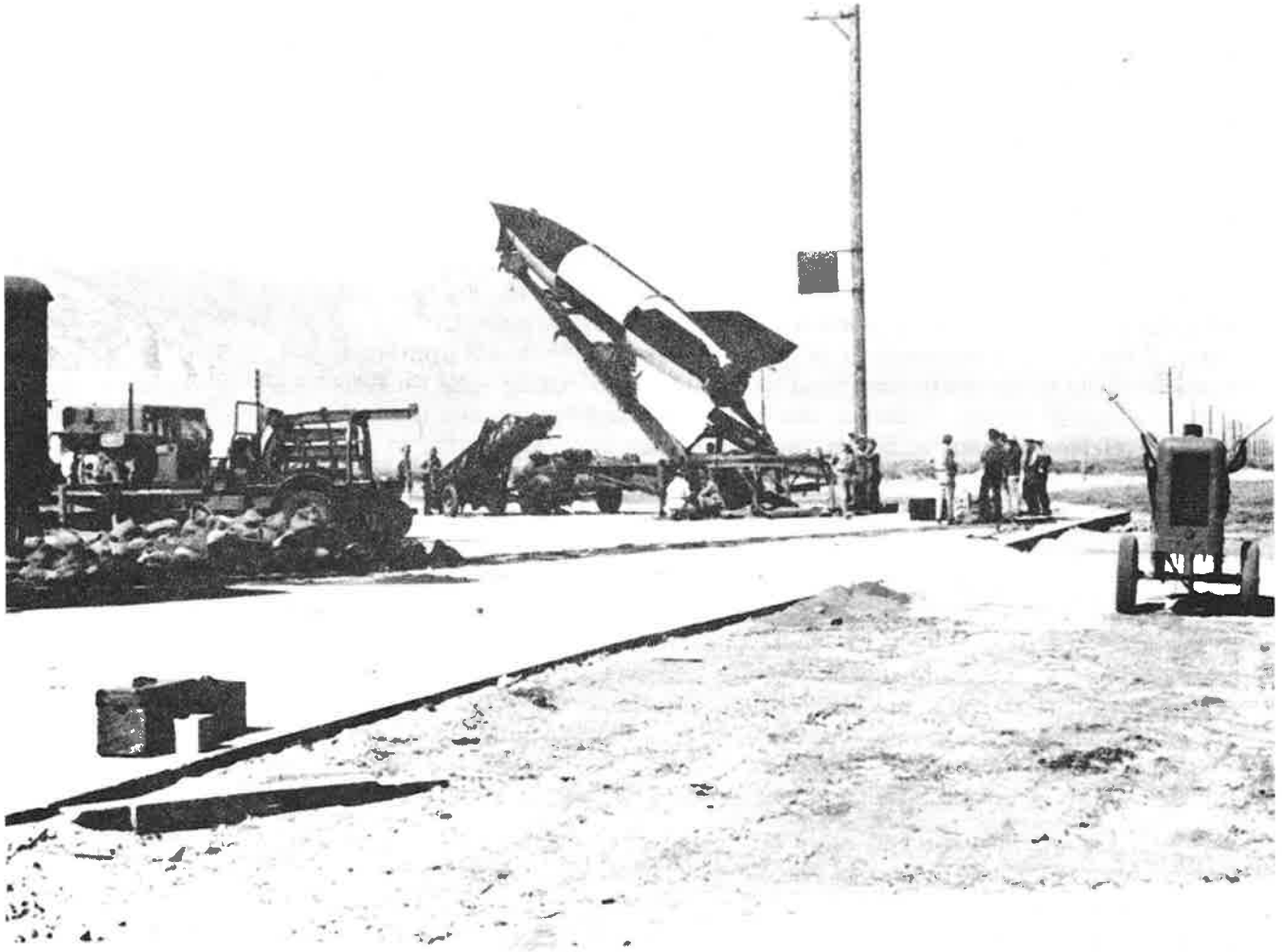
granting the president power to take "all necessary measures to repel any armed attack against the forces of the United States." China detonated its first atomic bomb on October 16, the day after Khrushchev was ousted as Prime Minister and Secretary of the Communist Party, and was replaced by Kosygin 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, 190-hour Gemini flight, demonstrating the feasibility of a lunar mission. In December, Gemini 6, manned by Schirra and Stafford, and Gemini 7, manned by Borman and Lovell, rendezvoused successfully in space.

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 was a 45-75 mile tactical fire-support system, eventually replacing the Honest John and Sergeant. By June, SAC had completely 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 over 6,000 miles.



Erection of V-2 at LC-33, circa 1946.

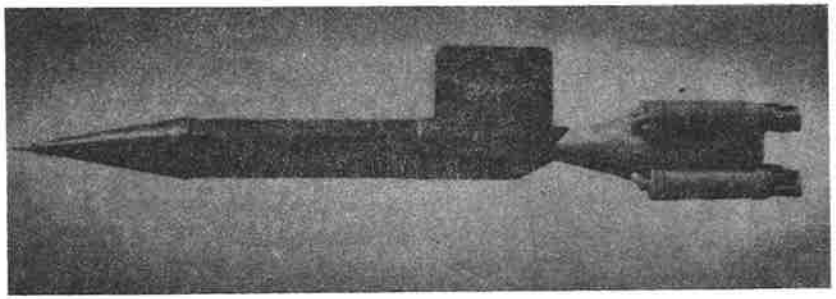
MISSILE PROGRAMS AT WSPG/WSMR, 1945-1964

White Sands Proving Ground was established on July 9, 1945, to facilitate the development of missile systems. The missile program served as the organizational structure for the research and development needs of missile systems. Missile programs that involved WSPG/WSMR during the period considered in this study are numerous (over 320 separate programs) and varied in scope from diverse programs, such as Hermes), to directed subprograms, such as Blossom. The program summaries offered in this section do not represent a complete inventory of programs hosted by WSMR but are a selection of the most important missile-development projects and some of particular interest. These project summaries do not focus upon the round history, or the success or failure of individual mission rounds, but on the development of the program and its contributions to developing missile systems that served to fuel the Cold War. Appendix B offers an annual round summary for the programs hosted or supported by WSMR.

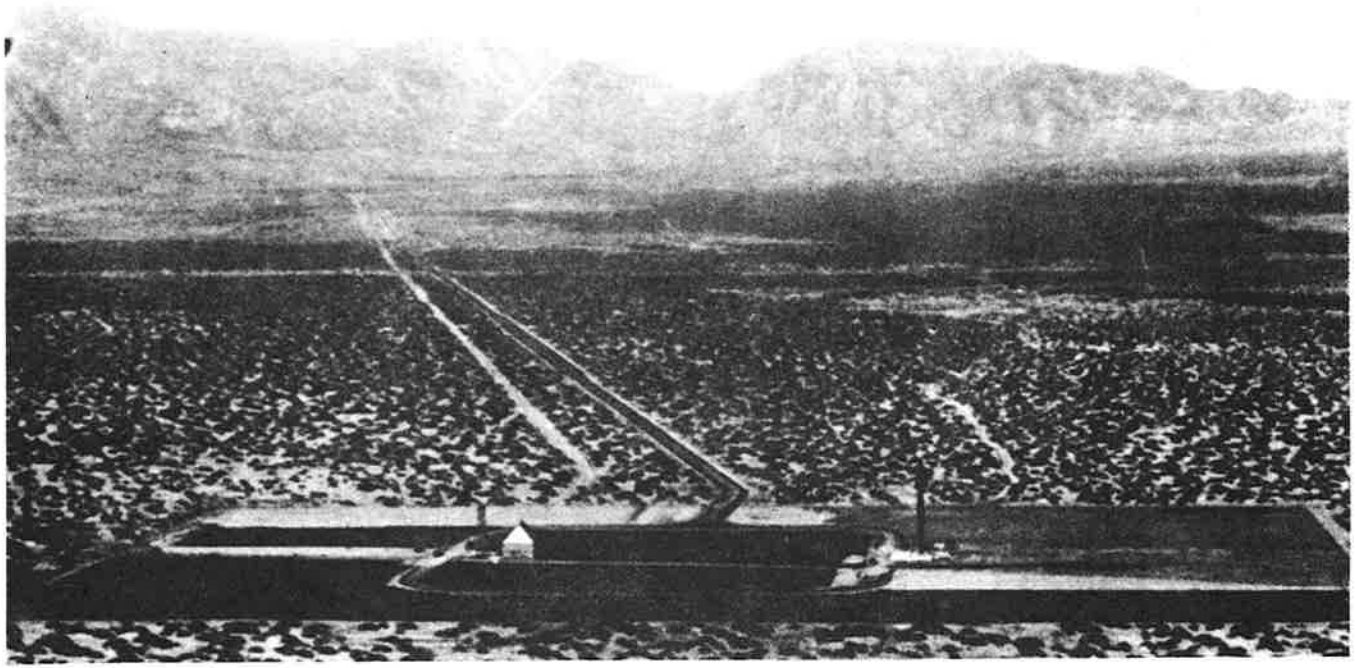
A variety of sources were consulted for this section and, for the purpose of readability, are not referenced in the text, but include Office of the Chief of Ordnance (1948), Portnoy (1957), Department of Defense (1958, 1959), Missiles and Rockets (1958, 1959), Gunston (1959), and Fitzsimons (1978).

PROJECT ORDCIT

Project ORDCIT began in May 1944, in a joint venture between the Army Ordnance Department (ORD) and the California Institute of Technology (CIT) to conduct fundamental research, development, and testing of jet-propulsion and guided-missile systems. It is important to note that this program, as conceived, was to conduct research in the fields of rocketry and jet-propulsion systems, rather than to develop specific missile systems. In essence, this program provided the foundation for parallel and subsequent missile-system development programs. The scope of this program was necessarily diverse and included the development of new fuels with the Jet Propulsion Laboratory (JPL) of CIT, synthetic lightweight materials with Cornell University, jet-assist take-off (JATO) systems, and guidance systems (Office of the Chief of Ordnance 1948).



Private F, no date.



LC-33, circa 1946.

A number of test vehicles were developed from this program, including the Private A, Private F, WAC Corporal, and Corporal E. The Private A tests were conducted in December 1944 at Camp Irwin, in the eastern Mojave Desert of California. This vehicle was designed to gather data on launcher and booster operations and was terminated after 24 rounds.

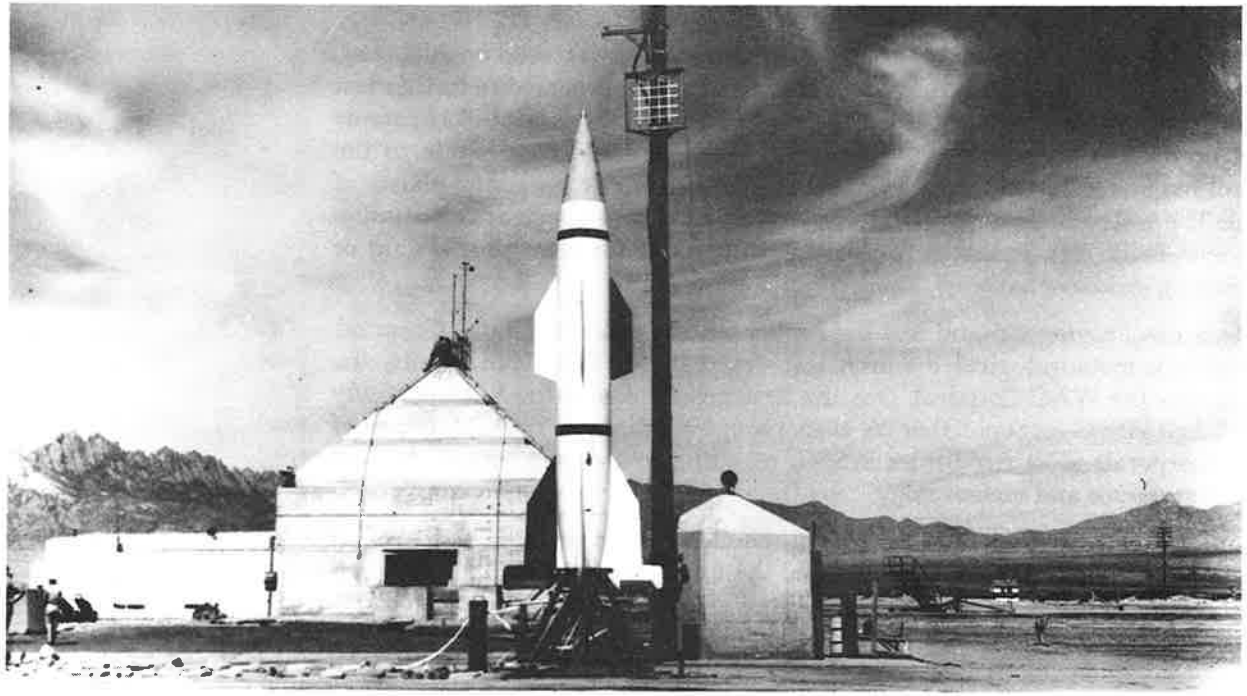
The Private F test vehicle was tested in April 1945 at Camp Hueco on Fort Bliss, Texas. Similar to the Private A mission, this vehicle was designed to further test rocket-booster capabilities and to refine launching methods. A total of 17 rounds were fired from Camp Hueco. Numerous small changes were made to the control the fins in an attempt to stabilize the vehicle during the initial phases of flight. The test vehicle demonstrated the need for either constructing missiles with extremely high precision (presenting difficulties for mass production) or developing guidance systems.

White Sands Proving Ground was the facility chosen to test the WAC Corporal, primarily a meteorological research test vehicle. The Tiny Tim missile, the booster for the WAC Corporal, was the first missile round fired at the newly established WSPG on September 26, 1945. From 1945 through 1949, 22 rounds of WAC Corporals were fired from WSPG, resulting in a diverse set of data on vehicle guidance and meteorology.

Experience gained from the previous research vehicles enabled ORDCIT to develop the Army's first guided missile, the Corporal E. From 1947 through 1950, eight rounds were fired from a simple, elevated launching platform at Army Launch Area 1 (LC-33).

Project Hermes

The first major U.S. ballistic rocket program was Project Hermes, which served as the foundation for later ballistic missiles. Project Hermes was spawned during World War II, when an awareness of the Germans' long-range surface-to-surface missile (the V-2) solidified in 1943. Early ORDCIT research into the possibility of the United States developing such a weapon involved a wide range of topics, everything short of the warhead. Army Ordnance established the project in 1944, with General Electric Company as the prime contractor to carry out the program. Initially, through 1951, the program was concerned itself with the overall study of the V-2. The thrust of the V-2 research was to gain experience



"HERMES A1-1 MISSILE"

Missile Erected For Firing at Army Blockhouse

DATE: 19 May 50 White Sands Signal Corps / WSSECA-1348 50
Hermes A1-1 Missile

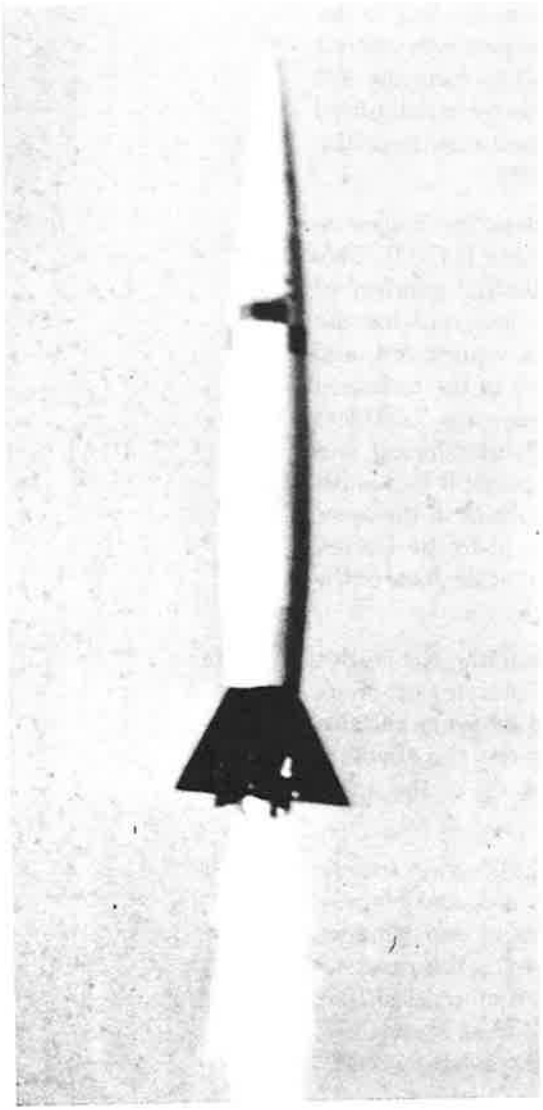
This WSPG photo is one of the rare few that were fully labeled and dated.

that would lead to design and operation of future guided missiles and to the research of the earth's upper atmosphere. This latter research aspect was offered to other government agencies and universities, which merged to form the V-2 Upper-Atmosphere Research Panel in 1946. Research proposals were submitted to this panel and evaluated to avoid redundancy in effort, and maximize the efficiency and use of the V-2 research vehicles (Brown et al. 1959).

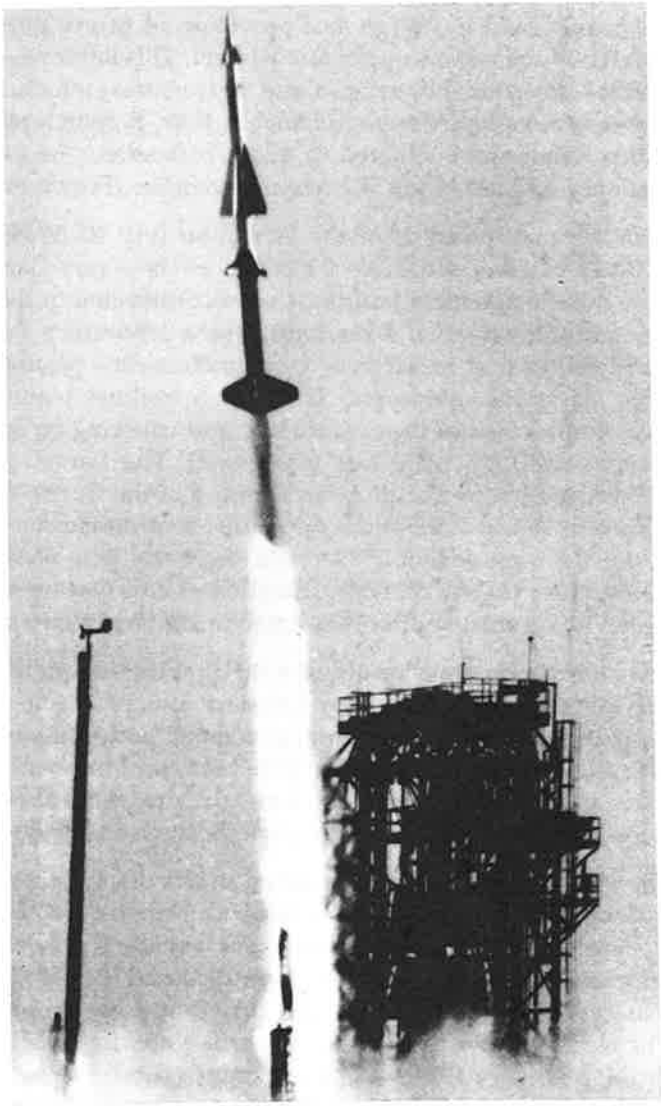
With the establishment of the WSPG on July 10, 1945, construction began on facilities to carry out Project Hermes at the Army Launch Area (LC-33). Two large missile-assembly buildings were constructed in the "industrial quarter" of the cantonment area. Also built was a laboratory facility designed for the maintenance and research of gyro instruments, photographic equipment, and other electronic equipment. The launch facilities were located in the technical area, 6 miles east of the cantonment and covering an area measuring 1,500 feet (north-south) by 1,000 feet (east-west). The launch-control blockhouse was constructed by the Fortification Division of the Corps of Engineers. It had walls that were 16 feet thick and a pyramidal roof measuring 27 feet thick at the apex. Under the supervision of German engineers who were brought to the United States under project Paperclip, a static-test area was constructed at the base of the Organ Mountains, south of the cantonment (Anonymous 1946).

The Hermes program resulted in the first motion pictures depicting the earth's curvature and cover the largest surface area per frame taken to date. Off-shoot programs, like Project Blossom, developed parachute-payload recovery systems that allowed for upper-atmosphere biological experiments to test the effects of space travel upon living organisms; the programs also took some of the initial steps toward getting man into space (Brown et al. 1959).

The Hermes program also resulted in the development of the Hermes missile system, with three variants developed: Hermes A-1, Hermes A-3, and Hermes B. Hermes A-1 was essentially a test vehicle for vehicle-control experiments, with six rounds fired between June 1950 and July 1951. However, the program was canceled the day before the first round was fired (Brown et al. 1959:103). The Hermes A-3 was a surface-to-surface missile (SSM), tested from March 1953 through January 1954, with seven rounds fired. The Hermes B was also a SSM.



Hermes A-3, no date.



Nike-Ajax, no date.

The flight-test program for Hermes B was initiated at WSPG in early 1953, with the first round fired May 11, 1954. A total of seven test rounds were fired through November 1954. The Hermes project at WSPG ended on December 31, 1954.

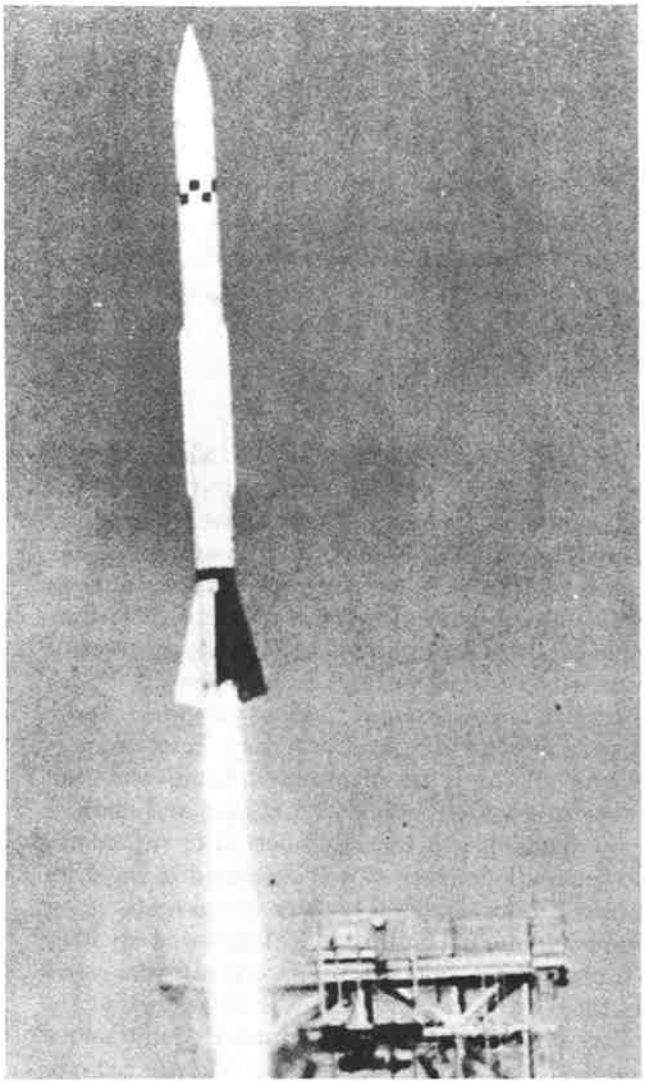
Subsequent Army Missile Systems

In this section, we present a brief description of the missile systems developed by the Army, Navy, and Air Force that were tested at the WSPG/WSMR or were supported by the facilities of the range. The program inventory in this section and that presented in Appendix B were derived from data contained in the offices of the National Range.

Nike-Ajax

Named after the Greek goddess of Victory, Nike was the Nation's first supersonic, antiaircraft guided missile designed to intercept and destroy all types of bomber aircraft, regardless of evasive action. It represented an order of magnitude improvement in air-defense capability over that possible with the conventional gun-type weapons of World War II. Ajax units had been operational on site in the continental United States since 1953. By 1958, they were deployed around vital industrial and highly populated strategic areas of the United States. Additional units were deployed overseas. Over 3,000 Ajax missiles had been fired in the Army's various test and training programs, and it has displayed a remarkable degree of reliability and accuracy. Performance-wise, it was capable of combating all the types of manned bomber aircraft known to be operational. The Ajax missile was about 20 feet long and about 1 foot in diameter, with fins for guidance. It was initially boosted to supersonic speed by a solid propellant and separable booster; it was sustained in flight by an integral liquid-propellant motor. The missile and booster weigh a little over 1 ton. The Nike battery was completely mobile and could be employed in either fixed or field positions. With 12 launchers, about 100 officers and men were assigned to the unit. Personnel for these batteries were initially trained at the Army Air Defense School on Fort Bliss, Texas, while Ordnance Maintenance Support personnel were trained at the Ordnance Guided Missile School, Redstone Arsenal, Huntsville, Alabama.

NIKE-AJAX
length: 33 feet
range: 25 miles



Corporal, no date.

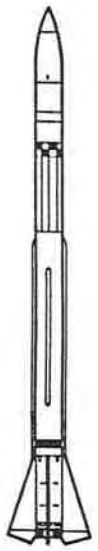
The Ajax system was initially developed by the U.S. Army in 1945, from design concepts developed out of WWII German efforts. Bell Telephone Laboratories and Western Electric were contracted to join the development team in the fall of 1946, with the first dummy missile round fired on September 24. Launch pads were constructed in the northeast corner of LC-33. The first drone was intercepted in November 1951, and the first intentional kill was executed on April 10, 1952. The Nike-Ajax went into production in 1952. It was developed as SAM-A-7; as a system, it was known as the M-1 by the Army, and MIM-3 and 3A by the DoD.

CORPORAL

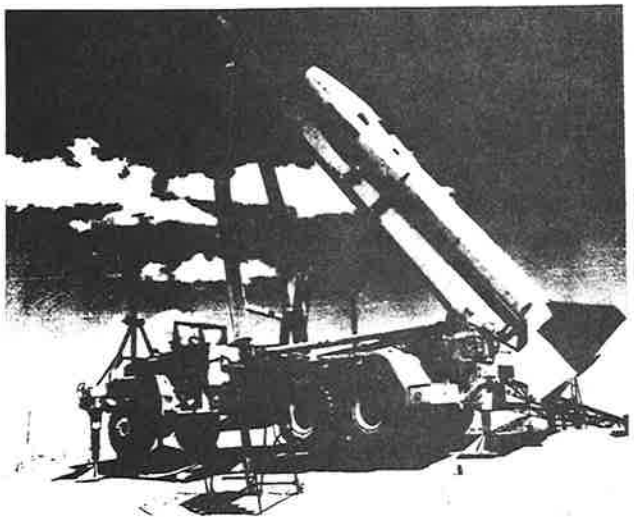
Designed and equipped with either an atomic or conventional-type warhead, the Corporal guided missile was the nation's first ballistic missile capable of engaging tactical targets at ranges over 75 miles away. The weapon gave the field commander great firepower on the battlefield and enabled him to strike selected targets deep in enemy territory. The Corporal followed a ballistic trajectory during most of its flight to the target. The propulsion system used a liquid-propellant rocket motor. The missile traveled through space at several times the speed of sound. A Corporal battalion had 250 men. Each battalion had two batteries--a Firing battery and a Headquarters Service battery. There were two operational launchers to a battalion.

The origins of the Corporal reach back to January 1944 and the ORDCIT program's efforts to develop long-range surface-to-surface missiles. The Type I, or WAC Corporal, and Corporal E were the origins of the Type II, or ordnance, version. In 1953, the Type I was turned over to the Field Force Unit of the Army, and one battalion was sent to Europe in late 1954. The flight evaluation program for the Type II Corporal began in March 1955. Early versions of the Corporal (WAC Corporal) were fired from LC-33 using a railed launcher. Later versions of the Corporal (Type II) were launched from LC-36, at the Corp Site (WSMR Facility 23330), east of the vehicle assembly building (No. 23358). Between 1947 and 1964, over 590 Corporal rounds were fired from WSPG/ WSMR.

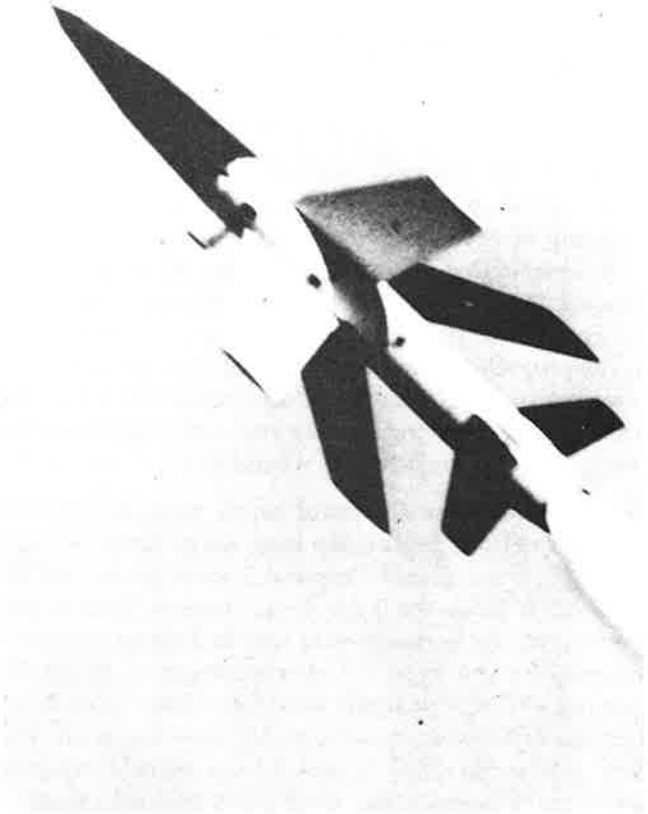
Corporal battalions were deployed in Europe and remained operational until 1966. The Army designation for the missile was SSM-A-17, M2 when in the production phase, and subsequently the MGA-5a and M2A1.



CORPORAL
length: 46 feet
range: 70-86 miles



Honest John, no date.

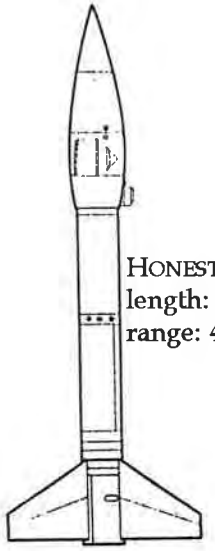


Lacrosse, no date.

HONEST JOHN

Honest John was a long-range artillery rocket developed for the Army that was capable of carrying an atomic or high-explosive warhead. It was the first post-war American missile to become operational. The weapon was used tactically to provide close fire support in ground-combat operations. Honest John was a free-flight rocket as distinguished from a guided missile. Having no electronic controls, it was simple in design and easy to operate. Its range was equivalent to medium- to long-range artillery. It had considerably more battlefield mobility than conventional artillery shells. The Honest John system consisted of a rocket weighing several tons and a highly mobile, self-propelled launcher.

Honest John was developed by Army Ordnance and designated M31 and M50. The test program at WSPG began in June 1951, with launch facilities located at LC-33, northwest of the flame pit, with the first round fired on June 29. Round testing continued through 1964, as improvements to the system developed. During these years, over 1,260 rounds were fired from WSPG/WSMR. The original designation for the missile was M31 and M50 during the production phase, which was changed in 1962 to the MGR-1A and 1B. The weapon has given way to guided missiles, although it was employed by many European and Asian armed forces until recently.

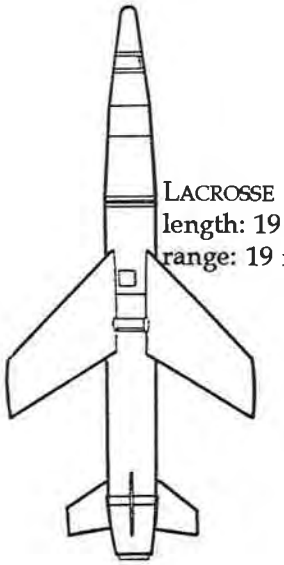


HONEST JOHN
length: 24 feet
range: 4.5-23 miles

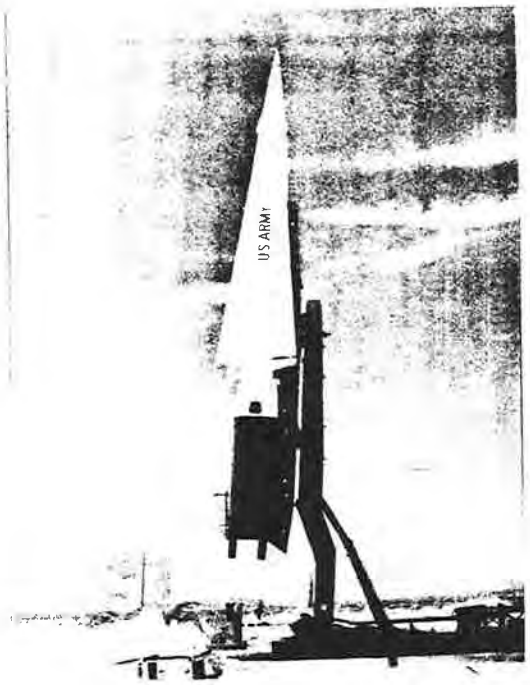
LACROSSE

Lacrosse was a highly accurate, general support field-artillery guided missile used in close tactical support of ground troops. It was an all-weather guided missile capable of carrying highly effective, area-type warheads and was sufficiently accurate for destroying hard-point targets.

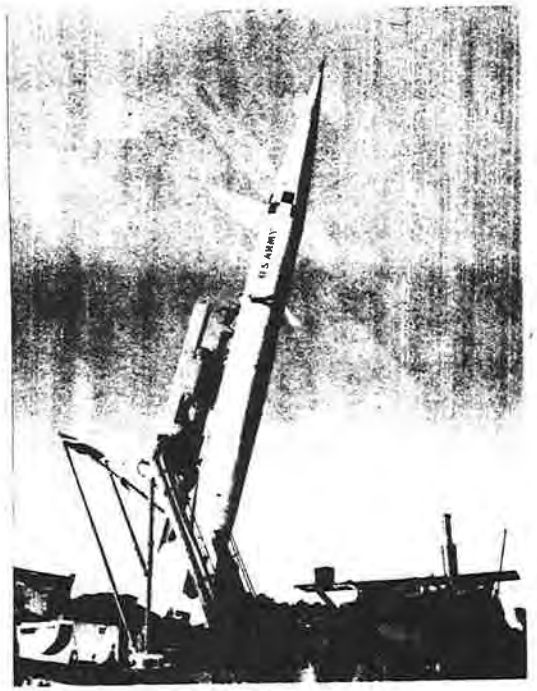
The Army began developing the Lacrosse beginning in 1950, after taking over the Navy program that started in September 1947. Cornell Aerojet Laboratory was the primary contractor. Test firings of the Lacrosse JATO began at WSPG in March 1952. Air-drop launches were conducted throughout 1953, and the first successful ground launch occurred in August 1954, probably from a launch facility constructed 10 miles north of LC-33. Testing of the system continued through 1963, with over 280 rounds fired from a variety of sites, including the Small Missile Range. The system reached production in early 1957 and was built to replace and supplement conventional artillery. Its propulsion system



LACROSSE
length: 19 feet
range: 19 miles



Nike-Hercules, no date.



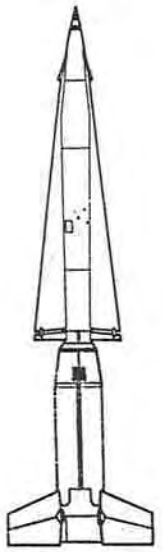
Sergeant, no date.

used a solid-propellant rocket motor. The Lacrosse system included the missile, a launcher mounted on a standard Army truck, and other ground equipment. It was initially designated the SSM-A-12 and, later, the M4 and MGM-18A. The United States and Canada deployed the Lacrosse in Europe until the early 1960s.

NIKE-HERCULES

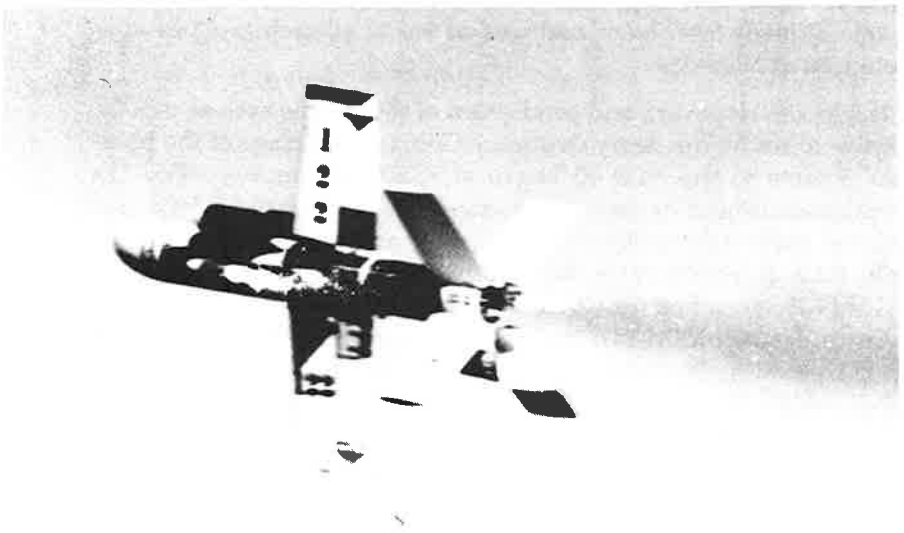
Nike-Hercules was the second land-based, combat-ready, completely mobile, surface-to-air guided missile system to be placed into the active air-defense system of the United States. The Nike-Hercules made a major advance in the Nike family of guided missiles and was many times more effective than its predecessor, the Nike-Ajax. The Nike-Hercules, a relatively inexpensive and simple missile, used solid propellants. An air-to-surface missile or a bomber complete with its bomb load could be destroyed well beyond the radius of the defended area. The missile, with instantaneous responsiveness, was propelled to a range substantially greater than that of Nike-Ajax. The system was capable of operating in an electronic countermeasures environment and had the ability to progressively accommodate improvements to the system. The Nike-Hercules was sited to defend many SAC bases and was added to all metropolitan areas under the protection of Nike-Ajax.

The Army's design, development, and production of the missile system was the result of extensive effort by the Army Ordnance Corps. Test firings of the Nike-Hercules (then known as the Nike B) began at WSPG in January 1955. The development program scored its first drone intercept on October 31, 1956, and its first intentional drone kill on April 25, 1957. During the years from 1956 to 1964, over 810 Nike-Hercules were fired from the range. The missile was designated SAM-N-25 when first introduced and M6 and M6A1 when deployed. The system was designated MIM-14A and B. At its peak deployment, the Nike-Hercules had 134 batteries. The Patriot replaced this system by the mid-1970s.



NIKE-HERCULES
Length: 41 feet
Range: 87 miles and up

Little John, no date.

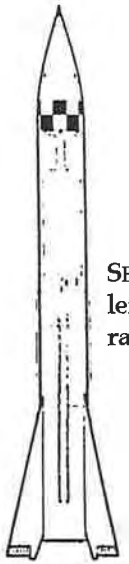


Dart, no date.

SERGEANT

Sergeant was a solid-propellant surface-to-surface ballistic guided missile that succeeded the four-year-old Corporal. The Sergeant was 30 feet long and incorporated many improvements over its predecessor in power, range, and accuracy. It could deliver a nuclear blow deep into enemy lines and was invulnerable to any known enemy countermeasures. Sergeant had greater mobility and could be more easily stored and put into action more quickly than many other weapon systems of its day. It was transportable by air and could be rapidly emplaced and fired under all conditions of weather and terrain by a comparatively small crew.

The Sergeant was under-designed and developed by the Jet Propulsion Laboratory in 1955. The program moved to WSPG that same year, and the first round was fired from the newly constructed Sergeant Launch Site at LC-32 on January 19, 1956. Over 96 rounds were fired from the range between 1956 and 1964. It was designated XM15 and, finally, MGM-29A. Sergeant became operational in 1961 and was withdrawn in 1978.



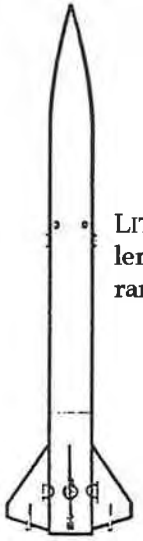
SERGEANT
length: 30 feet
range: 28-87 miles

LITTLE JOHN

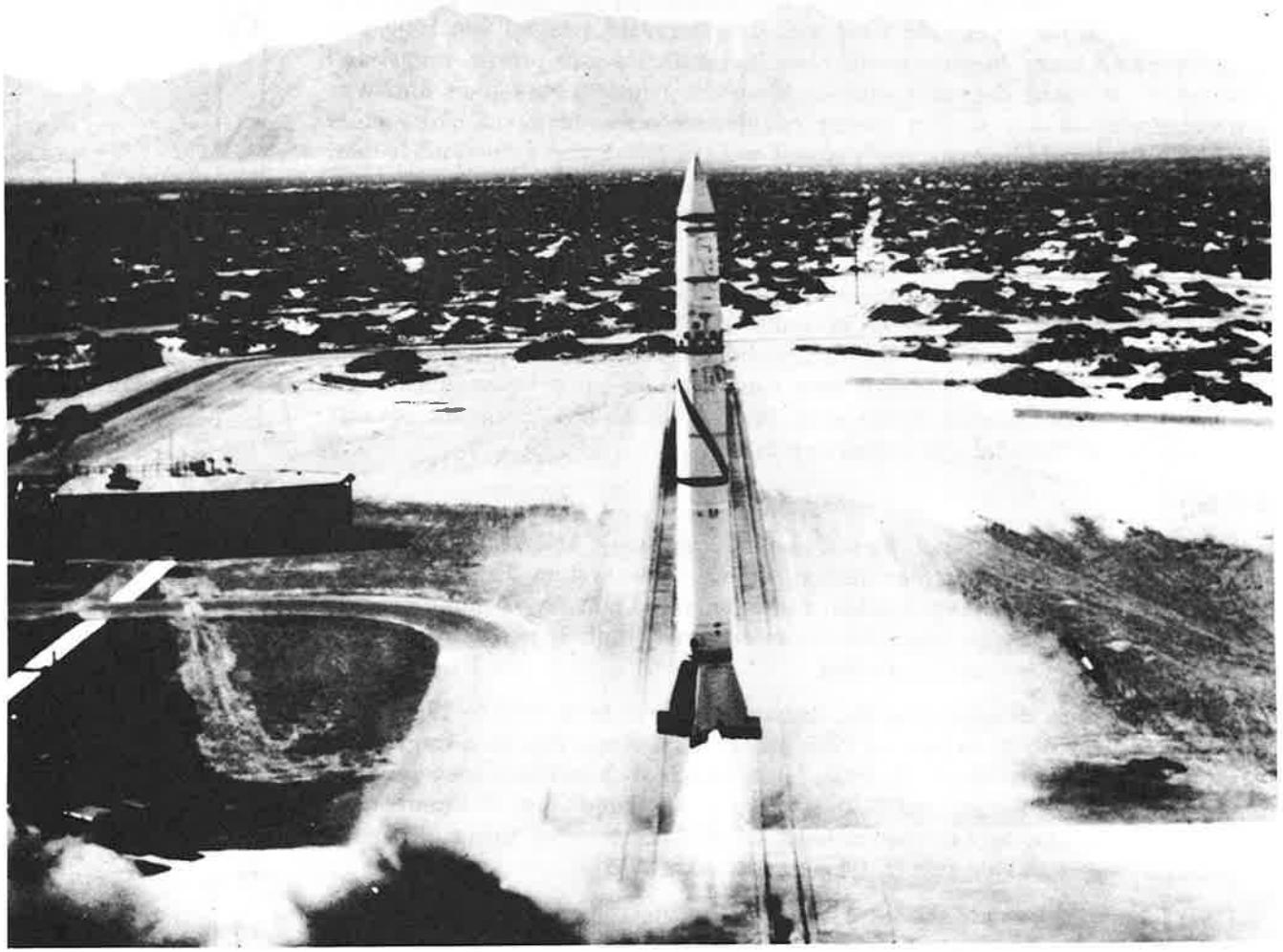
Little John was a 12 1/2-inch rocket, about 12 feet long, and was packed with explosive power greater than heavy artillery. The system was simple and reliable and used a solid-propellant rocket engine. Lightweight launchers and ground equipment were adaptable for an extremely high degree of mobility on the ground and were easily air-lifted.

