13 February, 1953

Mr. J. G. Trimble
2450 Easy Ave.
Long Beach 10, California

Dear Mr. Trimble,

At your request, I am mailing you the only informative booklet we have available on rockets. As you already know, much of our information is classified and is not available for public use.

If at any later date more data is unrestricted, I will be glad to forward it to you. Your quarter is being returned as there is no charge on this booklet.

My best wishes for the success of your Universal Rocket Society.

Very truly yours,

Louis M. Liggitts, Jr.

LOUIS M. LIGGITTS, JR.
2nd Lt., Ord Corps
Ass't Public Information Officer

A BRIEF HISTORY

White Sands Proving Ground is the principal rocket testing station in the United States. It is the result of the greatly accelerated rocket development program of World War II. It is located in South Central New Mexico, in the Tularosa Basin between the San Andres and the Sacramento Mountain Ranges, approximately 50 miles north of El Paso, Texas. The name is derived from the White Sands National Monument, a 250 square mile area of pure white gypsum within the Proving Ground.

White Sands Proving Ground is an Army Ordnance activity, the technical functions of which are under the control of the Chief of Ordnance. It is one of the newest military establishments and unique in that all services, the Army and Navy, the Air Force and the Marine Corps, are stationed here. Besides military personnel, civilian establishments, both academic and industrial, are permanently located on the Post. The mission of the Proving Ground is the testing of intermediate range rockets. Rocket flight testing involves the cooperative effort of all of the above groups, both military and civilian.

Prior to its establishment the entire country was surveyed for a suitable location. As a part of the rocket program, flight tests must be made requiring an area large enough to permit firing the rockets in relative safety, at the same time recording the entire flight and recovering parts for further study. The flat, timberless, sparsely populated White Sands area, with its cloudless skies, most nearly filled all the requirements.

On June 25, 1945, the actual work on the construction of White Sands Proving Ground was started. The first Commander was Lt. Col. Harold R. Turner. Brig. Gen. Philip G. Blackmore succeeded Colonel Turner on August 4, 1947. Colonel G. G. Eddy, Ordnance Department, the present Commanding Officer, was appointed Commanding Officer on February 1, 1950. The first troops arrived on August 10, 1945. Original personnel consisted of 163 officers and men of the 9393rd Technical Service Unit, which was activated simultaneously with the activation of the station. The personnel has greatly increased as necessitated by the increase in activities of the station.

The first rocket tested was the American designed "Tiny Tim" on September 26, 1945. Since that time a great many rockets have been tested here. Each service has contributed in the construction of rocket testing facilities and all use the same firing range and to a great extent the same personnel in firing and instrumentation of a rocket flight.

The mission of rocket testing has three principal aims at the present time. The aims are military training, experience for industrial concerns and scientific investigations of the upper atmosphere. Since the rocket is the first vehicle man has had at his disposal to use as a laboratory in outer space, it lends itself to unique scientific investigations. It has carried instruments to measure cosmic radiation, to record spectra of the sun, to photograph large areas of the earth, to test parachutes, and to measure temperatures and pressures far above the earth.

On February 24, 1949, a two-stage missile was fired consisting of a V-2 and WAC missile combined. This firing established a world altitude record of 250 miles.

ADMINISTRATIVE AREA - V-2 Museum

The Rocket Museum contains a complete V-2 missile with sections of the hull removed to enable visitors to see the various instruments and parts that are used in the construction of a V-2 rocket. In addition, there are many instruments mounted on individual display blocks, with caption cards explaining their function, purpose, and their location in a completed rocket.

A rocket motor has the sections removed to enable closer examination of the firing jets, and to show the two-metal wall construction. A separate display tail section offers the visitor the opportunity to see how the rocket is controlled and stabilized. There are also numerous photographs and charts pertaining to the V-2 rocket.

TECHNICAL AREA

A - V-2 Assembly

The V-2 shop was erected to serve as a main assembly shop. It is fitted with an overhead five-ton electric trolley to handle the completed rockets and sub-assemblies. To facilitate the repair, construction and assembly of rockets, the assembly building contains electrical shop, machine shop, sheet metal shop, welding shop and model shop. These shops are all engaged in the fabrication of various parts and components that go into the V-2 and other rockets that are fired at White Sands Proving Ground.

