

# Germany's V-2 Rocket

**A Lethal First Step Into Space** BY BARRETT TILLMAN

The German word was *Vergeltungswaffe*, which means “retribution weapon” but is normally translated as “vengeance.” Generically, the V program included a family of advanced concepts beginning with the V-1 cruise missile. The “buzz bomb” carried an 1,800 lb. warhead at around 400mph, but was susceptible to defending fighters and anti-aircraft guns. (See *Flight Journal*, June 2015.) The V-2 was unlike anything that had ever flown—it arrived by surprise and was immune to any kind of defense.

## Brilliant Minds Given Destructive Goals

The V-2 program's leaders were General Walter Dornberger and Dr. Wernher von Braun. Dornberger, an artilleryman captured in WW I, saw the potential of rockets and pursued that goal from the early 1930s.

Born in 1912, von Braun was fascinated with rocketry and astronomy from childhood. He became a civilian employee of the Army Ordnance Department in 1932, and his doctoral dissertation examined the prospects of liquid-fueled rockets. He began working with then-Captain Dornberger, forming a lifelong alliance. After some success with small rockets, planning for the futuristic A-4 began in 1936.

At Peenemunde on the Baltic coast, Germany's rocket program took shape. The team produced a workable design designated the A-4, but political setbacks occurred when von Braun was arrested for declaring his main interest was space travel rather than military use. Armament Minister Albert Speer had to spring the scientist.

## The Chemistry of Terror

The heart of the A-4 was its propulsion. Steam produced by a hydrogen peroxide mixture drove fuel and oxidizer pumps. The fuel, an ethanol-water mixture with liquid oxygen as an oxidizer, was forced into a combustion chamber. At temperatures approaching 5,000 degrees F, the motor produced 25 tons of thrust, boosting the V-2 higher than ever.

On ignition, the rocket had fuel for about one minute of powered flight. Then gyro-controlled pitch and steerable vanes directed the rocket until engine shutdown provided the trajectory to the intended target. A maximum apogee of 50 to 55 miles was possible.

Evaluation began in March 1942 with nearly 900 tests at at Peenemunde and two sites in Poland. At length, the A-4 reached maturity, prompting Dornberger's announcement:

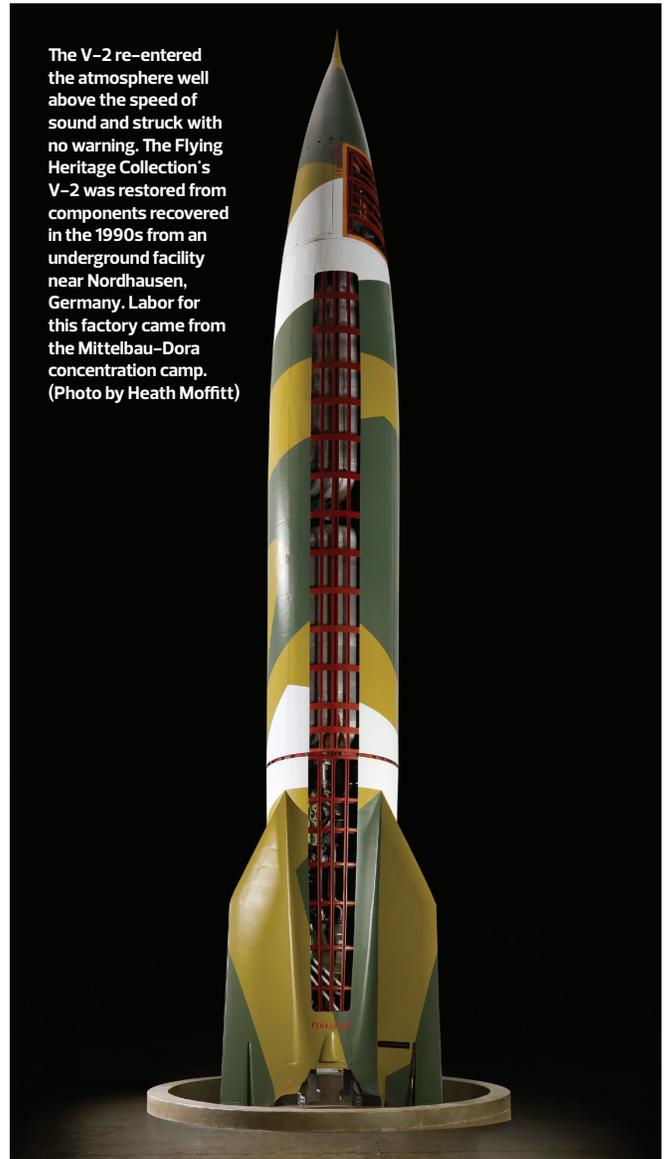
“We have invaded space with our rocket for the first time. We have used space as a bridge between two points on the earth; we have proved rocket propulsion practicable for space travel. This third day of October, 1942, is the first of a new era of transportation, that of space travel.”