This missile was developed at the Redstone Arsenal from 1955 to 1956. Little John arrived at WSPG in January 1956, and the first round was fired from LC-33 on July 28, 1956. By March 11, 1957, Little John launch facilities were ready at the Small Missile Range, and the test program escalated from 15 rounds fired the previous year to 132 rounds fired in 1957. Test-round firing continued through 1964, with an excess of 611 rounds fired at WSPG.

Little John was issued to the 101st Airborne Division, Fort Campbell, Kentucky, for training and developing combat techniques in 1958, and it reached combat deployment in 1961, although it was abandoned soon after.



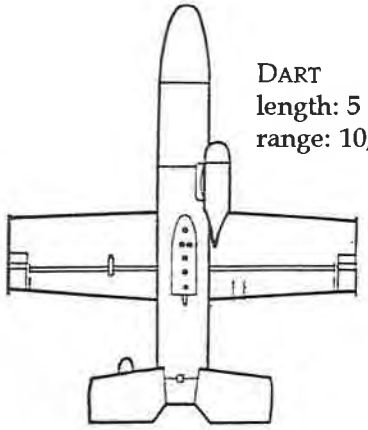
LITTLE JOHN
length: 12 feet
range: 10 miles



Redstone launch from LC-36, no date.

DART

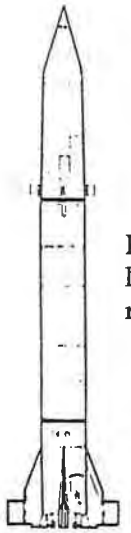
Dart was a wire guided, anti-tank and anti-placement missile that was used by infantry and armored units. The development program, initiated in April 1953, was developed by Aerophysics Development Corporation. Flight tests began on August 24, 1954, and in February 1955, the program saw the first successful hit on a stationary target. In May 1956, the missile successfully destroyed a M4A-1 tank. The missile went into production in 1958, after 175 test rounds were fired at WSPG. However, it was terminated on September 15, 1958, with the recognition that other similar systems were further along in their development. The missile continued its utility in the upper-atmospheric research programs when combined with other small booster systems, such as Loki, to serve as a rocket sonde.



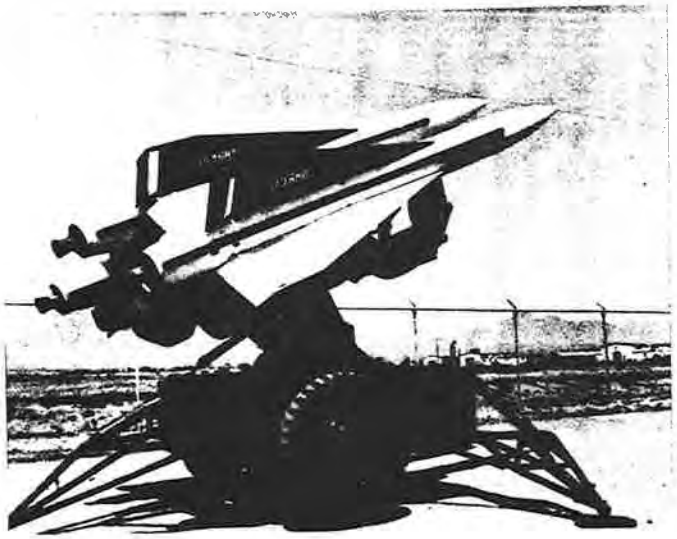
DART
length: 5 feet
range: 10,000 feet

REDSTONE

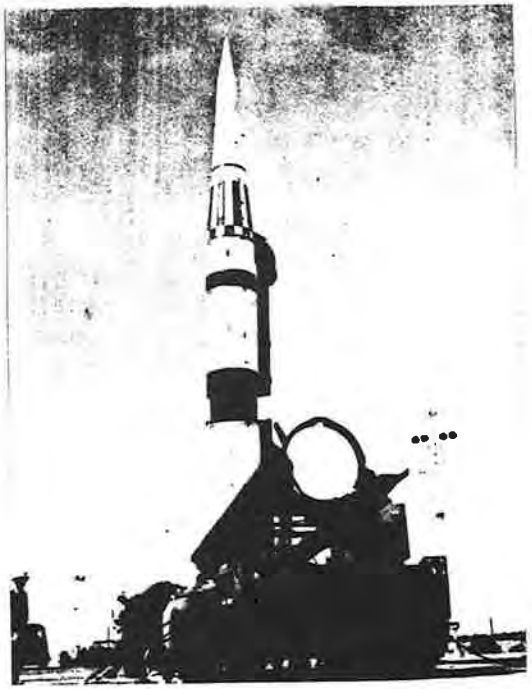
Activation of the first U.S. Army unit to fire the Army's supersonic Redstone missile was announced on March 14, 1956, eight months after the OCO activated the program at WSPG on July 20, 1955. The Redstone was developed under the supervision of Dr. Wernher von Braun, developer of the German V-2 rocket. Hot-round firing of the Redstone at WSPG began in March 1958, employing both the 500-K Static Test facility and LC-36. From 1958 through 1964, WSPG/WSMR participated in at least 15 tests of the Redstone. The Army used surface-to-surface artillery missile units armed with Redstone and other Army missiles to extend and supplement the range and firepower of artillery cannon. It was capable of delivering both atomic and nonatomic projectiles. Redstone was one of the largest surface-to-surface ballistic guided missiles employed by the Army. Named for the place of its development, the Army's Redstone Arsenal at Huntsville, Alabama, it was an operational field missile. Redstone was deployed to support U.S. forces in Europe. The Redstone was designated SSM-A-14 in its development phase and became the PGM-11A after deployment. Also the basis of the Jupiter-C vehicle carrying America's first satellite, it launched the first American astronaut into suborbital space in 1961. The Redstone was replaced by the Pershing system in 1963.



REDSTONE
length: 63 feet
range: 249 miles



Hawk on mobile launcher, no date.



Pershing on mobile launcher,
no date.

JUPITER

Jupiter became the Free World's first intermediate-range ballistic missile (IRBM). It was conceived in mid-1955 and designed by the Army's Ballistic Missile Agency in Huntsville, Alabama for use by both the Army and Navy. Jupiter had a range of 1,500 miles and carried a nuclear warhead. It was powered by a Rockedyne liquid-propellant motor with about 150,000 pounds of thrust. Chrysler Corporation was awarded the contract for its development in June 1956. In June 1957, WSPG began supporting the Jupiter program, and two rounds were supported that year. On December 13, 1958, a Jupiter with a live monkey in its nose cone was launched. The first operational Jupiter was launched on January 22, 1959. Jupiter was slated for deployment in Italy in 1959. The Jupiter motor was subsequently employed to place nonmilitary satellites into orbit.

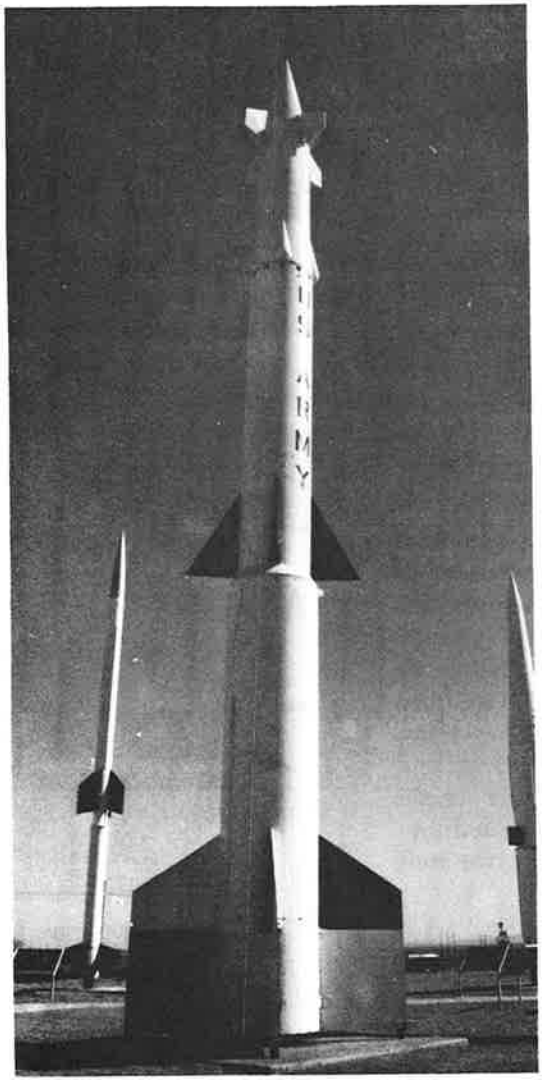
JUPITER
length: 60 feet
range: 1,500 miles

HAWK

Hawk was capable of carrying a modern warhead and destroying attackers flying "on the deck" at ranges that would ensure effective protection of defended areas. This system was designed to complement the defense provided by the Army's Nike-Ajax and Nike-Hercules, wherever its extreme low-altitude capability was required. The Hawk system was designed for the air-defense programs as a mobile system used by both the Army and Marine Corps troops moving in the field. This system is unique when compared to other systems, because of its ability to engage extremely low-flying targets at tree-top level and its capability to maintain a rapid rate of fire. The equipment, which is simple, rugged, and easy to maintain, is air transportable by helicopter or medium-sized aircraft. The missile uses a solid-fuel propellant and is approximately 17 feet long, with a 14-inch diameter.

The Hawk development program was initiated on April 9, 1953. Test firings of the Hawk missile at WSPG began on August 16, 1955, from LC-32, and continued past 1964, with over 500 rounds fired between 1955 and 1964. The Hawk system was phased out and replaced by Patriot in the Army, but it is still used by other agencies.

HAWK
length: 17 feet
range: 22 miles



Nike-Zeus.

Shillelagh

Pershing

Pershing was a solid-propellant ballistic missile developed for the field Army. The missile is smaller, lighter, and more mobile than the Redstone, and it provided the Army with a more versatile and flexible weapon with which to discharge its role on the battlefield.

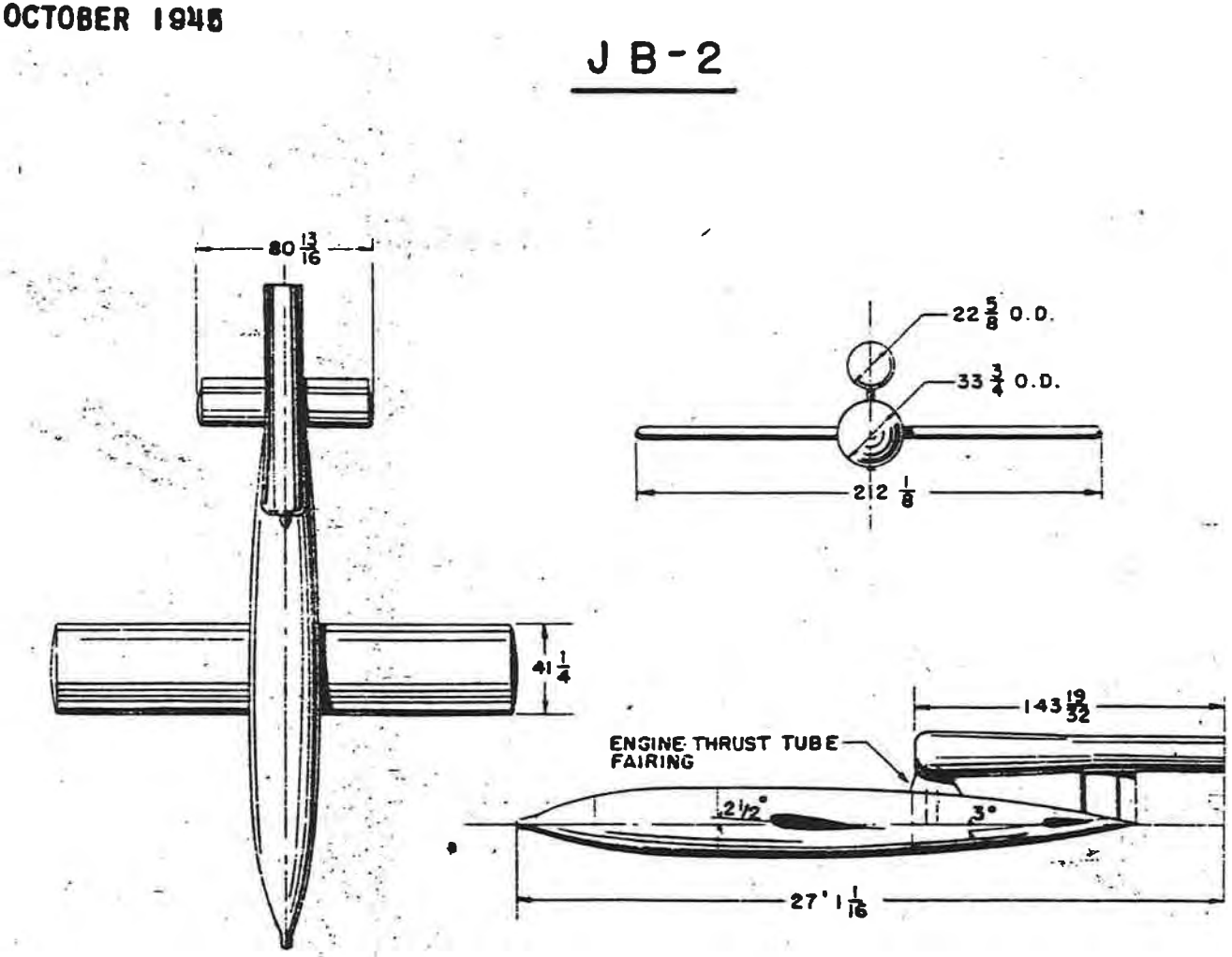
On January 10, 1958, the Army was authorized and directed by Secretary of Defense McElroy to proceed immediately with the development of the Pershing. Recent advances in solid-propellant technology, resulting in large part from the Army's Sergeant and the Navy's Polaris programs, made it possible for development without delay. Work on the Pershing was under the supervision of the Army Ballistic Missile Agency, Redstone Arsenal, Huntsville, Alabama. Flight testing began at the AMR on February.24, 1960. The program moved to WSMR in July 1960, and in the next four years at least 13 Pershing rounds were fired from the range. The weapon system was designated XM14 and became operational in 1962, when it was designated MGM-31A. It is still operational.

Nike-Zeus

Nike-Zeus was developed to defend the continental United States against all forms of air threats in the 1960s and 1970s, with special emphasis on the ICBM threat. Nike-Zeus was the only active system under development to meet the ICBM threat at that time. All members of the Nike family, including Nike-Zeus, utilize the command-guidance principle. Designated the XLIM-49A, the test program began in August 1959 and was first fired at WSMR on December 16, 1959, at newly constructed facilities at LC-38. By 1964, at least 240 rounds had been fired at WSMR. It ultimately evolved into the Safeguard system, after Eisenhower canceled the program in May 1959.

Shillelagh

Shillelagh was a surface-to-surface, light-weight missile system developed for close-in support of ground troops. Vehicle mounted, the weapon system was being developed by Ford Aeronutronics Company in 1959. The flight test program at WSMR began in July 1962, and 11 rounds were fired by the end of the year. The missile went into production phase in November 1964 and was expectedly deployed in 1966. Production ended in 1970.



JB-2, adapted from Army Air Technical Service Command (1946:4)

Redeye

Redeye was a shoulder-fired, air-defense guided missile for use against low-level aircraft attack. Convair Pomona Division was developing the system in 1959, in a joint effort by the Army and Marine Corps. Testing of the system was carried out at WSMR during 1962 at LC-34, with the first hot-fire round recorded in June 1953. The missile went into production in 1964.

SS-10 and SS-11

The SS-10 and SS-11 were antitank missiles developed by Nord Aviation of Paris, France, and were procured by the Army in 1959 for possible use by ground forces. They are remote-controlled, wire-guided missiles with solid-propellant motors that were intended for use against armored units.

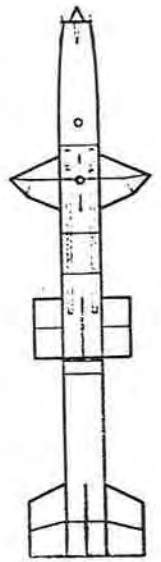
Early Missile Systems of the Navy

Loon

Loon was a Navy adaption of the USAAF JB-2, an American copy of the German V-1. Adapted for launch from submarines, the program was approved in March 1946 and was carried out at Point Magu, California. In December 1953, a single round was fired from WSPG. Initially designated the KUW-1 and later the LTV-N-2, it became known as the Loon. This was essentially a cruise missile and, while actually fired from a submarine on February 12, 1950, the system never became operational, and the program was terminated in 1950.

Talos

Talos was a supersonic, surface-to-air missile named after the Greek mythological demigod who guarded the island of Crete. Talos was powered by a ramjet 40,000-horsepower engine, weighed about 3,000 pounds, and was about 20 feet long, with a 30-inch diameter. It could destroy enemy aircraft at extremely high altitudes and had a range of over 65 miles. Since a ramjet must be boosted to supersonic speed, a solid-propellant rocket was utilized during the few seconds of the boost phase. The booster fell away and the ramjet engine took over the propulsion. A mechanical brain within the weapon guided the missile



Talos SAM
Length: 30 feet
Range: 50 miles

Sidewinder.

to the target. When it was within lethal range, a proximity fuse detonated the warhead. It could carry either high-explosive or nuclear warheads. The missile could destroy both supersonic and subsonic targets.

The development of the system can be traced to the Bumblebee program, under the direction of the Applied Physics Laboratory of John Hopkins University. Bendix Aviation Corporation, a division of RCA, was the primary contractor for the project.

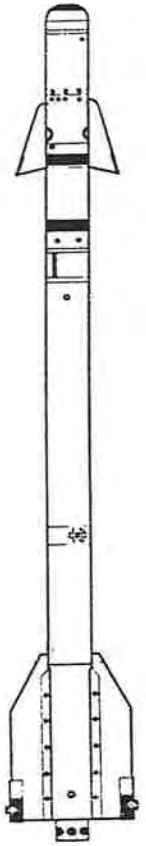
Flight testing was conducted at WSPG under the direction of the Naval Ordnance Missile Testing Facility, a part of the joint command of WSPG. The Talos arrived in mid-1951, with the first round fired on July 10 of that year. The Navy's Desert Ship test facility, with its automated missile transport capabilities, was employed during the evaluation of the missile system in 1957. In October of that year, the Army acquired the missile and conducted its first test round on November 20, 1957. From 1951 through 1964, at least 456 Talos rounds were fired from WSPG/WSMR.

The missile saw action in the Vietnam War. By 1974, the missiles were rebuilt into Vandal target drones, and the program was abandoned in 1985.

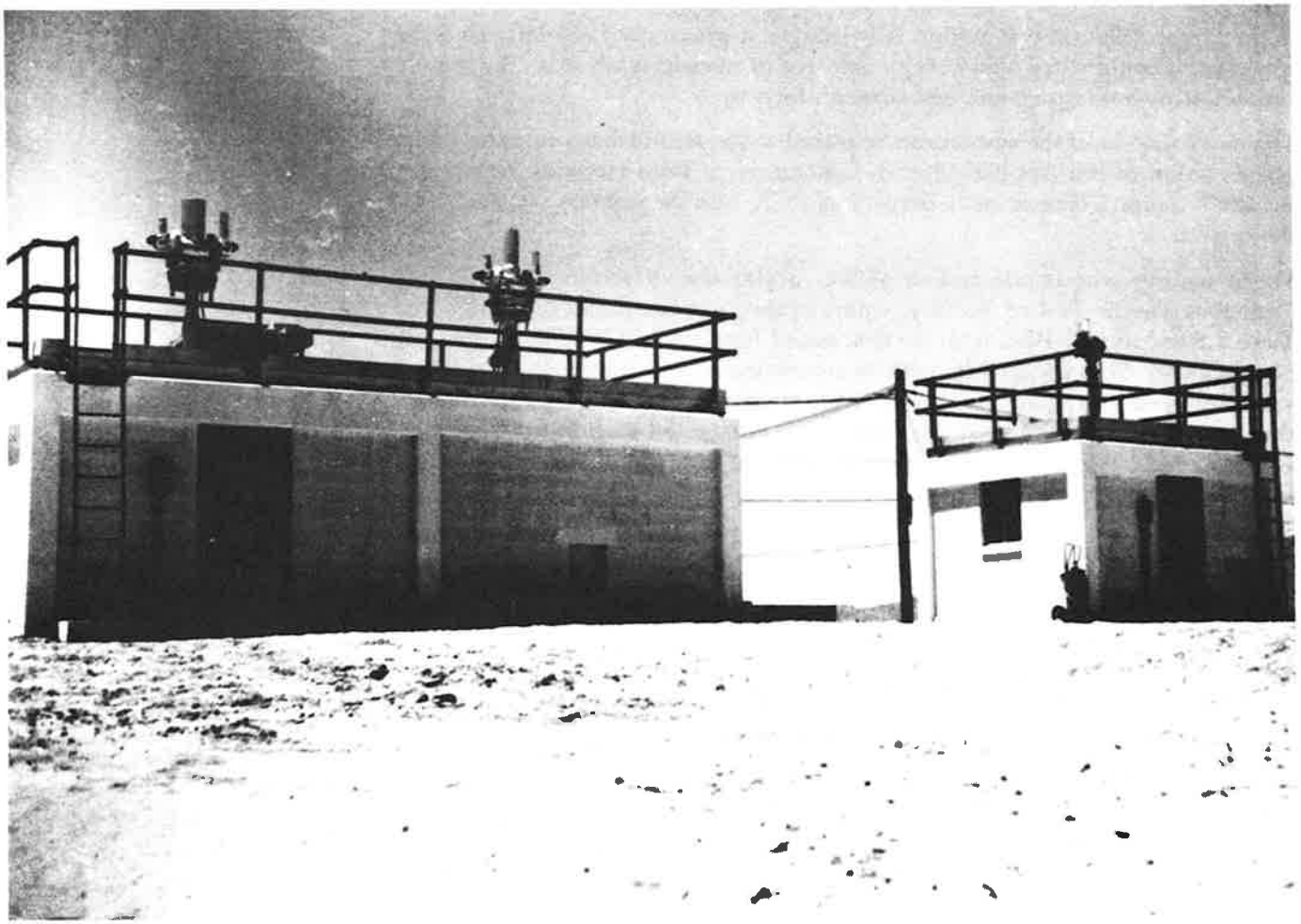
SIDEWINDER

One of the most influential missiles in history, the Sidewinder was named after the desert rattlesnake of the same name. The missile was guided by an infrared or heat-seeking device. It seeks the target by homing in on the heat emitted from the aircraft. It is a relatively inexpensive and reliable weapon, measuring 9 feet long and weighing about 155 pounds. Sidewinder is designed for destroying high-performance enemy fighters and bombers from sea level to altitudes over 50,000 feet. The missile, which has very few moving parts and no more electronic components than an ordinary radio, requires no specialized technical training to handle and assemble effectively.

The missile was initially designated XAAM-N-7 during its development phase, and N-7 (USN), GAR-8 (USAF), and SW-1 (NOC) when in production in 1956. Sidewinder was the primary guided-missile weapon used by aircraft squadrons of the Sixth Fleet in the Mediterranean and the Seventh Fleet in the Western Pacific. It is basically a defensive air-to-air weapon to protect our sailors and ships at sea from attacks by enemy aircraft. The Navy and the Air Force also



SIDEWINDER
length: 9 feet
range: 50,000+ feet



Double Askania and Mitchell optical instruments used to track such missiles as Sparrow.

employed it for air defense of the Continental United States. The missile permits defending fighters to knock down the fastest enemy aircraft, even when it is miles away.

Development of the Sidewinder was assigned to the Navy Ordnance Test Station of the Bureau of Ordnance, China Lake, California, in 1950. Dr. William B. McLean of the test station, who originally developed the missile, saved the Navy over $40 million and was subsequently awarded $25,000 for his outstanding achievement. The first round was fired on September 11, 1953.

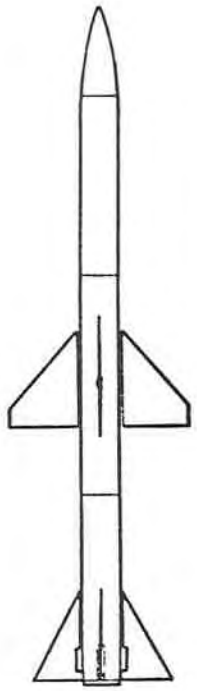
Sidewinder-1C is an advanced (second-generation) model of the Sidewinder, and was in use in 1962. It provided higher-speed and greater range capabilities than the Sidewinder. Naval Ordnance Test Station conducted development work. The adaptability of the system was amply demonstrated by the 12 variants developed over the years. The missile is employed by 28 nations across the globe.

SPARROW

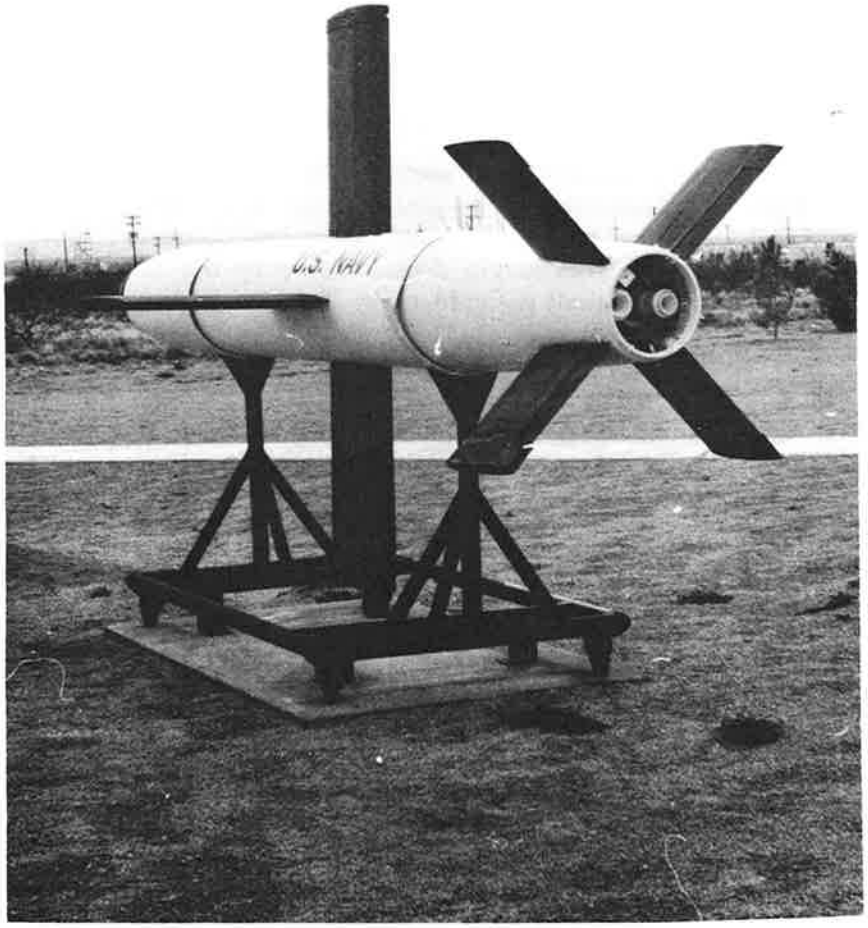
Sparrow I was an air-to-air missile that became operational within the fleet in the spring of 1956. It was 12 feet long, weighed 300 pounds, and had a speed of over 1,500 miles per hour. The missile was powered by a solid-propellant rocket motor. After being fired from Navy fighters either singly or in rapid-sequence salvos, the Sparrow was guided to a target by a beam transmitted from the launching aircraft's radar. It did not have nuclear capability. The missile was developed by the Bureau of Aeronautics as a versatile weapon, permitting effective attack against high- and low-altitude enemy jet bombers and fighters. It has been phased out of production.

Sparrow II was developed as an experimental missile in 1955 and was not intended for fleet use. This large United States/Canadian program, with Douglas Aircraft as the prime contractor, was canceled in 1958.

Sparrow III replaced its predecessor, Sparrow I, in fleet air defense. Raytheon began development in 1955, and it became known as the AIM-7C as it went into production in 1958. The missile was 12 feet long, weighed about 350 pounds, and attained a speed of over 1,500 miles per hour within seconds after launching. It was an all-weather missile that could be fired above or through clouds with accuracy. Navy fighters could carry two to four Sparrow IIIs. Further



SPARROW
length: 12 feet
range: 5-62 miles



Lark.

variants (AIM-7E and -7E2) were employed by NATO, and Sparrow remain in the Navy's arsenal. In December 1963, the Navy fired seven Sparrow rounds.

HVAR

HVAR, or High Velocity Aircraft Rocket, was a 5-inch World War II weapon. The 5-inch rocket was also known as Holy Moses, because of the rigor of its blast. It was about 6 feet long, weighed about 140 pounds, and had a velocity of about 1,500 feet per second. It had been in use since July 1944. Six test rounds were fired at WSPG beginning on October 13, 1945. Two additional rounds were fired in 1954 from WSPG, and the HVAR production was terminated in 1955.

Corvus

Designed as a supersonic, liquid-propelled ASM by the Navy, the Corvus never reached the deployment stage. In January 1957, Temco Aircraft received the award for to develop the Navy's ASM-N-8, a guided missile to be launched from carrier-based aircraft, such as the Vigilante and Intruder. In 1959, the test program reached WSPG, with 10 rounds fired that year. The system was developed to the extent of fully guided flights but was canceled in July 1960.

Lark

Development of the Lark began during WWII as the Little Lark by the Navy Jet-Propelled Missile Board and underwent flight tests at the NOTS at China Lake and Point Magu. It was a liquid-propelled rocket vehicle with a complicated flight-control profile, tail fins, and forward wings. It was never used in WWII but continued development through 1950 in California. In late 1951, it reached WSPG, and the first firing occurred on November 29. One more round was fired that year, and the program faded from WSPG with only two rounds fired.

Typhon

Born from the Bumblebee program, the Typhon was designed as a fleet-area defense weapon. Built by the same team that produced Talos, the Typhon went under contract in 1961. In March 1962, the first round was fired from LC-35 and, by 1964, 12 rounds of the missile were fired. Nearing the production-deployment stage of development, the program was canceled in favor of the Terrier/Tartar/Standard system.

Terrier.

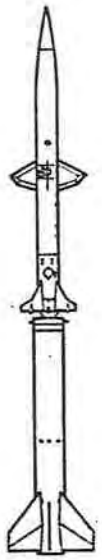
TERRIER

Terrier was an all-weather surface-to-air missile. Designed to intercept enemy aircraft at longer ranges and higher altitudes than conventional antiaircraft guns, the 15-foot weapon weighed about 1.5 tons, had a range of about 10 miles, and utilized a solid fuel. It employed beam-riding guidance.

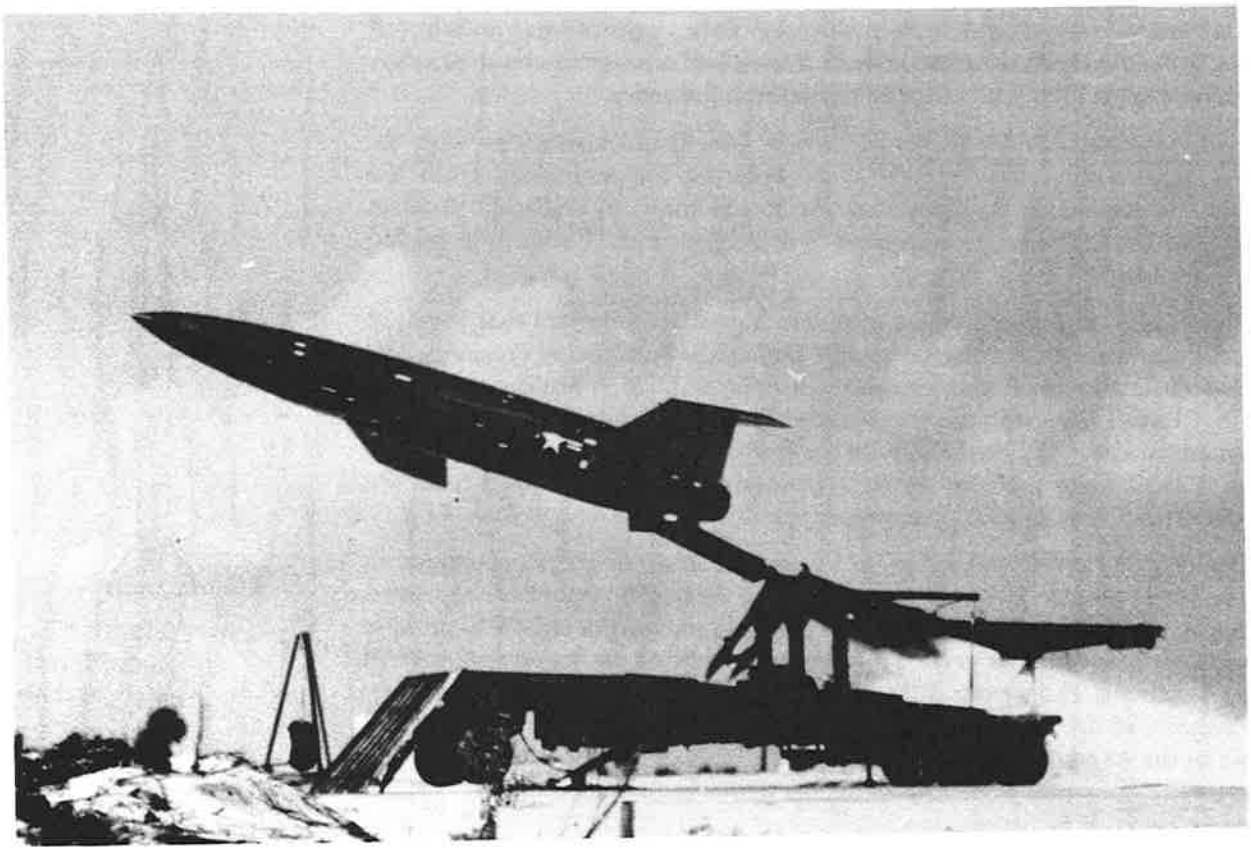
The missile was suitable for shipboard use or beachhead operations with the Marine Corps. Shipboard Terriers were selected automatically from the magazine and loaded on the launcher, which was then automatically trained, elevated, and fired. The entire operation took only seconds. Radar then guided Terrier to the target.

Terrier was the result of eight years of research and development that began in 1949 under the direction of the Bureau of Ordnance Bumblebee Program. The research-and-development version was called the SAM-N-7. Testing took place at NOTS China Lake, with the first round fired on February 16, 1950. The program arrived at WSPG in 1952, with the first Terrier booster rounds fired on October 9, 1952. Over the next month, two more rounds were fired from the Navy launch facilities (LC-35). The system was finally deployed in June 1956.

The advanced Terrier was intended for the same surface-to-air requirements as noted for Terrier above. However, the advanced Terrier incorporated improved guidance features (the beam rider and tail control) and was designed to provide substantial improvements over the original Terriers in coverage against supersonic threats. The system RIM-2C was deployed on 3 carriers, 6 cruisers, and 30 frigates of the U.S. Navy. The Terrier, combined with the Tartar, formed the basis of the standard system in use today.



TERRIER
length: 15 feet
range: 10 miles



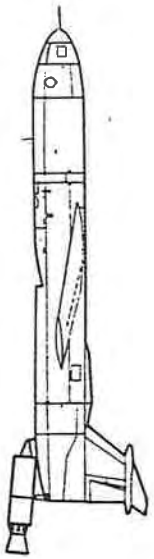
Matador, no date.

HI-ROC

In October 1945, the Air Technical Service of the Army requested proposals to design missiles with ranges of up to 5,000 miles. Consolidated Vultee Aircraft Corporation (Convair) responded in January of the following year. Convair's proposal was accepted and awarded $1.4 million, and project MX-774 was instituted. Much of the project was designed to overcome the limitations of the V-2; its weight, its single-component configuration without a detachable payload container, and its rigid strut-support system. Convair removed the double-walled arrangement, which increased the fuel capacity; produced a detachable payload package, which increased the range of the missile; and used the nitrogen gas pressure to make the air frame rigid instead of metal struts. HI-ROC was developed under the Belgian-born Karel J. Bossart and was constructed in Downey, California. Reaction Motors, Inc., of New Jersey built the engines. The AAF canceled the program in July 1947, but with remaining funds, Convair continued and began captive tests at Point Loma, California from November 1947 through May 1948. After these tests, the program was moved to WSPG. On June 13, 1948, the first round was fired, but failed because of a premature fuel cutoff, allowing the round to only reach an altitude of 6,200 feet. Two more unsuccessful rounds were fired, on September 27 and December 2, 1948, before the remaining funds ran out. The program successfully tested a number of important components, including the gimble-mounted motor configuration, detachable payload, and pressurized hull configuration. The program fell victim to the Navy's Viking and was terminated in February 1949.

MATADOR

Matador (TM-61 or TM-61C) was an Air Force tactical missile. The jet-driven, 650-mile per hour Matador was the Air Force's first operational missile. Its relative mobility, reliability, and accurate guidance system made it an ideal vehicle for delivering atomic destruction to targets several hundred miles away. This tactical missile could also carry a conventional warhead. It was powered by a jet engine and was surface-launched by rocket booster. About the same size as a jet fighter, the Matador had a wingspan of 28.7 feet, a length of 39.6 feet, and a diameter of 9 feet. It could be easily transported and immediately launched from its special trailer platform, and it could fly at an altitude of over



MATADOR
length: 39 feet
range: 650 miles

Falcon.

35,000 feet. Three versions of the Matador were developed. The TM-61A had a line-of-sight radar guidance system, the MSQ radar guidance system. The TM-61B was the latest version, being several feet longer than earlier versions, with a ground-assisted guidance system (this became the MACE). The TM-61C employed the MSQ radar and the Shanicle system for guidance and became the first system to use the Hyperbolic Grid System.

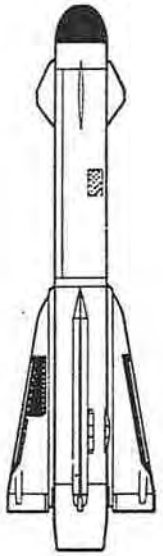
The Matador made its first flight in 1950. In 1955, WSPG began supporting the development program through its instrumentation facilities. Between 1955 and 1960, WSPG/WSMR supported over 69 Matador rounds. It had been in quantity production for a number of years, and units were deployed overseas since early 1954. Matador units were stationed in Germany, Taiwan, and Korea.

FALCON

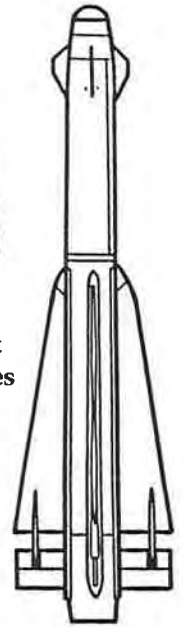
Falcon (GAR) was the name of a family of supersonic air-to-air rockets, which were among the smallest missiles in production for their day. They could be carried either internally or under the wings of interceptor aircraft. These solid-propellant rocket-powered missiles were approximately 6 feet long, had a span of 20 inches, and a diameter of 6.4 inches They weighed slightly over 100 pounds each. Launched miles from their target, the Falcons were guided automatically either by radar or by a supersensitive heat-seeking device. During development tests, even unarmed versions destroyed drone targets.

The Falcon was developed by Hughes Aircraft Company as part of the weapon system for the Northrop F-89 and the Convair F-102A and 106A interceptors. The majority of the development program took place at ARDC at HAFB, with WSPG aiding with its instrumentation.WSMR supported the Falcon program through 1962, with over 1,182 rounds monitored.

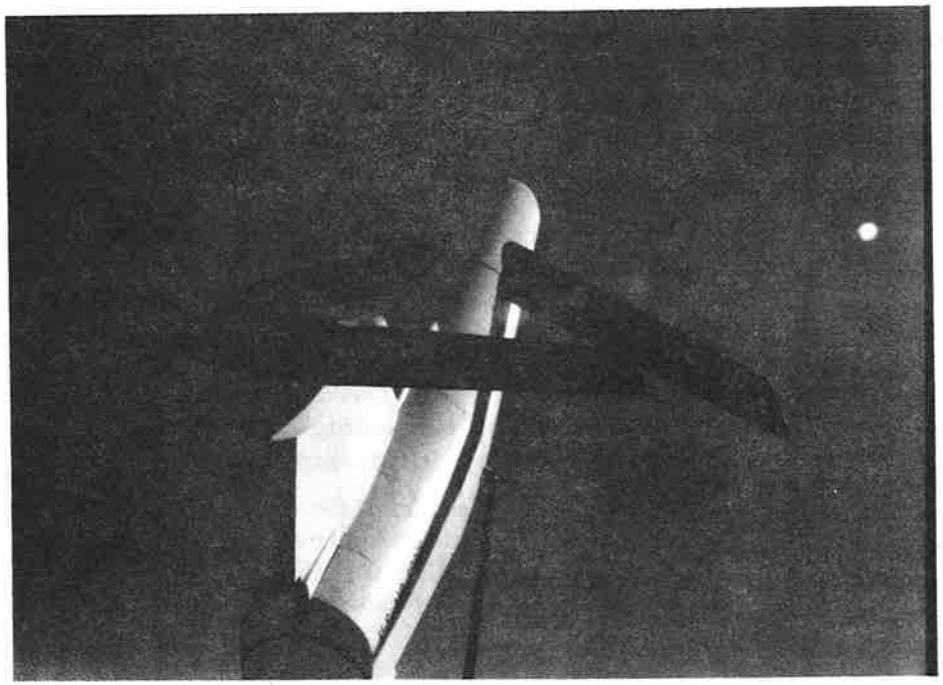
Assigned to operational units of the Air Defense Command since 1958, the Falcons are designated as GAR-1, GAR-2, GAR-3, or GAR-4. GAR-3 and GAR-4 are advanced versions of GAR-1 and GAR-2, respectively. The odd-numbered GARs are radar-guided, while those designated with even numbers are heat-guided.