B - V-2 Calibration

In order to predict a rocket trajectory and to realize optimum performance, it is necessary to have correct thrust and burning time. This is accomplished by adjusting the flow of the propellants to the correct mixing ratio and total flow rate. The desired mixing ratio is 123 pounds per second of alcohol, to 152 pounds per second of oxygen, or 81 percent. This gives a total flow of 275 pounds per second.

Mixing ratio is adjusted by inserting an orifice in the pump discharge of the system having too high a flow. Total flow is adjusted by regulating the steam pressure. For the calibration test, the steam plant is charged with hydrogen peroxide and sodium permanganate which react to produce steam for driving the turbo-pump. Water is used in place of oxygen and alcohol and combustion pressure is simulated by orifices placed in the oxygen and alcohol lines. The test is run measuring the flow of water from each tank, pressures throughout the system, turbine speed and temperature. A total of 21 quantities are measured and recorded. From analysis of the data, calculations are made to determine the proper orifice to be inserted and the proper steam pressure.

This method of calibration has been checked by static firings. Results of these firings indicate that the present procedures are of sufficient accuracy.

C - Aerobee Missile

The Aerobee is an American-made, booster type missile which is used for upper atmospheric research. The fuels are forced into the combustion chamber by air pressure, and ignite on contact with each other. The rocket has a solid fuel booster which drops off when the missile attains a height of approximately one mile. It is capable of a maximum speed of 3,000 miles per hour.

BLOCKHOUSE AREA

A - The Blockhouse

The blockhouse was built in the summer of 1945, to withstand the impact of a rocket falling from one hundred miles, and travelling two thousand miles an hour. The walls are of reinforced concrete, ten feet thick. The roof is twenty-seven feet thick. The doors are blast proof.

The building is used to house the firing controls, communications and instrumentation equipment, as well as firing personnel. In actual warfare, the missiles would not be fired from a blockhouse. This is done here as an extra safety precaution.

B - Static Test Pit

The static test pit is used for testing completely assembled rockets. The rockets are tied down in the firing stand and fired. The jet stream goes down into the pit, and is reflected by the pit's sloping walls. A spray of water also aids in keeping the pit cool. The rockets tested are of the smaller type developing around 25,000 lb. thrust.

C - V-2 Rocket and Equipment

The V-2 is supersonic, achieving a top speed of more than one mile per second, and is still travelling at a rate of 2,500 miles per hour when it comes in on a target. The total weight empty is approximately 9,000 lbs. Fueled, it weighs approximately 28,500 lbs. Fuel is consumed at the rate of 275 lbs. per second, in the first minute of flight. The rocket with warhead is 46½ feet long, 5 feet in diameter. All rockets are launched from a vertical position, the nose pointing straight up. Aiming is accomplished by presetting of controls of the four vanes on the tail, which extend into the jet stream of the rocket. They are made of pressed pure carbon, to withstand the terrific heat. The shell is rough. The design of the rocket makes a smooth surface unnecessary, since the nose splits the air and permits the rocket to travel in a void.

The Meiller Wagon is a device used to transport the V-2 from the assembly shop to the launching area. It has an electric motor, which drives hydraulic lifts which raise the rocket to a vertical position. The Meiller Wagon is also used to place the rocket on the firing table at the launching area. Bands which hold the rocket in place in the cradle of the Meiller Wagon, are then removed and the wagon moved from the firing site.

The Firing Table is the device on which the rocket rests when fired. It is of steel construction, with adjustable legs, so that proper tilt and firing angle can be obtained.

The Gantry Crane greatly facilitates the work on the V-2 by use of the platforms on the gantry, that can be varied in height in a few seconds, so that work can be carried on at any level of the rocket, while it is in a vertical position. The gantry is self-powered, and is moved to the north end of the track when firing preparations are complete. It can be used with other types of rockets as well.

