History of Rocketry and Astronautics

Proceedings of the Twenty-Fourth Symposium of
the International Academy of Astronautics

Dresden, Germany, 1990

J. D. Hunley, Volume Editor

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AAS History Series, Volume 19

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 11

AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 1997

ISSN 0730-3564

ISBN 0-87703-422-2 (Hard Cover)
ISBN 0-87703-423-0 (Soft Cover)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198

Printed and Bound in the U.S.A.

Chapter 5

The Legacy of Hermes*

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United States exploitation of War II German rocket development was carried out primarily by the Army Ordnance Department, supported by the General Electric Company, under the Hermes contract. Army and GE technical intelligence teams acquired documents, rocket hardware and people who had developed the V-2 rocket. These people were interrogated and documents were translated. This was followed by a massive technology transfer to the U.S. rocket and missile community. Concurrently, German and U.S. crews started launching captured V-2 rockets altered to carry scientific payloads to high altitudes. At the same time, U.S. industry was contracted to copy and improve subsystems and components as a first step towards designing complete new hardware using the latest postwar technology. Finally, new missile programs that evolved from the acquired knowledge were carried through development and flight tests. Many operational rocket and missile programs used key components derived from the development of the V 2 rocket.

Project Hermes began as the end of World War II in Europe neared. Under the project, the U.S. Army Ordnance Department contracted with the General

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* Presented at the Twenty-Fourth History Symposium of the International Academy of Astronautics, Dresden, Germany, 1990. **Editor's Note:** There were some illustrations which belong at the end of this paper, which were not of high enough quality to reproduce in this volume.

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Electric Company (GE) to study captured German rocket and guided missile systems and related technology, with an objective of exploiting what was discovered. As fighting came to an end, Ordnance and GE technical intelligence teams commandeered, and shipped to the U.S., large quantities of captured rocket hardware and support equipment. Much of it was from the Eastern portion of Germany, an area that was soon to be turned over to the Soviets. In an operation that reads like fiction, 841 hastily loaded railcars full of missile booty were moved to the port of Antwerp for trans-shipment to New Mexico, and buried caches of documents were located in abandoned mines and spirited out of East Germany under the noses of the British, and just ahead of the arriving Soviet occupying forces.

In mid-1945, a select group of 118 captured German rocket scientists and engineers, led by Dr. Wernher von Braun, were brought from a Bavarian collection and interrogation center to the Beaumont Hospital Annex at Fort Bliss, Texas. There the imposing task of questioning and document translation, that was begun in Germany, was completed. Some key studies of future missile systems, that were interrupted by Germany's defeat, were resumed. A number of the German engineers supervised the assembly, calibration and launching of the first V-2 rockets fired at White Sands Proving Grounds in New Mexico, and through a formidable language barrier, they explained what they were doing, in great detail, to anyone who could understand.

Simultaneously with all this activity, the Army initiated a massive technology transfer from the rocket scientists to the neophyte U.S. rocket and missile community. There was a steady flow of visitors from industry, government labs, universities and other services. Of the visitors, there were some who were able to comprehend the real significance of what they had seen at Fort Bliss and White Sands. They were the ones who went on to become the key scientists, engineers and leaders of the emerging U.S. missile and space program.

After the war, Project Hermes was expanded to include an R&D support effort, in which GE and Army Ordnance provided engineering services and support to the von Braun team. By 1947, U.S. personnel had assumed full responsibility for assembling and launching the V-2s. These rocket launchings had no military function other than training. Rather, they carried scientific payloads to high altitudes for universities and government research laboratories. The Blossom project was a typical example. Six V-2s were fitted with ejectable canisters to be lowered to the Earth by ribbon parachutes. The canisters carried small laboratories containing various experiments, including mice, monkeys, or upper atmosphere physics measurement equipment. Although the parachutes did not work, the animal experiments were considered successful, because test results were telemetered. During this phase, industry was contracted to copy and then improve on subsystems and components as a first step toward designing completely new hardware using the latest postwar technology.