FALCON I
length: 6 feet
range: 5 miles



FALCON II
length: 7 feet
range: 6 miles



Mace.

Mace

Mace (TM-76A) was an improved version of the Matador, with innovations that may warrant its classification as an entirely different missile. Although the speed remained near-sonic, the effective operational range had been increased to over 600 miles. This missile had a much-improved guidance system, which enhanced its operational use. Martin-Baltimore designed the system as the primary contractor. WSPG began supporting the Mace development mission in January 1958, and by 1964, had supported in excess of 234 rounds. Mace went into production in 1958 and was operational in 1959.

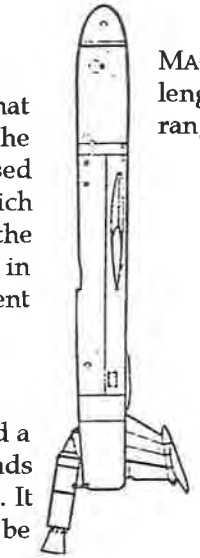
Atlas

Atlas (SM-65, WS107A-1), America's first intercontinental ballistic missile, had a speed in excess of 15,000 nautical miles per hour and weighed 195,000 pounds when loaded for launching. It was 80 feet long and had a diameter of 9 feet. It was powered by liquid-rocket engines. Two types of guidance systems could be employed, radio inertial or all inertial.

Convair Division of General Dynamics Corporation was the prime contractor for the development of this system. Round records from the National Range indicate that Atlas prototype testing was supported at WSPG. Three rounds of the Atlas AM-1 were supported in 1955, and three Atlas rounds in 1956. The first hot round was fired in June 1957, and the first successful flight using both boosters and sustainer engine took place in August 1958. The first Atlas squadron was scheduled to become operational at Vandenberg Air Force Base, California, in 1959, and the second Atlas squadron was to be deployed to Warren Air Force Base, Wyoming. The Atlas, carrying a nuclear weapon, would be used for strategic missions.

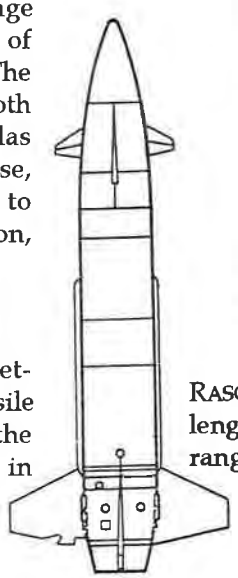
Rascal

Rascal (GAM-63) was an Air Force air-to-surface guided missile. Rocket-propelled, the hard-hitting Rascal was a bomber-launched supersonic missile that could reach out and destroy enemy ground targets without exposing the aircraft and crew to local defenses. The Rascal was 32 feet long and 4 feet in diameter. With a range of over 75 miles, it carried a nuclear warhead.

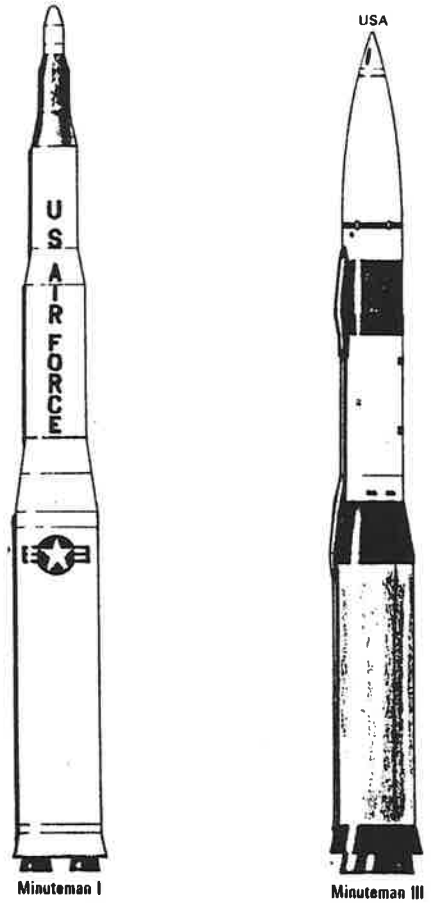


MACE
length: 40 feet
range: 600 miles

ATLAS
length: 75-80 feet
range: 10,360 miles



RASCAL
length: 32 feet
range: 75 miles

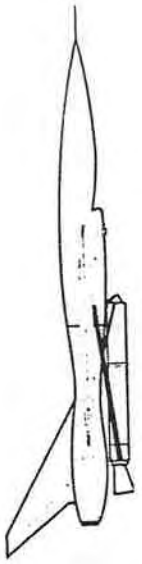


Minuteman I and III (after Gunston 1979).

Bell Aircraft was the principal designer of the Rascal system. During tests, it scored direct hits as well as near-misses well within the 1,500-feet effective target area. Testing was completed in the fall of 1957, with WSPG participating in the program beginning July 14, 1955. Through 1958, WSPG supported 830 Rascal rounds. The Strategic Air Command's first Rascal missile unit became operational during 1958. Cancellation of the Rascal program was announced on September 9, 1958, after falling behind other air-launched missile systems.

Goose

Goose (SM-73) was a ground-launched diversionary missile designed for the Strategic Air Command to penetrate enemy defenses. In 1955, Fairchild Engine and Airplane Corporation designed and developed this plastic, rocket-boosted and turbo-jet powered decoy. The program arrived at WSPG in March 1956 and continued through 1957, with WSPG supporting a total of six rounds. It was designed for zero-launching in advance of the attacking bombers to confuse enemy radar and bait defensive forces. Cancellation of the Goose program was announced on December 12, 1958.



GOOSE
length: 38 feet
range: 1,500 miles

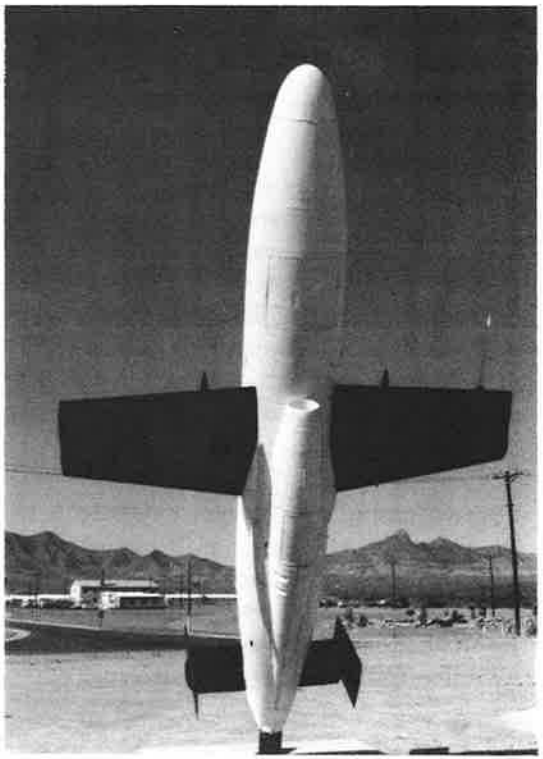
Quail

Green Quail (GAM-72) was an air-launched diversionary missile developed for the Strategic Air Command to penetrate enemy air defenses. It was part of the Corvus family of surface-to-surface missiles, but it evolved to be launched from air platforms. It was powered by a jet engine and launched from a B-47 or a B-52 upon approaching the target. It was flight tested from 1957 through 1963, with WSMR supporting over 75 missions.

Minuteman

Minuteman was a ICBM designed to replace the Atlas and Titan missiles. It was designed to be lighter, smaller, and simpler than earlier intercontinental ballistic missiles. It was a three-stage solid-propellant missile in the 5,000-mile class, with nuclear warhead capability. Development began in 1956, and the system was in the early phase of development by 1958. Early design specifications called for a mobile system using railroads, but this concept was abandoned in favor of underground silo launchers. Testing at Cape

Hound Dog.



Crossbow.

Canaveral and Hill AFB, Utah, continued through 1961. In March 1962, WSMR added support of the program, testing eight Minuteman rounds over the next two years.

The missile was deployed in 1962 and, by July of the following year, the entire Minuteman system was operational. In 1964, the Minuteman II first flew from Cape Canaveral, followed by the development of the Minuteman III.

Hound Dog

Hound Dog (GAM-77) was an air-launched cruise-missile strategic-penetration weapon system, with the B-52 as its transport vehicle. This supersonic missile was designed to deliver a nuclear warhead over a distance of several hundred miles after launch from the aircraft. It was powered by a jet engine and directed to the target by an inertial guidance system.

Initial testing of the weapon took place at over-water ranges in 1960, with the first test taking place at the Atlantic Missile Range on April 23, 1959. In October 1960, on-range overland flights were initiated at Air Force Missile Development Center (AFMDC); these continued until June 1963, when the system went into production. WSMR supported eight Hound Dog missions, beginning in June 1962 and ending in 1963.

Hound Dog
length: 43 feet
range: 710 miles

Crossbow

Crossbow was an adaptation of a drone aircraft for an air-to-surface missile to be used against enemy radar installations. Radioplane was the prime contractor for developing the weapon in 1955. Between June 1955 and 1957, eight rounds were supported by WSPG.

DYNA-Soar

DYNA-Soar had its beginnings as a rocket-powered lifting body in the 1930s, with the studies of Dr. Eugen Sanger. The Air Force began to consider a manned, rocket-boosted vehicle that would glide to its landing site. As initially designed by Boeing and Martin, the DYNA-Soar would become the delivery vehicle for a missile, but it evolved into an experimental aircraft, the X-20, and was evaluated at the Air Force Flight Test Center (AFFTC), Edwards Air Force Base, under the direction of Gen. Charles Yeager. The program was supported by WSMR in 1963, with 17 missions.

White Sands Proving Ground. Photo circa 1947.

EXAMPLES OF EARLY COLD WAR HISTORIC PROPERTIES

With America's entry into World War II, military and civilian agencies in the Tularosa Basin region began to play an active role in ordnance research, testing, and training, leading to a position of leadership in Cold War research and the development of guided missiles. Military training within the region began in 1854 at nearby Fort Bliss, which subsequently provided the setting for, among others, "Black Jack" Pershing, Patton's Armored Corps, the 3rd Armored Cavalry Regiment, and the 7th Ranger Battalion. Fort Bliss also supported Air Defense Artillery training and, along with Alamogordo Army Air Field, bomber training over the Alamogordo Range. White Sands Missile Range and neighboring Holloman Air Force Base were the scene of early Army, Navy, and Air Force missile programs based on captured German missile systems. Ultimately, the region has become an integrated, international, multiforce training theater for such exercises as Border Star and Roving Sands.

Documenting the role played by the region's cultural and natural landscape during the Cold War is a complex task. A wide variety of property types, facilities, features, and artifacts, many of them unfamiliar to traditional historical pursuits, must be considered. Historical documentation and oral history are essential elements for establishing what role a property might have played during the Cold War. The region's unique role in guided-missile research and development, influencing and influenced by global Cold War events, has a significance that cannot be overemphasized.

Military research and development, much of which took place in the deserts of southern New Mexico, fueled the Cold War and the resulting Arms Race, continually creating new tactical and strategic challenges, while developing the capabilities that ultimately carried our species into space. Each weapon system developed demanded a defensive response, and each problem solved bred another, fueling an apocalyptic nuclear-arms race that became the predominant leitmotif of modern times. This is the context within which each Cold War property must be assessed. What role did each play in the Cold War? Is each an essential and contributing element of a significant property type? Is the property unique or of exceptional value or associated with persons or events crucial in our nation's modern history?

Thematic Group	*Property Type*	*Facility Name*
World War II Bombing/Artillery	WWII Targets	Auxiliary Target, Blockhouse Targets North, Blockhouse Targets South
WSPG Test Bed	Army Infrastructure	Sierra Chapel, Enlisted Men's Barracks, Officer's Club
	Lab/Assembly	von Braun's Missile Assembly, The Mill
	Navy Infrastructure	USN Headquarters, USN Bachelor Enlisted Quarters, USN Administration/Technical Facility
	Launch Complexes	LC-33, LC-35, Lacrosse Launcher and Target, ORK Rail Launcher
	Static Test Stands	20-K, 100-K, 300-K, 500-K
	Instrumentation	A Station, B Station, Bx Station, C Station, Cowan, DOG, D-5, D-6, D-9, EASY, FOX, G Station, Jones, K Station, Locker, Nan, Nancy, Parker, Ram, Rampart, R Station, T-1, T-3, Tare, Two Buttes, Uncle 2, Unicorn, V Station, VIP (Davy), Viper, W Station, W Prime
Research Rockets (NASA)	Launch Complex	LC-36
Uprange Support	Range Camps	Tularosa Range Camp, Salinas Camp

List of Cold War properties documented during this study by thematic group and property type.

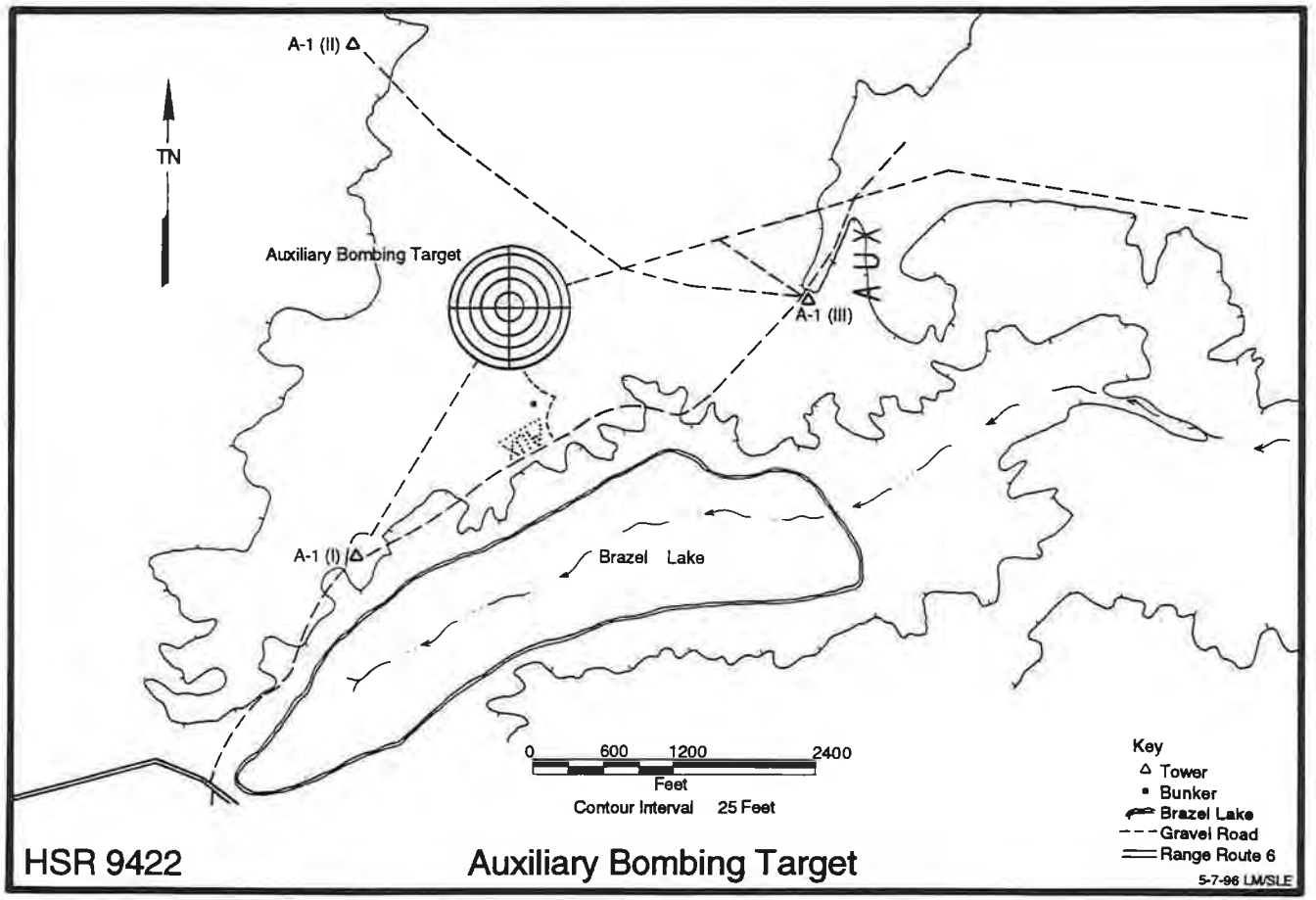
Over 2,000 Cold War era properties remain on WSMR. It was not our intent in this study to identify every Cold War property potentially eligible for inclusion into the NRHP, but to employ a variety of source information to target individual properties among the Cold War property population. WSMR real property records, WSMR "As-Built" drawing inventories, and existing historical overviews were used to help target facilities associated with individual missile-system programs. Subsequently, thematic groups were defined and used to develop sets of property types distinct in function, which together serve to form a guided-missile development center. Thematic groups include WWII Bombing/Artillery, WSPG Test Bed, Research Rockets (NASA) and Uprange Support. Property types defined include WWII targets, Army infrastructure, lab/assembly facilities, Navy infrastructure, launch complexes, static test stands, instrumentation, and range camps.

As a result of this approach, certain unique properties or the "best" of a property type may not have been recorded. In some cases, specific properties were not fully documented because of limited or denied access. By no means was this study a complete inventory of historically important Cold War facilities at WSMR. However, it does present a glimpse into the variety of property types important to the history of the Cold War and the development of guided missiles. Examples that are representative of the variety of property types associated with WSMR's role in the Cold War are provided here.

World War II Targets

Presentation of Cold War properties on WSPG begins with sites or features associated with pre-Cold War contexts. These include WWII facilities associated with the Alamogordo Bombing and Gunnery Range and Biggs Air Force Base Bombing Range. Their relationship to the Cold War is historical in nature.

During WWII, the U.S. Army Air Corps established 14 aerial bombing training bases in the western United States, principally in Texas and New Mexico. The Alamogordo Bombing and Gunnery Range was established in 1941, on lands that are now a part of WSMR. Numerous bombing targets were constructed throughout the Tularosa Basin to serve Alamogordo and Biggs Army Air Fields. Available 1946 aerial photographs and 1948 Army Map Service (AMS) quadrangle maps show at least 19 WWII targets, including 12 blockhouse/hardened shelter targets and 7 precision bombing targets.

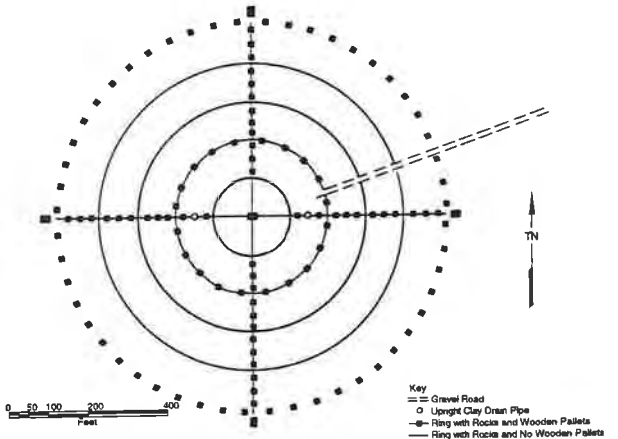


WWII auxiliary bombing target documented on WSMR. HSR site map 1996.

The blockhouse/hardened shelter targets and one precision bombing target were documented during this study. The former are depicted on 1948 AMS quads as "Blockhouse Targets" and the latter as an "Auxiliary Target." The Auxiliary Target is similar in construction and design to precision bombing targets found throughout the western United States, a design first implemented in the 1930s and used as far west as Muroc Army Air Field (Edwards AFB) in southern California. The blockhouse/hardened shelter targets probably occur on other installations, but thus far, none are reported elsewhere. Later WSPG staff probably did not reuse the blockhouse targets as targets per se, yet these structures retain an interesting historical connection to America's guided-missile development program. At German WWII rocket-development installations such as Peenemünde and deployment sites along the coast of France and Belgium, hardened shelters or blockhouses were constructed and became targets for Allied bombardiers. It is speculated that the blockhouse targets documented on WSPG were used to train bomber crews to destroy the German rocketry development and deployment program, which in turn became the foundation of America's guided-missile and space programs.

Auxiliary Bombing Targets (AUX)

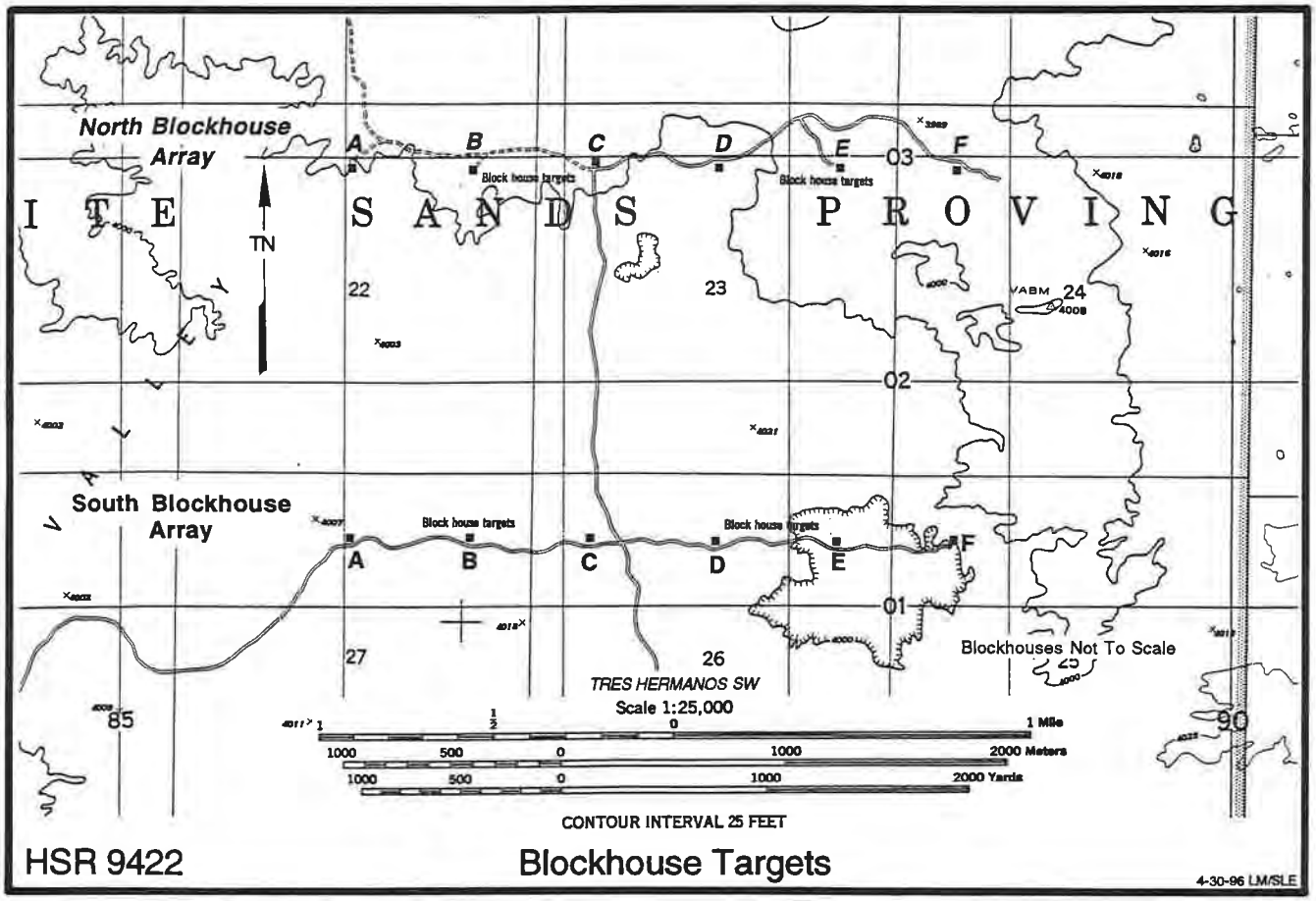
The Auxiliary Bombing Target is an example of a precision bombing target that served as an alternate practice target during WWII. This target was used when the primary target was not accessible. The target area measures 1,000 feet in diameter and covers an area of about .75 square mile along the north side of Brazel Lake. The target consists of concentric rock rings and a target cross constructed of large rocks. Wooden target features are located along the cross and on some of the rings. Thousands of practice bombs and impact depressions are visible throughout the area.



Auxiliary Bombing Target

Three observation towers, A-1 (I, II, and III) were once strategically located at points around the target. Presently, the appearance and construction of these towers is unknown. None of the towers remain today, but their archaeological footprints are visible in the form of concrete tower footings and refuse scatters dating to the early 1940s.

Two aerial-recognition features mark the target on the ground, one adjacent to tower A-1 (III) and the other near the gravel road leading to it. Both features are comprised of large letters spelling "AUX." One covers an area approximately



Blockhouse/harden shelter targets constructed pre-1948.

200 by 600 feet and was created with a bulldozer; the other is spelled out with large rocks in an area approximately 200 by 400 feet. The target and the aerial-recognition features remain intact and are in excellent condition.

Blockhouse Targets

Very little is known about the 12 blockhouse targets north of Orogrande gate, which may have been constructed for artillery and/or bombing practice during the later years of WWII. These targets, constructed pre-1948, consist of two east-west rows of blockhouses located in the active dunefield on lands then identified as Biggs Army Air Field Bombing Range, now part of WSMR. Ten of the 12 blockhouse targets were documented during this study. Two blockhouse targets were not accessible because of their location deep with the dunefield, but their rooftops were visible from the road. The blockhouses are situated in two parallel rows of six blockhouses each. The rows are spaced a mile apart, each stretching 1.7 miles, and the blockhouses within each row are spaced .3 mile apart.

The blockhouses are similar in shape, size, and construction. All are single-story, one room buildings constructed of reinforced concrete set on a continuous concrete footing. The structures measure 15 ft 6 in. square, with walls that are 9 inches thick. They all have gambrel roofs of reinforced concrete and dirt floors but no windows. Several appear to have been whitewashed. Eight of the blockhouses documented contain entryways, all on the north side, that measure 5 feet high by 1 ft 6 in. wide. All of the blockhouses are intact and appear to be in good condition. Two of them received impacts, exhibiting large holes in their roofs, vividly illustrating their function.

Army Infrastructure

Funds for the construction of cantonment facilities for WSPG were authorized on June 12, 1945, and ground-breaking ceremonies took place during the first week of July. The cantonment was expedient and temporary. The original plans for WSPG called for a cantonment area consisting of living quarters, mess, and sanitary facilities to accommodate 500 persons; office, storage, and shop facilities for the technical requirements of guided-missile testing; and transportation, communication, water, and electrical systems.

Original hutment area of WSPG, circa 1946.

The following description, recorded in April 1946, characterizes the early WSPG cantonment:

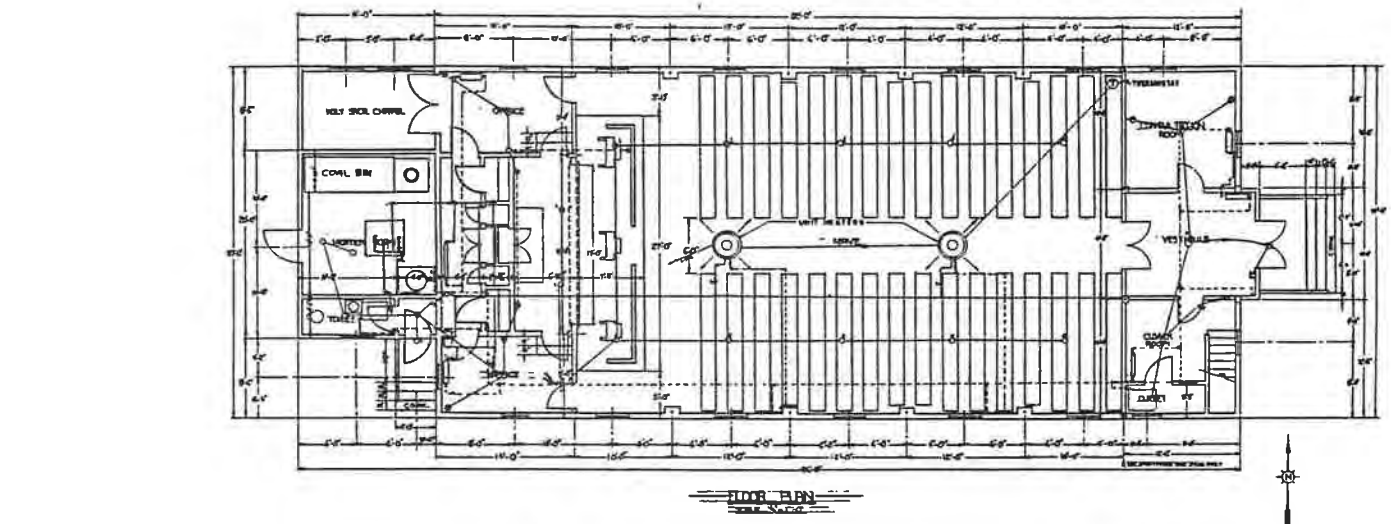
> At present, there are approximately 75 buildings in this area, varying from small hutments of the so-called Dallas type to a mill building 180 feet long and 120 feet wide. These buildings are distributed over four sections, each arranged to provide adequate space for future expansion without rearrangement of other sections. The NE area is assigned for housing enlisted personnel and at the moment provides quarters for approximately 300 men. The SE area is allotted to maintenance and supply functions with warehouses for various types of property and the motor pool. The NW section is devoted to headquarters facilities, officers' and visitors' quarters, the post exchange, and recreational facilities for all personnel on the station (n.a. 1946:3).

Between 1947 and 1948, the Army began removing Dallas-type hutments, replacing them with a number of relocated WWII mobilization buildings. In addition, the Army may have begun constructing new buildings following mobilization plans. The original quadrant division of the cantonment into functional units survives today to some degree, but very few of the original structures remain. A few of the surviving buildings are described below.

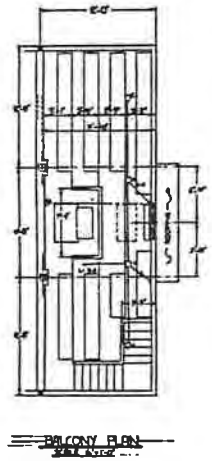
Sierra Chapel

Architecturally, Sierra Chapel (T-145) is reminiscent of a Colonial Revival style executed within the Series 800 Mobilization series. The chapel is probably one of the early cantonment construction buildings, but its precise origin remains unclear. WSMR Real Property records list a 1951 date of service, while recording that the chapel was transferred in 1947 to the original cantonment from Camp Luna near Las Vegas, New Mexico. Whether transported to or erected at the original cantonment, this chapel ministered to the religious needs of WSMR personnel during the uncertain days of the Cold War.

Sierra Chapel is a rectangular, two-story wood-frame building with a simple gable roof. The building rests on a concrete foundation. A rectangular room with a shed roof, which may be a later addition, extends from the west wall.



Sierra Chapel relocated to WSPG in 1947, from Camp Luna, NM.

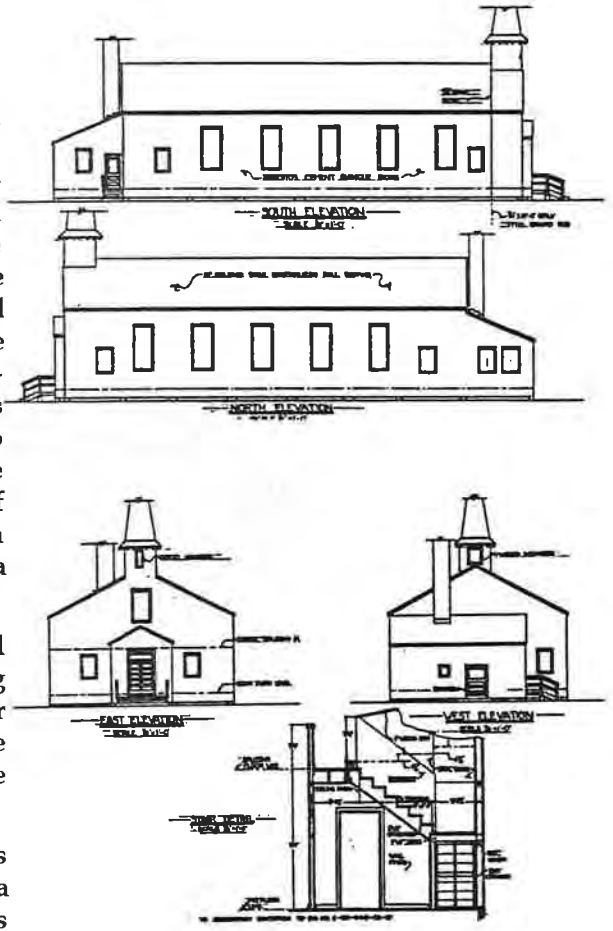


Floor plan of Sierra Chapel. Army Engineer's drawing, dated January 28, 1955.

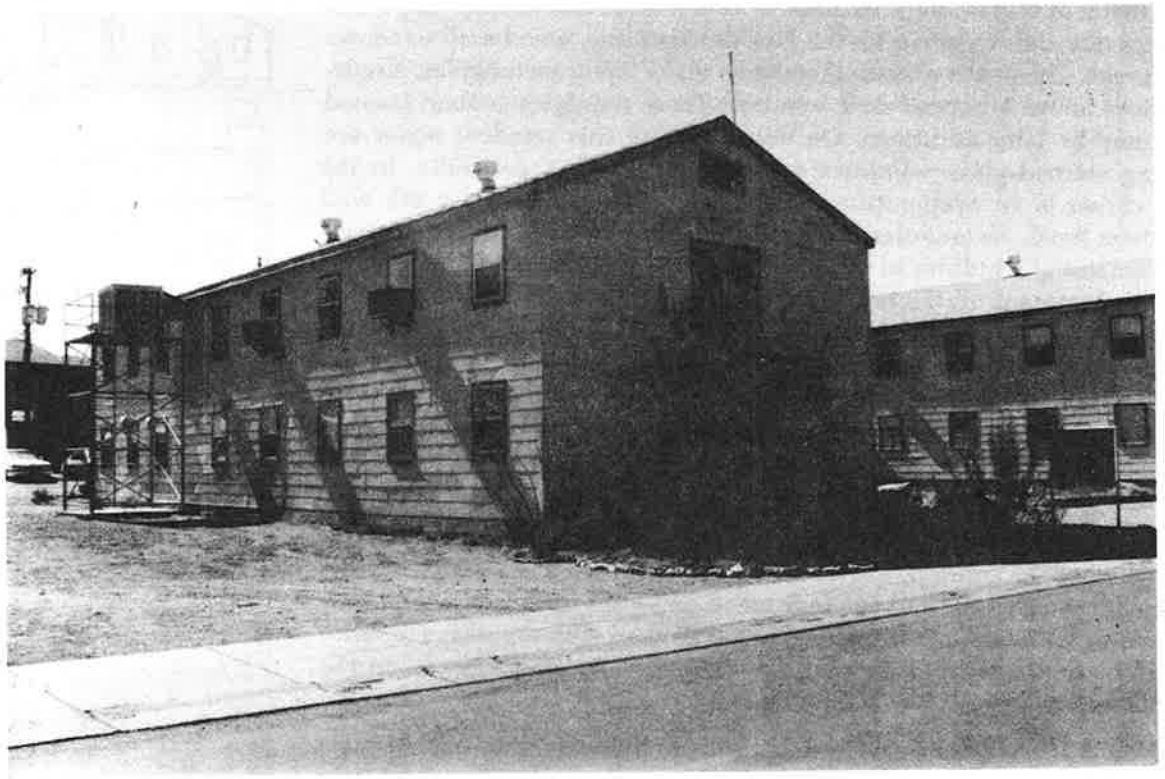
The east elevation contains the central entrance consisting of glass doors set into a 14-foot projection, with a gable roof. The entrance doors are flanked by decorative metal and glass light fixtures. A concrete threshold with steps and metal railings descends to ground level. Five double-hung, wood-sash windows are also present. The south elevation contains eight fixed, rectangular, single-pane windows above a hopper-style window. These windows contain stained glass and may be later additions. On either side of this window series are double-hung stained-glass windows with wooden sashes and sills. In the southwest corner is an evaporative cooler on a metal stand. The north wall contains seven fixed, rectangular, single-pane windows above a hopper-style window. Remaining windows in the south wall are either double-hung wood-framed or replacement aluminum sash styles. The northeast corner contains wood stairs that lead to second-story offices and the choir loft balcony. Entry to the second-story is through a decorative wood-veneer door. All wall surfaces are covered with rigid asbestos shingles. The central steeple consists of a hip roof with a vented tower base. Roofing material is green asphalt shingles with a wood facia, subsequently covered by metal. Affixed to the steeple finial is a lightning rod.

The interior walls have faux decorative columns, partially covered by wood paneling. Between the columns are stained-glass windows. The concave ceiling is covered with acoustic tile and has four metal-and-glass chandeliers. The altar area is recessed, with two raised platforms, and flanked with doorways to office spaces and/or the exterior. The foyer has doorways to office spaces on the ground floor and to the stairway ascending to the choir loft.

Modifications to the exterior include an addition to the west wall, stained-glass windows and replacement aluminum-sash windows, and replacement of a window in north wall by a metal door, and new concrete handicapped access ramp, concrete retaining wall, and handicapped wheelchair ramp. Evaporative coolers on metal stands may also represent later modifications. Interior modifications include acoustic ceiling tiles, carpeting, and possibly wood paneling of faux columns.



Elevations of Sierra Chapel. Army Engineer's drawing, January 28, 1955.



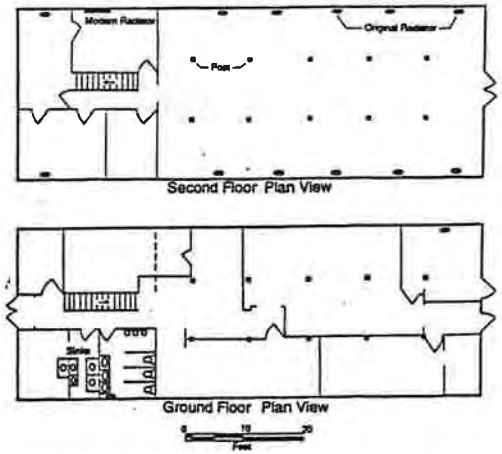
The enlisted men's barracks is a 800 Series mobilization building that could house 63 or 74 men.

Enlisted Men's Barracks

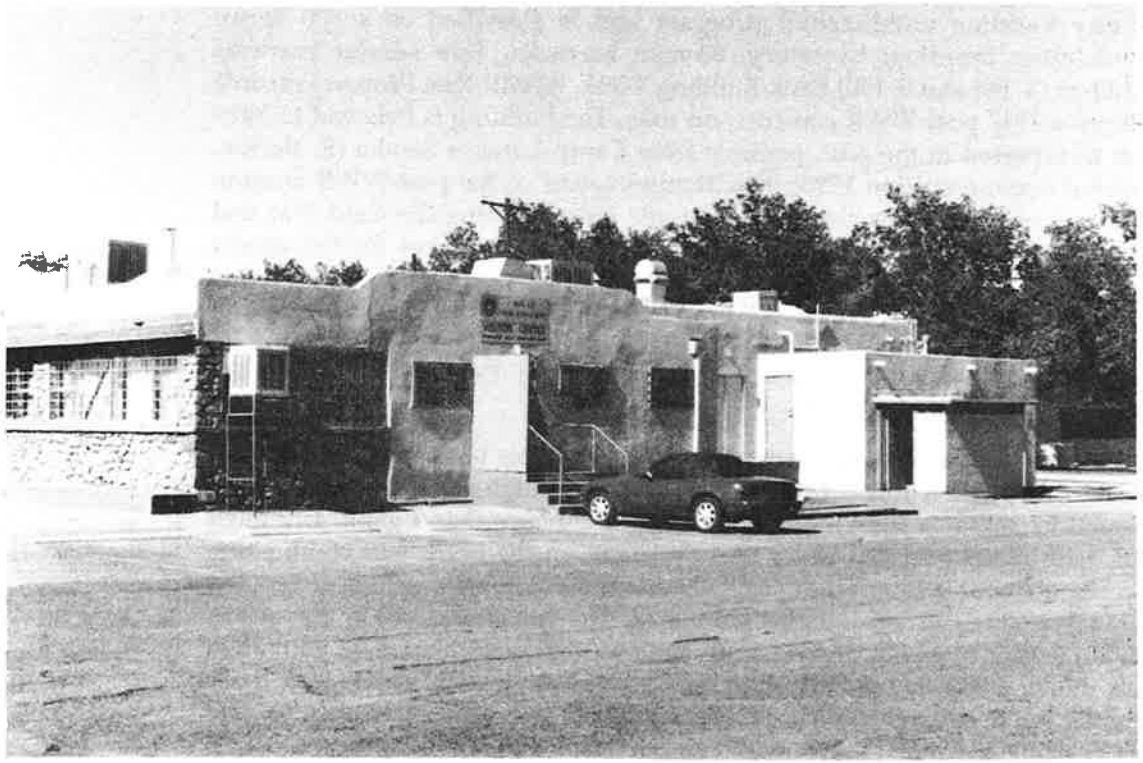
The enlisted men's barracks (T-149) is associated with the WWII temporary military building mobilization program and is classified as a 800 Series Mobilization Building: two-story, 63-man barracks. Two similar barracks buildings (T-148 and T-150) flank Building T-149. WSMR Real Property records indicate a 1947 post-WWII construction date. The building is believed to have been transported to the post, possibly from Camp Luna or Sandia (R. Burton, personal communication 1996). It is representative of the post-WWII mission objectives of WSMR associated with missile testing during the Cold War and housed NASA's engineering directorate administrative offices for the Apollo program in the early to mid-1960s (F. Hemingway, personal communication 1996). In the mid-1980s, it was used for a brief period by U.S. Army Corps of Engineers as support offices for the Ground Base Free Electron Laser project (P. Hoffer, personal communication to M. Lawson 1994). Currently, it houses the WSMR Natural and Cultural Resources offices.

Building T-149 is a rectangular, two-story, wood-frame temporary building set on concrete piers, with exterior walls of diagonal rough-sawn wood sheathing covered by asbestos shingles painted tan. The building has a gable 4:12 pitch roof, with wood-enclosed eaves that overhang on the north and south sides. Roofing material is interlocking asphalt shingles and metal flashing covers the original wood trim around the perimeter. The north and south elevations contain double rows of evenly spaced windows that are replacement aluminum sash, double-hung, 1/1 style. Evaporative coolers set on metal stands have ducts entering the north and south walls. Entry is from the east and west sides. The east entrance has metal doors, with concrete steps and metal railings. Original wood doors remain on the east balcony. The west entrance consists of double-hung metal doors, a concrete threshold, and steps with metal railings.