UNIVERSAL MOTOR TEST STAND

The 500,000 Lb. Universal Rocket Motor Test Stand is capable of testing various types of rocket motors, both solid and liquid, having a sustained thrust up to and including 500,000 lbs. for a two-minute period. A motor of this size would have approximately ten times the thrust of the V-2 motor, but would actually be only twice as large in physical dimensions. Facilities are provided to handle various types of fuel, such as liquid oxygen, alcohol, acid, analine, or various types of malignant fuels that are presently being developed as possible rocket fuels. The fuel tanks will hold 15,000 gallons each, and will be provided with quick-opening dump valves, so that in case of emergency the fuel can be dumped to prevent serious damage to the site, due to possible explosion or fire. In addition, 100,000 gallons of water from the water tank will be dumped through the fuel tanks and together with the fuel drained to the open desert.

This 500,000 lb. motor test stand will provide measurement and instrumentation during burning of thrust of the rocket motor; magnitude of internal vibration in three planes; velocity and temperature of the jet stream; gives samples within the absorption of radar waves by the jet stream; amount of ionization caused by the jet stream; and the amount of static electricity generated by the jet stream.

INSTRUMENTATION

The instrumentation at White Sands Proving Ground may be divided into two main categories, optical instruments and electronic instruments. Bowen-Knapp, Mitchell and Askania Phototheodolites, Ballistic cameras, and large tracking telescopes comprise the battery of optical tracking devices that are trained on each missile tested. The phototheodolites, of which 13 are in use, are the most precise of the optical position and measuring devices.

Two types of electronic devices are in use at White Sands. The familiar radar of World War II, and a new and little known system, the Doppler velocity and position instrumentation. The Doppler system, making use of the doppler effect at radio frequencies, supplies the most precise velocity, acceleration and position information.

"C" STATION

A - Radar & Tracking

Due to rockets' great potential range, which can carry them to nearby inhabited communities, they must fly within a restricted zone. The rocket's course is determined in the first minute of flight. To provide instantaneous information on its position and speed during flight, the radar beacon technique of tracking is employed. A wave transmitted by the ground radar equipment is received by a small transponder in the rocket, which in turn sends a burst of radio waves of its own. These waves, which originate within the rocket, rather than being reflected, are then received by radar set on the ground.

Incorporated in this system of tracking, are plotting boards, which chart immediate position information on the rocket, so that the operators at the plotting board can tell whether the rocket is going in such a direction as to indicate that it will leave the confines of the Proving Ground before it returns to earth. Screening lines are established on the radar plotting boards. These lines indicate the points which the rockets should not cross, without encountering the danger of leaving the firing range. If the plotting board indicates a rocket is in danger of leaving the firing range, the flight is terminated.