In the meantime, von Braun and some of the team, plus supporting U.S. personnel, resumed work on a broad program of improvements to V-2 technology. Special emphasis was placed on guidance and control systems to tighten accuracy and increase reliability. Propulsion experts from the team traveled to North American Aviation in Southern California, to assist in formulating a program to design, build and test large liquid propellant rocket engines. This program led to the formation of the NAA Rocketdyne Division. In a similar manner, guidance specialists provided the basic concepts around which the NAA Autonetics Division ultimately evolved. AC Spark Plug Division, IBM, RCA, and many other organizations also developed guidance and control skills by expanding on the V-2 experiences.

The first major hardware development activity for the team was a V-2 range extension program. The resulting missile was called Hermes II. It entailed a radical change from the ballistic trajectory of the V-2 to an atmospheric Mach-3 cruise flight profile. This was to be achieved by separating the payload and guidance section from the V-2 rocket propulsion main body. The nose section was then powered by six rectangular ram jets built integrally inside stub wings. Pitch stability was provided by small canard control surfaces at the front of the vehicle. Hermes II test vehicles were the first aerodynamically unstable missiles to be successfully controlled in supersonic flight.

To prove the concept of rectangular cross section ram jets, tests were conducted with two-dimensional diffusers and combustion chambers in a portable test stand at the 3,000-meter-high Parcher's Camp, South Lake, in the California High Sierra mountains. The test stand was based on large-throat, blow-down wind tunnel developed in Germany during the war, and was able to simulate 1,000 meter/second cruising speeds at altitudes from 20 to 30 kilometers.

The V-2 range extension program was doomed to a short life, but the long-forgotten Hermes II, which was one of the first of a series of comprehensive U.S. exploitations of captured German rocket technology, served as a catalyst for a broad spectrum of national programs. The most significant were stable platforms, air bearing gyros, a new generation of pendulous integrating accelerometers, supersonic ram jets, canard cruise missiles, Mach-3 plus blow-down wind tunnels, exotic fuels, large liquid propellant boosters, plus guidance and control systems, and computers with no vacuum tubes.

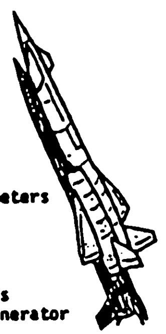
Many other V-2 related developments were examined and exploited under Project Hermes. These included such diverse items as winged V-2s, large A-10 boosters to give the V-2 intercontinental range, submarine V-2 launchers that were almost operational at war's end, underwater ignition and launching of solid propellant rockets from below the surface, railroad launchers, Earth satellites, manned space stations, radio guide beams, radio Doppler determination of velocity and position for range instrumentation, precision optical phototheodolites, field handling of large quantities of liquid oxygen, 3,000 psi mobile free-piston compressors, and a host of lesser items.

The Hermes II never received the recognition it deserved. Indirectly, its demise in 1953, came about as a result of a drastic realignment of military service roles and missions in 1947. The new U.S. Air Force, no doubt inspired by the promise of supersonic cruise missiles, as manifested in the Hermes II, initiated the North American Aviation Navaho program. Everything the Army Ordnance designers had incorporated in Hermes II, was included in Navaho, but with massive component development funding far greater than any sums the Army budgeteers could visualize. The program that the Army had nickel-and-dimed was infused overnight with big bucks, with a new configuration and an enthusiastic sponsor.