The first-floor interior has been partitioned into new office spaces. Original wood wainscoting, painted white, remains. The second-story interior retains the open space of the original floor plan. Modifications include replacement windows, metal doors, evaporative coolers, and interior ducting, which were added in the 1950s. Some asbestos shingles have been replaced by fiberglass (or possibly metal) shingles. Interior modifications include modern additions of acoustic tile, light fixtures, cooler ductwork, and women's restroom facilities.



Plans of Building T-149.



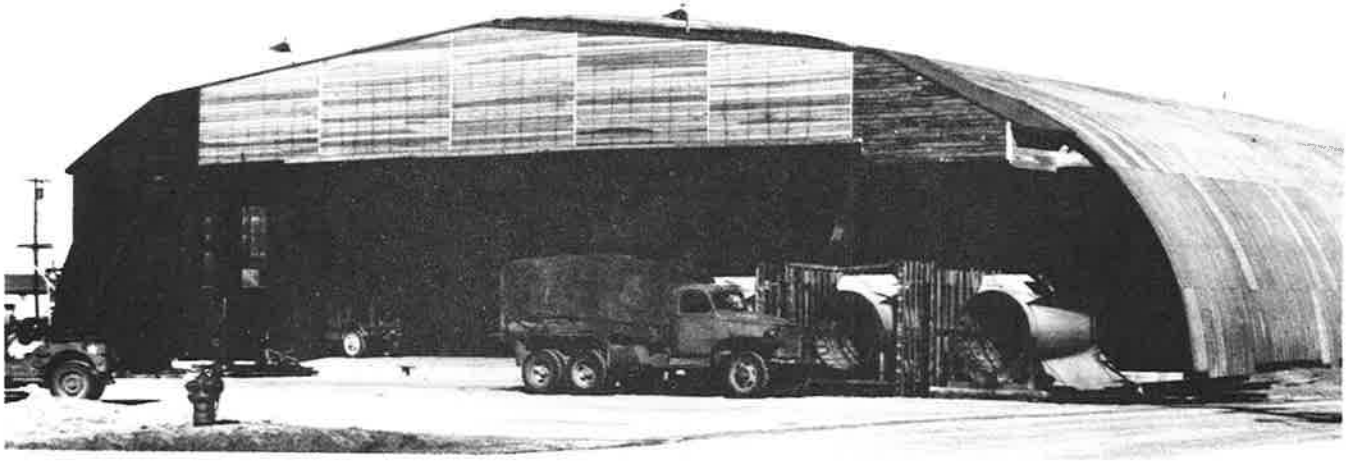
The Officers' Club was constructed in 1948 within the original WSPG cantonment.

Officer's Club

The Officer's Club (Building 122) was constructed in 1948 within the original WSPG cantonment area. The building now serves as the Public Affairs Office and provides various interpretive services to visitors, including a new auditorium, interpretive area in an open ballroom, and the WSMR Hall of Fame. Building 122 is single story and constructed of cinder block covered with plaster. Several features resemble a vernacular Pueblo Revival architectural style, including the plastered wall surface; *canales* below the roof line that exit through the exterior walls of recent additions to the building; the flat roof with stepped, raised parapet that also shields a metal gable roof in the northeast corner of the building; and *faux* viga motif along the east wall (with an aluminum rain gutter attached), constructed of squared, milled lumber and tongue-and-groove lumber. Remodeling and new construction in the vernacular Pueblo Revival style have lent an overall visual unity to this building, which appears to have incorporated disparate motifs if not separate buildings.

Windows in the west wall are double-hung, 1/1, with wood frame and sill, or wood-frame picture windows, that rest on a horizontal decorative concrete beam. These windows are covered by either wire mesh or metal bars in a lattice pattern. Below and between window sets is decorative granite in mortar. This rock work also extends around the southeast corner to cover a portion of the south wall. The west entrance consists of double-hung metal doors with a single, fixed window pane covered by metal mesh. Older concrete steps and newer handicapped access ramp with metal railings provide access. A decorative planter of concrete has been placed along the base of the west wall. To the north of this entrance, cyclone fencing topped with barbed wire provides a security area that includes the north wall of the building.

Entrance in the south wall of the building consists of a single-hung wood door, concrete steps with metal railings, and a metal wind screen on one side. No picture windows are present in this wall, but overall window treatment (perhaps reflecting some remodeling) is similar: wood frame, two-pane sliding glass covered by metal lattice barricade. The plastered wall appears to rest upon a concrete foundation. The inset remainder east of the entrance includes a cement loading dock with steps and an 8-by-15-ft rectangular, plastered cinder-block addition. Another 6-by-15-ft cinder-block room with shed roof on wood



von Braun's Missile Assembly building, circa 1945.

von Braun's Missile Assembly building present day.

supports has been added to the south wall of this addition. A stepped (or pueblo style) effect is suggested by the descending heights of the various roof lines in this portion of the building. The largely solid, original surface of the east wall is broken only by the stepped, or rounded, raised-parapet (streamline style) motif and several windows. Here (and in the north wall), windows are elongated, wood framed with single, fixed panes or hopper style, with or without concrete sills. All widows are covered by metal wire mesh. The north wall, behind the security fencing, includes a recent rectangular addition with sliding double doors (possibly used as a service entrance), a plastered chimney, and various other doors. With the exception of the chimney, the roof line is largely horizontal here. In a portion of the northwest corner, the stone-and-mortar foundation is visible.

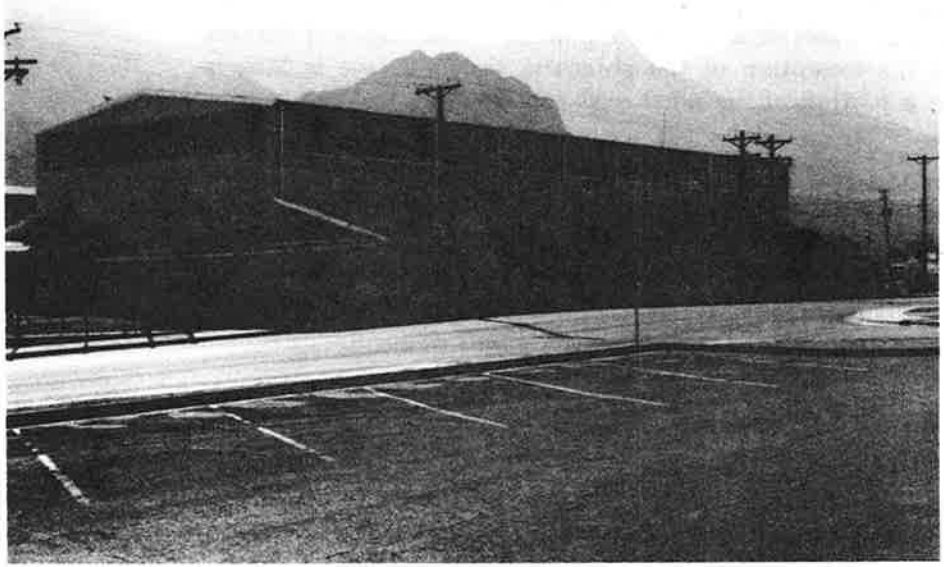
From the west entrance, the interior of the building appears to have once been an open-ceiling dining or lounge area, since partitioned into office and storage spaces with a lowered ceiling. Decorative stone and mortar work remains visible. The northeast portion of the building consists of an open ballroom with high ceiling (gabled exterior partially visible) and knotty-pine paneling. Other portions of the interior include a modern auditorium and visitor interpretative areas.

Modifications to the exterior of the building suggest incremental growth tempered by an overall vernacular Pueblo Revival treatment. The interior spaces, once confined to dining and/or recreation, now reflect an administrative space and function. Other visitor interpretation spaces are largely modern.

Laboratory/Assembly Facilities

von Braun's Missile Assembly Building

Building 1538, the V-2 assembly hangar, is a large, single-story, arched-frame Quonset (130 by 160 feet) constructed of corrugated aluminum over steel framing, set on a concrete foundation. The building is currently occupied by Cortez III Technical Services Department, a WSMR contractor. Dating to 1945, this facility is one of the earliest buildings constructed at WSPG and served as an initial German V-2 rocket assembly and component-storage facility. The property is associated with Dr. Wernher von Braun and other significant German Paperclip personnel who helped train Army personnel in handling



The Mill was erected in 1946 and served as the primary assembly area for the German V-2 rocket.

large guided missiles. The area surrounding the building is protected by security fencing. The arched corrugated aluminum surface is currently covered by insulated foam. Both the east and west end walls contain large double sliding doors, flanked by industrial sash windows. The west wall also contains an addition used for storage.

The north elevation is plain but contains ducts from several evaporative coolers set on low, exterior stands. The south elevation contains two single-hung entrance doors.

Modifications to the building include partitioning the interior into office and technical work areas, the exterior wall surface treatment of insulated foam, and the addition of evaporative coolers.

The Mill Building

Building 1558, referred to as the Mill, was erected in 1946 and became the primary assembly area for the German V-2 rocket. After leaving the assembly, or Mill Building, the rockets underwent preliminary static motor tests monitored at the nearby blockhouse, Building 1592. The Mill is now occupied by the Optics Branch, is a hangar-style building. The building, measuring 180 by 155 feet, has a steel frame covered by corrugated metal siding with a gable roof and is set on a concrete foundation. Roofing materials for the gable consist of asphalt shingles with metal flashing, rain gutters, and *canales*. A three-sided room with shed roof has been added to the northeast corner. The building is enclosed by security fencing.

The west elevation contains original double sliding metal doors on rails, with fixed glass windows. The east elevation contains a single sliding door without rails and a metal awning. Clear-story lighting for the assembly area is provided by continuous industrial sash, fixed windows. The interior assembly area of the building is open. Office space is provided within lean-to bays both north and south of the assembly area. Rails once used to move the V-2 rockets are still visible in the cement floor.

Exterior modifications include replacing original double sliding doors in the east wall with a single sliding door, the addition of a metal awning to the east wall, a three-sided room with shed roof at the northeast corner, and evaporative coolers. Interior modifications include new restroom facilities and office space.

USN Headquarters was constructed in 1951 and served the Navy's missile program at WSPG.

NAVY INFRASTRUCTURE

Less than a year after breaking ground, the young WSPG took on a dramatic growth spurt through a partnership with the Navy. The Navy Bureau of Ordnance accepted the Chief of Ordnance's invitation to join the Army in developing missile systems. In the Spring of 1946, after the establishment of the U.S. Naval Ordnance Missile Test Facility (USNOMTF), construction began on temporary structures for Navy support facilities and barracks in the cantonment area. This initial construction continued through 1947.

USN HEADQUARTERS

Building 1438N (N103) was constructed in 1951 and served as USN Headquarters for the Navy's WSPG missile program. It continues to serve as the USN Headquarters today. This building is an irregular-shaped, three-story with basement, plaster on cinder block structure, built on a concrete foundation. The roof is slightly pitched and covered with rubberized insulation and aluminum. Neither the basement nor the third-story interiors were accessed during this study. The building is surrounded by security fencing.

The main entrance, on the north side of the building, consists of double glass doors with glass side panels, which lead into a brick-walled foyer. In front of the entrance are a cement walkway and steps and a handicapped access ramp with metal railings. A blue cloth awning is mounted over the doors. The north exterior wall surface contains a belt course of decorative brick placed between two windows, which have four fixed panes and brick sills.

The south wall of the building serves as a utility entrance, with an overhead monorail, concrete loading dock with steps, below-ground utility access, and a square brick chimney with a cement cap that rises above the roof. The chimney is no longer in use. The east and west walls each contain corner windows that border the north wall and a metal access door.

The interior of the ground floor includes the foyer and sleeping quarters, as well as office space. Modifications to this building include new roofing, utility upgrade in the basement, office remodeling, a new lunch room and restroom facilities, and new ceilings and light fixtures.

USN bachelor enlisted quarters was constructed in 1950 to provide quarters for personnel assigned to the U.S. Naval Ordnance Missile Test Facility.

USN Bachelor Enlisted Quarters

Building 456N (N97) was erected in 1950 to provide quarters for personnel assigned to the U.S. Naval Ordnance Missile Test Facility (USNOMTF). Today, this building serves as a USN bachelor enlisted quarters.

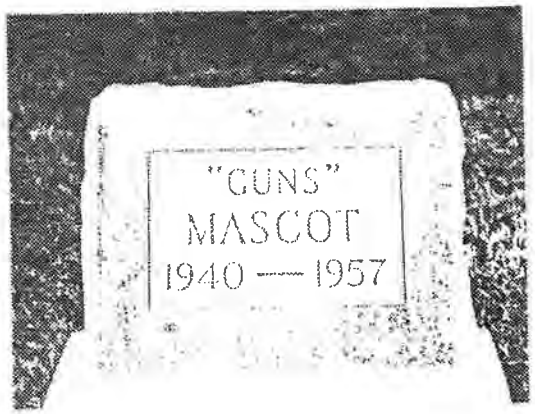
This two-story, rectangular building is set on a concrete foundation. The main entrance, located on the north side, is recessed with metal and glass swinging doors. At the entrance are concrete steps with metal railings that descend to ground level. Partial metal uprights in the bottom cement step and semicircular wall brackets indicate that the entrance may have once had a cloth-and-metal awning. Entrance steps are flanked by cinder-block planter boxes. Three circular, porthole-style windows are located east of the entrance at ground level. Windows are aluminum framed, 2/2 style, set into the exterior wall without a sill. The windows are generally paired in a series that is set off by a single window frame. To the west of the entrance is a large, modern air-conditioning unit.

The south wall is comparable to the north wall, except for landscaping vegetation and a blue cloth-covered entrance awning to curbside. The porthole motif found on the north wall is repeated here. A capped and plastered chimney with venting stands near the roof edge of this wall.

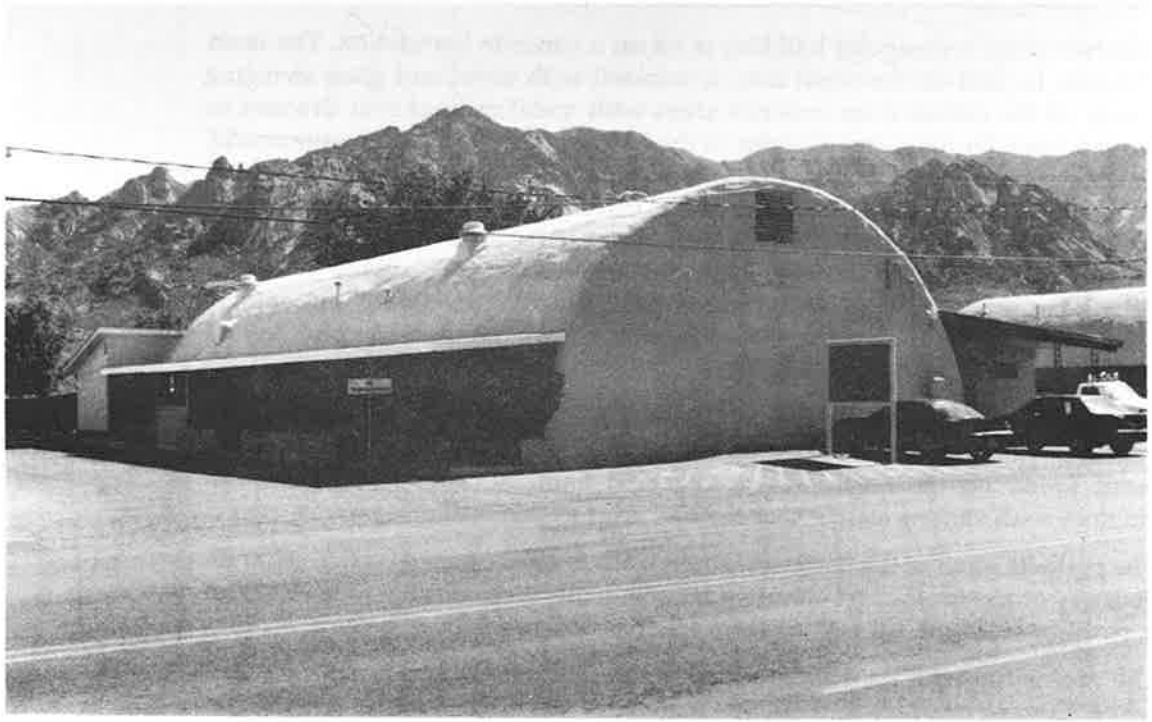
The porthole motif of the north and south walls is also repeated on the east wall. Stairway access for the east elevation is open, while access for the west elevation is partially enclosed. All wall surfaces are stuccoed and painted beige.

The roof is flat with an overhang and metal rain gutters and *canales* painted white. Exterior modifications include removal of the north entrance awning and the addition of air-conditioning units.

Associated with this building is a cement-flanked grave site located to the west outside of the south entrance. The headstone commemorates the Navy mascot "Guns" (1940-1957), a stray bulldog found in the desert by sailors and brought back to the facility. Melba Thomas, NOMTF, supposedly said that Guns "became so Navy-oriented that he refused to associate with Army personnel, unless they wore civilian clothing" (James Glynn, Chief Journalist, USNR 1969).



The final resting place of "Guns," Navy mascot.



Building 1473 (N62) was occupied in 1947 and served the U.S. Naval Ordnance Missile Test Facility as an administrative/technical facility.

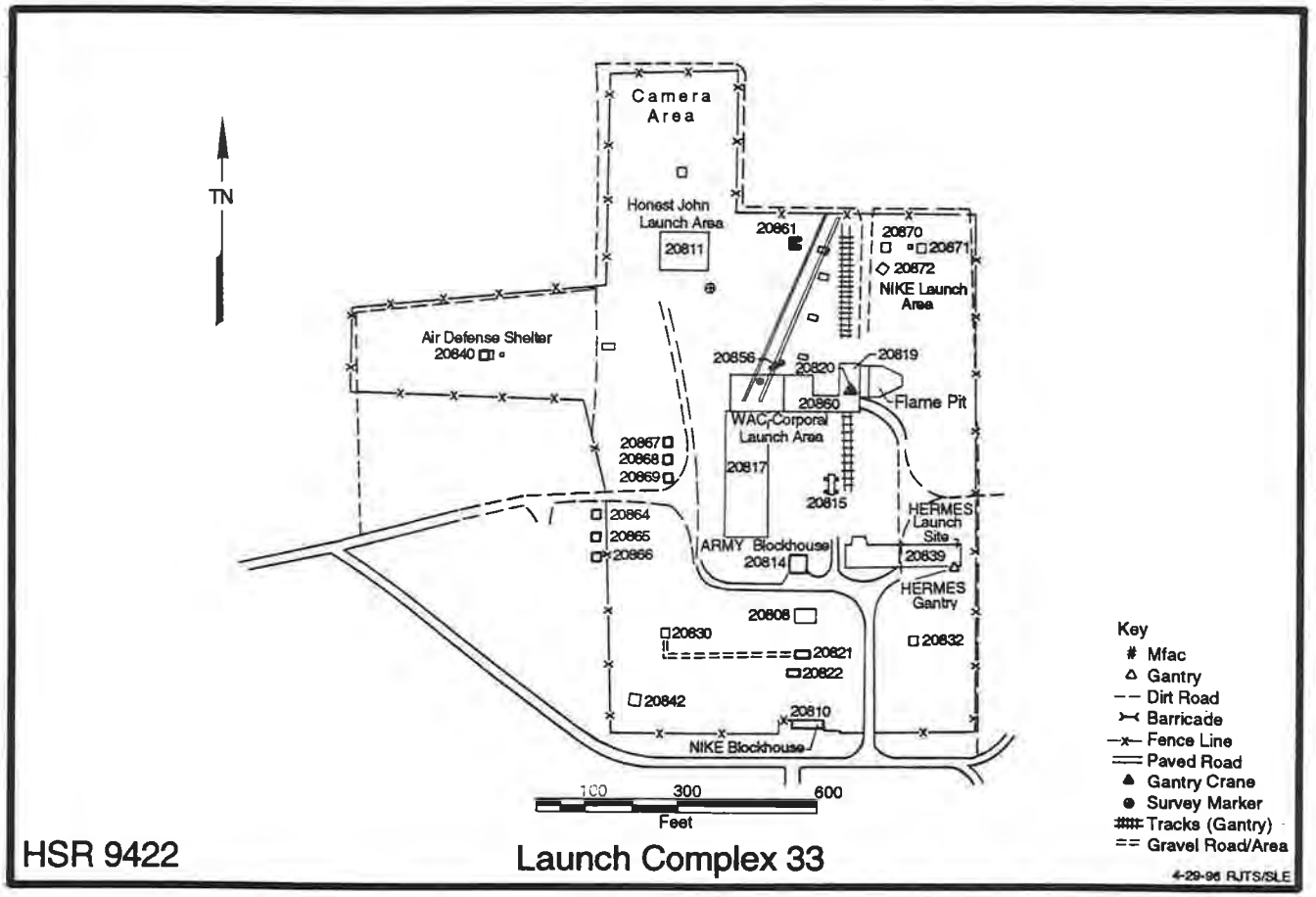
USN Administrative/Technical Facility

According to the WSMR Real Property Records, Building 1473 (N62) was occupied by 1947 and served as an early administrative and/or technical building for the U.S. Naval Ordnance Missile Test Facility. Today, it serves as administrative offices for the U.S. Navy Space Rockets program. The building is a single-story Quonset manufactured of corrugated metal on an arched steel frame that sits on a poured-concrete foundation.

The arched wall surface, including the original sliding-door entrance on the north wall, is covered by insulated foam. The main entrance, on the east side, consists of a sloping metal awning over a three-sided brick entryway. This entryway is supported by decorative metal uprights rising from noncontinuous brick planters placed on the edge of a poured-concrete walkway. Flush against the east exterior wall is a continuous-brick planter running the length of the building. Access into the building is through two single-hung metal doors, one at the north end of the entryway and one on the south end of the entryway. The exposed east wall of the entryway contains a fixed, 4-pane window set in a wood frame with a brick sill.

The west wall consists of a one-story, rectangular, cinder-block room addition. Metal uprights and brick planters on poured concrete provide support for the roof overhang, repeating decorative elements of the east entrance. The roof supports an evaporative cooler. Metal single-hung access doors are located at the north end of the addition, one central on the west side and one at the southwest corner. Two aluminum framed, 1/1 style windows with brick sills break the west wall. Double rows of glass-block windows also provide filtered light into the interior of the building on both the west and north walls. The west addition has a shed roof of asphalt shingles, with an overhang.

The south end of the Quonset consists of a single-story, rectangular, cinder-block room addition on a concrete foundation. Located on the south wall are paired, fixed-pane windows set in wood frames that provide a view to the lawn and tables outside. The lawn is enclosed by a 1-by-12-inch "peek-a-boo" wood fence and concrete walkway. This area also contains a large metal barbecue on brick supports, flanked by concrete pedestals on a poured concrete slab. Above the barbecue is a metal awning.



Site map of Launch Complex 33 (Army Launch Area 1), 1996. LC-33 was the first launch complex at WSPG (1945).

Original Quonset entrances are not visible. Additions to the west and south walls provide additional interior space. Modifications to the south wall consist of a new, three-sided brick entrance with awning, decorative planters, and poured concrete walkway.

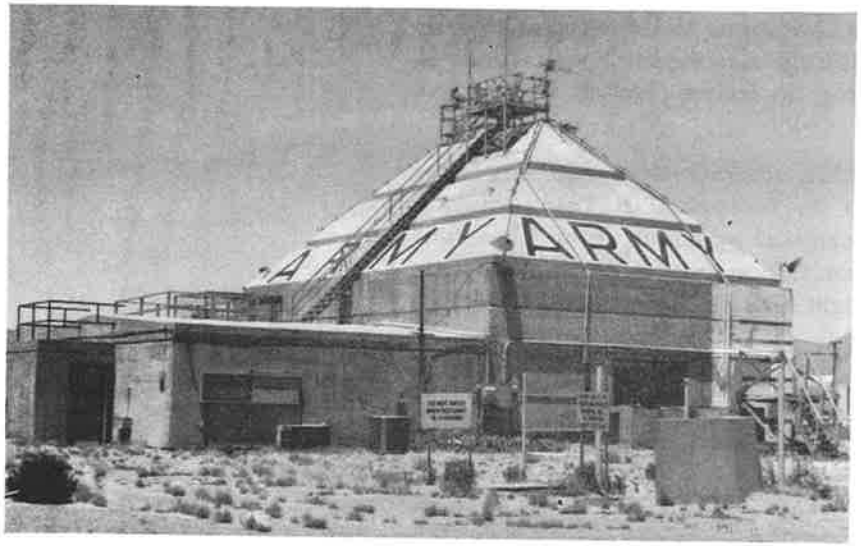
Additions described above reflect the expanding administrative requirements of the USN missile-testing program since its inception in 1946. Interior modifications include partitioning the original spacious floor plan into individual office and conference-room space. Office space is partitioned with sheetrock, and a false ceiling with modern light fixtures has been added.

Launch Complexes

Launch Complex 33

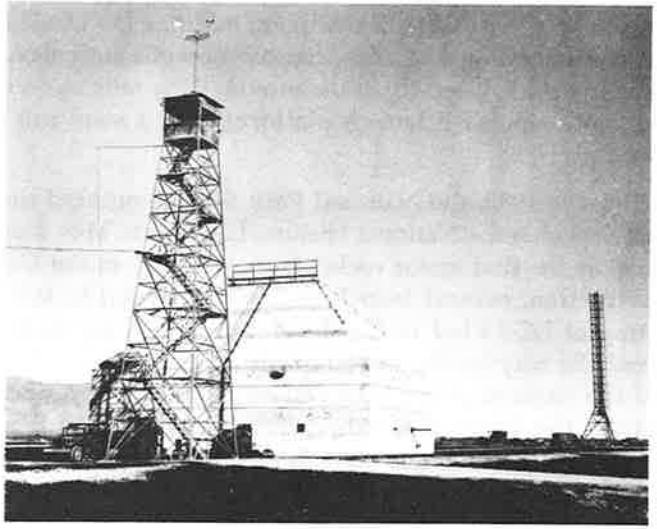
Army Launch Area 1 (now Launch Complex 33, or LC-33) was the first launch facility at WSPG. Construction of LC-33 began 6.5 miles east of the cantonment on July 10, 1945, with the Army blockhouse. The initial launch facilities were simple concrete pads. Captured, German-designed *meilerwagons* brought the V-2 rockets from the cantonment assembly building to the launch area and raised them to launch position. Subsequent additions to LC-33 include a Nike launcher that was operational by 1946, construction of a steel elevated launch platform for the Corporal E, a gantry crane mounted on rails to service the V-2 launch pad and the Corporal E launch platform, and a steel rail launcher for the WAC Corporal.

In October 1985, the National Park Service notified the Army that LC-33 had been designated a National Historic Landmark. This designation reflects LC-33's status as the first major rocket launch facility in the United States. After initial construction, several launch areas were added to the complex. Early missile testing at LC-33 led to the development of large-scale missile programs and paved the way for the development of orbiting satellites, manned space flight, and the space shuttle in the United States. Early launches conducted at LC-33 include the Navy's modified Tiny Tim booster, JPL's WAC Corporal, the captured V-2, Bell Nike, GE Hermes, Consolidated Vultee MX-774 Hi-Roc, and Martin Viking.



(top) The Army blockhouse at LC-33, 1995.

(right) The Army blockhouse at LC-33 with the WAC Corporal launch tower in background, and WWII era observation tower in foreground.



LC-33's most prominent historic features include the Army blockhouse; gantry crane and associated rail track and flame pit; the Nike control blockhouse; and the Hermes gantry. Remaining buildings and features include an air-defense shelter (Building 20840), an environmental-control missile storage facility (no number), three temporary buildings (no numbers), three underground explosive-storage bunkers (Buildings 20867, 20868, and 20869), numerous concrete pads, camera mounts, three wooden barricades, and target poles.

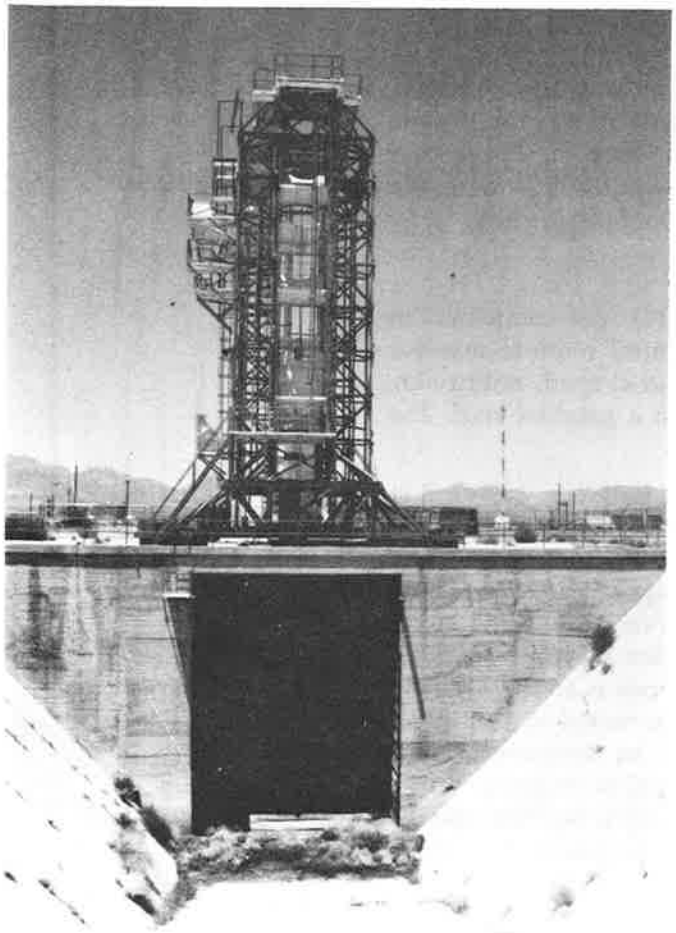
The Army Blockhouse

Construction of the Army blockhouse (Building 20814) was completed in September 1945. The blockhouse served as a firing control room to monitor launching activities. This first blockhouse is a pyramid-shaped, multiroom, single-story structure built of reinforced concrete with a gambrel roof. The building remains intact and in excellent condition.

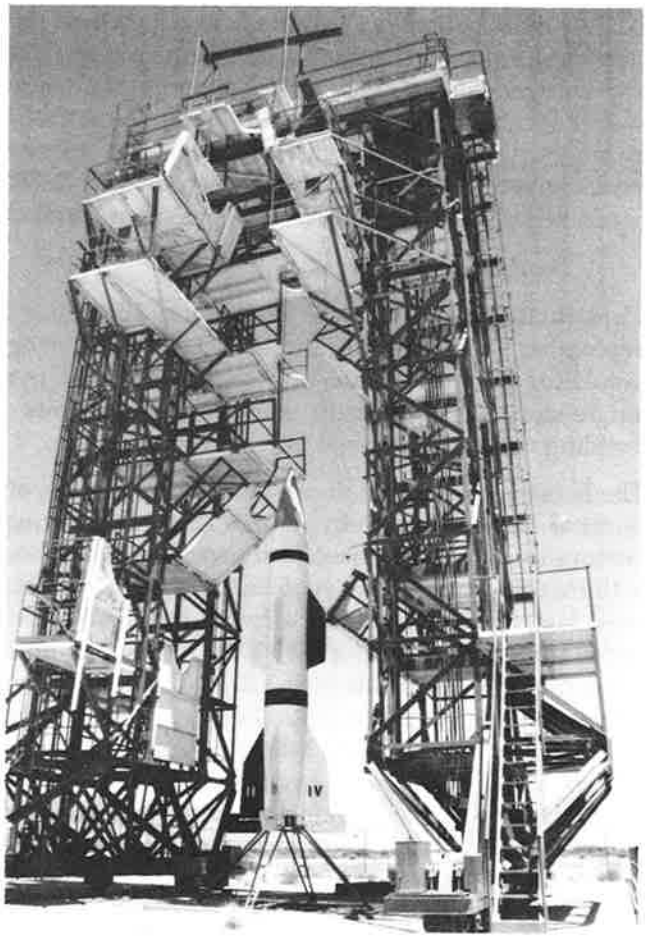
The firing control room, located on the north side of the building, was used to monitor launching activity. It also housed the firing controls, monitoring and communications equipment, and personnel. This room has walls 10 feet thick on a 10-foot-thick pad and a roof that is 27 feet thick at its apex. This construction was designed to withstand a free falling V-2 impact from an altitude of 100 miles traveling at a speed of 2,000 miles per hour. Two viewing ports are located on the north side of the firing control room, and one is on the east side. The remaining walls are plain. Each viewing port is constructed of blast-proof safety glass. A four-stage, 3,000-pounds-per-square-inch air compressor and 6 storage tanks were housed in a small room off the west wall of the firing control room. Here, compressed air was supplied directly through a pipeline into the rockets during the prelaunch fueling stage. The communication room encompasses the south portion of the building and received communications and data transmissions from range instrumentation facilities.

The Gantry Crane

The gantry crane, constructed in 1946, is best-known for its use during the V-2, Hermes, and Viking launches. The gantry is in excellent condition at 75 feet high by 25 feet wide and contains four platforms for preflight servicing of rockets. The platforms swing inward to the center of the crane from two framed metal stands to form vertical stabilizing supports. Block-and-tackle pulleys from



The Gantry Crane at LC-33, 1995. It was constructed in 1946 and known for its use during the V-2, Hermes, and Viking launches.



The Gantry Crane at LC-33, 1995; shown here with a Hermes missile on display.

the top platform were used in vehicle placement. To the east of the gantry-crane launch pad is a concrete blast deflector pit.

Nike Control Blockhouse

The Nike control blockhouse (Building 20810) was constructed in 1954 for early Nike testing at LC-33. This blockhouse is a single-story building of poured, reinforced concrete on a concrete foundation slab. The building is rectangular, measures 24 by 105 feet, with a flat roof; the building appears to have been constructed in two joined sections. This building contains no windows, but it does have a massive air-conditioning system for temperature control. The building remains intact and in excellent condition.

The Hermes Gantry

The Hermes gantry (Building 20839) is located in the southeastern portion of LC-33, in the southeast corner of a large concrete launch area later used for Nike Zeus. Remaining in excellent condition, this gantry, constructed in 1951 of poured reinforced concrete, is partially covered with steel doors. It measures 10 ft 5 in. by 9 ft 7 in. and stands approximately 50 feet high. Lining the bottom of the gantry is a steel scoop for the fire pit. A thick steel door, hatch, and steel cross-beams cover the front (north side) of the gantry. Protruding horizontally from the top of the gantry is a hoist constructed of metal beams. The pad associated with this gantry measures 72 by 156 feet and consists of three distinct launching areas. "Ghosts" of launch instrumentation placements are visible within each launch area, and a single brass cap stamped with "WSPG-FDL, HERMES LAUNCHER" is located in the southeast portion of the pad.

Honest John Launch Area

The Honest John launch area occupies the northwestern portion of LC-33. All that remains today is a large concrete pad with thick vertical and horizonal steel deflectors on the west side, and two large air-cooled condensers located at the southwest end of the pad. In the north-central portion of the pad is a wooden rectangular control building filled with electrical equipment. Adjacent to and due north of the Honest John launch area are approximately 30 camera mounts and 10 target poles. A concrete foundation for a temporary building also occupies the camera-stand area, which may be associated with Honest John launching activities.

The WAC Corporal in the WAC Corporal launch tower at LC-33, circa 1946 (courtesy of Sauber collection).

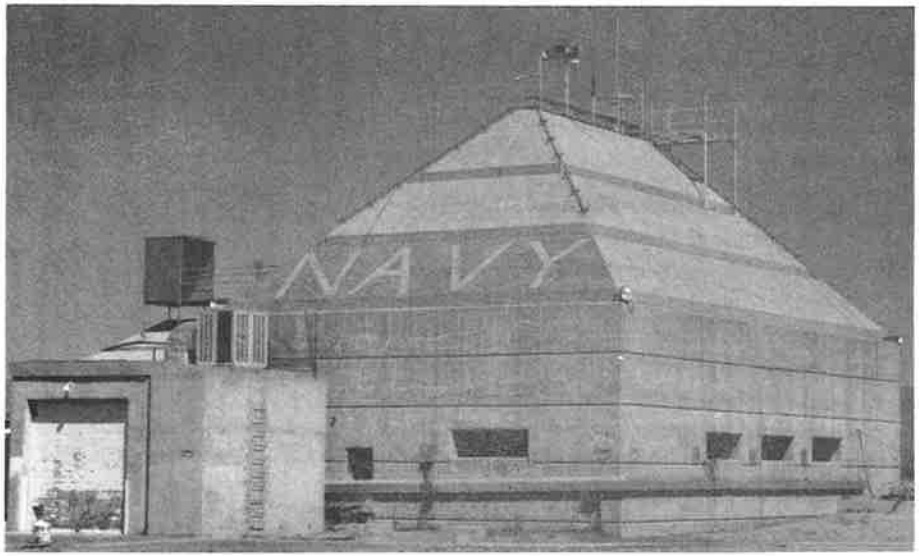
WAC Corporal Launch Area

Between 1945 and 1947, 19 WAC Corporals were successfully tested from the WAC Corporal launch tower located due north of the Army blockhouse at LC-33. The tower no longer exists today; all that remains is a large concrete launch area, tower footings, cable races, and connectors.

The WAC Corporal was designed as a liquid-propellant high-altitude sounding rocket assisted by a Tiny Tim solid-propellant booster. The booster generated 222 kN of thrust for .5 seconds to provide enough lift to clear the 100-foot-high launch tower. The program consisted of four separate phases. During the first phase, four Tiny Tim boosters loaded with a 250-pound lead nose were fired on September 26 and 27, 1945. In phase two, a pipe filled with cement simulated the WAC Corporal. Two such booster-powered tests were fired on September 27 and 28, 1945. Two phase-3 rockets, consisting of a booster and a partially charged WAC Corporal, were fired on October 1 and 2, 1945. Finally, six fully powered WAC Corporals were fired in phase four, beginning October 11 and ending October 25, 1945. Round 5 reached a record altitude of nearly 44 miles.

Nike Launch Area

The Nike launch area is located in the northeast portion of LC-33, east of the gantry crane tracks. The Nike antiaircraft missile program was one of the earliest at LC-33. The first Nike dummy prototype was fired on September 24, 1946, followed by Nike 1 (fully powered) on October 8, 1946. Later tests include the Nike-Ajax interceptor. Today, the Nike launch area consists of an underground bunker/shelter (Building 20872) used for observation and control, two 3-by-30-foot concrete pads with utility stands, a 6-by-6-foot concrete pad, and a series of poured reinforced-concrete footings with angle-iron nails that may have once supported a ramp. The first pad of the series measures 4 by 6 feet and is flush to the ground. A series of progressively taller, raised concrete footings starts at the north end of this pad, measuring (from the shortest to the tallest, northward) 1, 5, and 7 feet high, placed at 12-foot intervals. West of the gantry tracks, four camera pads measuring 12 by 16 feet, with cable races, sit 96 feet apart in a north-south line.



The Navy blockhouse at LC-35 (Army Launch Area 2), 1995.

L.L.S.-1 U.S.S. Desert Ship at LC-35, 1995; constructed in 1952.

LAUNCH COMPLEX 35

With the arrival of the Navy to WSPG came the development of a Naval launch facility LC-35 (Launch Area 2), located 3 miles east of LC-33. Initially, a blockhouse, a launch pad and a rail launcher were constructed for the Aerobee research vehicle. Two additional launch pads were poured at LC-35 and, in 1953, the famous Land Lock Ship-1 (L.L.S.) U.S.S. *Desert Ship* was constructed. The Talos was an early Navy missile system tested at this facility. Over the years, missile systems tested at LC 35 include Aerobee, Corvus, Crossbow, Lark, Loon, Nike VIP, Pogo-Hi, Pogo-Lo, Talos, Tartar, Terrier, Typhon, and Viking.

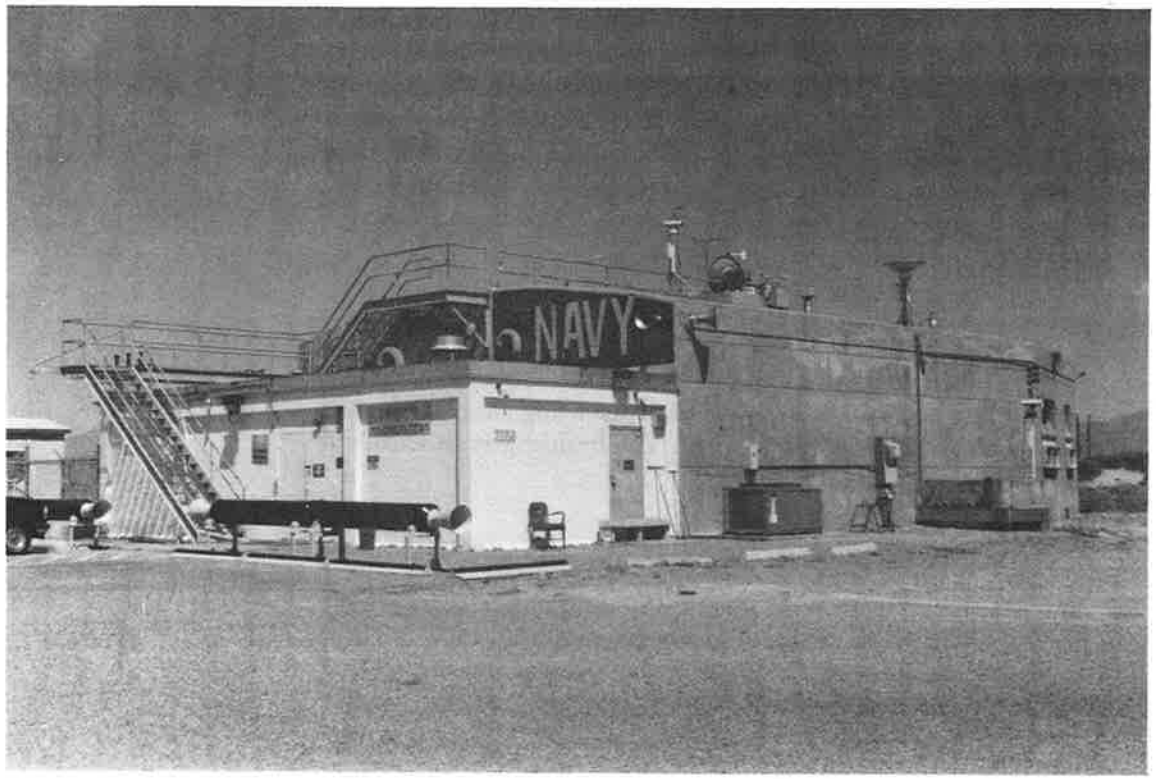
The Navy Blockhouse

The Navy blockhouse (No. 23240; N78) was constructed in 1947 and followed the original plans for the Army blockhouse. The building is identical to those plans and does not contain the later southern addition added to the Army blockhouse at LC 33. The building was and continues to be used for firing control. Painted on the roof in white letters is the word "Navy." The building is in excellent condition.