B - Impact Computer

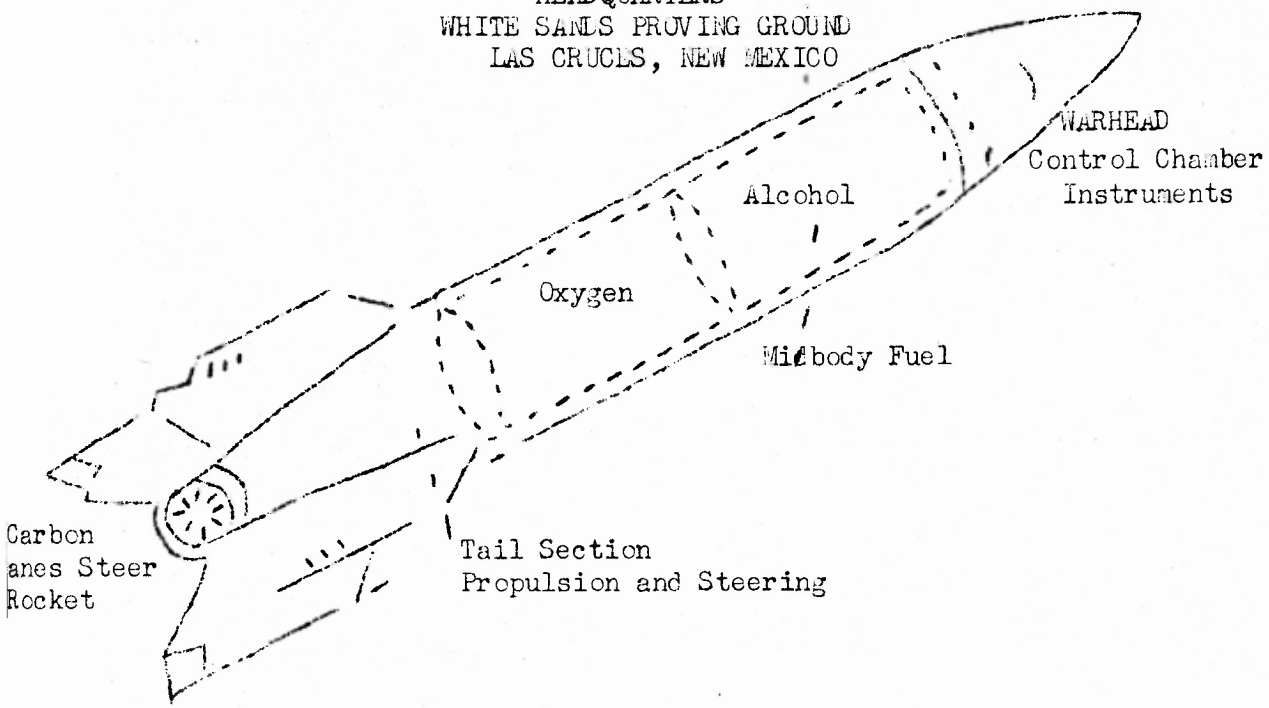
Another aid in tracking, is an instrument called the Impact Computer. This apparatus combines, optical tracking for furnishing azimuth elevation and speed information, to another plotting board, the probable impact point of the rocket is known in the instant of maximum velocity, which occurs at approximately sixty seconds after take-off.

C - Sky Screen and Transmitter

The sky screen is a system of wires representing safe and unsafe flight limits, varying according to the type of missile being fired.

The transmitter is the point of control of radio signals to the rocket, to indicate the fuel cut-off, warhead separation and activation of scientific equipment carried in the rocket for research.