Achieving operational capability, the A-4 became the V-2.

## Technological Wonder With Limited Scope

Sitting on a pad, a V-2 was nearly 46 feet long with a launch

The V-2 re-entered the atmosphere well above the speed of sound and struck with no warning. The Flying Heritage Collection's V-2 was restored from components recovered in the 1990s from an underground facility near Nordhausen, Germany. Labor for this factory came from the Mittelbau-Dora concentration camp. (Photo by Heath Moffitt)



weight of 27,600 pounds. Despite its maximum velocity of 3,500mph, its effective range was only about 200 miles. Therefore, launch sites were necessarily placed in northern France and the Low Countries, but in the three months after D-Day, Germany's geographic options were limited. Fixed and mobile firing batteries supported the V-2 campaign, but both got an erratic start in September 1944. The early efforts in Belgium fizzled, but on the 8th, rockets exploded near Paris and London, inflicting damage. The RAF was quick to locate the firing batteries and attacked whenever possible, often through heavy flak.

Despite its sensational record, the V-2 remained an imprecise weapon, useful only against “area targets.” Those areas, of

course, were cities—mainly Antwerp and London. Antwerp was the primary port supporting Allied forces on the European continent, and citizens who'd lived under German rule for four years had to endure the eerie experience of a supersonic bomb that arrived soundlessly before detonation.

The warhead was typically a metric ton of amatol, a combination of TNT and ammonium nitrate. Therefore, the V-2 was a poor bargain, offering minimal bang for the buck. The tremendous engineering and production effort to place 2,200 pounds of explosive somewhere within miles of an aim point represented poor return on investment.

Nonetheless, the missile's terminal velocity was rated at some 1,700mph—over twice the speed of sound. Consequently, some London residents reported that they heard the approaching sonic boom after impact, though in most cases the noise had been lost in the explosion. Depending on the composition of the soil, a rocket's crater might measure 60 feet wide by 25 deep.

A purely ballistic trajectory was more an exercise in probability theory than mathematics. However, a radio-controlled guidance system offering improved accuracy began tests in late 1943, eventually receiving in-flight data on velocity. The equipment proved workable, but did have limited range and could be jammed by Allied "spoofers."

### The High Cost of High-Tech

Being lost in the excitement of reaching space was the human cost of the V-2 program. The rockets probably killed or wounded 9,000 people in Britain and some 6,000 around Antwerp. The estimated 4,500 killed averages out to two deaths per rocket. But individual strikes could be devastating: some 850 were killed or wounded in an Antwerp theater, and 270 at a London department store.

Additionally, thousands of concentration camp prisoners died constructing rocket facilities.

Apparently, the Vengeance campaign ended in late March 1945 after some 3,100 launches: 51% against Antwerp and 42% on London. Other targets were struck in France, Holland, and Germany itself.

Dornberger, von Braun and many other German scientists and engineers were brought to the U.S. after the war, where they became integral to the space program. Some Americans questioned whether men who'd served Hitler should be granted citizenship, but supporters noted that their knowledge was unrivaled—and they could hardly have refused the Führer.

Probably more than 100 V-2s were shipped to America along with tons of engines, spare parts, and vital engineering data and drawings. From 1946 to 1952, the Americans expended more than 60 V-2s at White Sands, New Mexico, including U.S.-built "Bumper" rockets testing two-stage configurations. In 1950, the last Bumper was the first missile launched from Cape Canaveral, Florida.

The other retribution weapon was the V-3 super gun, a 150mm cannon using sophisticated sequential propulsion.



Above: An A-4 (V-2) rocket at Altenwalde near Cuxhaven, on a Meillerwagen, which was used to lift the rocket into its firing position. (Photo courtesy of EN-Archive) Below: The controllable fin surfaces gave the missile a degree of guidance, but it was basically ballistic in nature. (Photo by Heath Moffitt)



Two were used briefly against Luxembourg in the winter of 1944-45 with scant results.

Meanwhile, in late 1947, the Soviets fired 11 V-2s with three judged "successful." The Russians produced a V-2 clone that NATO dubbed the SS-1 Scunner. The R-11, dating from 1957, showed V-2 influence but became the separate "Scud" series of tactical ballistic missiles. The Scud D was rated at a 400 mile range.

Scuds were employed by Egypt, Afghanistan, and Iraq in the 1970s and 80s. However, the V-2's influence made headlines when Baghdad dictator Saddam Hussein launched Scuds against both Coalition targets and Israel during Operation Desert Storm. Blow-dried "war correspondents" stated that it was the first time ballistic missiles had been used against cities—a claim that residents of London and Antwerp were bound to object to. (The same "journalists" assured us that it was the first time a nation went to war over oil, though surviving members of the Japanese Imperial General Staff could have educated them otherwise.)

Whatever its origin or purpose, the V-2 remains a landmark in aerospace achievement. As with the airplane, rocketry and astronautics received a powerful boost from the impetus of world war. †