Land-Locked Ship-1 U.S.S. Desert Ship

Building 23270 (N165), L.L.S.-1 U.S.S. *Desert Ship*, is a unique single-story, multiroom building completed in 1952. Its layout was designed to simulate the on-board conditions of a U.S. naval vessel. The building served as a U.S. Navy command, control, and monitoring facility for the Navy's missile testing program at WSPG, and functions the same today.

The building is in excellent condition and is constructed of poured reinforced concrete with a smooth surface and horizontal cast lines. The southeast side serves as the principal entrance. A pair of observation windows are located in the northeast wall, with fixed metal blast shields. A concrete barrier and metal-hinged blast shields provide protection for three observation windows positioned above the roof of a cable tunnel that leads to the launch area. A concrete and brick chimney is located next to the south wall. The concrete roof is flat, designed with a ship-deck railing of cable and posts along the perimeter. Several instruments for monitoring missile-test launches are mounted on the roof. The building interior consists of several rooms at varying floor levels, equipped with missile test command, control, and monitoring equipment.



The U.S. Navy blockhouse at LC-36, 1995. It was constructed in 1958, as a firing control facility for the Redstone program.

Launch and Blast Area

Another unique feature at LC-35 is a blast area designed like the deck of a U.S. naval cruiser. The area is a large (216 by 120 feet) concrete pad work and blast surface, with two railed launchers (L-648E and L-648W). This area once served as a launch and blast area for testing the Talos and standard missile weapon systems deployed aboard U.S. naval vessels. The design of L-648E is unique—it is a dual railed launcher constructed to look like a turret. Associated with this launcher, on the south side of the pad, is a metal building (No. 23268; N168) referred to as the Deckhouse. The layouts of both L-648E and the Deckhouse were used to simulate shipboard conditions. Launcher 648E is now inactive, superseded by a vertical launch system (L-648W) currently undergoing tests in the western portion of the launch complex.

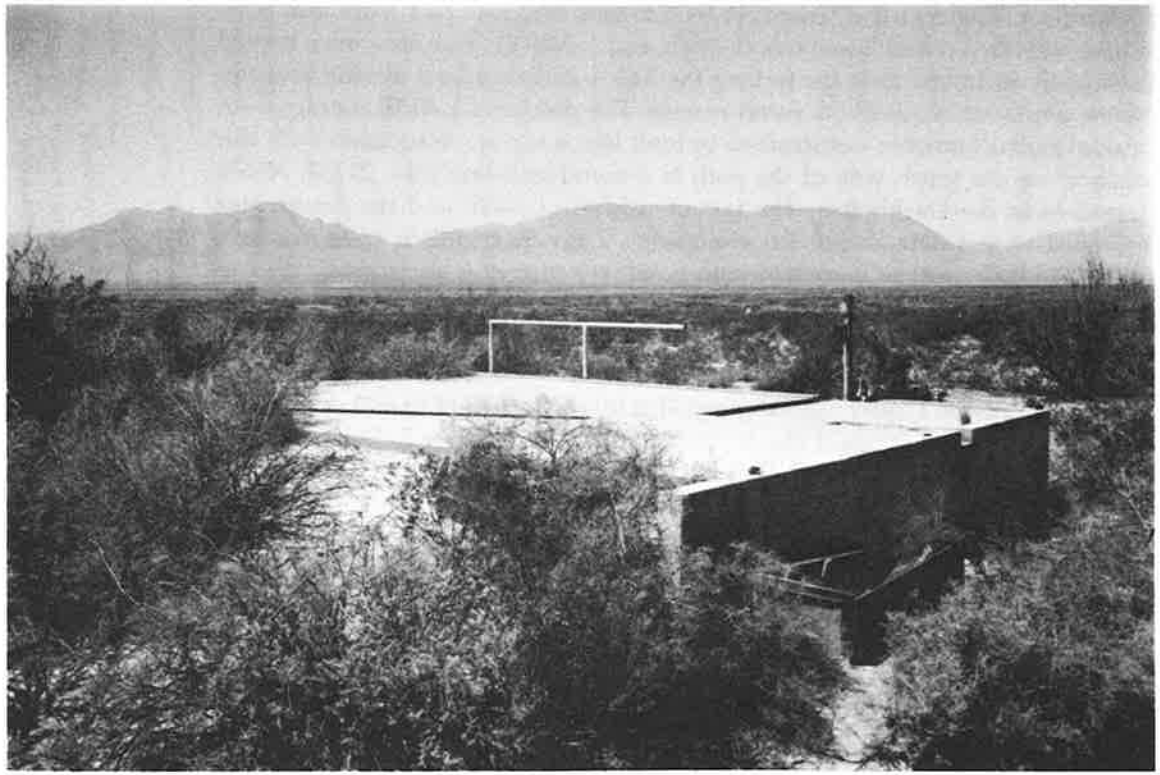
Launch Complex 36

Launch Complex 36 (Army Launch Area 3) is located adjacent to and due east of LC-35. The Navy established this second complex in 1958 for field trials of the Redstone missile (Powell and Scala 1994). A blockhouse and gantry were constructed that same year. The first Redstone was tested on June 3, 1958. In 1963, the blockhouse and gantry were reconfigured for NASA's Little Joe II launch vehicle, a 89.2-foot solid-propellant rocket designed to test the Apollo launch escape system. Between 1963 and 1966, Little Joe II was launched five times. After 1966, testing at LC-36 was sponsored by NASA's Sounding Rockets Program (SRP). Rockets tested include the Canadian-built Nike-Black Brant and Terrier-Black Brant rockets, Aries, Nike, Orion, Tomahawk, Taurus, and Malemute rockets that were launched from the Athena launcher (NASA 1993:106).

The LC-36 facility includes the Navy blockhouse (Building 23350), vehicle assembly building (No. 23358), ordnance storage building, and five launchers—AML 4.3-K launcher, Aries launcher, Launch Tower L-350 (Building 23362) originally constructed for Aerobee 350, MRL 7.5-K launcher, and Athena launcher (No. 23366).

U. S. Navy Blockhouse

The U.S. Navy Blockhouse (No. 23350; N215) at LC-36 is an irregular-shaped, five-sided, single-story building constructed in 1958. This building was used as



Lacrosse launch pad on WSMR, designed to test Lacrosse surface-to-surface artillery missiles.

a firing control facility for the Redstone program. In the early 1960s, it was used for the Little Joe II vehicle for the Apollo program. The original blockhouse was built of poured reinforced concrete, with an arched roof. A cinder block, pillar-and-spandrel, rectangular room with a flat roof has been added to the south end of the building. The roof tops for the original blockhouse and the addition are accessible by metal stairs and landings from the south end of the building. The word "NAVY" is painted in gold letters with a blue background in the upper southeast portion of the original blockhouse. The northwest and northeast ends of the building are bayed and contain observation viewing ports. The blockhouse is in excellent condition, and today serves NASA's and the Navy's Sounding Rocket Program.

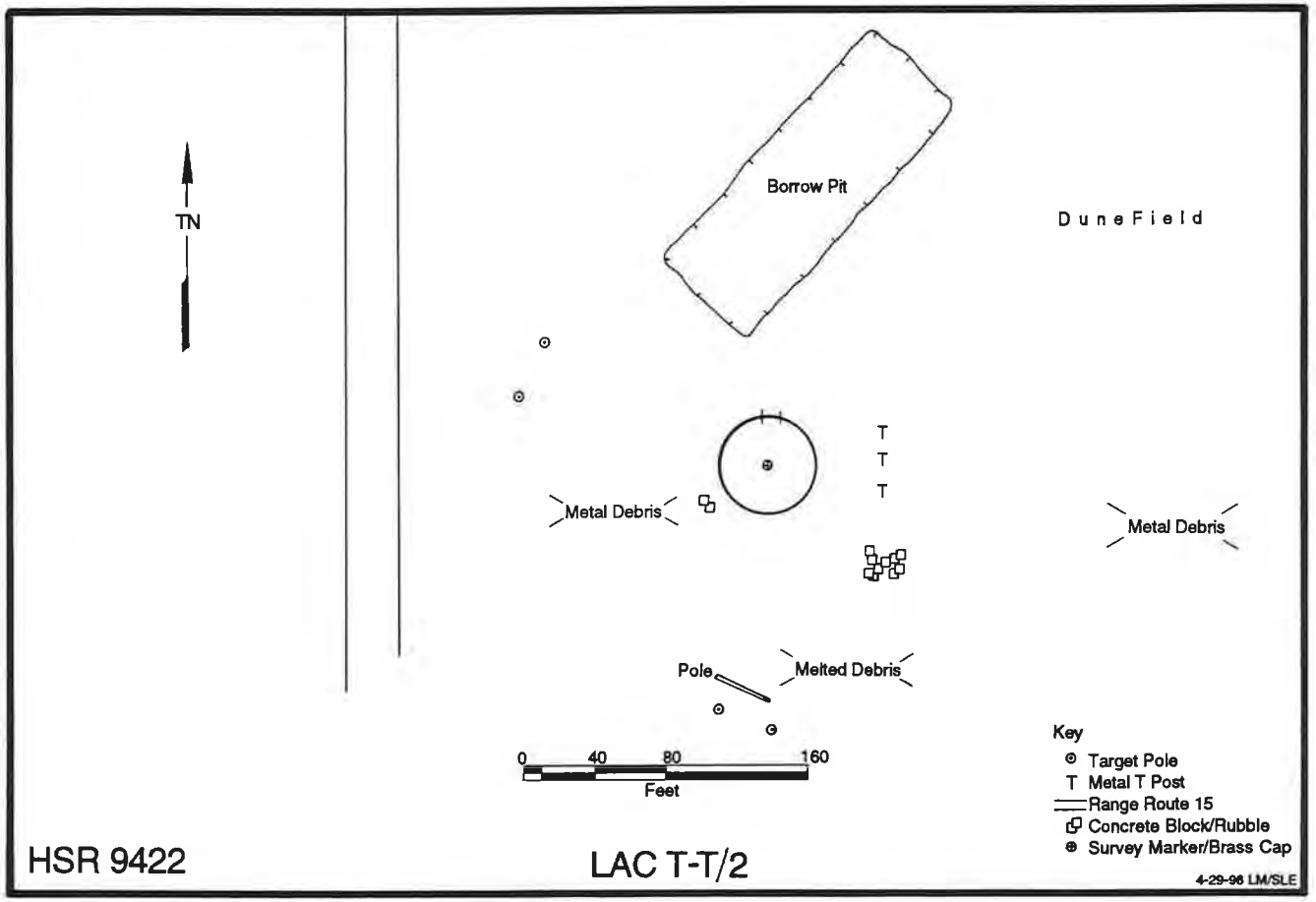
Vehicle Assembly Building

The vehicle assembly building (No. 23358; N242) is a square, multiroom, single-story steel-frame building of dark blue corrugated sheet metal siding, built on a concrete foundation. It was constructed in 1963 in two sections. The south section is approximately 30 feet high, and the north section approximately 80 feet high. Both roof sections are gabled. Tall loading doors are located on the north and south ends that slide sideways. The word "NASA" is in large red letters on the south and east sides of the building. A white sign with black letters is located under the word "NASA" on the east side that reads "VEHICLE ASSEMBLY BUILDING." This building was once used for the assembly of vehicles tested at LC-36. Today, it houses electronic equipment.

The building is in excellent condition. Additions to this building include a cinder-block room, used as a dark room, that was constructed in 1990 at the southeast corner of the building and a sprinkler system added to the east side. Modifications include sealing the north doors.

Lacrosse Launching Facility

Additional launching facilities are located throughout the undeveloped rural landscape of WSMR. One example of such a launching facility, for the Lacrosse surface-to-surface artillery missile and its associated target, was documented during this study. Lacrosse was a mobile battlefield weapon developed for the U.S. Marine Corps and produced by Martin. The first ground-launched test took place in August 1954 at WSPG.



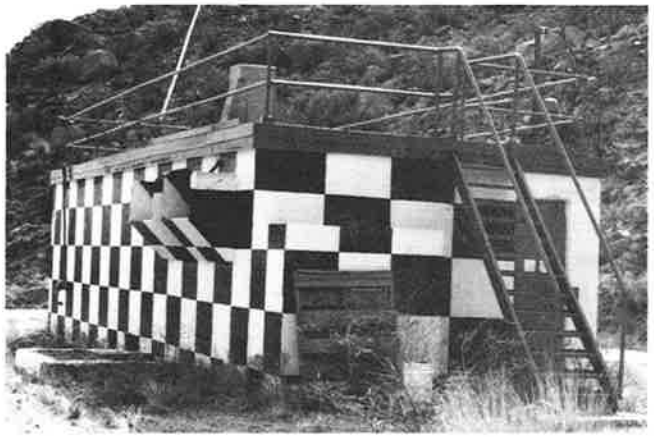
Lacrosse target (LAC, T-T/2). HSR site map.

The Lacrosse launching facility, located approximately 11 miles northeast of the cantonment area, consists of a raised launching platform (No. 25171), a concrete foundation, a collapsed latrine, three target poles, a rock cairn, and associated refuse. The launching platform is oriented at 34 degrees and is constructed of poured concrete that is 5 ft 2 in. thick. It once contained steel pipe railings on the north and east sides, now visible only on the north end. Three cable races extend through the platform from an electrical conduit box. The north and east walls of the pad are buttressed with an 8-inch thick wing wall that extends 4 feet out on the west end and 3 feet out on the south end. A brass cap is located in the south corner that reads "WHITE SANDS PROVING GROUND TRIANGULATION STATION, GEODETIC CONTROL F.D.L. STATION, LACROSSE F.O."

Approximately 250 feet to the southeast of the platform is concrete foundation, 20 by 24 feet, containing three concrete thresholds. Communication wire is strewn around the foundation. The actual type of structure that once stood at this location is unknown. Approximately 210 feet southeast of the platform is a collapsed wooden latrine complete with two metal splash guards. The three target poles are located to the northeast, southeast, and southwest. Refuse documented includes sardine cans, sanitary cans, Coca-Cola bottle fragments, and Pepsi bottle fragments, one embossed with the date 1955.

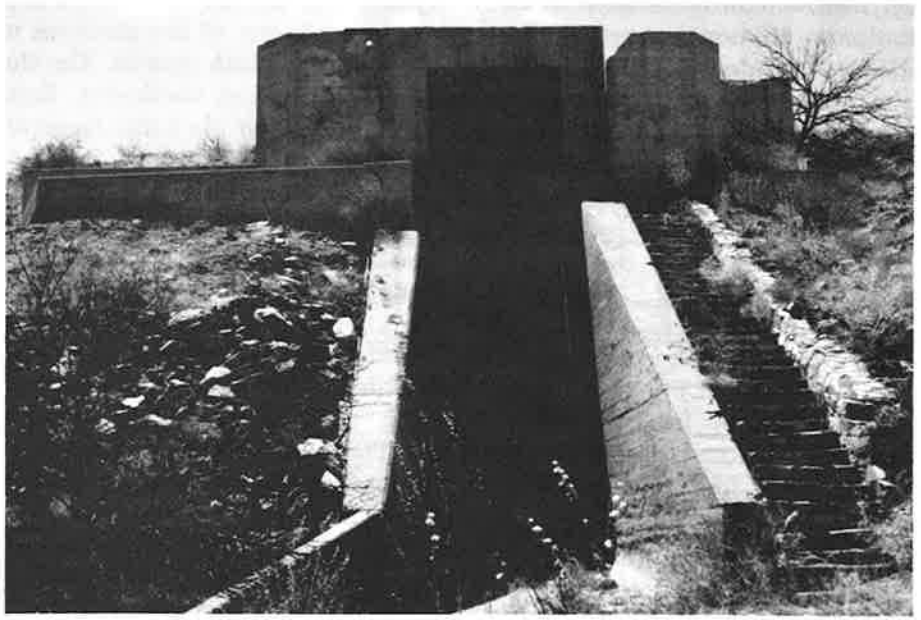
Lacrosse Target

The Lacrosse target is located approximately 2.5 miles northwest of the launcher. It consists of a large round concrete bunker on a continuous concrete footing, two pairs of target poles, and refuse, including metal debris, concrete block fragments, scraps of milled lumber, plywood, and a Coca-Cola bottle base embossed with "LUFRIN TX" dated 1967. A line of steel posts are adjacent to the east side of the bunker. Northwest of the bunker is a large borrow pit that measures 50 feet wide by 175 feet long. The bunker measures 50 feet in diameter, is 12 feet high, with walls 5 feet thick. It can be accessed through a subterranean doorway that measures 5 feet high by 6 feet wide. A steel-plate threshold provides support for the doorway entrance. On top of the bunker, a partially melted brass cap was found in the center that reads "LAC, T-T/2." The target poles stand approximately 150 feet from the center of the bunker and are approximately 35 feet apart.



The control building at the 100-K static test facility was constructed in 1946 to serve as a command and observation facility of static test firings of the V-2 rocket.

The 100-K static test stand, capable of testing up to 100,000 pounds of thrust.



Static Test Stands

To test the capabilities of rocket motors and complete missiles prior to actual flight, captive motor tests were necessary. These tests were designed to insure that motors performed properly and to measure thrust output. Static motor test stands were constructed along the slopes of the Organ Mountains south of the cantonment area. The first test stand, designed for the V-2 program, was constructed in 1946. This was a vertical captive motor test stand built to withstand 100,000 pounds of thrust. In 1949, a larger 500-K vertical test stand was constructed, which was expanded in 1957 for the Redstone program. In 1953, a 300-K stand was constructed to expand test support for new programs, and in the late 1950s, a 20-K stand was constructed adjacent to the 100-K stand.

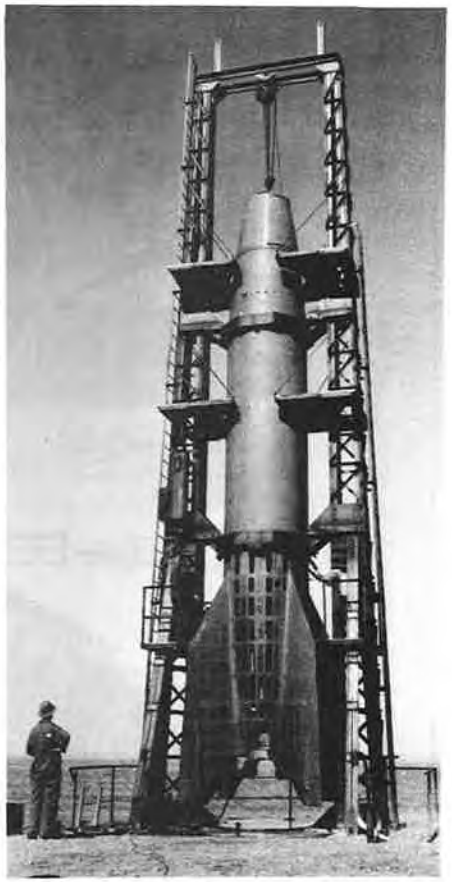
The 100-K Static Test Facility

The 100-K static test facility is described in a confidential WSPG manuscript listing technical facilities, circa 1950:

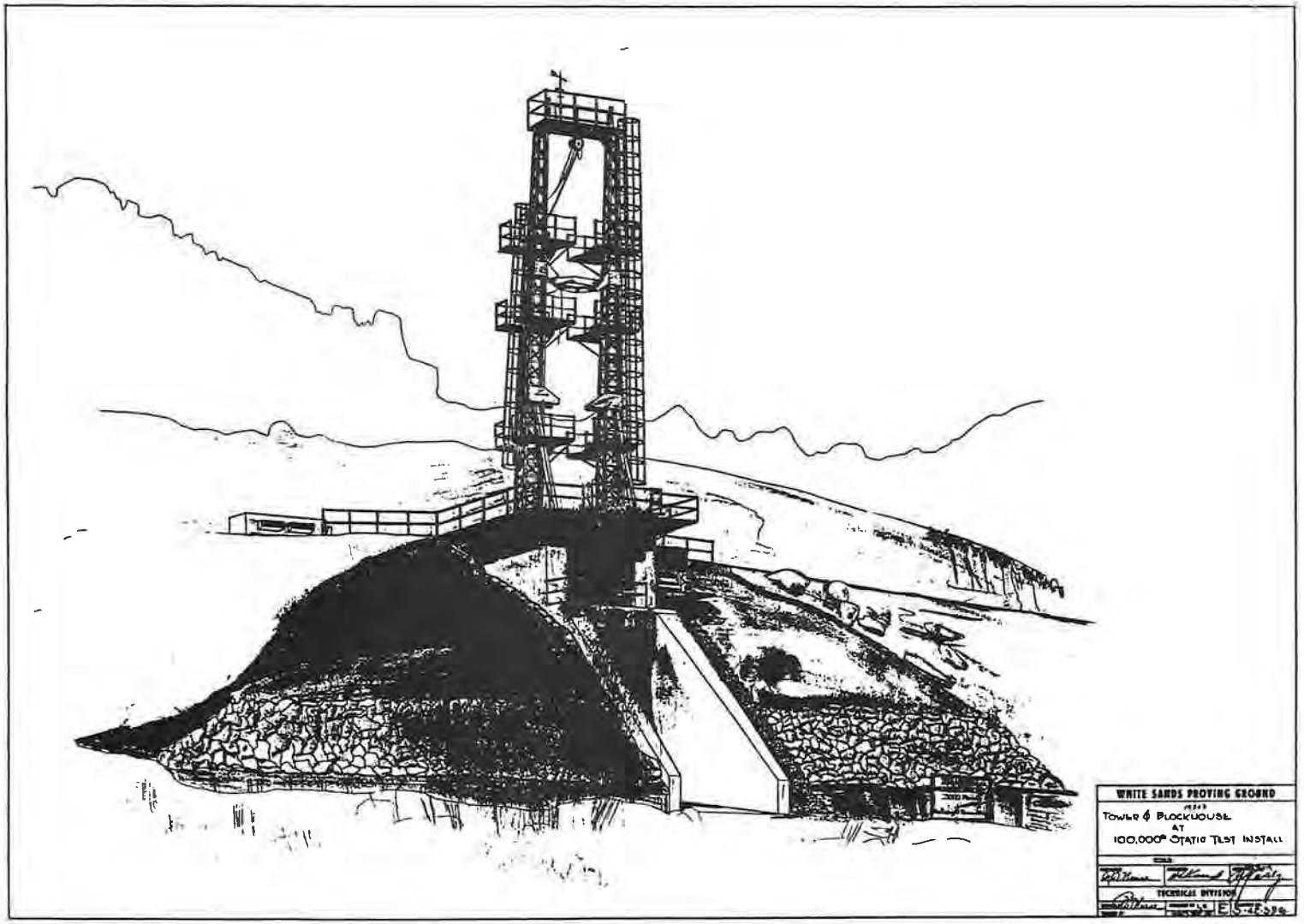
> This facility...is for either vertical or horizontal static tests. The test site consists of a reinforced concrete thrust stand, closed on three sides, and a steel thrust tower for vertical tests of complete missiles up to and including V–2 type missiles. A reinforced concrete control room is provided for operating personnel and the housing of control and instrumentation equipment.

Control Building and Static Test Stand

Erected in 1946, the control building (No. 19300) for the 100-K is a single-story concrete and cinder-block building that served as a command and observation facility for static test firings of the V-2 rocket. It has a flat roof with two anchored camera mounts. The north, east, and south sides are painted in a black-and-white checkerboard pattern, but the west wall is solid white. Two periscope viewing ports are in the east wall, protected on all four sides by a metal projection and a retractable lever over the opening. These viewing ports once held mirrors to reflect an image into the control room for viewing. A cable-access box and cable race that run out to the test stand are located directly below the viewing ports. Single-hung metal doors on a recessed north wall and the west wall provide access to the interior. A poured concrete walkway leads from the west wall to a nearby large concrete pad.



The 100-K test stand, circa 1946.



The 100-K static test facility. Army Engineer's drawing, dated September 25, 1950.

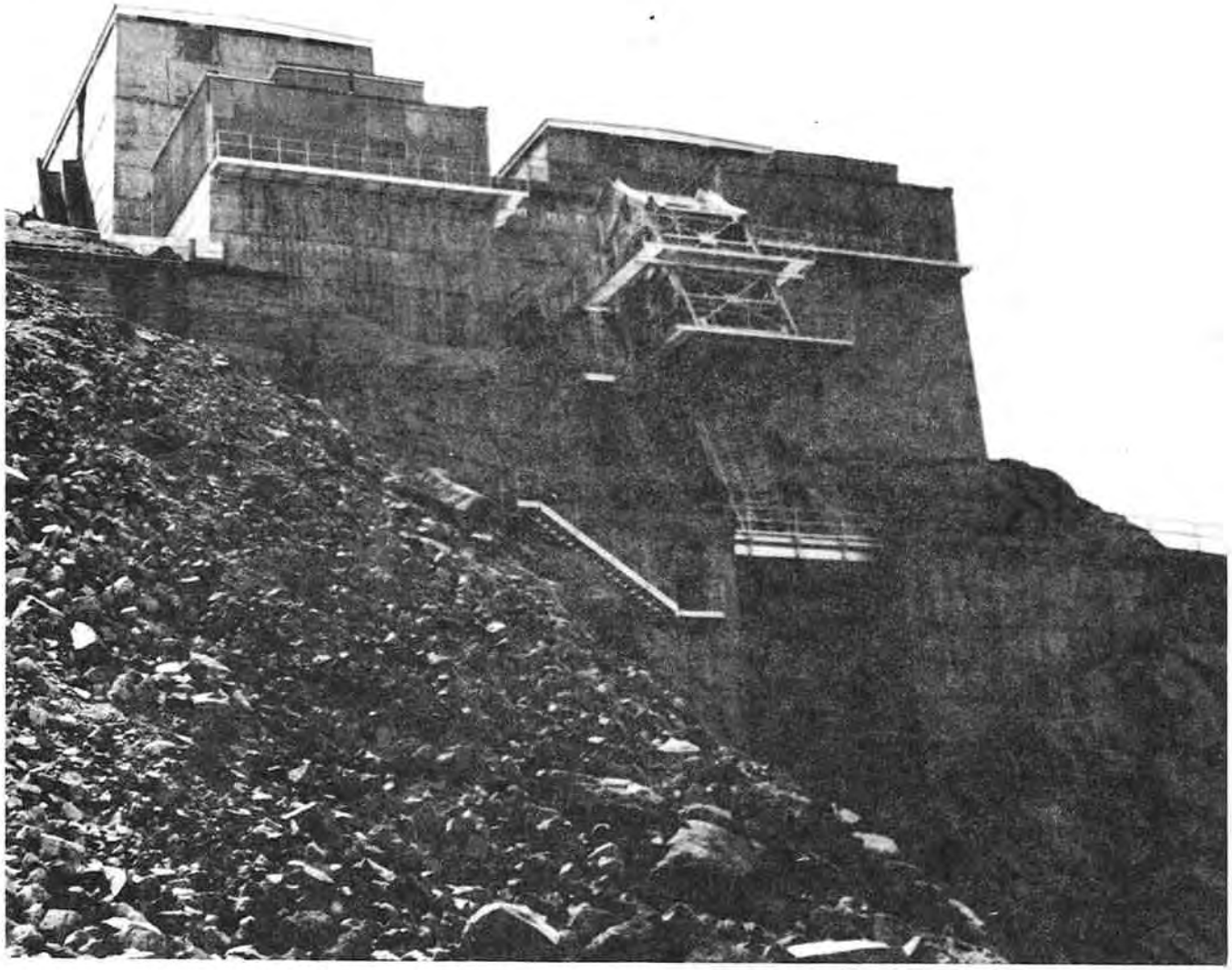
The 100-K static test stand is located 75 feet east of the control building, situated on the side of a ridge. It is constructed of poured reinforced concrete and stands approximately 36 feet high, and once contained a 50-foot tall steel thrust tower.

The control building and thrust stand remain in excellent condition. Preservation efforts by WSMR include a new roof and repainting of the checkerboard pattern and reuse of the control building as a curatorial facility.

The 500-K Static Test Facility

The 500-K static test facility is also described in a confidential WSPG manuscript of circa 1950 listing technical facilities:

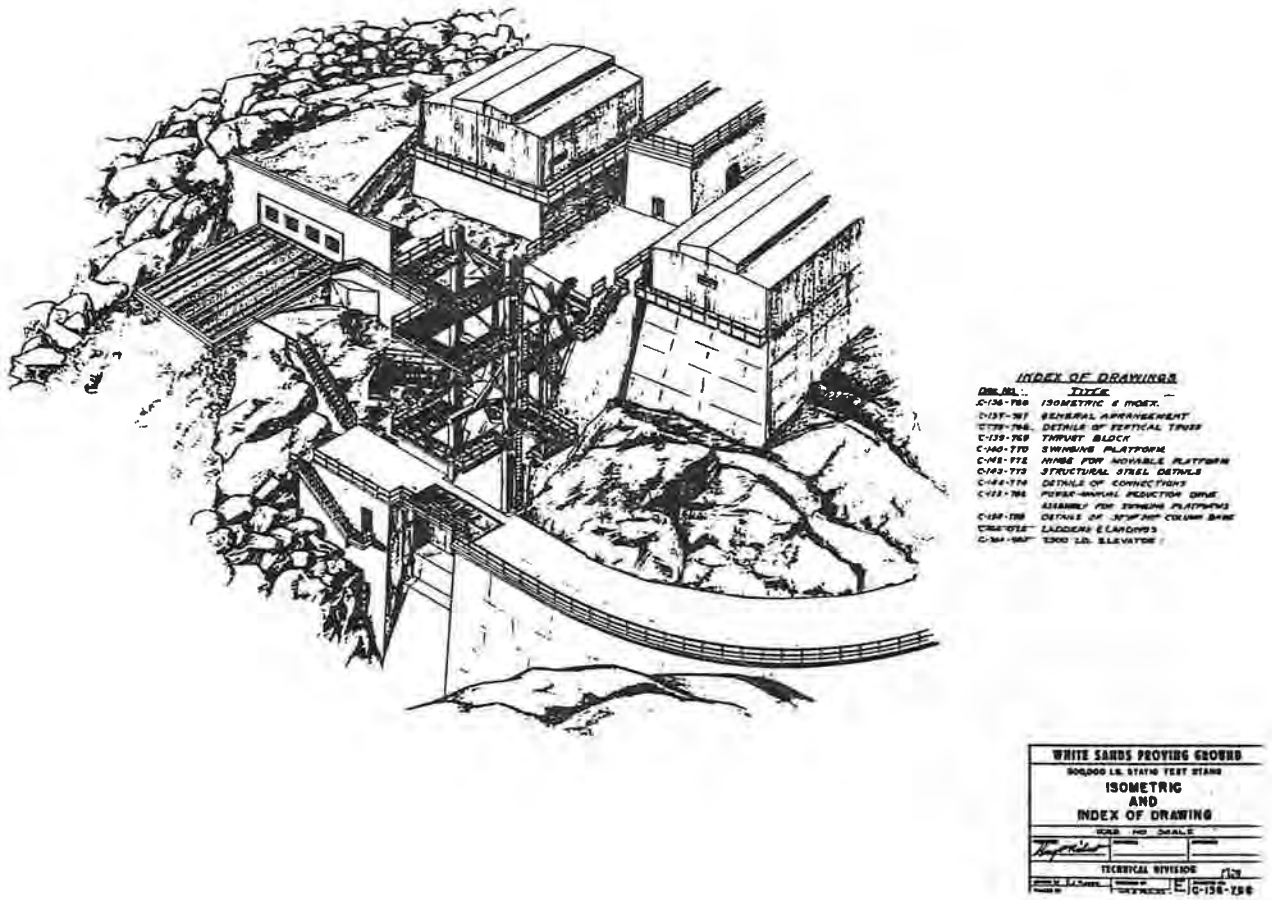
> This static test facility...is designed to provide a universal-type mounting with adequate support facilities to handle a variety of rocket-type propulsion systems and fuels. This 500,000 lb. Motor test stand consists of two (2) propellant tanks, two (2) pump houses, the universal motor mount, and the underground fire control and observation room.
>
> (1) Motor mount – The mount, a circular steel frame work [sic.] having inside diameter of 9' and a length of 22' and mounted 30 deg. To the vertical is designed to handle a sustained thrust of 500,000 lbs. With a safety factor of two.
>
> (2) Pump houses – There are two (2) pump houses located above and on each side of the motor mount for the housing of propellant pumps. These pumps will be supplied by the agency performing the test, an integral part of the development program.
>
> (3) Fuel Storage Tanks and Barricades – In each of the tank barricades, located above the pump houses, are 15,000 gallon pure aluminum tanks. Each tank barricade consists of two separate structures, one located within the other and the annular space filled with sand. These structures are of light weight concrete and marked to control fragmentation in the event of an explosion.



The 500-K static test facility designed for the Redstone program; capable of testing up to 500,000 pounds of thrust.

The 500-K static test stand, 1996.

The 500-K metal observation house camouflaged with large rocks and cacti.



The 500-K static test facility. Army Engineer's drawing, dated February 4, 1952.

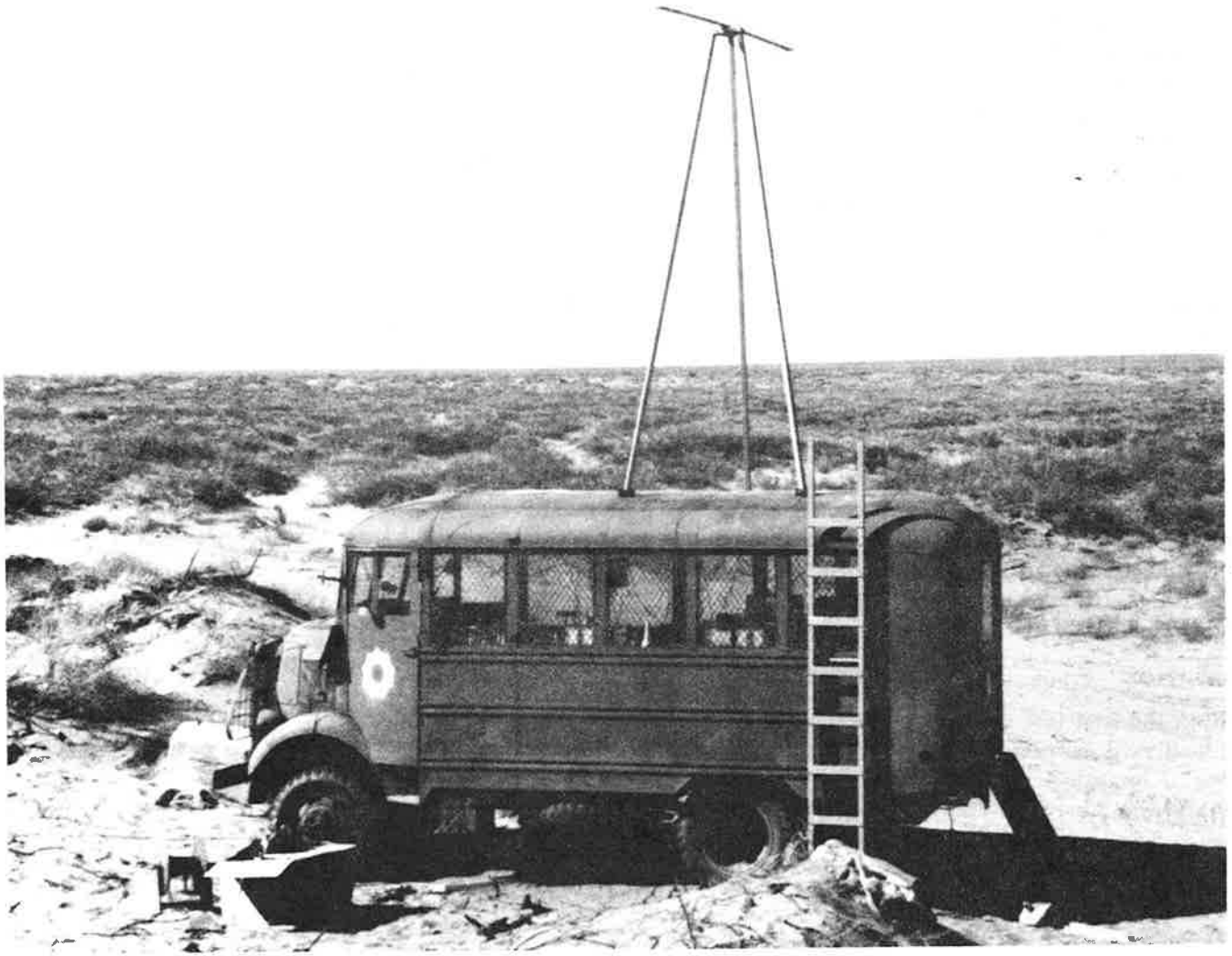
(4) Observation and Control Room – Access to this room, adjacent to the motor mount, is provided by an under ground (sic) tunnel. Every precaution is taken to insure complete safety of operating personnel in the room and a means of escape in the event of an emergency. Observation of the test in the motor mount is by mirrors located on platforms which can be preset prior to the test. All instrumentation and control conduit to the mount terminates in this room.

The 500-K static test facility is an ominous and unique complex of poured reinforced concrete chambers or rooms. It is situated high on the east face of Soledad Peak in the Organ Mountains and consists of two large fuel tank barricades, two pump houses, a valve control station, two concrete observation rooms, one metal observation room, an escape hatch, two water tanks, and the static test stand. A tunnel accessed on the north side of Tank Barricade No. 1 runs under both tank barricade rooms leading to the main observation room at the southeast end of the complex. This tunnel also provides access to the escape hatch, which is located on the west side of Tank Barricade No. 2. The observation room contains rectangular-shaped viewing ports constructed of thick glass. Outside the room, in front of the viewing ports, is a platform that held large mirrors to reflect a view of test firings back through the viewing ports for observation.

INSTRUMENTATION

Within the first few years of operation (circa 1950), WSPG had developed a sophisticated instrumentation system to support missile research. The original system, operated by the White Sands Annex of the Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland, consisted of three major groups providing (1) trajectory tracking and observational flight performance data; (2) recorded telemetry data from the missile itself; and (3) standard time signals for calibration and control.

Two complementary approaches, electronic and optical, supported the tracking and flight-performance observations. Various types of electronic and optical observation sites were established throughout the range to track missiles in flight. Radar, phototheodolites, and telescopes were observation methods. The optical systems operated in sequence, based on their ranging capabilities. Take-



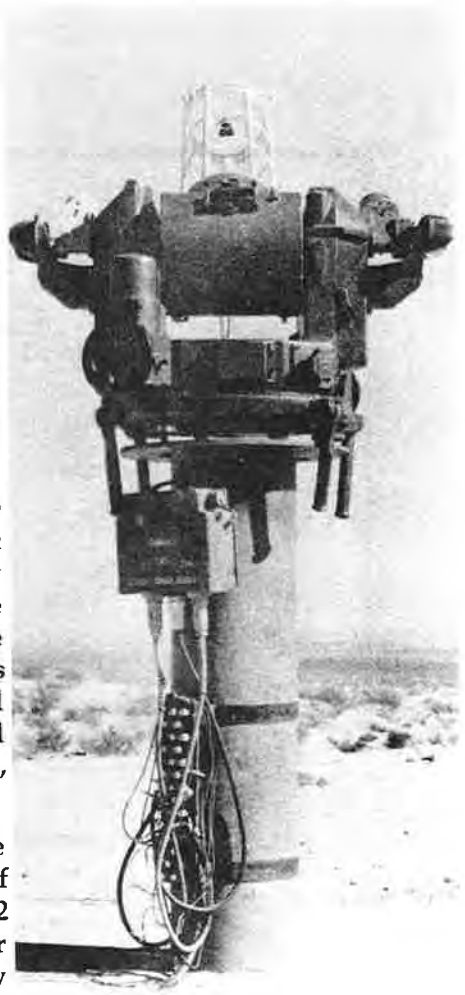
Instrumentation van at WSPG, circa 1947.

off and initial trajectory to an altitude of 3,000-4,000 feet were observed by Bowen-Knapp cameras. Higher-altitude and longer-range observations were provided by Askania phototheodolites and teletheodolites, supplemented by Mitchell phototheodolites. More detailed observations were provide by five tracking telescopes photographing at 16 feet per second. The Askania and Mitchell theodolites utilized motion-picture film to record vehicle flight, while the Bowen-Knapp and ballistic tracking cameras provided stills.

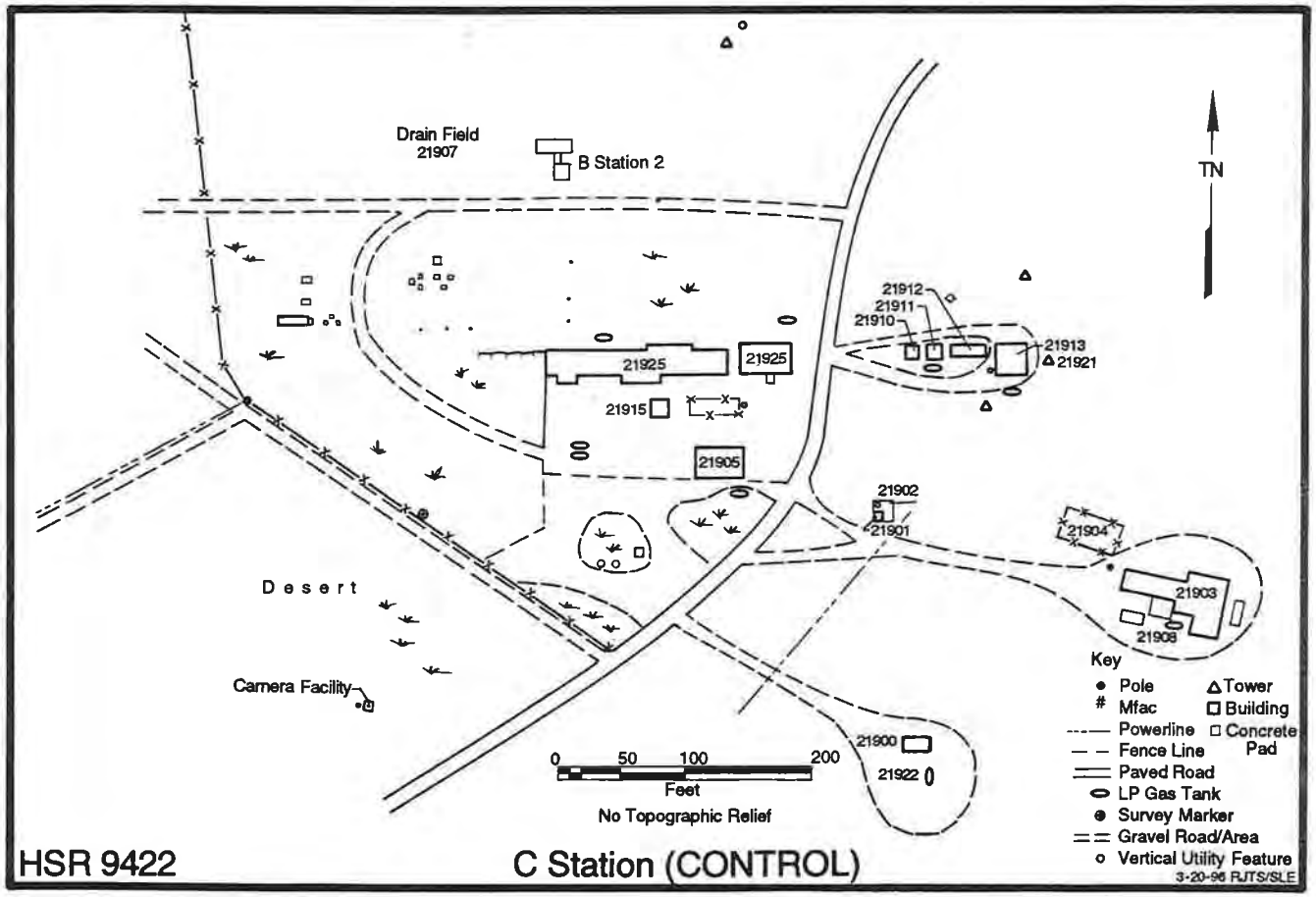
Three types of electronic instrumentation were in place for trajectory observation: "advanced" radar, DOVAP (DOppler Velocity and Position system), and the impact computer, which relied on impulses from optical tracking heads. The original ballistic radar facility was housed at C Station. The Chain Radar, probably in operation by 1951, supplemented the basic system with companion radars linked by microwave at Holloman (King 1), Alamo Lookout, Oscura Range Camp, Oscura Peak, and Red Butte.