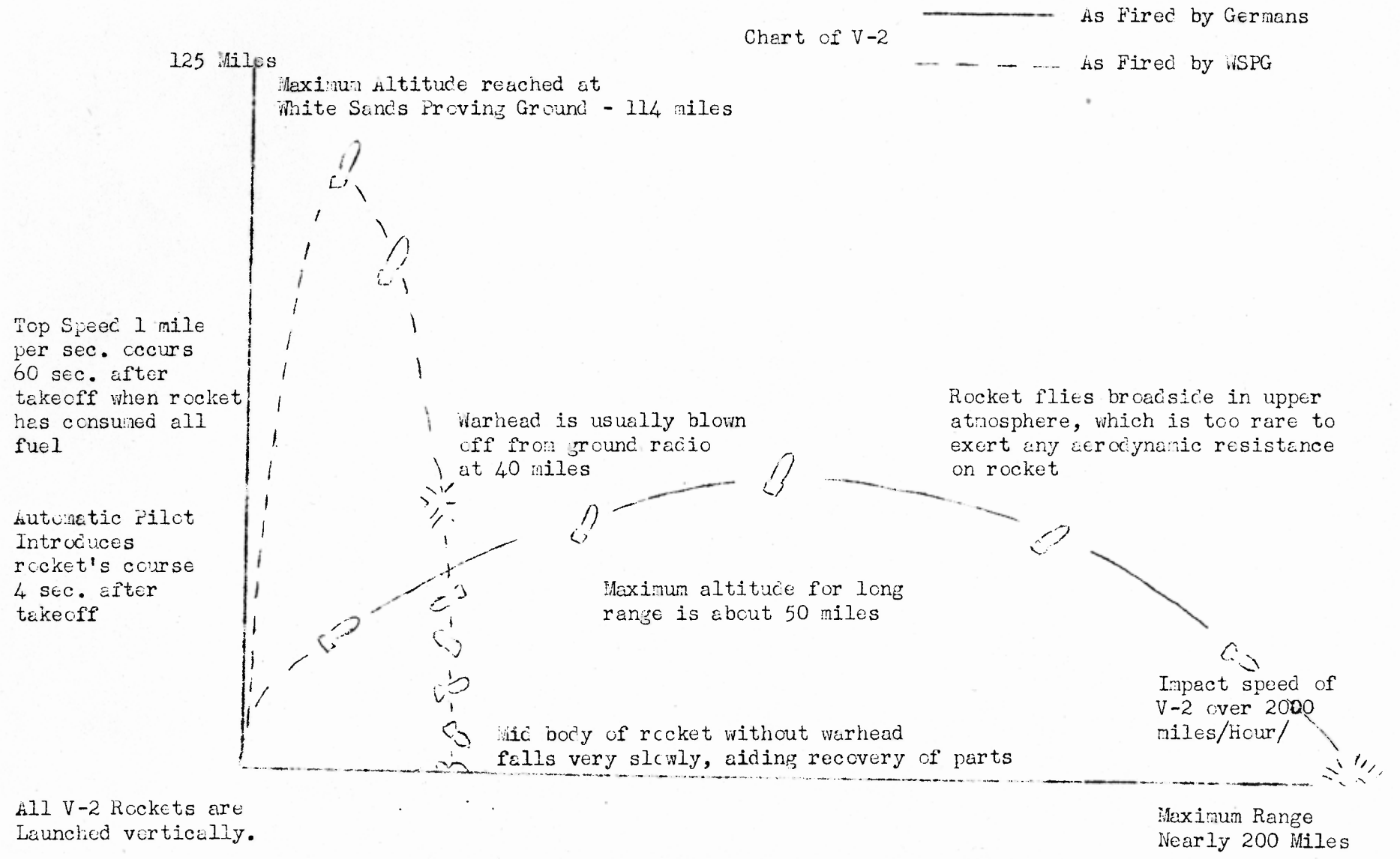
ORDNANCE DEPARTMENT
HEADQUARTERS
WHITE SANDS PROVING GROUND
LAS CRUCES, NEW MEXICO



Basic Data on V-2 Rocket as Fired at White Sands Proving Ground

Range	20 to 50 Miles
Velocity, maximum	1 mile per second (Depending on experiment)
Altitude, maximum	114 miles (Altitude not always principal factor in test)
Program angle (Deviation from Vertical)	7 Degrees
Weight at Takeoff	27,940 to 28,900 lbs.
Weight of warhead	2,000 to 3,500 lbs.
Weight empty	8,800 lbs. approx. (Depending on experiment)
Weight of Oxygen to overflow	10,800 lbs.)
Weight of Alcohol	8,360 lbs.) Used to produce
Weight of Hydrogen Peroxide	385 lbs.) steam which
Weight of Sodium Permanganate	28.6 lbs.) drives fuel pump
Weight of Compressed Air	39.7 lbs.
Acceleration, max.	180 ft. sec.
Max. surface temp. Apex of Warhead	850° C
Fuel Consumption:	
Oxygen	152.5 lb./sec.
Alcohol (25% weight is water)	123.5 lb./sec.
Thrust, Maximum	56,500 lbs.
Length, overall	46.5 ft.
Diameter	5.5 ft.
Velocity at impact	3,000 to 9,700 ft./sec. (if intact at impact)

Chart of V-2


As Fired by Germans
As Fired by WSPG
125 Miles
Maximum Altitude reached at White Sands Proving Ground - 114 miles
Top Speed 1 mile per sec. occurs 60 sec. after takeoff when rocket has consumed all fuel
Automatic Pilot Introduces rocket's course 4 sec. after takeoff
Warhead is usually blown off from ground radio at 40 miles
Rocket flies broadside in upper atmosphere, which is too rare to exert any aerodynamic resistance on rocket
Maximum altitude for long range is about 50 miles
Impact speed of V-2 over 2000 miles/Hour/
Mid body of rocket without warhead falls very slowly, aiding recovery of parts
All V-2 Rockets are Launched vertically.
Maximum Range Nearly 200 Miles