There was also an understandable desire throughout the U.S. R&D community, especially in the very hungry postwar aircraft industry, to forge out on its own, without the indignity of having to rely on captured German programs. Far more significant was the obsession throughout the newly independent USAF, to totally eliminate the Army from all air-supported missile developments. Remember the infamous edict that *if it had wings, the Army couldn't own it.*

Hermes II

Navaho



Common Characteristics

- Mach-3 Cruise Missile
  - Nuclear Warhead
  - Ram Jet Powered
  - Canard Configuration
  - Inertial Navigation
    - Stable Platform
    - Pendulous Integrating Accelerometers
    - Air Bearings
    - Mixer Computer and Programmer
    - Elimination of Vacuum Tubes
- Separate Booster
  - Bipropellant Liquid Rocket Engines
  - Axial Turbopump powered by Gas Generator

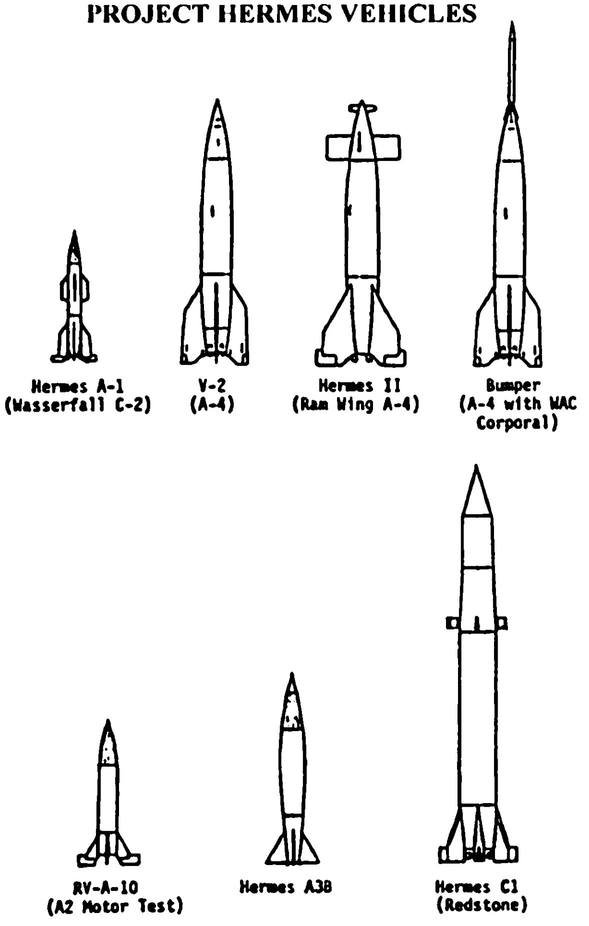
These factors were combined with a decision by top Army development people to wash their hands of any missiles that competed directly with the Air Force. Finally, security classification clamped a lid on what had happened, and Hermes II was unceremoniously buried, even though its offshoots were to influence U.S. missile development for the next 20 years.

As work on the Hermes II cruise missile was phased out in mid-1960, program emphasis shifted to a surface-to-surface ballistic missile, designated

Hermes C1. In September 1950, the Ordnance Department transferred the C1 project to Redstone Arsenal. It was known by various names, including C1, Major, Ursa, XSSM-G-14, XSSM-A-14, and finally, in April 1952, it was named Redstone. Although no longer part of the Hermes program, it maintained the development continuity of the original Peenemünde team that would ultimately see man land on the Moon.

There were other Hermes programs. One was designated the Hermes A1, an American-built copy of the Peenemünde-developed surface-to-air Wasserfall C-2. Five were launched in 1950 and 1951. It used a GE-developed, pressurized liquid propellant rocket motor, had four cruciform wings, and was radar tracked and command guided. The program was canceled in 1952, because home-grown anti-aircraft missiles, such as Nike and Terrier, were close to becoming operational. Prior to cancellation, the Hermes A1 was tested in a surface-to-surface mode, and many subsystems of the missile were adopted by other Army programs.

PROJECT HERMES VEHICLES



The surface-to-surface Hermes A2, partially derived from the A1, but using a solid propellant rocket motor and a low-cost but highly accurate guidance concept, was investigated and all were components successfully tested. An alternate hybrid motor, using solid polyethylene fuel and concentrated hydrogen peroxide oxidizer, was also demonstrated at the GE Malta test station, a Hermes funded facility.