The beginnings of the WSPG instrumentation system were humble. By October 1945, contracts had been let design and build instrumentation and photographic facilities to support the newly activated 1st Guided Missile Battalion of Army Ground Forces. In 1945, the Chief of Ordnance established administrative operation of the WSPG instrumentation system as the responsibility of the Ballistics Research Laboratory, Aberdeen Proving Ground, which established its White Sands Annex at WSPG in March 1946. On April 2, 1946, 10 men and 2 radar vans on loan from the Evans Signal Laboratory, a branch of the Signal Corps Engineering Laboratory (SCEL) at Fort Monmouth, New Jersey, established the SCEL Field Station No. 1.

This first radar site at WSPG was A Station, located approximately 1 mile due south of the Army blockhouse at Launch Area 1 (LC-33). Until the summer of 1947, A Station consisted of two SCR-584 radar vans set up to track the V-2 launches. With increased requirements for further rocket-test programs and for safety reasons, A Station was moved to permanent quarters at the newly established C Station (Billups 1959:4; Powell and Scala 1994). C Station was established approximately 2 miles due south of the Army blockhouse and utilized the SCR-584 radar, as well as the Askania, Mitchell, and ballistic theodolites.



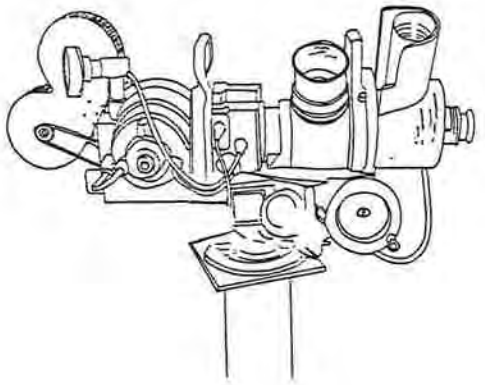
Askania cinetheodolite.



C Station 1996 site map. C Station served as the central timing and control facility for all instrumentation at WSPG.

C Station

C Station was the focal point for the early instrumentation at WSPG. The facility still serves as a central control facility for radar, observation, telemetry, impact prediction, timing, and communications. Several of the existing instrumentation buildings at C Station date to the earliest WSPG missile testing. All of the buildings remain standing today, and some are still in use. Facilities at C Station are a control building, a communications building, a Flight Safety Office, an impact predictor building, a double Askania building, a Mitchell camera shelter, a ballistic camera building, and a telemetry building. All are in excellent condition, as described here.



Mitchell camera.

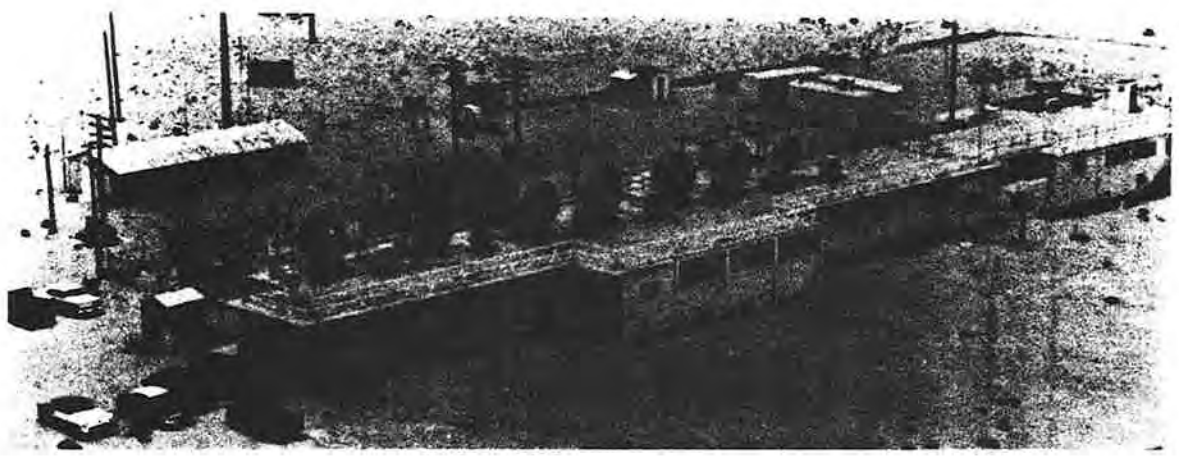
Control Building

The control building (No. 21925) at C Station was erected in 1950 to serve as the central timing and control facility for all instrumentation at WSPG. Over the years, use of this building has changed. Subsequent additions occurred in 1951, 1954, and 1955, resulting in two separate buildings that share the same number. The original, west building (No. 21925A) currently houses a meteorological station. The smaller east addition (No. 21925B) houses a nuclear dosimetry laboratory and administrative offices.

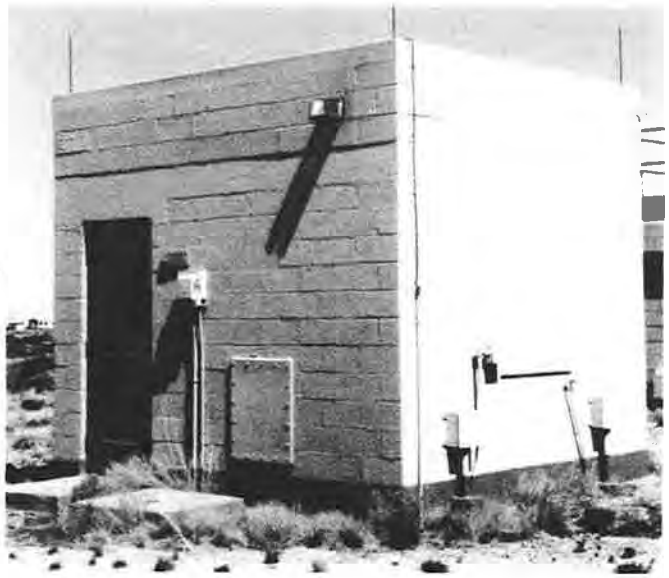
Both are pillar and spandrel construction with concrete-block infill. The west building is single-story and multiroomed, with a basement. It is irregularly shaped, with numerous observation windows and doors, a flat concrete slab roof supporting radar and other instrumentation. The building measures approximately 15,000 square feet. The east building is a rectangular, single-story, multiroom building with a low gable roof. It measures 3,370 square feet and contains 3 doors and 16 windows. Buildings 21925A and B are in excellent condition.

Impact Predictor Building

Building 21910 is a small, rectangular impact predictor building measuring 11 ft 4 in. by 14 ft 4 in. Located in the northeast portion of the C Station facility, this building was constructed in 1950. It is single-story, one-room, and constructed of concrete block set on a poured concrete slab foundation. The roof is flat, with a concrete parapet, and covered with asphalt roll roofing. The building contains one metal casement window and a single-hung, two-



The control building at C Station, post-1950.



The impact predictor building at C station.

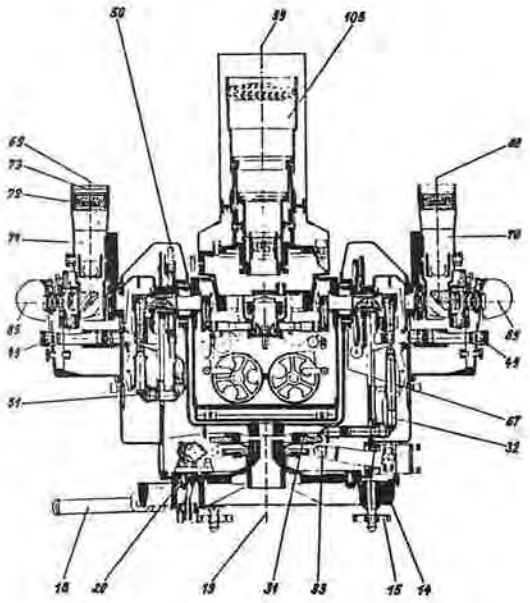
panel wood-core door covered with aluminum sheathing on the west side. A wooden *canale* for roof drainage is located at the southwest corner.

Mitchell Camera Building

Building 21911 is a Mitchell camera building located approximately 8 feet east of the impact predictor building. This building is rectangular, single-story, one-room, and measures 12 by 14 feet. Built in 1950, it is of pillar and spandrel design with concrete-block infill, set on a poured concrete foundation. The roof is flat with a metal toeplate installed over it. A moveable metal cover with a circular base and a pyramidal dome is installed over the instrument pedestal in the center of the roof. A standard pipe railing surrounding the perimeter of the roof is bolted onto the toeplate, and a Navy-type metal ladder on the north wall provides access to the roof. The entry door, single-hung, two-panel wood-core with aluminum sheathing, is located on the north side. Two 3-pane casement windows with metal frames are set in plain openings with concrete slip sills.

Double Askania

Constructed in 1950, Building 21912 is a double cinetheodolite (Askania) building located 8 feet east of the Mitchell camera building. It is a rectangular, single-story, one-room building measuring 12 by 28 feet. Construction is pillar and spandrel style of reinforced concrete, set on a poured concrete slab foundation. The roof is flat, constructed of reinforced concrete, and has been painted with aluminum paint. A standard pipe railing mounted on the roof forms a U-shape enclosure on the east end of the building. Two 3-pane casement windows and a single-hung, wood-core entrance door are located on the north side.

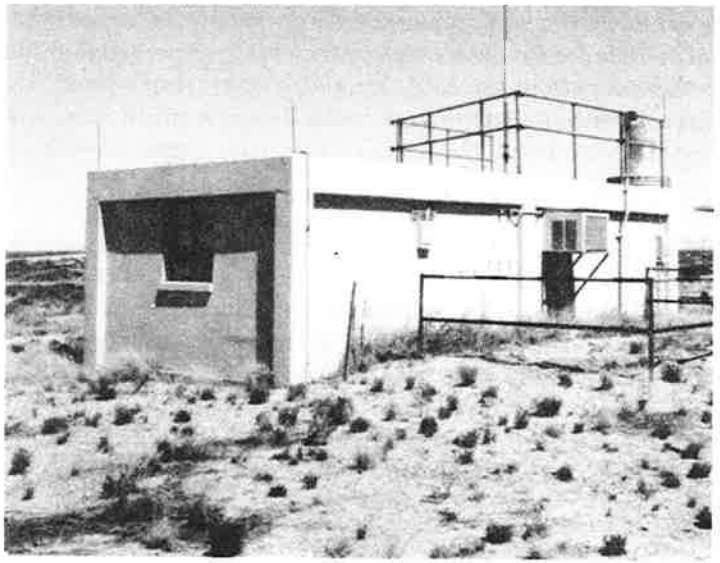


Askania cinetheodolite.

Telemetry Building

Building 21913 is a rectangular, single-story, two-room, telemetry instrumentation building consisting of two buildings joined together. It measures 29 ft 6 in. north-south by 30 ft 6 in. east-west. Constructed in 1952, the building is of concrete block set on a poured concrete foundation slab, all of which has been stuccoed and painted tan. It has a flat, gravel roof with projecting eaves on the east and west ends. The west half of the roof has 6-inch metal flashing over 1-by-8-in. wood framing; the east half has a concrete

The Mitchell camera building
at C Station, facing northeast.

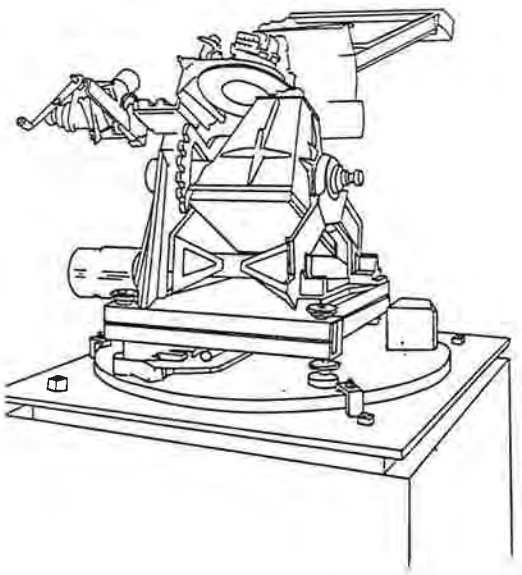


The double Askania cinetheodolite building
at C Station, facing northeast.

parapet, with wooden *canales* for roof drainage on the south end. Lightning rods are mounted on the roof at each corner, and a wall-mounted, metal Navy-type ladder provides access. Windows include fixed-glass panes set in metal frames and glass block mortared with concrete. The entry door is single-hung, wood-core with aluminum sheathing, set in a metal frame, located on the south side. The wall surface is painted tan, and window frames, doors, ladder, and wooden porch are painted brown. Two poured-concrete slabs are located at the east and west ends of the south wall. The slab on the east end contains a USGS Reference Marker with "WSPG 'C' No. 1, 1952" stamped on it.

Ballistic Camera Building

Building 21901, located in the south-central portion of the facility, was constructed in 1952 and served as a ballistic camera building. The building is rectangular, 12 by 14 feet, single-story, one-room, constructed of concrete block set on a poured concrete foundation. It has a flat, tar-and-gravel roof with a concrete parapet. Lightning rods are mounted at each corner on the roof. The building has a solid-metal, standard-size entrance door and two casement windows.



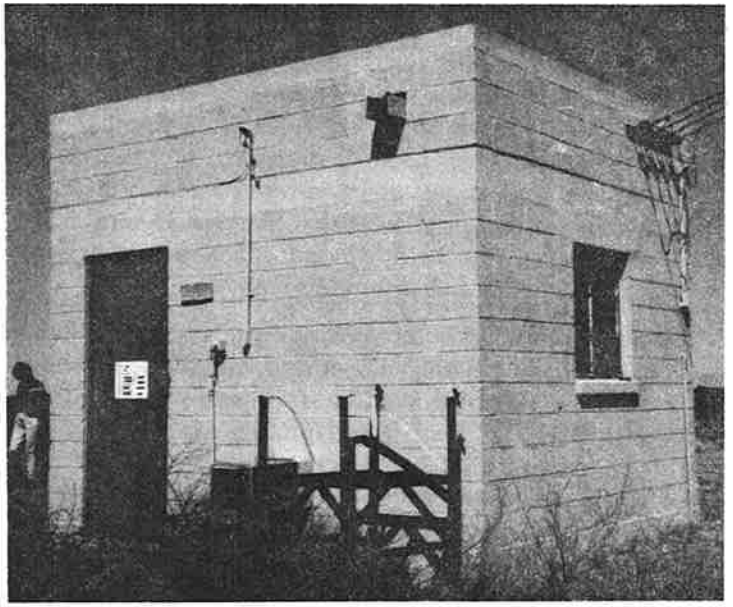
Ballistic camera.

Building 21901 sits on the southwest corner of a poured concrete slab measuring 12 by 24 feet. Mounted on the eastern half of this slab are two metal angle rails and bumpers that were used to support a moveable metal instrument cover. These rails, spaced 11 feet apart, run north-south the full length of the slab. A concrete camera mount measuring 3 feet square and 3 ft 6 in. high is situated between these rails at the north end of the slab. A square, angle-iron frame is bolted to the concrete slab around its base.

Access to the building is through an entrance door on the north wall. This door is 3 feet wide, solid metal, and set in a steel frame. Mounted on the west end of the wall is a Navy-type steel ladder leading to the roof. The east and south walls are plain. The south wall contains a single U-shaped wooden *canale* for roof drainage and an exhaust vent. The west wall of Building 21901 contains two 3-pane casement windows, each measuring 3 feet wide by 2 feet high. They are set in plain openings with no sills. Four concrete nails surround each window, two on each side, and may have secured screens or some type of window cover. A junction box and cable connector are also present in this wall.

The telemetry building at C Station.

The ballistic camera building at C Station.



USN Bowen-Knapp Instrumentation Array

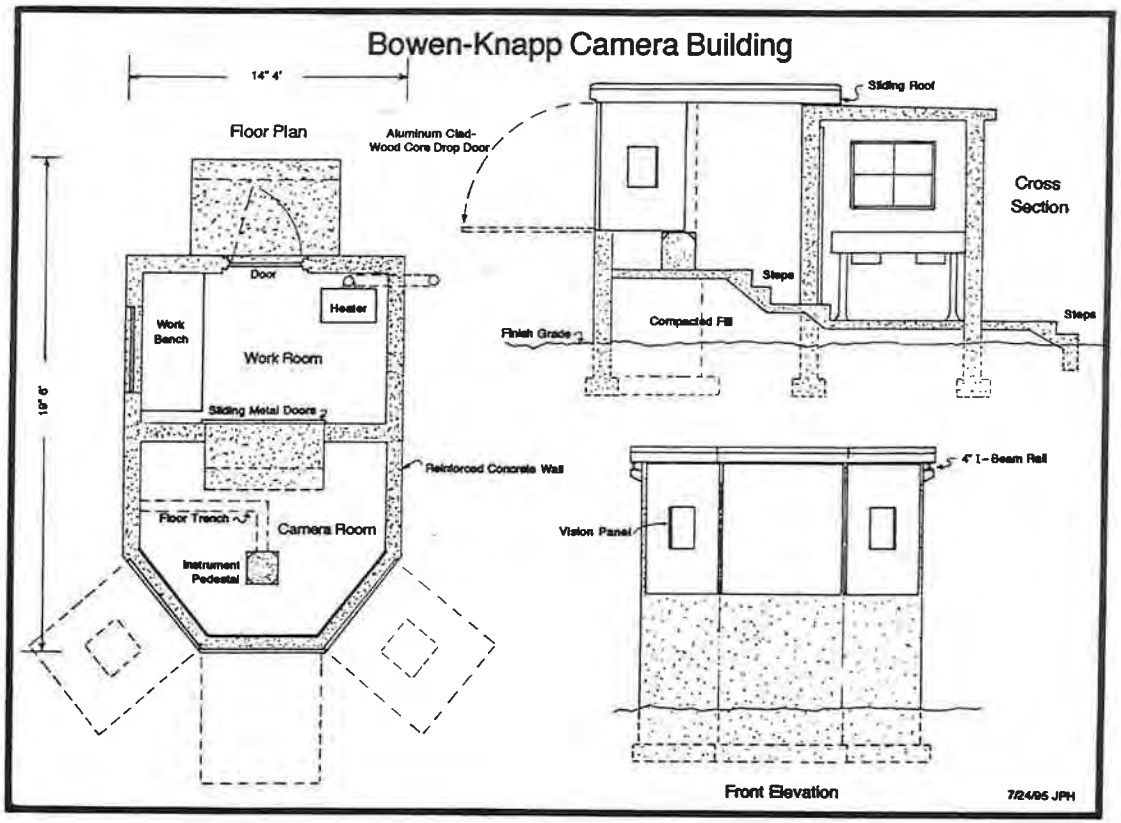
The Navy's Bowen-Knapp close-in instrumentation array includes five facilities known as VIP (possibly Davy), Jones, Locker, Unicorn (previously termed Uncle), and Viper. All five facilities include uniquely designed buildings strategically located east of the cantonment area. They are single-story, irregularly shaped buildings, with bayed observation windows; construction is poured concrete panels. Each building measures approximately 125 square feet and has two rooms divided by a pair of interior sliding doors. One end of each building has three observation bays that are constructed in upper and lower sections so that the upper section opens out flat and rests on spring-action metal braces mounted on the lower section. The top sections are covered with aluminum insulation cloth. The upper section of each side bay contains a fixed Plexiglas window. The roofs are flat and divided into two halves—a retractable metal half over the bay end and a fixed concrete half over the other end.

Range Camps

During WWII and the early years of WSPG, several range camps were built to support personnel located some distance from the main cantonments of WSPG and AAAF. These range camps provided sites for training, testing, logistic support, test instrumentation, and housing. At various times during WSPG's first two decades, these camps included Tularosa Range Camp (RC), Oscura RC, Salinas Camp, Rhodes Canyon RC, Stallion RC, and Red Canyon RC. Two camps were recorded.

Tularosa Range Camp

The Tularosa Range Camp, occupied as part of the Alamogordo Bombing and Gunnery Range during WWII, served as a camp and landing strip. The camp is located mid-range, along the eastern WSMR boundary, at the north end of HAFB, and west of the town of Tularosa. This once-thriving camp consisted of a landing strip, at least 17 structures, 2 water storage tanks, and a spring-fed swimming pond. The inhabitants enjoyed the luxury of running water, electricity, liquid propane gas, and indoor plumbing. Very little remains of the original camp today, except for the landing strip, a few concrete foundations, the swimming pond, old roads, depressions that once held household storage



The Bowen-Knapp camera building - floor plan, elevation and cross section.

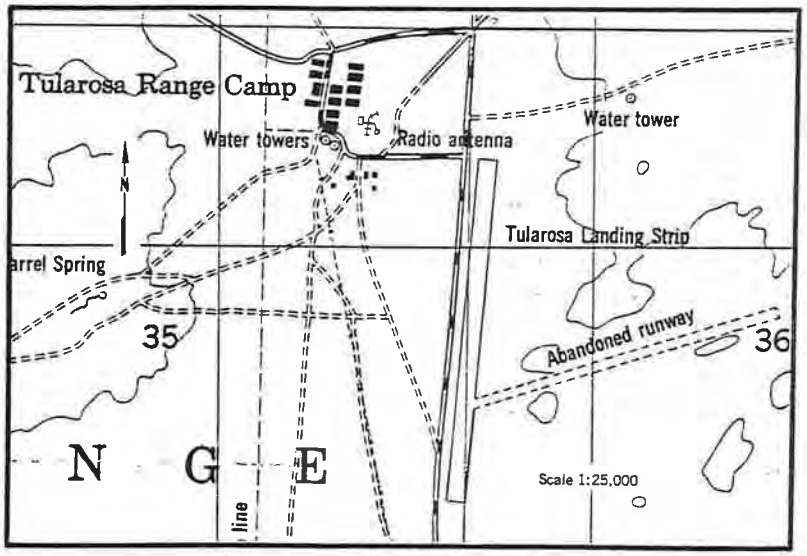
tanks, the septic holding tank and drain field, bottle glass fragments, and ceramic refuse. Today the range camp is utilized by HAFB as a recreation area and contains a dirt batting field with batters' cage and picnic tables.

Salinas Camp

Salinas Camp served as a range camp in the late 1950s for WSMR. It is located northwest of Salinas Peak in the San Andres Mountains on WSMR. This camp consisted of an enlisted men's barracks with mess hall (Building 32280) and a metal addition (No. H5032) to Building 32280 for added accommodations. Additional features include a liquid propane gas storage tank, a diesel storage tank, a wash rack, and an elevated water storage tank (22,300 gallons).

A temporary wooden structure once stood northwest of the mess hall. The collapsed remains of this building can be observed today adjacent to a chinked, or fortified, natural rock face. Several vertical utility stands are adjacent to this feature. An old power-line road with associated electrical debris passes northwest-southeast through the northwest portion of the camp. To the southeast of the mess hall is a campsite comprised of axed and hewn upright juniper logs, and numerous car parts, bottle glass, and can fragments. Military refuse scattered throughout the area includes 55-gallon steel drums, a missile/rocket fin, numerous condiment and paint cans, bottle glass fragments, culvert pipes, one large tractor tire, scraps of milled lumber, drain-field piping, and clear insulator fragments.

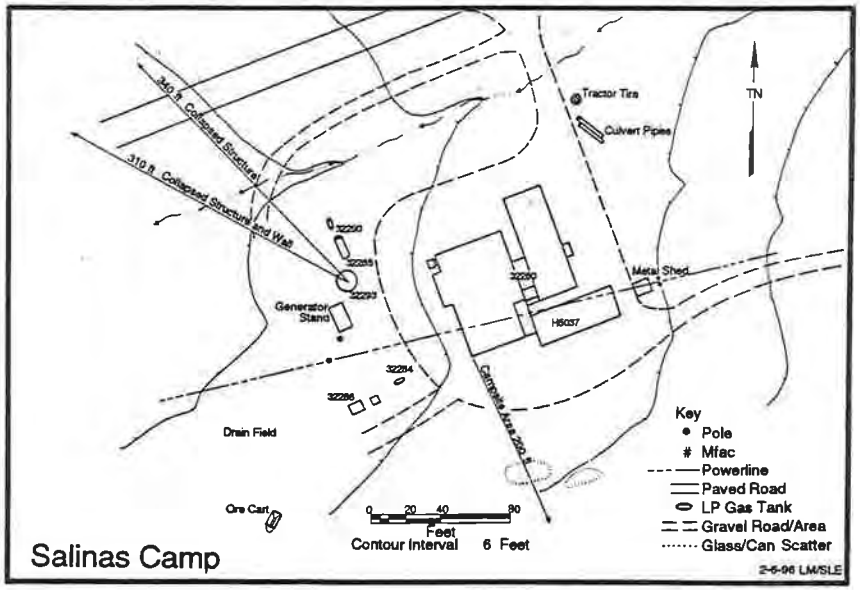
The enlisted men's barracks and mess (Building 32280) is a single-story, multiroom, two-winged structure constructed of concrete block set on a poured concrete-slab foundation. The west wing, originally built in 1959, is pillar-and-spandrel style construction. The east wing is T-shaped, pillar-and-spandrel construction of concrete block, with 13 concrete-block columns, set on a poured concrete slab foundation. The date of construction for this addition is unknown. At some point, a rectangular, single-story temporary building (No. H5032) constructed of corrugated metal was joined to Building 32280 by an enclosed porch.



During WWII and the early years of WSPG, several range camps were built to support personnel distantly located from the main cantonments of WSPG and AAAF. These range camps provided sites for training, testing, logistic support, test instrumentation, and housing.

Tularosa Range Camp (top) was occupied as part of the Alamogordo Bombing and Gunnery Range during WWII and served as a camp and landing strip.

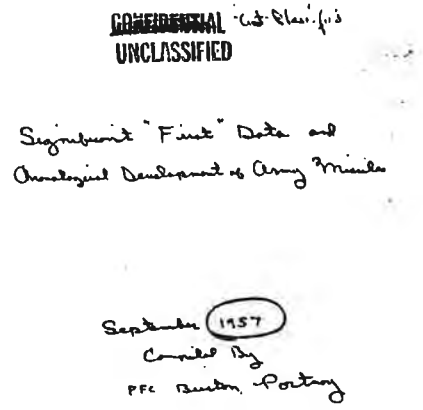
Salinas Camp (right), located in the San Andres Mountains on WSMR, served as a range camp in the late 1950s for WSMR.



PRACTICAL LESSONS

This investigation into the early Cold War history and origins of White Sands Missile Range was both frustrating and instructive. It rapidly became apparent that very little synthesis of early WSMR history had ever been attempted. Tom Starkweather's (1989) historical manuscript and serialized *Missile Ranger* columns were the exception to that rule; without Tom's unheralded research and conservation efforts, our task would have been nearly impossible. His work often relied on obscure summaries (a few of which later turned up, often in incomplete fragments), but it provided the starting line. A combination of luck, circumstance, persistence, and the memory and expertise of many people at WSMR helped us reach our goal.

One lucky circumstance is the continuing transfer of long-outdated documentation to the new WSMR Museum. We learned over and over that, until a document becomes accessible, its very existence remains unknown. Such was the case with the original *Army Ordnance Department Guided Missiles Program* summary (OCO 1948). At the other end of the spectrum lies *Significant "First" Data and Chronological Development of Army Missiles*, by PFC Burton Portnoy, dated September 1957. Both these documents turned up during the course of the project in unsorted, uncataloged boxes transferred to the Museum from the WSMR Technical Library; they were brought to our attention by Bruce Allan and his Museum staff. Portnoy's 7-page typescript is unique (or perhaps typical) in several ways. First, it is dated. Second, as hinted at by its handwritten title page, it is purely unofficial, yet it contains the most detailed firing summary found thus far on WAC Corporal, Nike-Ajax, Lacrosse, and other early, key missile programs. Nothing on the document even suggests that it was cataloged. A third example in the last batch of outdated documents was sandwiched between several cataloged folders. It consisted of three faded ditto pages signed by WSPG's first commander, Lt. Col Harold R. Turner, and his AAAF counterpart, Col. Paul F. Helmick. Dated July 28, 1947, these pages outlined the first operational integration of the New Mexico Guided Missiles Range.


CONFIDENTIAL
UNCLASSIFIED

Significant "First" Data and
Chronological Development of Army Missiles

September 1957
Compiled By
PFC Burton Portnoy

Portnoy manuscript cover sheet.

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IRIS NUMBER 01013653      DOCUMENT TYPE
CALL NUMBER          MICFILM 31731
INCLUSIVE DATES      41/00/00  TO 66/06/00     DATE PUBLISHED
TITLE EXTENSION
DOCUMENT SECURITY: U     NL
REEL 00000731731 BEG FRAME 000775 END FRAME 000000 OLD REEL NUMBER
MAIN ENTRY           AIR FORCE MISSILE DEVELOPMENT CENTER
TITLE                AIR FORCE MISSILE DEVELOPMENT CENTER HISTORIES
TITLE ADDED ENTRY
AUTHOR
ABSTRACT             CONTAINS SEVERAL BRIEF HISTORIES OF THE AFMDC AND OF THE
                     HOLLOMAN AIR DEVELOPMENT CENTER (HADC). ALSO INCLUDED A
                     MONOGRAPH ENTITLED: "THE AIR FORCE MISSILE DEVELOPMENT
                     CENTER GUIDANCE TEST COMPLEX-1961".

MAIN ENTRY           AIR FORCE MISSILE DEVELOPMENT CENTER
TITLE                CHRONOLOGIES OF AFMDC AND HADC
TITLE ADDED ENTRY
AUTHOR
ABSTRACT             ITEM CONTAINS A GLOSSARY OF ACRONYMS, PROGRAMS, AND
                     ABBREVIATIONS OF THE DEP (DEFENSE ELECTRONIC PRODUCTS) SEP
                     1968, AND A PAMPHLET ON THE HOLLOMAN AIR DEVELOPMENT CENTER
                     (HADC) AND THE ALAMOGORDO, NEW MEXICO COMMUNITY (AGU 1962).
                     A DRAFT OF A STUDY: "SUMMARY OF ACTIVITIES AT HADC" IS
                     INCLUDED. SEVERAL CHRONOLOGIES OF EVENTS AT THE AFMDC AND
                     HADC WERE ALSO INCLUDED.

MAIN ENTRY           AIR FORCE MISSILE DEVELOPMENT CENTER
TITLE                HOLLOMAN AIR DEVELOPMENT CENTER SELECTED BIBLIOGRAPHIES
TITLE ADDED ENTRY
AUTHOR
ABSTRACT             SEVERAL ANNOTATED BIBLIOGRAPHIES OF RESEARCH REPORTS AND
                     STUDIES CONCERNING PARTICULAR PROJECTS, PROBLEMS, SUPPORT,
                     AND OPERATIONAL ACTIVITIES OF RELEVANT IMPORTANCE TO THE
                     HOLLOMAN AIR DEVELOPMENT CENTER (HADC) AND AFMDC.

MAIN ENTRY           AIR FORCE MISSILE DEVELOPMENT CENTER
TITLE                REORGANIZATION OF THE HOLLOMAN AIR DEVELOPMENT CENTER
TITLE ADDED ENTRY
AUTHOR
ABSTRACT             A ROUGH DRAFT STUDY OF THE VARIOUS REORGANIZATIONS OF THE
                     HOLLOMAN AIR DEVELOPMENT CENTER FROM 1942 TO 1955.

MAIN ENTRY           AIR FORCE MISSILE DEVELOPMENT CENTER
TITLE                HOLLOMAN AIR DEVELOPMENT CENTER (HADC) SPECIAL STUDIES
TITLE ADDED ENTRY    UNITED STATES BATTLES COMMUNISM, 45/00/00-61/00/00
                     IMPACT OF SPACE TECHNOLOGY ON MEDICAL RESEARCH, 1959
                     REORGANIZATION OF HOLLOMAN AIR DEVELOPMENT CENTER, 1942-195
AUTHOR
ABSTRACT             ITEM CONTAINS INFORMATION CONCERNING PAST, PRESENT, AND
                     FUTURE ACTIVITIES AT THE HADC AND THE AFMDC, INCLUDING
                     TRANSCRIPTS OF SPEECHES AND SLIDE ORIENTED BRIEFINGS.
SUBJECTS             MEDICAL RESEARCH
                     COMMUNISM
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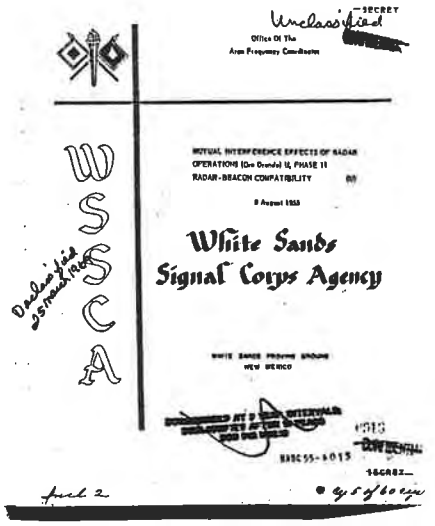
Microfilm index entry from Maxwell AFB History Office.

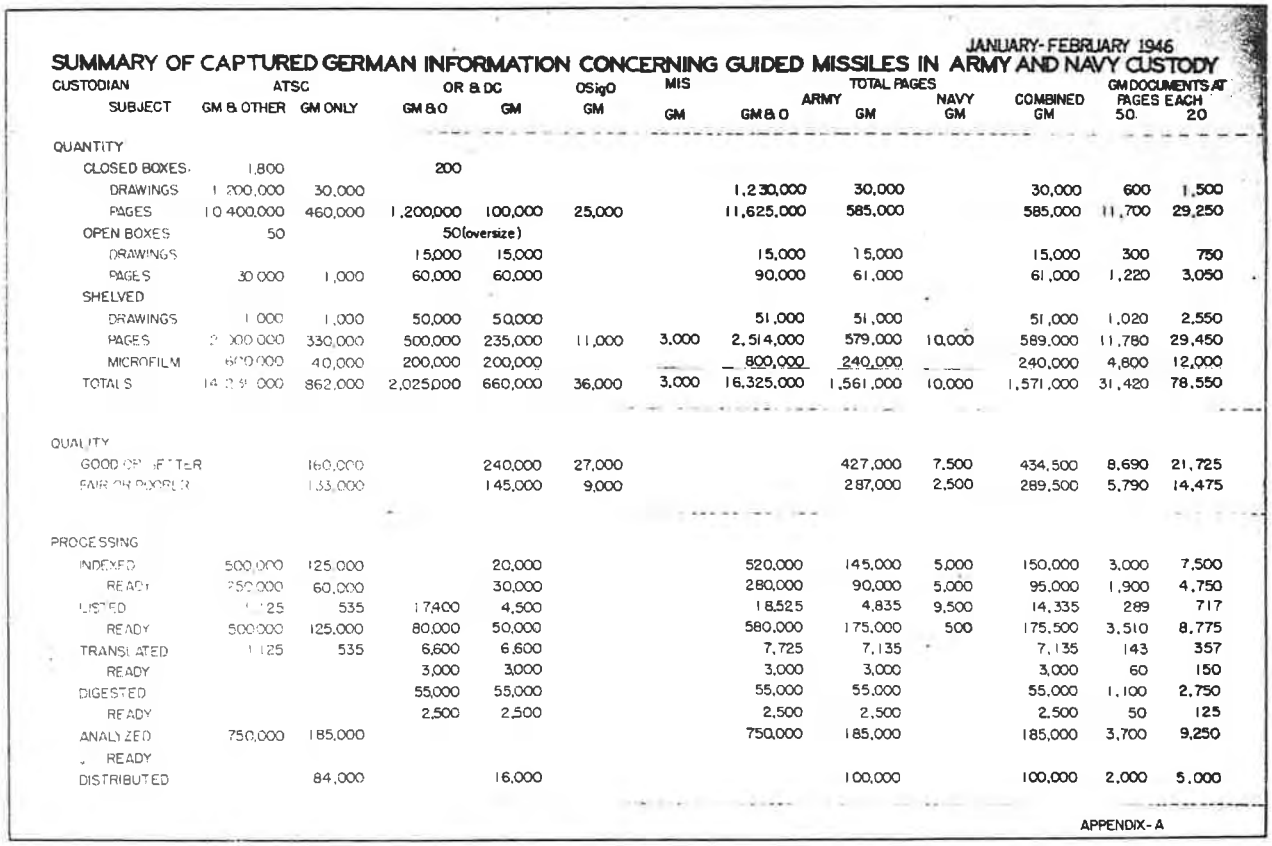
Secondary synthetic sources present another set of problems. Perhaps the best published source for early American missile program history was British: *The Rocket* by David Baker (1978). The least useful was an official Air Force history, *Ballistic Missiles in the U.S. Air Force, 1945–1960*, by Jacob Neufeld (1990). Despite thorough coverage of both early Army and Air Force programs (Hermes, Matador, and Snark), Neufeld (1990:130) mentions HADC/AFMDC (where Snark, Matador, and Mace were developed and tested) only once and provides no index entry. WSPG is similarly relegated to one index entry. According to Neufeld, Operation Paperclip took place solely at Fort Bliss, Texas, and Huntsville, Alabama.

Secrecy, classification, and regular document disposal are probably the main reasons for these deficiencies and biases. Review of several dozen historical microfilm records from the USAF History Museum have also revealed that catalog entries prepared by nonhistorians are often inadequate. The mixture of uncataloged items included in these microfilms, along with cited records, was often bizarre: everything from a Loren Eiseley biography of Charles Darwin clipped from *Scientific American* to previously classified theses and monographs such as Helfers' (1954) *The Employment of V-Weapons by the Germans During World War II* and King's (1963) *A Discussion of Overland Missile Flights in the United States.*

The inadequacy of inventories prepared by untrained personnel has another, perhaps more significant implication. A wide range of primary and secondary sources refer to the 300 freight-car loads (640 tons) of V-2 materiel ultimately shipped to WSPG. We know from several studies that only about 100 V-2s (some partial) were represented. We also know that the Nordhausen area, where most of the captured V-2 and Wasserfall materiel was collected, was a major production center for a wide range of guided missile and weapons technology. It seems likely that, in the rush to monopolize German technology, almost anything that looked like a missile would have been seized by untrained Army personnel. The recent reappearance of a scale model V-2 deployment set—complete with missiles, fuel trucks, tanks, meilerwagans, etc., all in a wooden and plexiglass case—helps confirm this speculation and begs the question: What else was included in 640 tons, filling 300 freight cars?



Declassified document cover.



JANUARY-FEBRUARY 1946

SUMMARY OF CAPTURED GERMAN INFORMATION CONCERNING GUIDED MISSILES IN ARMY AND NAVY CUSTODY

CUSTODIAN	ATSC		OR & DC		OSigO	MIS	TOTAL PAGES				GM DOCUMENTS AT PAGES EACH	
							ARMY		NAVY	COMBINED		
SUBJECT	GM & OTHER	GM ONLY	GM & O	GM	GM	GM	GM & O	GM	GM	GM	50	20
QUANTITY												
CLOSED BOXES	1,800		200									
DRAWINGS	1,200,000	30,000					1,230,000	30,000		30,000	600	1,500
PAGES	10,400,000	460,000	1,200,000	100,000	25,000		11,625,000	585,000		585,000	11,700	29,250
OPEN BOXES	50		50 (oversize)									
DRAWINGS			15,000	15,000			15,000	15,000		15,000	300	750
PAGES	30,000	1,000	60,000	60,000			90,000	61,000		61,000	1,220	3,050
SHELVED												
DRAWINGS	1,000	1,000	50,000	50,000			51,000	51,000		51,000	1,020	2,550
PAGES	2,300,000	330,000	500,000	235,000	11,000	3,000	2,514,000	579,000	10,000	589,000	11,780	29,450
MICROFILM	600,000	40,000	200,000	200,000			800,000	240,000		240,000	4,800	12,000
TOTALS	14,329,000	862,000	2,025,000	660,000	36,000	3,000	16,325,000	1,561,000	10,000	1,571,000	31,420	78,550
QUALITY												
GOOD OR BETTER		160,000		240,000	27,000			427,000	7,500	434,500	8,690	21,725
FAIR OR POOR		133,000		145,000	9,000			287,000	2,500	289,500	5,790	14,475
PROCESSING												
INDEXED	500,000	125,000		20,000			520,000	145,000	5,000	150,000	3,000	7,500
READY	250,000	60,000		30,000			280,000	90,000	5,000	95,000	1,900	4,750
LISTED	1,125	535	17,400	4,500			18,525	4,835	9,500	14,335	289	717
READY	500,000	125,000	80,000	50,000			580,000	175,000	500	175,500	3,510	8,775
TRANSLATED	1,125	535	6,600	6,600			7,725	7,135		7,135	143	357
READY			3,000	3,000			3,000	3,000		3,000	60	150
DIGESTED			55,000	55,000			55,000	55,000		55,000	1,100	2,750
READY			2,500	2,500			2,500	2,500		2,500	50	125
ANALYZED	750,000	185,000					750,000	185,000		185,000	3,700	9,250
READY												
DISTRIBUTED		84,000		16,000				100,000		100,000	2,000	5,000

APPENDIX-A

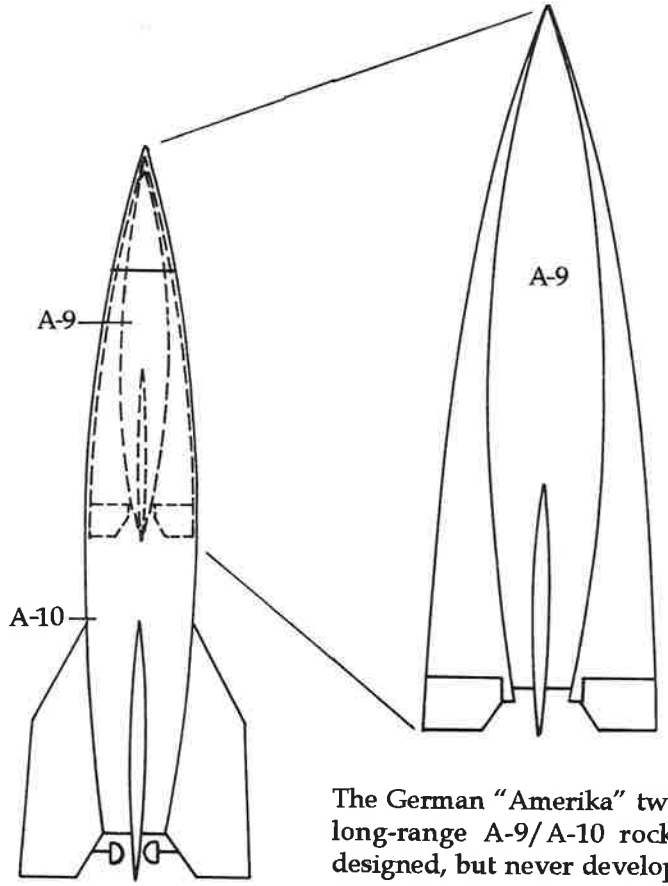
America's World War II missile technology booty.

Another recent Museum discovery points in the same direction. Two short articles in the July 1946 issue of *The Guided Missile* (published in classified, limited, individually numbered quantities by the Joint Chiefs' Guided Missiles Committee) confirm the vast quantities of missile-related documents captured, dwarfing the traditional figure of 12 tons hidden and later recovered by the Peenemünde team. The Air Materiel Command, Wright Field, and the Research and Development Service, OCO, both indicate that, by July 1946, more than 220 tons of documents had been received for cataloging, representing "more than 14,000,000 pages and 1,300,000 drawings, plus many thousand feet of microfilm reproductions" (St. John 1946).

Many studies indicate that the great potential represented by captured materiel and documents was clearly recognized by some military planners. At the end of the war, von Karman advised General Henry H. "Hap" Arnold, Chief of the Army Air Forces, that German missile expertise extended well beyond the Wasserfall, V-1, and V-2. Accordingly, Arnold began to steer funding toward some 26 long-range developmental projects encompassing all four classes of military missiles: AAM, SAM, ASM, and SSM (Futrell 1989:478). These German-inspired projects included, among others: Falcon, Rascal, Matador, Snark, Navaho, Hi-Roc, GAPA, Wizard, and Hermes II. Similar developmental programs were started by OCO (Army Surface Forces) and Bureau of Ordnance (Navy). Timing and technical similarities suggest that Nike and many other early programs benefitted from both German Paperclipper expertise and accumulated wartime research and development.

The formative role played by German technology in the birth of the American space and missile program has yet to be fully assessed or appreciated. Without question, that role was crucial. By the 1950s, U.S. missile programs had achieved general parity with the Soviets. The Soviets had taken an early lead, parallel to Germany, and had established the first government-sponsored rocketry research laboratory as early as 1921. By 1933, the Soviets had achieved reliable liquid-propellant motors and, by 1939, had tested the Project 212 flying bomb, similar to the V-1. Stalin's purges in the late 1930s helped stall these various rocket programs, but by 1941, the Soviets were still able to successfully deploy the solid-propellant SSM Katyusha BM-13 against Germany.

Cover of a 1945 German report entitled *The Missile A-4 Series B.*

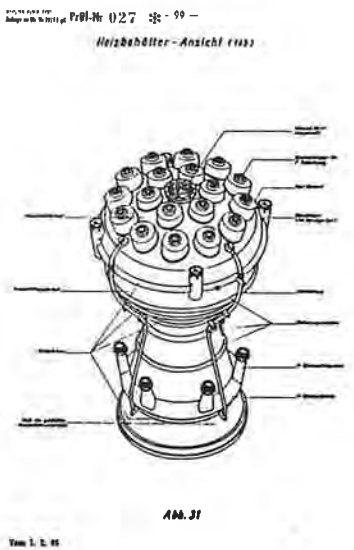


The German "Amerika" two-stage, long-range A-9/A-10 rocket was designed, but never developed.

WSPG was born out of the dimly perceived awareness that warfare had fundamentally changed with the first rockets to fall on London, England. That perception sparked an infant research industry whose rapid growth required use of the wide open spaces found only in the American West. The capture of a virtually intact German missile industry catapulted America into a trajectory that once was the sole domain of science fiction. The capture also denied the expertise to a future antagonist. That explosion of technology, which we are still riding today, may ultimately dwarf the other pivotal blast that shook the sky and lit the ground before the sun at Trinity.

The rapid, almost instantaneous, appearance of a new American missile industry reinvigorated its Soviet counterpart. Fueled by scientific optimism and new sources of funds freed by the end of WWII, America began to throw itself toward the stars in a new race with a new enemy. Under the 20-year tenure of OCO, WSMR helped achieve that goal. By the end of its second decade, WSMR had once again entered new territories of the imagination. No longer was the moon a bright, flat, distant disk. We had landed on her dry, dusty surface. Within a few more years we would walk there.

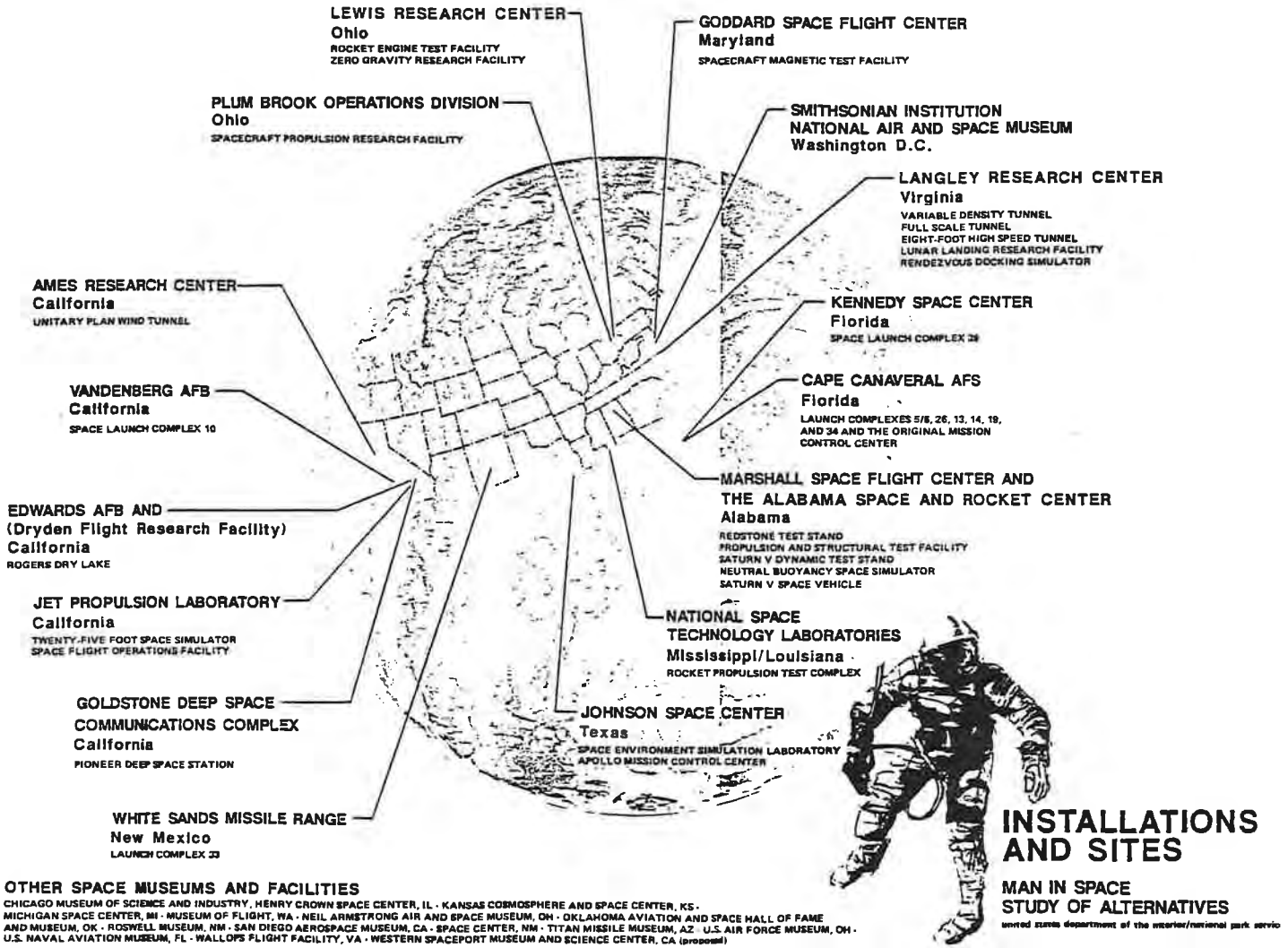
Missile technology had come full circle. The German fantasy of an ICBM ironically named Amerika was a threatening global reality. Missiles, not distance, had become our principal continental defense. New cruise missiles—looking like streamlined versions of their predecessors, the balsa and *papier-mâché* Bugs and pilotless bombers of yesterday—were being touted as the weapons of the future. Global attention was focused on the space race, which oscillated between reluctant cooperation and friendly rivalry, and light itself, in the form of lasers, had become a potential weapon.



V-2 combustion chamber illustration from a captured German document.

Giant Steps: WSMR's Role in the Leap to the Moon

Congress passed Public Law 96-344 in 1980, directing the Secretary of the Interior to conduct a National Register theme study of the sites and events associated with Man in Space (MIS) programs. Under the MIS theme, 25 sites were recommended for listing as National Historic Landmarks. Included in the list as a nationally significant property was LC-33 at WSMR, among the "best and most important remaining examples of the technology needed to land man on the moon and to explore the earth, planets, and solar system" (Spratt, et al. 1987:4). To those evaluators, the historic significance of LC-33 was its role in the

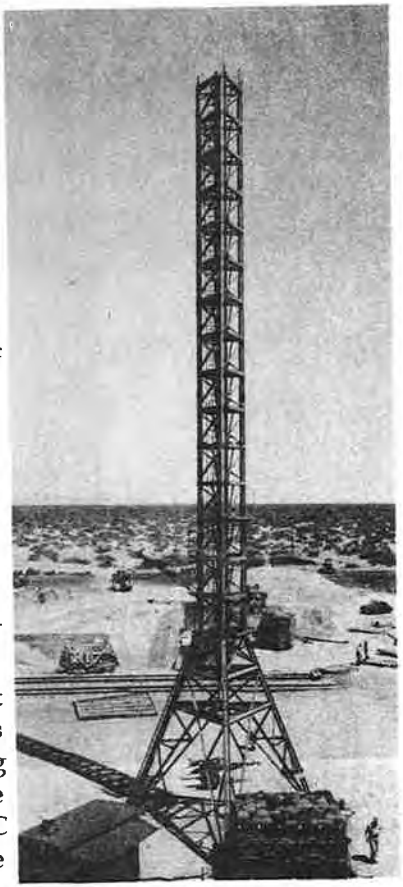


Nationwide Man in Space interpretive centers.

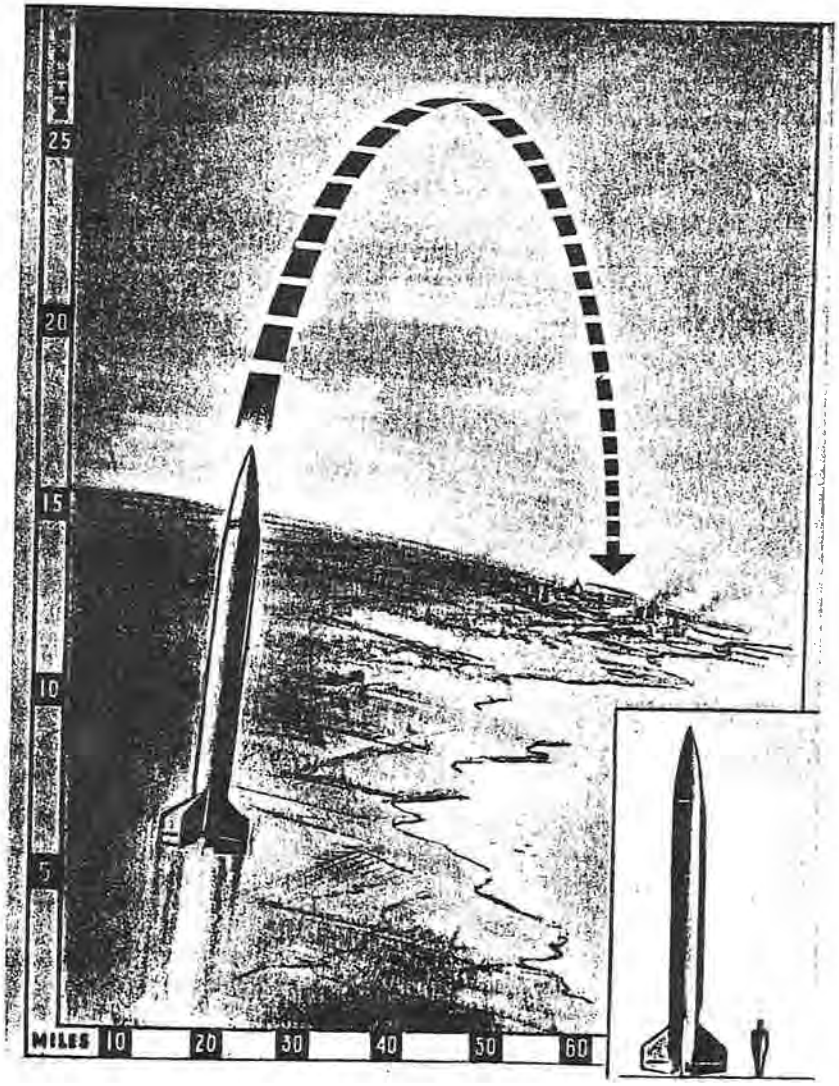
V-2 program and its importance to the first generation of rocket-testing facilities. Through this program, the United States began its exploration of space. The Army Blockhouse and Gantry Crane, however, are only two of the facilities at WSMR that were part of this first generation of rocket testing. Other first-generation facilities include laboratories, missile-assembly buildings, static test stands, rocket-impact sites, and instrumentation systems. Additional facilities important in America's effort to land man on the moon are scattered throughout the range. LC-36 was largely devoted to the MIS effort and the Apollo program. Both LC-35 and LC-36 were launch points for a multitude of upper-atmospheric sounding rockets, essential to our understanding of space.

The task of segregating properties in the MIS theme from those of the Cold War theme is often impossible, for the themes are intertwined. The Naval Bureau of Ordnance Hermes project began as a research program into the development of guided missiles but soon diversified to include upper-atmospheric research. The value of the V-2 expanded from merely a large missile-training program to a research program overseen by a diversified committee of both civilian and military personnel, universities, and contractors. Even the Redstone IRBM was pressed into service as a booster for our first manned space missions. Thus, the Cold War and Man in Space efforts went hand in hand, each serving the other, inseparably linking the arms and space races in a symbiosis that fulfilled John Kennedy's promise, a man on the moon within a decade.

The National Historic Landmark listing for LC-33 recognizes WSMR's important role in the early rocketry and upper-atmospheric research leading to man's landing on the moon. The WAC Corporal vehicle was the first true sounding rocket ever built. The first full round, fired on October 11, 1945, became the highest-flying object to leave earth, reaching an altitude of 44.5 miles. The WAC Corporal established a pattern of teamwork that became the hallmark for the entire space program. Built by Aerojet Engineering (a private firm founded as a spinoff by Cal Tech scientists von Karman and others), through a contract with the JPL-CIT and the Army Bureau of Ordnance, the WAC Corporal program developed a complex infrastructure based on cooperation between scientists, engineers, technicians, military personnel, and industrialists that led to the development of technology of mutual benefit to all (Burrows 1990:39).



WAC Corporal launcher at LC-33, no date. Gantry crane track installation in background (Sauber photo from private collection).

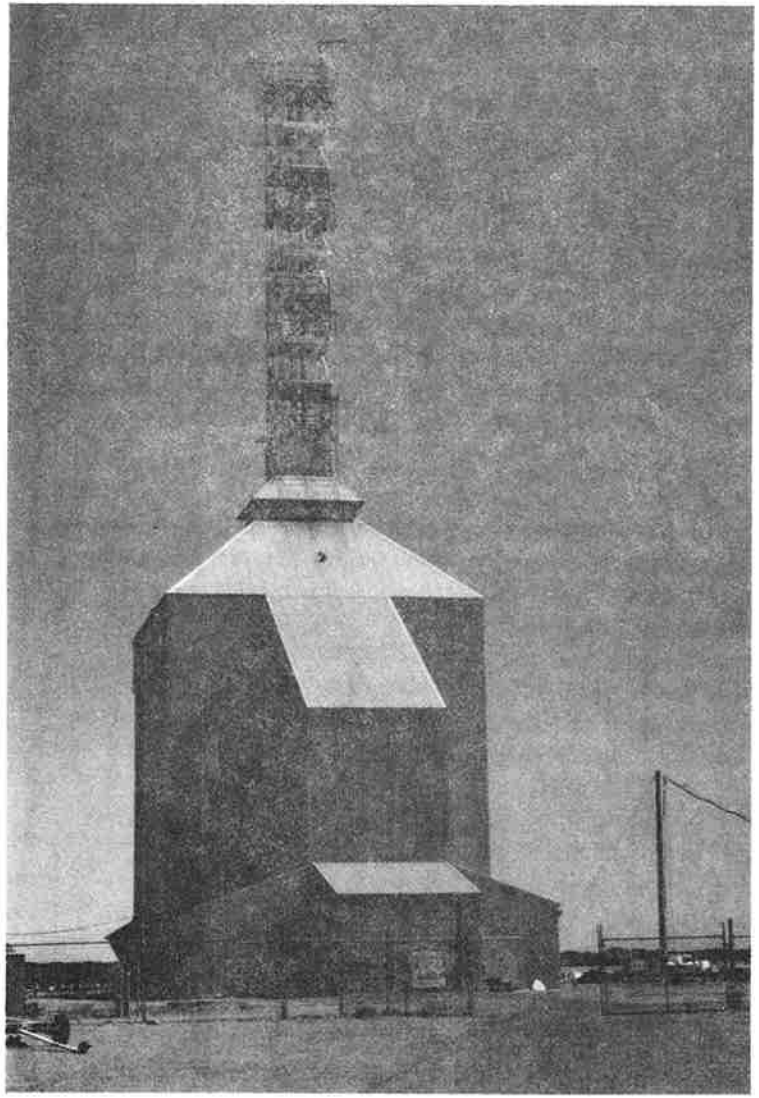


The research rocket Corporal E conceived as a missile (note Russian city target).

The WAC Corporal program, however, soon fell under the shadow of the A4 or V-2. Initially, the V-2 program was intended to train U.S. troops in the design and handling of large missiles, but was quickly expanded into an upper-atmospheric sounding program. The Army invited the Navy and academic institutions to join the program by filling the otherwise empty nose cones with scientific experiments. The Naval Research Laboratory responded by gathering a team of military officers, astronomers, and physicists interested in cosmic ray, solar, and atmospheric research. The team was headed by NRL's Ernest H. Krause and included James A. Van Allen, W. G. Dow of the University of Michigan, M. H. Nicols of Princeton, Fred Whipple of Harvard, contractors, and the Army Signal Corps. This informal, unchartered group, originally called the V-2 Panel, ultimately evolved into the Rocket and Satellite Research Panel and included over 50 of the most celebrated scientists and engineers in the country.

The V-2 program produced many firsts in America's space program, but significant problems with this vehicle remained. Most importantly, V-2s were finite in number. They could only be fired from WSPG, severely limiting important aspects of upper-atmospheric research such as polar phenomenon and upper and lower latitude research. The V-2s were also extremely complex vehicles and expensive to assemble and operate. Smaller and cheaper missiles were needed. To meet this demand, the Naval Bureau of Ordnance began development of the Aerobee, the workhorse of the sounding rockets, in 1945. That same year, the NRL began work on Viking, which became the foundation for Vanguard, the first satellite launch vehicle. But until the supply was exhausted, V-2s were employed, adapted, and redesigned to meet a broad range of research needs. By attaching a WAC Corporal to the nose of the V-2, a two-stage vehicle, Bumper, was developed to penetrate the Earth's atmosphere and reach outer space. After several failures, on February 24, 1949, a Bumper round flew 244 miles, breaking the altitude record and becoming the first machine to penetrate extraterrestrial space (Burrows 1990:56). Another V-2 subproject, Blossom, explored intact payload recovery to allow biological experiments—which included launching monkeys (the Albert series), mice, and fruit flies—into the upper atmosphere. Only the fruit fly experiment was successfully recovered intact by this Air Force program. The Blossom series, with 11 rounds fired from 1947 to 1951, was an important first step in studying the physiological effects of space flight on living creatures, including primates.

V-2 research rocket being readied for launch, no date (from Sauber private collection).

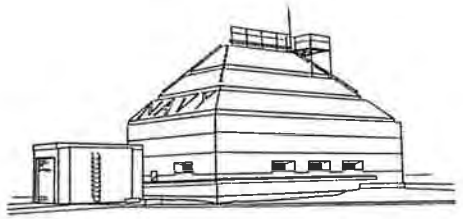


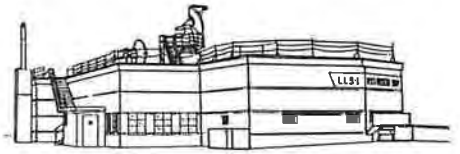
Aerobee 350 launcher at LC-36, 1995.

The Navy entered WSPG in 1946 with a broad vision of their program, building two railed launch towers at what is now LC-35, along with a blockhouse similar to the Army blockhouse at LC-33 to test launch Aerobee. The first fully configured Aerobee, a liquid-propellant sounding rocket, was fired on November 24, 1947. The various configurations of the Aerobee served for almost 40 years of upper-atmospheric testing and more than 650 rounds were fired at WSMR (Powell and Scalla 1994).

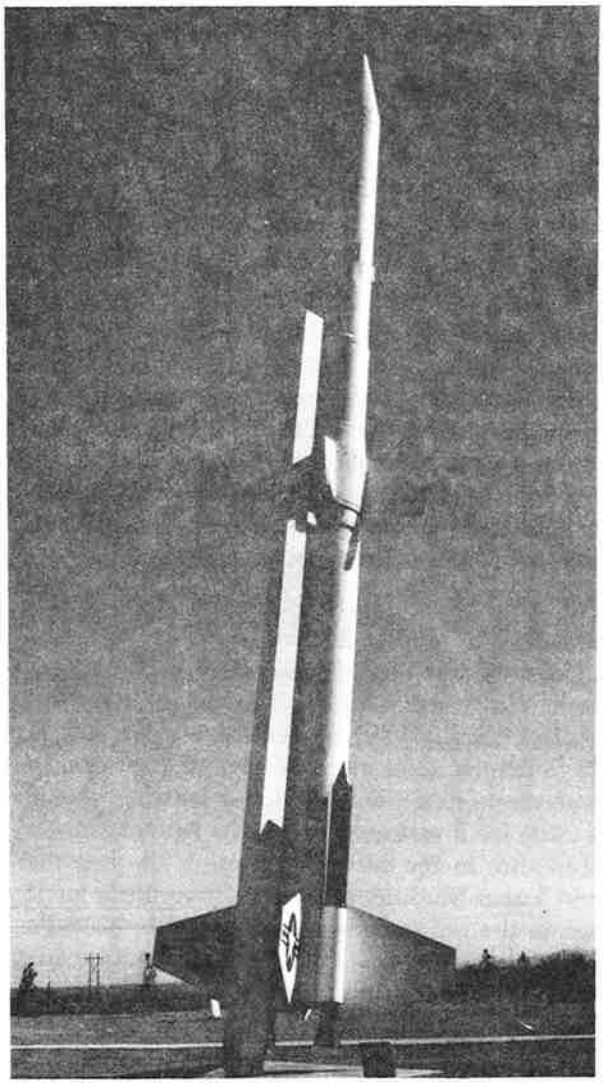
The Navy's Viking sounding rocket, because of its size and the need for a substantial blast deflector, had to be launched from LC-33. Design of the rocket began in 1946, under the Glenn L. Martin Company. Viking was first launched on May 3, 1949. In 1952, an upgraded Viking was moved to LC-35, after the blast-deflector pit had been constructed. In all, 12 Viking rounds were fired at WSPG from 1949 to 1955. The importance of this vehicle as a sounding rocket was somewhat offset by its expense and size and by subsequent, ill-fated events. The Viking became the booster for the Vanguard program, designed to launch America's first satellite during the International Geophysical Year. The first full launch was catastrophically unsuccessful, and the program was canceled (Powell and Scalla 1994).

In 1958, the Navy established a new launch complex 2 miles east of LC-35 to test and develop the Redstone IRBM. Redstone was the first reliable launch platform for America's manned space flight effort, providing a booster for our first manned space flight, Friendship 7. The first lift-off of the Redstone was at LC-36 on June 3, 1958, and a total of 25 Redstone missions used WSMR facilities. In 1963, LC-36 was reconfigured to accommodate the Little Joe II launch vehicle. The 89-foot high, solid-propellant Little Joe II was used to test the Apollo capsule escape system. In the event of a misfire in the Saturn V booster, the capsule would detach from the booster and Lunar Module for reentry. Five Little Joe II rounds were fired from LC-36 before the program was transferred to NASA's Wallops Flight Facility on Wallops Island, Virginia. LC-36 continues to function as a sounding rocket launch facility and is currently used by both the Navy and NASA.





The Navy blockhouse (top) and *U.S.S. Desert Ship* (bottom) at LC-35.



Athena research rocket, 1995.

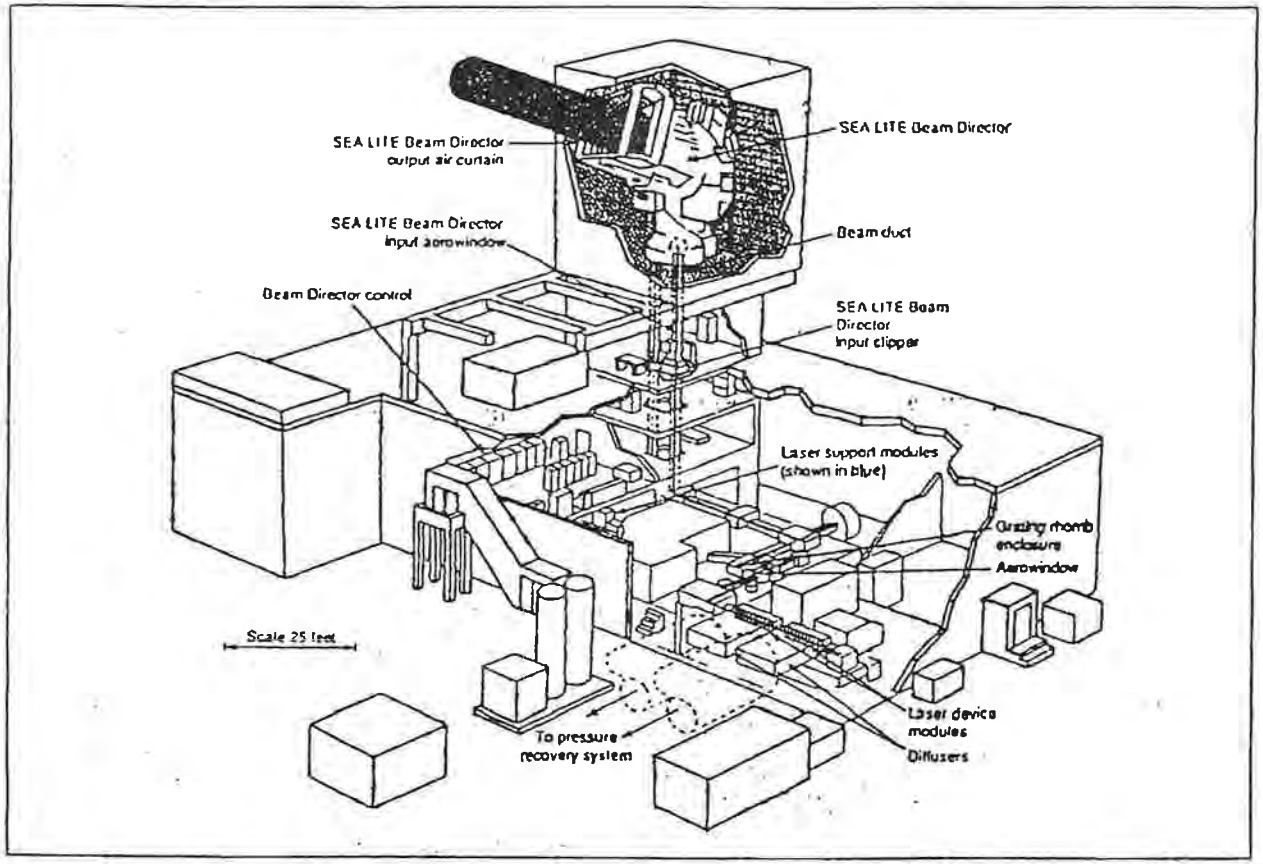
LASERS IN THE DESERT

Since the early 1960s, lasers have taken on an ever-increasing and diversified role in defense systems, ranging from target acquisition and tracking to weapons in orbit around the earth. White Sands Missile Range has played a critical role in developing and testing laser systems for the Army.

The concept of a laser, light amplified by stimulated emission of radiation, can be traced back to Einstein in 1919. The term laser was coined in 1957, and the Department of Defense took an immediate and active interest in early theoretical laser research. In 1960, Gordon Gould and his TRG, Inc., became the first to apply for a grant for laser research from the DoD's Advanced Research Projects agency. Gould asked for $200,000 and was granted $1,000,000. While most laser researchers worked with gaseous mediums, Theodore H. Maiman, supported by the Hughes Research Laboratories, selected a synthetic ruby medium and produced the first working laser in mid-1960. By the end of the year, two other lasers were operational—a solid state, trivalent, uranium ion in calcium fluoride laser and a gaseous, helium-neon laser. Additional lasers followed in 1961, and the first semiconductor diode lasers were introduced in 1962. In 1964, William B. Bridges developed the basis for today's argon ion laser, and the following year the first chemical laser, hydrogen chloride, was demonstrated. Laser research slowed in the 1970s, but new progress was made in the early 1980s in semiconductor lasers, allowing entirely new families of tunable solid-state lasers to be developed (Hecht 1992:14-18).

Military applications for lasers are as diverse as the types of lasers developed. Ruby lasers found application in target ranging, while carbon-dioxide lasers were useful in power output applications such as laser weapons. By 1966, helium-cadmium lasers, because of their short wavelength and moderate power output, were ideal for information-handling systems. The short wavelength of semiconductor diode lasers were useful in military ranging systems and satellite communication. Neodymium lasers were also applied as ranging systems and target designators. The alexandrite-tunable vibronic solid-state lasers are still used in antisensor military laser systems (Hecht 1992).

While research into the military applications of emerging laser technology continued through the early 1970s, these efforts were carried on independently by each service until the summer of 1976, when the House Armed Services



Schematic of the Sea Lite Beam Director (SLBD).

Committee directed the DoD to select a government site for all of the services to conduct laser-system testing. The tri-service site selection committee concluded that WSMR was the best location for the High Energy Laser System Test Facility. HELSTF took on the missions of supporting the test and evaluation of high-energy laser systems and damage and vulnerability tests. HELSTF became operational on September 6, 1985, when the Air Force conducted the first Lethality and Target Hardening (LTH-1) program test as part of the Strategic Defense Initiative.

The first principal user of the new HELSTF was the Navy in the Sea Lite program, a self-defense lethality demonstration project initiated in 1977. This system involved the installation of the Mid-Infra-Red Advanced Chemical Laser (MIRACL), which was first lased, or fired, in September 1980. It remained the most powerful, continuous-wave laser in the free world for at least 13 years (Ferreira and Marcell 1993:107). The MIRACL became the primary source of laser energy for laser research at WSMR. To target the generated laser, WSMR employs the Sea Lite Beam Director (SLBD), which was delivered in 1984. In a 1989 test for the Navy, the MIRACL and SLBD destroyed a Vandal missile moving at a speed of Mach 2.2 on a crossing trajectory, simulating a low-altitude cruise missile flight.. This test demonstrated the value of laser weapons capable of eliminating an attack by antiship missiles. (Ferreira and Marcell 1993).

Today, HELSTF consists of a control center, the MIRACL and SLBD, an effects test area, a mobile test pad, a large vacuum chamber to simulate the environment of near space, and the Air Force's Excimer Raman Shifted Laser Device (EMRLD). The installation continues as one of the nation's premier technical research facilities in laser research.

Adding Texture to the Fabric of History: Collecting Cold War Oral History at WSMR

History based on preserved documents cannot be comprehensive, simply because people do not record everything. Often forgotten, the human element in history consists of the participants' personal experiences and feelings, and the invisible role played by the day-to-day context of recording (or not recording) factual detail. Oral histories focus on these aspects of history, supplementing the historical record and adding emotional texture to the dry fabric of purely factual history.

Charles A. Brink, WSPG pioneer from August of 1945 through May 1973. Interviewed on May 28, 1996.

I'LL TELL IT WAS A JOB PUTTING IN THE RANGE ROAD...

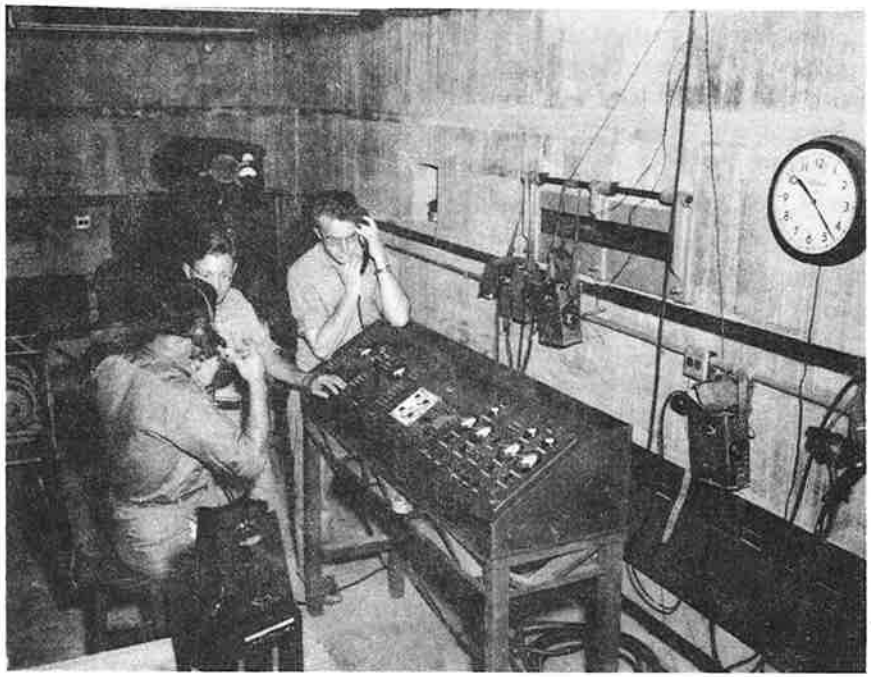
Of course there was an old wagon trail or road that the ranchers could use to get up to Luceros' and Baird's place but the road we put in out through there, we put it straight through. Originally we had thought if we go straight through Lake Lucero and then all the roads going to the site stations would come off of this central road and the central base line but I saw too many weeds, I saw too much Lake Lucero – we could get stuck in that pretty easy, especially after a rain or something like that – so we decided, Herb and I decided the thing to do was to go up on the west side. We camped out most of the time on the survey up there after we got past Lucero, and boy it was dusty and dirty and the road was the same way. After we got that road staked out, and we got heavy equipment, a bulldozer, and a bulldozer operator – and one of the GIs volunteered to go up there with us. He was to clear out the brush after we had made the survey through there. He cleared out the brush all right – when the bulldozer would go off, he would drop the blade down and when the blade was way down he raised it up. After a couple of days, I asked this guy, "why in the hell don't you keep that blade in a position so that this road your are clearing out here won't be washboard?" And I said how long you been operating a bulldozer? He said this is the first time I ever drove one and I said why did you come up here and he said I was just so damn glad to get away from that Army I volunteered to do this. Well he finally got so he could do pretty good and then he turned around and dropped the blade and back up and kinda smooth it. But the first road cleared and the traffic over it, I mean the dust was terrible. Sometimes you could hardly recognize a person after he had been up range all, he would be so dusty and dirty, and we camped out there for several weeks surveying that road, getting it laid out.

> Orally-communicated history—that vividly detailed information that is brought to light when people speak from memory of times past—is increasingly recognized as a valuable research tool. As the historian investigates his subject and moves from the documentary to the physical evidence, he still may be faced with gaps in the record. It is at this time that oral history—the living memory of the past—becomes important and useful. [Butowsky 1996:14]

Documenting WSPG's Cold War oral history is particularly enlightening because of its technical nature. Histories are abstractions from historical events, and those derived from technical documentation lack virtually any human dimension. This dimension can only be recovered from individual memories.

The recollections of Marvin Squires (interviewed on May 9, 1996) provide an excellent example. Squires, who as a young student assigned to the WSA-BRL, witnessed the first firing of a Redstone motor at the 500-K static test stand, described the tension and anxiety in the observation house as the countdown proceeded. When the motor successfully ignited, the observation house burst into a roar of applause and back-slapping. As a visitor, Squires realized that he was witnessing history in the making, but he never imagined that this event would lead to the launch of manned spacecraft and, ultimately, to the moon. Historically, this event was reduced from a mountain of printout and test results to a single line in a test- program round history. Oral history can and does enliven history.

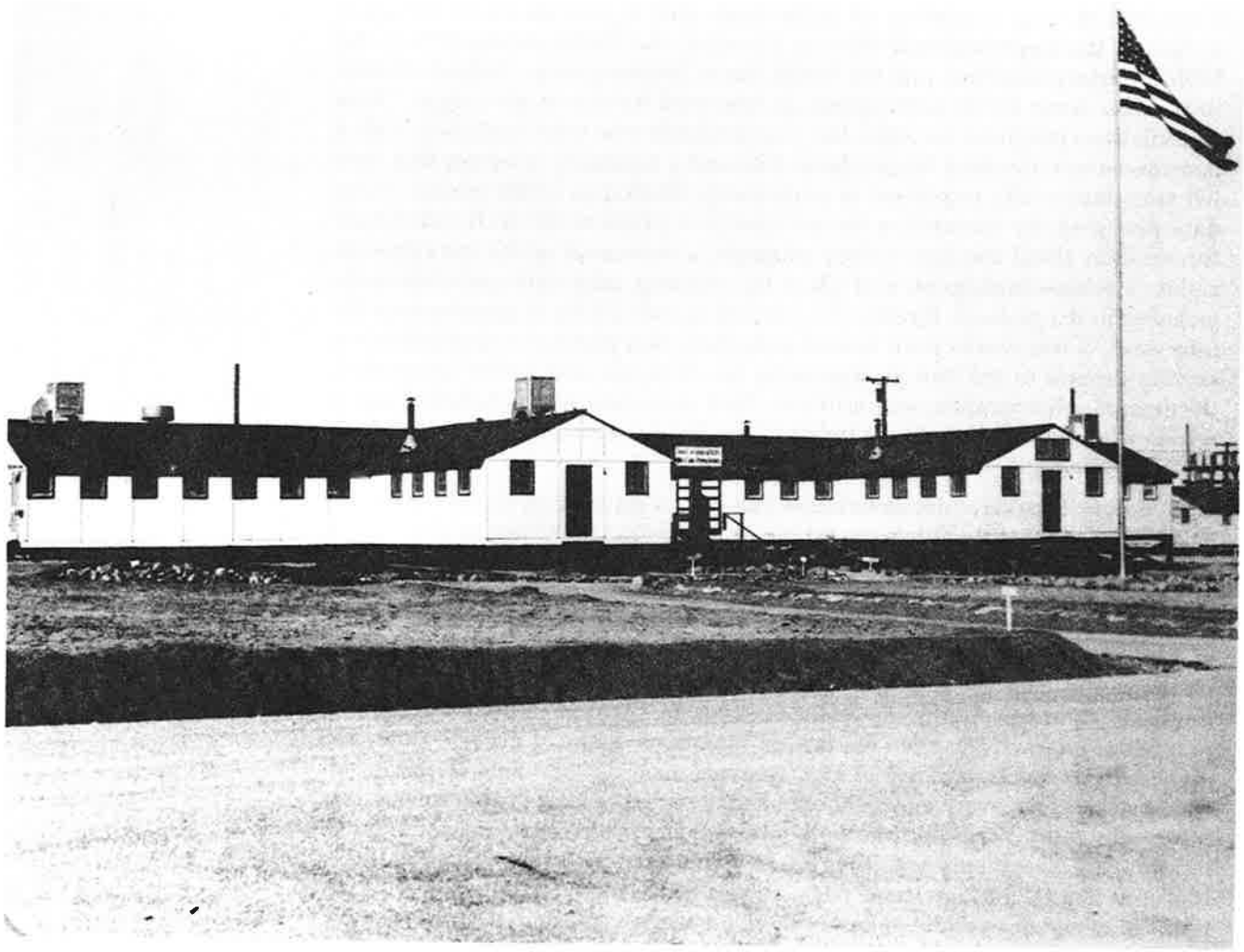
At present, the WSPG Cold War Oral History Program is in its infancy. This first phase was devoted to developing and demonstrating the program through a limited number of oral interviews. A formal plan is essential to operationalize an effective oral history program. Identifying critical interviewees, defining an interview protocol, and planning for the disposition of the materials for future use as research and interpretive materials must be clearly laid out. As time progresses, fewer and fewer people remember firsthand the early historic events at WSPG. Most of them are in their 70s and 80s. If an active oral history program is not implemented now, the human face of history will be lost forever.



Rare photo of Army blockhouse interior at LC-33, circa 1946 (from Sauber private collection).

Consultation with a number of individuals and organizations at WSMR—including the Environmental Services Division, the Public Affairs Office, the WSMR History Museum, and the White Sands Pioneer group—helped identify those who were active participants in historical events at the range. These consultations produced an initial list of individuals who were contacted, with a questionnaire requesting biographical data and a summary of events that they felt were historically important or particularly illustrative of the period. These data provided the foundation for an interview protocol for each individual. Information about the oral history program, a statement of the interviewees rights, a release statement, and plans for curating interview materials were included in the protocol. Finally, the protocol included a set of questions for the interview. A few weeks prior to each interview, this protocol was provided to each informant to aid him in organizing his thoughts and gather supporting documents, photographs, and artifacts. Each interview was scheduled and a setting was selected that met the technical conditions necessary for a successfully recorded interview.

Oral history interview documentation can take a number of forms, although audio tape remains the fundamental medium. Audio recordings are limited to verbal communication. Video documentation can supplement audio by recording nonverbal forms of communication and should be employed when possible. For this study, we employed Super-VHS as the video documentation medium, as well as standard audio cassette. When supporting documentation, photographs, and artifacts are made available, action should be taken to duplicate or inventory the materials and objects. Current technology offers a number of alternatives. Even the best of intentions, loans of historic materials carry with them a certain risk of loss. To avoid even the least anxiety produced by the risk of loss, every effort should be made to reproduce the material at the interview site. Portable photocopiers have proven very successful at reproducing documents and, to a lesser degree, photographs. Cameras (both film and digital formats) and copy stands are somewhat bulky, but often produce acceptable results in the duplication of photographs. Artifacts may be objects eligible to the National Register of Historic Places. These may be photographed at the interview site, and discussions may be initiated as to the ultimate curation in an archival/museum repository of the very important ones.