The surface-to-surface Hermes A3 was to be a smaller, but much improved, Americanized V-2, using precision ground radar to track the missile and send corrections to its inertial guidance system. The A3B had a 22,000-pound-thrust liquid propellant rocket motor, using alcohol and liquid oxygen fed by a hydrogen peroxide-powered geared turbopump. Five of six A3B missiles flown were successful, but after many reviews the program was canceled.

Project Hermes also brought forth the *Bumpers*. These were V-2 missiles modified as boosters for WAC Corporal sounding rockets. *(WAC* meant *Without Attitude Control,* not a woman soldier!) Eight very tired and much-modified V-2s were allocated for this Hermes project. Three flights were fully successful, two partially so, and three were failures. In one attempt, the V-2 actually passed the WAC Corporal. Bumper's original purpose was to investigate separation problems of two-stage liquid rockets, and also to attempt to set a high altitude record. Number 5 Bumper reached 250 miles in February 1949, thereby becoming the first true space vehicle.

Partially because of area constraints at the White Sands Proving Grounds, and also to inaugurate the newly established Florida Missile Test Center, Bumpers No. 7 and 8 were launched from Cape Canaveral in July 1950. The normal *Tilt* program was altered so that the V-2 missiles were moving almost horizontally when the WAC Corporal motors were fired, thus causing a very high speed, low altitude trajectory over what was essentially an aircraft-type, flight profile-configured range. Even with primitive support, delays, limited camera coverage and field-modified SCR-584 radars incapable of tracking multi-mach targets, both 200 mile-range flights were completely successful.

The U.S. Navy also participated, indirectly, in the program, through Operation Pushover. This two-test series investigated the effect of a catastrophic shipboard launch failure by deliberately toppling two V-2s with engines operating onto a simulated ship deck. In Operation Sandy, a V-2 was launched from the aft flight deck of the aircraft carrier *U.S.S. Midway*, and the era of sea-launched ballistic missiles was begun. This launch took place in September 1947.

Although not a direct descendant of captured technology, the RV-A-10 solid propellant rocket motor may have been one of the more significant developments under the Hermes umbrella. It was built for the Hermes A2 and was approximately 16 feet long and 31 inches in diameter. Four test vehicles were successfully flown at the Cape Canaveral, Florida, Missile Test Center in 1953. This first full-scale demonstration of the Caltech JPL-developed rocket motors, using Thiokol Chemical's polymer as a fuel in large propulsion packages, led directly to the Polaris, Sergeant, Pershing, and Minuteman, as well as the Shuttle's boosters.

Summary

The rapid exploitation and wide dissemination of captured information of WW II German rocket developments saved the U.S. at least ten years during the severe R&D funding cutbacks of the postwar period.

The U.S. Army Ordnance Department's Hermes contract with the General Electric Company effectively combined the capabilities of a large and diverse industrial complex with the experienced team of German rocket scientists and engineers.

Technology transfer to U.S. industry resulted in many organizations being formed to use this windfall of data and experience. Viking, Navaho, Polaris, Sergeant, Pershing, Redstone derivatives, the Jupiter and Thor IRBMs, Atlas, Juno, Saturn, SINS-ships inertial navigation system, and many other programs incorporated components that were derived from the V-2 and its Hermes follow-on programs.

When the fund-starved Army Hermes II was canceled and the Air Force Navaho became a national top priority program, the pace of rocket and missile development accelerated, and the scope expanded far beyond what the Army could have afforded. This bonus from the competitive nature of interservice rivalry was shared by all, and it far outweighed any disadvantages of duplication from multiple technical approaches.

The Army Ordnance team of U.S. military personnel, with German rocket scientists and engineers, supported by the General Electric Company, led the way, and the rest of the nation's rocket and missile community followed. That is *the legacy of Hermes*.

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