WSPG Post, first Headquarters, no date.

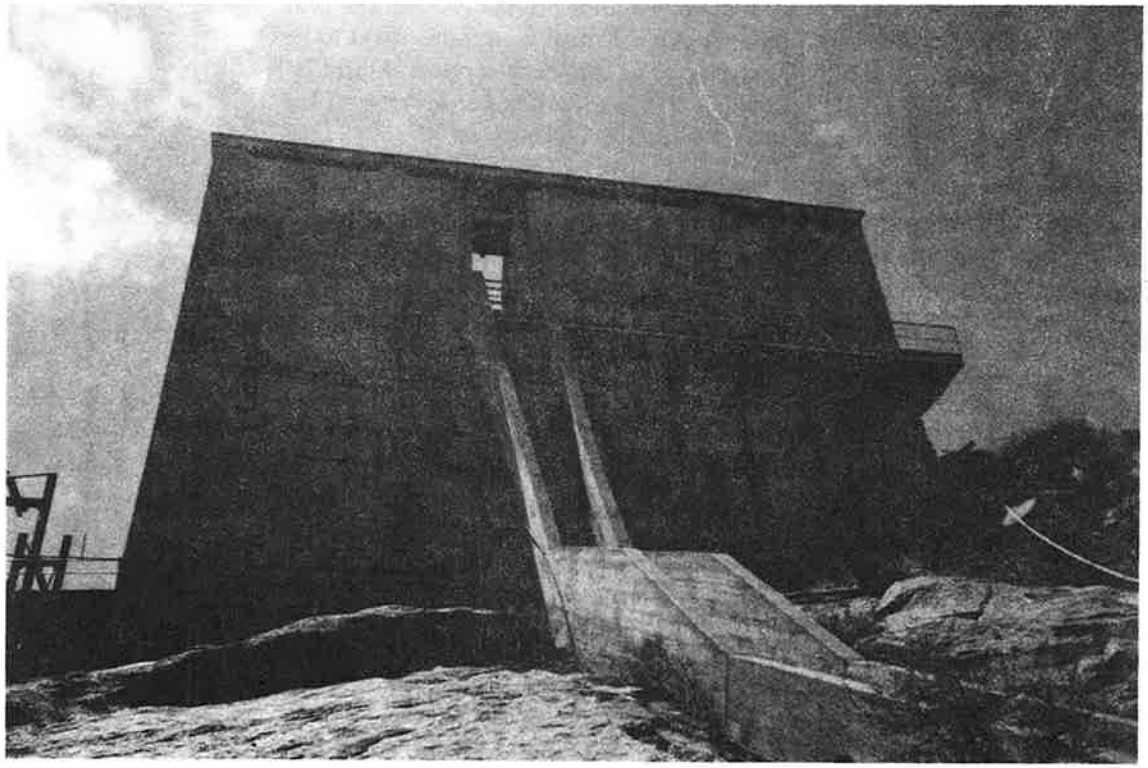
Upon completion of each interview, the labor-intensive process of transcribing the audio recordings and editing the transcripts begins. Once the tapes are initially transcribed, the editing process becomes a joint effort between the oral historian and the interviewee. Proper names, place names, and dates need to be verified with the interviewee, and final approval of the transcription should be secured from the informant. Ideally, a subject index should be developed for each transcript to make information more accessible to researchers.

Once completed, the oral history efforts will produce a compendium of eye-witness accounts of WSMR's role in the Cold War. This will not be merely a listing of historical fact, but an added dimension gained from the experience, emotions, and interpretation of the observers.

Early Cold War Public Education Outreach

The early history of WSMR and its role in the Cold War developed in this study provides the basis for public-education efforts for the range and local educational institutions. This publication is one of three projects supporting these education efforts. The two additional items include a 30-page booklet containing the early history of White Sands Missile Range from 1941–1945, drawn directly from the text and Appendix A of this report, and an early Cold War lesson plan designed for use by middle school grades.

All three outreach products are intended to enhance the appreciation of regional and military history in WSMR's local communities. Additionally, they provide the basis for making connections between people and the historic places that have shaped their lives and affected the social and economic structure of their communities. The WSMR history booklet and the lesson plan are complementary. The former provides a 25-year overview of range history, beginning with formation of the Alamogordo Bombing and Gunnery Range and Alamogordo Army Air Field. The lesson plan concentrates on the historic missile testing facilities at the first Army Launch Area, now known as Launch Complex 33, and its instrumentation support. LC-33 was the site of the first captured German V-2 rocket firings, as well as the first three Army Office of the Chief of Ordnance missile development programs: Hermes, ORDCIT, and Nike.



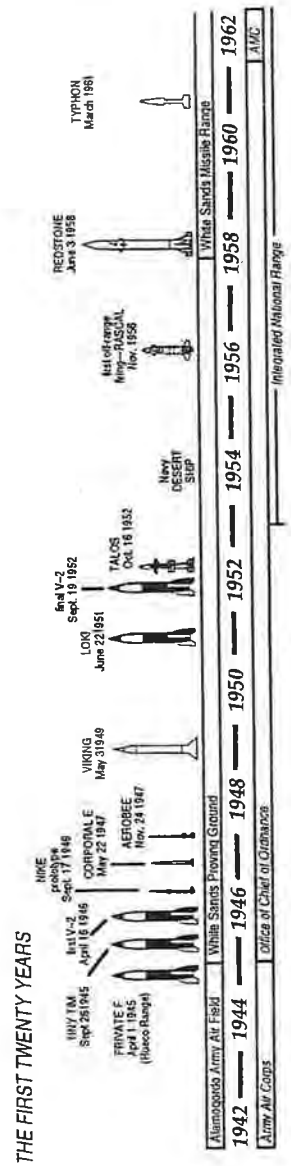
The 500-K Test Stand, 1995.

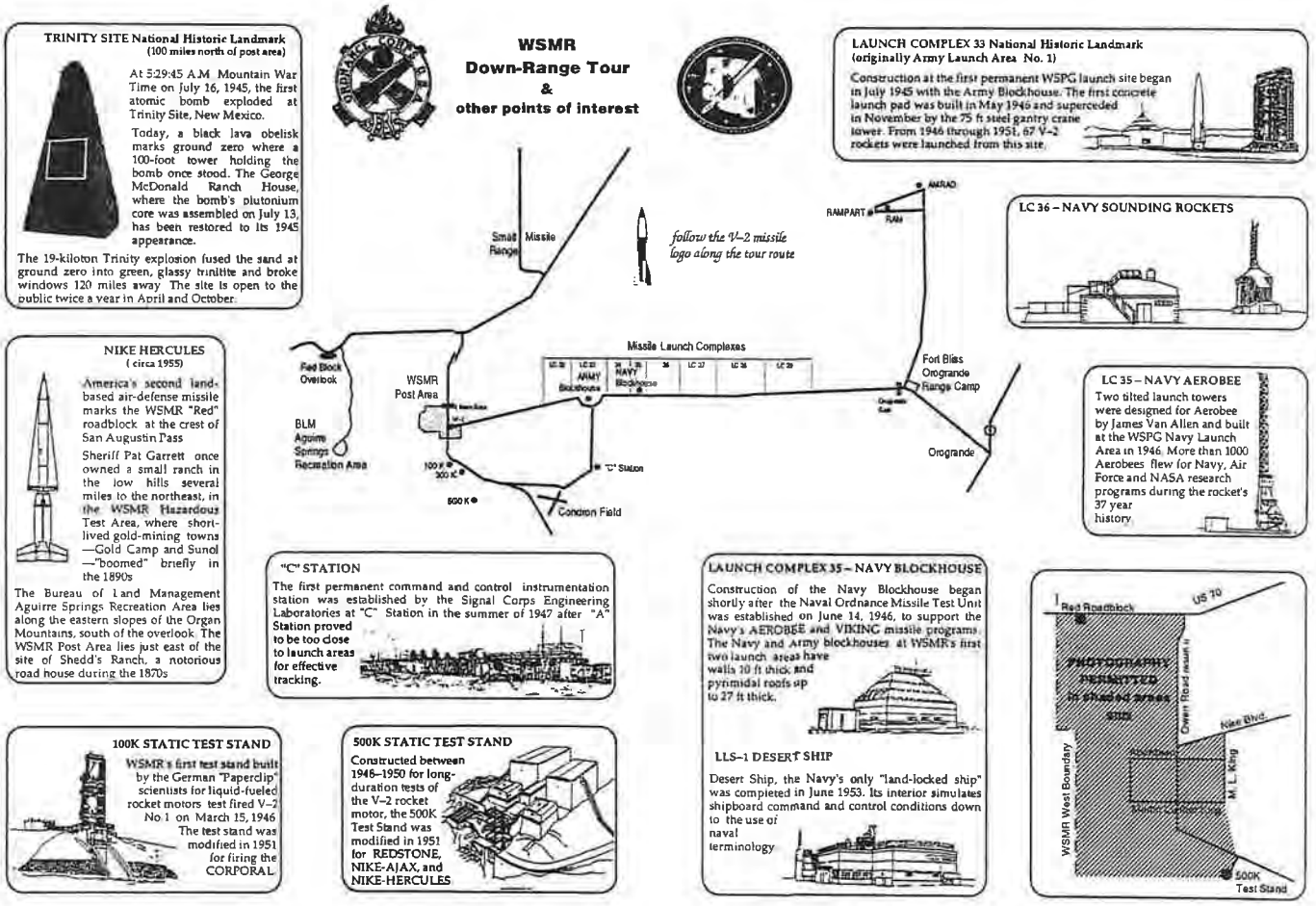
This lesson plan is one of several being prepared for WSMR under the series title *LESSONS FROM THE PAST – Historic Places on White Sands Missile Range*. The first lesson plan focuses on the earliest beginnings of America's space and missile program at the new Proving Ground and is entitled, *Arrival of the Star Throwers*. The plan is based on Teaching With Historic Places, a lesson format developed by the National Trust for Historic Preservation and the National Park Service.

The lesson plan presents a brief introduction to the region, a capsule history of early WSMR from 1941 to 1946, maps and a description of Army Launch Area 1 (LC-33) and the V-2 missile program, a description of the early instrumentation array that used captured German Askania cameras, illustrations of various V-2 and Hermes missiles, and several readings. The readings include Loren Eiseley's poem *Arrowhead*, an unclassified Secret document concerning the arrest of the Askania's manufacturers for trafficking with the Soviets in occupied Berlin just after the Armistice, and the text of an actual launch briefing and countdown. Suggested activities include a simple ballistics experiment, a chemistry exercise, and a tracking exercise. The lesson plan can be used by itself in the classroom or as a supplement for a site visit to LC-33.

Much of the Cold War history of WSMR is best seen from its unique set of properties, some of which are presented in this manuscript. But seeing these properties in this format does not compare with being there to see the massive, almost monumental architecture of the 500-K Test Stand, the simple yet unique monolithic impact of the Army and Navy blockhouses, or the vastness of the Tularosa Basin landscape dotted by isolate instrumentation sites. The opportunity of the public to appreciate the Cold War heritage of WSMR is limited. For the public to gain a better understanding and appreciation of the Cold War and WSMR's role, greater access to its historic facilities is necessary. Part of this project involved the development of a self-guided tour through the cantonment, static test stand area, and Army, Navy, and NASA launch complexes.

These DoD Legacy products are intended to promote preserving the past and enhance the public's opportunity to appreciate WSMR's Cold War heritage beyond the arms race and consider the technological achievements leading to landing Man on the moon; lessons for all.





WSMR driving tour brochure design.

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APPENDICES:

APPENDIX A: HISTORIC TIMELINE FOR WSPG/WSMR, 1941-1965

APPENDIX B: PROGRAM ROUND SUMMARIES

24 YEAR HISTORICAL TIMELINE
White Sands Proving Ground (WSPG),
also known as White Sands Missile Range (WSMR),
after 1958

1941
- – Alamogordo Bombing and Gunnery Range established.
- April 13 – Alamogordo Army Air Field established.
- June 20 – U.S. Army Air Corps (USAAC) renamed U.S. Army Air Force.
- September – Robert Goddard received his first military contract with Navy Bureau of Ordnance and Army Air Corps.
- October – ranchers on proposed bombing range ordered to dispose of livestock.
- December – stockmen in 55 townships in 4 counties notified that grazing leases were canceled and stock must be removed.

1942
- February 6 – construction began at Alamogordo Army Air Field (AAAF).
- February 15 – deadline for removal of livestock from bombing range.
- March 10 – Johns Hopkins University Applied Physics Laboratory (APL) founded.
- June – Manhattan Project transferred to U.S. Army under command of Major General Leslie Groves.
- July – Robert Goddard's rocket research group moved from Roswell, NM, to Naval Engineering Experiment Station, Annapolis, MD.
- October 3 – first successful launch of an ***A-4*** (V-2) at Peenemünde for the German Army.
- December – first successful test of the ***V-1*** at Peenemünde flies 3,000 yards.

1943
- – AAAF first considered as guided missile development site.
- August – GALCIT report by von Karman, Malina, and Hsue-shen Tsien recommended United States begin development of long-range ballistic missiles.
- August – Luftwaffe began air attacks with ***Fritz X*** ASM on Allied combat ships off Italy.
- September – Rocketry Branch, U.S. Army Ordnance Corps established.
- September 9 – Luftwaffe used ***Fritz X*** to sink battleship *Roma* and severely damaged *Italia* in the Strait of Bonifacio.
- November – Frank J. Malina (GALCIT) examined captured V-1 and V-2 launch facilities in France.

1944

- —Two crashed V-2 missiles recovered by Allies in Poland and Sweden.
- May—search began for a location to test the Manhattan Project's atomic bomb.
- May (or June 22)—Army Air Corps contracted with Guggenheim Aeronautical Lab, California Institute of Technology, for ORDCIT project to "develop long-range guided missiles and associated equipment" leading to the ***Private*** missile.
- June 13—the first ***V-1*** Buzz Bombs began to strike London.
- August 4—first radio-controlled ***Aphrodite*** drone aircraft delivered 20,000 pounds of TNT against rocket launch sites in Pas de Calais.
- Fall—selection began for establishing a guided missile test range under Major General G.M. Barnes.
- November—Trinity test site construction began.
- November 20—OCO contracted with General Electric for Hermes Project.
- December 1-16—first firings of 24 ***Private A*** missiles at Camp Irwin, CA.

1945

- —Dept. of the Navy initiated ***Bumblebee*** Project within Johns-Hopkins Applied Physics Laboratory.
- February 8—OCO directive to acquire lands for ORDCIT Range, Area 3 issued (COE Real Estate Directive 4279).
- February 19—last German firing of a ***V-2*** in Europe.
- February 20—White Sands Proving Ground (WSPG) site approved by Secretary of War.
- April-May—original camp layouts for WSPG prepared in Washington, D.C.
- April 1—first ***Private F*** missile fired from Hueco Range, Fort Bliss, TX.
- April 1-13—a total of 17 ***Private F*** missiles fired from Hueco Range, Fort Bliss.
- May 2—Wernher von Braun and his team surrendered to American forces at Oberjoch.
- May 22—first train of captured V-2 parts enroute to Antwerp and the United States.
- May 23—Eisenhower recommended recovery of Wasserfall missile materiel.
- June 11—OCO contracted with RCA for ***Seacoast*** Missile Project to investigate the use of shore station missiles against enemy ships at ranges up to 200 mi.
- June 12—WSPG preliminary plans review submitted by Albuquerque Corps of Engineers.
- June 25—first actual construction (drilling water wells) began at WSPG.
- June 29—actual camp construction (reerection of Sandia buildings) initiated.
- June 30—evacuation of Peenemünde personnel to United States approved.
- July 4—scheduled construction began at WSPG.
- July 9—WSPG officially established.
- July 10—beginning of construction of the Army Blockhouse, LC-33.
- July 13—actual order activating WSPG (effective 9 July) issued.
- July 16—5:29:45 a.m., Mountain War Time—ignition of the first atomic event at Trinity.
- July 19—Operation Overcast, forerunner of Paperclip, established to exploit German civilian scientists.

- late July—300 freight-car loads of V-2 components enroute to WSPG.
- August 6—Atomic explosion at Hiroshima, Japan.
- August 9—Atomic explosion at Nagasaki, Japan.
- August 10—death of Robert H. Goddard.
- August 10—163 officers and enlisted, 9393rd Technical Service Unit, arrived at WSPG, followed later by 4119th Area Service Unit.
- August 10—"C" Battery, 69th Antiaircraft Artillery Battalion, assigned to WSPG.
- mid-August—300 freight cars of V-2 parts arrived at WSPG.
- September—Army Blockhouse at LC-33 completed.
- September 1—4845th Service Command Unit, attached to 1852nd SCU, Fort Bliss, activated.
- September 26—first ***Tiny Tim*** booster fired at LC-33.
- October 11—first full ***WAC Corporal*** (round no. 5) reached 235,000 ft.
- October 11—First Guided Missile Battalion constituted and stationed at WSPG.
- October 26—contracts awarded for building 100-K static test stand.
- October 30—Chief of Ordnance invited Navy to participate in missile testing at WSPG.
- November—GE employees began to identify, sort, and reassemble captured V-2 components.

1946

- —Ordnance Research and Development Division Suboffice (Rocket) established at Fort Bliss, TX.
- —Amador Hotel agreement between Lewis Del Sasso, Ballistic Research Laboratory, and George Gardiner, New Mexico College of Agriculture and Mechanic Arts, leading to creation of NMSU Physical Science Laboratory.
- January—contracts awarded for modifications of firing facilities and gantry crane.
- January 16—V-2 Upper Atmosphere Research Panel formed.
- February—AAAF placed on stand-by basis following completion of wartime training mission.
- March—White Sands Annex-Ballistic Research Lab established.
- March 5—Churchill's Iron Curtain speech marked the beginning of the Cold War.
- March 15—***V-2*** no. 1 static test fired at 100-K Test Stand.
- March 16—Operation Overcast officially renamed Paperclip.
- March 21—Strategic Air Command created.
- March 21—Air Materiel Command contracted with Bell for development of the ***Rascal***.
- April 2—Signal Corps Engineering Laboratories personnel dispatched from Ft. Monmouth to establish SCEL Field Station No. 1, WSPG.
- April 10—AAAF reactivated; assigned to support V-2 project at WSPG.
- April 16—unsuccessful launch of first ***V-2*** fired in United States.
- April 22—Air Force contracted with Consolidated Vultee for Project MX-774 ***Hi Roc***, leading to Atlas.
- May 10—first successful American ***V-2*** launch reached 70 mi.
- May 15—BRL contracted with New Mexico College of Agriculture and Mechanic Arts for reduction of ballistic camera data.
- May 17—USN Bureau of Ordnance contracted with Aerojet to design and produce the first 20 XASR-1 ***Aerobee*** sounding rockets.

- June 14—U.S. Naval Ordnance Missile Test Facility (USNOMTF) established at WSPG.
- July—USN Bureau of Ordnance began construction of Navy cantonment area at WSPG.
- September—Board of Regents established Laboratory of Applied Sciences (later PSL).
- September 17—Bell ***Nike*** prototype static test fired at LC-33.
- October—first group of German scientists arrived at WSPG and were billeted in Building H.
- October 8—first successful flight of Bell ***Nike-Ajax*** no. 1 reached altitude of 28 mi.
- October 24—first motion pictures of earth from 65 mi into space taken from ***V-2*** no. 13.
- November—LC-33 gantry tower completed.
- December 17—first American night flight of ***V-2*** (no. 17).

1947

- —construction of first duplex family housing.
- January 21—Air Force Weather Service established Type-I Weather Station at WSPG.
- February 20—USAF ***Blossom*** I (V-2 no. 20; carrying fruit flies) successfully fired and parachute recovered.
- February 24—***WAC "B" Corporal*** (no. 17) reached record altitude of 240,000 ft.
- March—Manhattan Project transferred to the new Atomic Energy Commission.
- March 16—Air Materiel Command moved Wendover guided missile program to AAAF.
- May—construction began on Navy Aerobee Towers A & B at LC-35.
- May 15—V-2 no. 26 developed steering trouble and impacted near Alamogordo.
- May 22—first successful flight of Douglas ***Corporal E***, from LC-33, the first American designed, engineered, and fabricated surface-to-surface missile, reached 129,000 ft, impacting 62.5 mi downrange, within 2 mi of target.
- May 29—first successful flight of two-stage ***Hermes II*** (no. 0) ramjet missile, which landed near Juarez, Mexico.
- June 20—Project Bumper approved by OCO.
- July 26—National Security Act created Department of Defense with three branches, including U.S. Air Force.
- July 28—Lt. Col. Harold Turner, Commander, WSPG, and Col. Paul Helmick, AAAF, signed operating agreement for the New Mexico Guided Missiles Range.
- August—52 co-use and full-use agreements for ORDCIT range completed with landowners.
- November—first study of northern Range expansion by Albuquerque Corps of Engineers.
- November 24—first live ***Aerobee*** (no. A-4) launched at LC-35.
- December—plans for ***Loki*** antiaircraft rocket approved.

1948

- February 6—*V-2* no. 36 completed first successful electronically controlled rocket flight.
- May 13—first launch of large, two-stage rocket, ***Bumper-WAC***.
- June 11—USAF ***Blossom*** III (V-2 no. 37), carrying rhesus monkey Albert I, failed to reach recovery altitude.
- June 18—first firing of *V-2* carrying AeroMedical Lab biological experiment.
- July 13—first USAF Consolidated Vultee MX-774 (pre-ATLAS) ***Hi-Roc*** launch, at LC-33.
- September 16—WSPG designated as a permanent Class II activity.
- September 18—ceremony changing name of AAAF to Holloman Air Force Base.
- December—first live ***Firebird*** launch at HAFB.
- December 29—Sec. of Def. James Forrestal announced U.S. earth-satellite program.

1949

- —natural gas distribution system installed by El Paso Natural Gas Co.
- January 3—first successful ***Hermes*** B-1 (no. 1) launch.
- January 4—9577th TSU activated at Ft. Bliss to supplement SCEL at WSPG.
- January 7—Brig. Gen. Phillip Blackmore, Commander, WSPG, established Joint Range Coordination Committee.
- February 24—***Bumper*** 5, mating a WAC Corporal with a V-2, successfully penetrated outer space, reaching 250 mi altitude and a speed of 5,150 mph.
- March 3—co-use and full-use agreements terminated by joint Army and Air Force military directive ordering exclusive control acquisition.
- March 9—USAF operational control of Condron Field, WSPG transferred from Biggs AAF to HAFB.
- May 3—first successful live launch of Navy Martin ***Viking*** (originally Neptune), at LC-33.
- October 25-26—169th Signal Construction Company moved from Camp Gordon, GA, to WSPG.
- December 2—first Holloman launch of X-8 ***Aerobee***.

1950

- —Army Ordnance Missile Center established in Huntsville, AL.
- April—NSC 68 postulated a Soviet "design for world domination" and called for nuclear and conventional arms build-up.
- May 19—first unsuccessful launch of ***Hermes A-1*** (based on Wasserfall antiaircraft missile).
- June 15—the first HAFB 3,550 foot High Speed Test Track completed.
- June 25—North Korean troops invaded South Korea.
- July 29—***Bumper*** 7 attained Mach 9, highest sustained speed ever reached in earth's atmosphere.
- November—German Paperclip scientists transferred to Army Ordnance Missile Center in Huntsville, AL.
- November 21—Navy ***Viking*** V set single-stage altitude record of 107 miles.

1951

- January—Post Administration Building, No. 100, completed.
- March 29—first nation-wide broadcast of a missile launch (***Aerobee***) from HAFB.
- June 22—first firing of Bendix ***Loki*** antiaircraft missile (based on German Taifun) at SMR.
- June 29—first firing of ***Honest John*** missile.
- August—Navy ***Viking*** set another single-stage altitude record of 135 miles.
- November—free world's first antiaircraft interception by a ***Nike-Ajax*** destroyed a B-17 drone.

1952

- February 15—effective date for agreement between Aberdeen Proving Ground and WSPG transferring instrumentation responsibilities on-range from Ballistics Research Laboratory to WSMR Flight Determination Laboratory.
- May 21—Public Land Order 833 withdrew public lands for military purposes.
- July—Brig. Gen. G.G. Eddy, commander, WSPG, and Dr. J.W. Branson initiated New Mexico College of Agriculture and Mechanic Arts Student Cooperative Program.
- August—first launch of Type 1 tactical ***Corporal***, at LC-33.
- August 1—construction of 235 Wherry Housing units began.
- August 19—Sec. of Def. transferred control of 167,974 acres of Fort Bliss Range to WSPG and established WSPG as a permanent Class IV activity under the Chief of Ordnance.
- September 1—Holloman and White Sands ranges consolidated.
- September 19—73rd and final ***V-2*** fired at WSPG.
- September 22—General Order No. 30, "Plan for the Operation of the Integrated Range," issued by Commanding General, WSPG.
- October—Detachment 3, 9393rd Technical Services Unit (now U.S. Army Garrison, WSPG) assigned to Holloman to provide missile recovery services to range users.
- October 16—first Navy ***Talos*** fired at WSPG.

1953

- —Schellenger Research Laboratories founded at Texas Western College (later UTEP).
- June—U.S. Navy LLS-1 Desert Ship facility completed.
- June 13—first successful ***Hermes*** A-3A (no. 2) launch.
- July 1—WSPG assumed maintenance and operation responsibility for all integrated range instrumentation sites.
- August—first successful ground launch of ***Lacrosse*** missile.
- October 6—final clarification of WSPG-Ft. Bliss boundary by letter from Dept. of Army, Office of Adjutant General to Commanding General, Fourth Army.

1954

- —WSPG survey of possible range extension areas and flight lines up to 2,000 miles long into Alaska.
- March 19—Lt. Col. John Paul Stapp reached a top speed of 615 fps on the first human rocket sled test at the High Speed Test Track, HAFB.
- May 11—first launch of ***Hermes*** A-3B (no. 1) under radar guidance.
- May 24—Navy ***Viking*** no. 11 set new single-stage altitude record of 158 mi.

1955

- —numerous plans for range extensions of 100-, 140-, and 200-nautical-mile corridors and impact areas.
- January 13—first ***Nike-Hercules*** firing.
- February—***Dart*** (#20) missile successfully guided to stationary target.
- March—first on-range USAF ***Matador*** firing.
- June—first nation-wide Civil Defense exercise.
- August—first firing of the ***Hawk*** missile.
- December 20—Acting Commander, WSPG, proposed acquisition of 216-sq-mi northern range extension.

1956

- January—first firing of ***Sergeant*** missile.
- January 26—Joint-Use Tenancy Agreement between Holloman Air Development Center and WSPG.
- February 1—U.S. Army Ballistic Missile Agency established at Huntsville Arsenal.
- February 20—OCO recommended 250- and 1,500-mi impact areas for WSPG.
- June—detailed plan for 250-, 500-, 750-, 925-, and 1,500-mi flight corridors and impact areas.
- July 28—first successful ***Little John*** launch from Army Launch Area 1 (LC-33).
- November 26—Secretary of Defense limited Army missile development to ranges less than 200 mi.
- November—first intentional off-range test firing overflight—a ***Rascal***, air launched 7 mi southwest of Orogrande onto WSPG.
- December 12—Navy (on behalf of USAF) contracted with RCA for land-based Talos Defense Unit.

1957

- April 30—Navy ***Aerobee-Hi*** set new altitude record of 190 mi.
- August—Russia announced its first successful ICBM launch
- September 25—first long-range off-range ***Matador*** flight impacted at inactive Wendover Bombing Range.
- October 4—Russians achieved earth orbit with Sputnik 1.
- November 20 - first Army firing of ***Talos*** from a land base.
- December—first U.S. ***Atlas*** ICBM launch.
- December—Gaither Report to NSC concluded Soviet ICBM superiority.
- December 13—successful launch of ***Talos*** controlled by Talos Defense Unit.

1958

- —Navy constructed Army Launch Area 3 (LC-36).
- January—WSMR Flight Determination Laboratory renamed Integrated Range Mission.
- January 29—America achieved earth orbit with ***Explorer 1***.
- February 6—USAF ***Mace*** firing along Wendover corridor was first inertial guidance missile flight over a populated area in the United States.
- May 1—WSPG renamed White Sands Missile Range.
- June 3—first ***Redstone*** launched from ALA 3 (LC-36).
- July 29—NASA established by President Eisenhower.

1959

- April—OCO Legislative Liaison Plan and Public Relations Plan for Northern Extension forwarded to WSMR.
- August 25—operational responsibility for Rocket Research Facility, Ft. Churchill, Manitoba, Canada, assigned to Commanding General, WSMR.
- August 25—Acting Secretary of the Army approved Northern Extension Plan.
- December 16—first ***Nike-Zeus*** successfully test fired at WSMR.

1960

- —***Nike-Hercules*** intercepted ***Corporal*** missile over WSMR.
- January 1—all co-use agreements completed and Northern Extension (FIX Area) established.
- March—***Mercury*** astronauts began weightlessness training aboard a C-131 over the range.
- May 16—Commander, Army Ordnance Missile Command, requested WSMR to consider off-range launch of ***Redstone***; Fort Wingate proposed.

1961

- February 13—proposed off-range launch of ***Redstone*** from Fort Wingate denied.
- March—first ***Typhon*** integrated weapon system missile fired at WSMR.

1962

- May—Office of the Chief of Ordnance discontinued; transferred to U.S. Army Materiel Command.
- September—Air Force Green River Launch site for ***Athena*** component of ABRES (Advanced Ballistic Re-entry Systems Program) approved.
- October—WSMR Integrated Range Mission renamed Range Operation Directorate.
- October 11—first completely successful Air Force ***Hound Dog*** firing.
- October 30—first off-range Air Force ***Hound Dog*** firing from Del Rio launch area crashed into Guadalupe Peak.
- December 28—Sacramento District Corps of Engineers began Green River land acquisition.

1963

- —***Nike X*** program authorized.
- —***Sprint*** SAM development contract awarded to Martin Marietta.
- —***Pershing*** began off-range testing at Fort Wingate.

1964

- —***Athena*** program began testing with WSMR support.
- —Multifunction Array Radar (MAR) system for ***Nike X*** program began tests.
- —***Nike-Hercules*** program moved into tactical and scientific applications development phase.

1965

- March—***Lance*** missile firings began.
- June—SAC completed deactivation of first generation ICBMs ***Atlas*** and ***Titan***.

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APPENDIX B:

PROGRAM ROUND SUMMARY

Appendix B:

WSPG/WSMR Round Summary

SYSTEM	AGENCY	'WSMR 1st Fire YYMMDD	Year 45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
ASP	?	560204												5									5
B-26	?	600200																5					10
B-47	?	600100																4					9
B-57	?	600100																9					13
BEECH	?	600915																20					29
COMET	?	600810																1					21
DRACO	?	600300																1					2
DRUMSTICK	?	601004																1					2
F-104	?	600400																6					5
FAREWELL	?	600700																1					7
GLRP-76	?	600400																1					2
HI-FLY 208A	?	560120												2									3
HIVAR	?	600100																4					6
IRM CHECK	?	600800																2					6
PANCHO	?	601005																1					3
PARAHOT	?	600300																7					8
POPSICLE	?	600727																1					8
QF-80	?	600100																23					24
ROCKAIR 2710	?	561214												4									27
STARBURST	?	601206																1					5
TASAS	?	601201																1					2
XTA	?	561221												1									2
AEROBEE	NASA	630700																			4		5
GEMINI	NASA	640400																				1	5
LITTLE JOE II	NASA	640500																				3	4
PEP-AEROSHELL	NASA	720000																					3
SATURN I	NASA	640500																				2	2
4150	USA	590500															11						13
AEROBEE	USA	481209				1	5	7	5	6	4												39
AORS	USA	580100														49	58						135
ARCAS	USA	600718																49	43	98	54	71	422
BANSHEE	USA	620700																		7	9		331
BMTS	USA	640800																				5	21
CHEROKEE, OPERATION	USA	591200															1						6
COPPERHEAD	USA	720000																					1
CORPORAL	USA	470522			3		1	2	6	26	39	50	71	80	72	97	40	31	24	31	17		590
DART	USA	540824										15	32	32	34	62							765
DASA HAR	USA	640300																				7	182

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
DEMI JOHN	USA	531023									6		3										16
DM-15	USA	580900														7							16
DRONE USD5	USA	590500															3						10
FATHER JOHN	USA	530115									5							34					42
FIRETRACK	USA	590600															8						47
GLMX-21	USA	590800															32	4					44
HAR	USA	641000																				6	42
HAT	USA	640600																				6	12
HAWK	USA	550816											5	21	21	48	209	50	27	54	55	33	529
HERMES A-1	USA	500519						2	3		6												534
HERMES A-3A	USA	530313									6	1											18
HERMES A-3B	USA	540511										6											13
HERMES II	USA	470529			1	0	2	1															10
HIBEX	USA	650000																					4
HIGHBALL	USA	600100															7	6					13
HONEST JOHN	USA	510629							15	63	112	152	160	133	117	130	57	37	40	116	109	18	1272
HV	USA	590200															4						1263
JATO	USA	500511						2															6
JATO T-50	USA	530805									4												6
JUPITER (CORPORAL)	USA	570600													2								6
KUN-1	USA	460916		2																			4
LACROSSE	USA	540817										3	12	5	18	49	129	30	21	8	7		284
LACROSSE JATO	USA	520324								3	3												288
LANCE, OPERATION	USA	591000															1						7
LITTLE JOHN	USA	560726												15	132	56	173	50	70	75	28	12	612
LOKI	USA	560510												1	5			34	37	161	40	158	1047
LOKI-DART	USA	510000																					436
LOKI-NAKA	USA	590300															8						8
LOKI-WASP	USA	561211												13									21
MARK MET	USA	581100														3	14						30
MAULER	USA	601012																4	4	30	7	16	78
MERCURY (IRM)	USA	620800																		4	2		67
MISSILE A	USA	600000																					6
MLRS	USA	770000																					0
NIKE, UNDIF	USA																39	4					43
NIKE-AJAX	USA	480000					3	21	14	84	215	370	569		49			3					1371
NIKE-BC	USA	560112												21									1349
NIKE-C	USA	560111												76									97

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
NIKE-C APACHE	USA	640600																				5	81
NIKE-DUMMY	USA	460924		3	5	9																	22
NIKE-E	USA	521107								3				45	5								70
NIKE-HERCULES	USA	550000												1	118	185	339	53	37	37	10	9	842
NIKE-P	USA	560200												15									804
NIKE-PROTOTYPE	USA	461008		6	4	17																	42
NIKE-T	USA	531125									3	4	408	560	582	738							2322
NIKE-ZEUS	USA	590300															11	26	35	65	66	37	2535
PAPA JOHN	USA	540804										3											243
PATRIOT	USA	700000																					3
PERSHING I	USA	600720																3	2			8	13
PRECISE	USA	600300																4	1				18
RAVEN	USA	640300																				34	39
REDEYE	USA	630600																			2		36
REDHEAD	USA	640400																				3	5
REDSTONE	USA	590800															8	4	1		1		17
REDSTONE (T-FORM)	USA	580300														1							15
ROCKET WIND	USA	581100												1			6						8
ROLAND	USA	750000																					7
ROTO RETRIEVER	USA	470323			2																		2
RP-76	USA	580200														6	31	7					46
RP-77D	USA	590500															16						60
SANDIA	USA	581000														1	5						22
SERGEANT	USA	560119												4	3	11	19	10	8	11	14	16	102
SHAVETAIL	USA	590000															11						107
SHILLELAGH	USA	620700																		13	28	82	134
SO-SR	USA	641000																				5	128
SQUIRT	USA	640700																				2	7
SS-10, SS-11	USA	600000																					2
T-2044	USA	581200														3	21						24
T-358 SHELL	USA	580400														9							33
TALOS S/D	USA	580500														2							11
TINY TIM BOOSTER	USA	450520	13																				15
TOW	USA	631200																			3		16
V-2	USA	460416		16	12	6	10	2	4	3													56
V-2 BLOSSOM	USA	470220			2	2	4	1	2														64
V-2 BUMPER	USA	480413				2																	13
V-2 STATIC FIRE	USA	460315		1																			3

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
WAC CORPORAL	USA	451045	6																				7
WAC CORPORAL B	USA	461202		6	5		2	1															20
WAC DUMMY	USA	450927	2																				16
XM-185/186	USA	640300																				10	12
XM-21	USA	600000																34					44
XM-50	USA	580900														15	133	11					193
XM-90	USA	591000															1	2					162
ZURF	USA	600700																13	6				22
0720-E	USAF	580900														3							22
1795	USAF	560300												51	30								84
5784	USAF	560126												64	2								147
A-4-D SKYHAWK	USAF	600300																40					106
ABEL STAR TRACKING	USAF	620600																		1			41
ABRES	USAF	640300																				9	10
AEROBEE	USAF	491202					2	6	11	12			10	12	17	5	57	24	7	11	5	5	193
AFSWC PROP	USAF	590900															155	24				122	485
ALAAR	USAF	640400																				3	304
ARCAS ROBIN	USAF	611000																	6				9
ARIAC	USAF	641000																				1	7
ATHENA	USAF	640000																					1
ATLAS	USAF	560519												3									3
ATLAS AM-1	USAF	550916											3										6
B-52	USAF	600100																2					5
B-58	USAF	560714												1	4	11	32		3	20	23	7	103
B-61B	USAF	550316											2										103
BALLOON	USAF	581000														2	13	2	1		20	20	60
BELLBOY	USAF	560627												17	19								94
BLUE STRAW	USAF	621100																		2			38
BOMB DROP	USAF	481007				1																	3
BOMB E-120	USAF	570400													1								2
BOOGAR	USAF	560511												9	3								13
BULLPUP	USAF	601103																1	1	6			20
CLEAN SWEEP	USAF	640500																				3	11
CROSSBOW	USAF	550608											4	2	2								11
CROSSFIRE	USAF	560706												14	21								43
DAD	USAF	620600																		1			36
DELTA	USAF	560711												40	46								87
DISCOVERER	USAF	600400																11	8	6	8	1	120

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
DUCK (122A)	USAF	551117											4										38
DYNASOAR	USAF	630700																			17		21
E-112	USAF	570900													1								18
F-101B	USAF	571100													1	133	565	6				16	722
F-102 GAR	USAF	550314											52			5		5	14				797
F-106	USAF	580300														74	692	52	28	6		3	931
F-89 J-WS	USAF	570300													4			3					862
FALCON	USAF	550209											126	247	190	119	339	76	68	23	5		1200
FIREBEE	USAF	561114												2	58	63	48	16				66	1446
GENIE	USAF	560000																					253
GOOSE	USAF	560321												4	2								6
HI DIVE	USAF	590100															1						7
HI-EYE	USAF	640500																				3	4
HOUND DOG	USAF	620600																		5	5		13
HTV	USAF	550617											7	21	5	5	14	2	1				65
MACE	USAF	550000														27	187	5	1	7	5	2	289
MATADOR	USAF	550620											8	17	18			26					303
MB-1 WCC	USAF	570100													6		9						84
MED	USAF	601026																1					16
MGT	USAF	600919																6			52		59
MINUTEMAN	USAF	620300																			8		66
MTV	USAF	581100														1							9
MX-1961	USAF	550421											1										2
MX-2013	USAF	540929										5	5										11
MX-2224	USAF	550302											5										15
MX-2227	USAF	541118										4	2										11
MX-774 HI-ROCK	USAF	480714				3																	9
MX-775 SNARK	USAF	510221							16														19
MX-776 SHRIKE	USAF	510830							2														18
MX-883 PARA BOMB DROP	USAF	540224										10	11										23
NIKE-CAJUN	USAF	560807												3		8	7	1			1		41
OQ-19 DRONE	USAF	570500													1								21
OWL	USAF	580800														29	44	22	20				116
PEGASUS	USAF	620600																		1			116
QUAIL	USAF	570800													3	10	53	5	3		1		76
RASCAL	USAF	541129										1	12	814	8	1							911
ROCKET SONDE 1	USAF	560918												4	2	2	1	3					848
SAGMI	USAF	720000																					12

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
SAMOS	USAF	620200																		2			2
SIDEWINDER	USAF	550614											4	5	18	81	78						188
SMOKE 6875	USAF	570900													3								189
SPARROW	USAF	550707											4			2							9
SRAM	USAF	690000																					6
STARGAZER	USAF	631200																			1	2	3
SURVEYOR	USAF	630800																			16	1	20
SW-221A	USAF	590100															234						251
THIOKOL	USAF	580800														1							235
TRACK	USAF	561215												1	32	250							284
VULDISCRIT	USAF	600700																3	2	4			292
WHOOSH	USAF	551021											1										10
WR-6226	USAF	590500															21						22
X-17	USAF	560630												1									22
X-7A	USAF	550907											18	6	14	17	32	6	2				96
X-7B	USAF	560818												5	1								101
XM-25	USAF	600900																1					7
XQ-2 DRONE	USAF	541122										1	2				105	80	54	32	31	112	418
XQ-4 DRONE	USAF	580000													10	11	26	14	14	18			510
XQ-5 DRONE	USAF	570500													4	5		2					104
XQ-6	USAF	561115												1									12
YTM-61B	USAF	570800													8								9
AEROBEE	USN	470925			4	5	5	2	3	5	7	4	12	9	4	4	2		3	6	2	29	114
ASM-1	USN	640400																				4	110
CLEAN SWEEP	USN	580100														8							12
CLOVER LEAF	USN	580100														2							10
CORVUS	USN	590000															10						12
CROSSBOW	USN	560000																					10
F-4-H	USN	610800																	60	68	20		148
HUGO III	USN	620500																		2			150
HVAR	USN	451013	6									2											10
HYPER VELOCITY	USN	640400																				9	17
INTRUDER A6A	USN	640400																				349	358
LARK	USN	511129							2														351
LOON	USN	531216									1												3
MARGO	USN	590000															1						2
NIKE-VIP	USN	590700															1						2
PLUMBOB	USN	570500													4								5

Appendix B:

WSPG/WSMR Round Summary (cont.)

SYSTEM	AGENCY	YYMMDD	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	Total
POGO-HI	USN	540420										7	1	10	9	17	9	46					103
POGO-HI LOKI WASP	USN	561018												1	1								101
POGO-LOW	USN	540726										16	22	5				7					52
PX-1	USN	630300																			7		57
SPARROW	USN	631200																			3		10
SPINDRIFT	USN	641200																				1	4
SWORDFISH	USN	601116																1					2
TALOS	USN	510710							3	6	11	22	27	52	61	67	101	36	32	31		7	457
TARTAR	USN	660000																					456
TERRIER	USN	660000																					0
TERRIER BOOSTER	USN	521009								2	1												3
TYPHON	USN	620300																		3	7	2	15
UPSTART	USN	630300																			4	4	20
VIGILANTE	USN	620200																		27	447	177	659
VIKING	USN	490403					2	1		2		2	1										659

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