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HISTORICAL SUMMARY

on the

VON BRAUN MISSILE TEAM

II. 1
IV. 4

by

Major General H. N. Toftoy

Colonel J. P. Hamill

The Ordnance Corps became involved with the German V2's and the technical people who developed them through our Ordnance Technical Intelligence Teams in Europe. It was the mission of these Ordnance Technical Intelligence Teams to keep abreast of enemy weapons, study and make reports on captured equipment, and to ship specimens to the United States and United Kingdom.

The V-2, which is still considered a scientific milestone in man's technological advance, created special interest.

Ordnance Technical Intelligence received a cable requesting some V-2's for test firing in the United States but no operational missiles were available. (The Germans had fired them as fast as they were checked out and V-2's caught enroute to firing sites had been destroyed before they were abandoned).

Ordnance Technical Intelligence discovered a large number of V-2 parts in an underground factory at Nordhausen and suggested these parts be shipped to the United States for assembly and firings.

Army Ordnance requested parts for assembly and firing of 100 V-2's be shipped to the U. S.

Colonel J. P. Hamill, then a Major, selected the parts and shipped them to the States. This had to be done quickly because the area was to become a part of the Russian Zone.

16 Liberty shiploads (300 European carloads) of V-2 parts were deposited on the open desert of the then new White Sands Proving Ground during the summer of 1945.

The German missile development center was at Peenemunde, located in Germany on the Baltic Sea. Here General Dornberger and Dr. Von Braun headed up a 3000-man German missile organization which had developed the V-2 and were working on several more advanced missiles.

In the spring of 1945 Allied bombings and the approaching Russian forces made it senseless for the Von Braun team to remain at Peenemunde. They took off for a retreat in the Hartz Mountains of Bavaria where they hoped to be able to continue business.

Before they became reestablished, the U. S. 3rd Army overran their new area. They knew Germany had lost the war and decided to surrender to the U. S. Army.

Army Technical Intelligence interrogated the Germans and became convinced that these Germans wished to cooperate with the U. S. and were the bona fide developers of the V-2.

Major General H. N. Toftoy, then a Colonel (Chief of Army Technical Intelligence in Europe), knew that the U. S. could save a lot of time and money in its infant missile program if we could start where the Germans left off, so he recommended the top 300 V-2 experts be brought to the U.S.

Shortly thereafter came victory in Europe. In June 1945, General Toftoy was assigned the responsibility, under the Chief of Ordnance, for developing Army Guided Missiles. One of his first actions was to personally plead the case and succeeded in getting approval to bring 100 V-2 scientists to the U.S., not the 300 requested.

General Toftoy returned to Germany in July 1945 to select them and make arrangements for their passage to the United States.

This project became known as "Operation Paper Clip" and was classified "Secret" until the termination of the hostilities.

Cutting the list from 300 to 100 was a problem.

Experienced technical people only were selected with a view to the eventual establishment of a fully integrated team of top scientists and engineers in each of the fields required for the development of a complex guided missile system. Since 100 could not meet the requirement, General Toftoy selected 127 of the bona fide experts - the creative scientists and engineers - as the original team for employment by the Army in the U. S.

At that time they were the world's only experienced supersonic ballistic missile team.

The first of the scientists arrived in September of 1945 - eight, including Von Braun. They were brought to Aberdeen Proving Ground where they worked with the sorting and translation of a mass of captured documents which our Technical Intelligence teams had collected. Von Braun was taken to Ft. Bliss where we set up an R&D sub-office in charge of Major Hamill, with housing, laboratory and shop space for the German group.

By the close of 1945 the majority of the group had reached Ft. Bliss.

The first mission was to assist in the firing of V-2's at White Sands Proving Ground. Initially this was a sizable effort which diminished as U. S. personnel were trained. By the end of the program approximately 87 V-2's were fired for various R&D purposes.

In cooperation with BRL, Dr. Schmidt and others perfected tracking methods and set up the data reduction effort at New Mexico A&M.

They were made available to the Navy and the Air Force and to their contractors, as well as to our Army contractors, for interrogation. They gave advice freely and by warning of pitfalls and engineering difficulties which they had encountered were able to save our contractors time and millions of dollars of research effort.

The Germans had detailed plans for the design of a device which would have enabled them to tow a V-2 behind a submarine to within one hundred miles of the East Coast and launch it. At the request of Colonel Toftoy a presentation was made to the Navy. Much interest was shown and the Navy requested the group to work with their people in certain areas. This was done.

The Navy in the middle 40's was doubtful of the feasibility of launching a large missile from an aircraft carrier. The Germans in cooperation with White Sands Proving Ground proved it could be done by launching a V-2 from the Midway in 1947.

In 1947 long discussions were held between Dr. Haber, a German scientist in the Air Force Space Medical Division, Von Braun, and others. From these discussions came the plan for giving a ^{man} private a ride in a V-2 at White Sands Proving Ground.

The greatest single value of the group was their collective experience as a team over many years. Their technical ability coupled with the most practical approach, their thoroughness and attention to minute detail, plus their 20 years of experience, gives them the edge over other groups today regardless of size or technical competence.

In late 1945 Major General G. M. Barnes and Colonel H. N. Toftoy visited Ft. Bliss and approved a proposal to undertake a project to be known as Hermes II - a two stage

missile which utilized a modified V-2 as a booster for a second stage split wing ramjet. The missile was to travel 500 miles at Mach 3.3 at 60,000 feet altitude.

At this time (1945) the Germans were in this country on a one-year contract and the probability of extending the contracts was still uncertain. Some resistance to the German group developed in the U. S. Several influential groups petitioned the President and the Congress to return the V-2 scientists to Germany at once.

The General Electric Company under contract provided supplementary personnel promptly for the operation of a model shop and the augmentation of the drafting capabilities of the group.

Facilities for the conduct of this development were below the bare minimum essential. Some temporary type buildings were obtained from the Post Ordnance officer and converted into a model shop and laboratories. Later Colonel Toftoy obtained approval for the transfer of William Beaumont Hospital Annex, located at Ft. Bliss, to the Ordnance Corps. This provided additional laboratory

space. The wards of the hospital were converted into apartments for the families of the group, who were brought to the U. S. during late 1946 and 1947.

Most of the equipment for the laboratories was war surplus and was obtained by virtue of an A-1-A priority given the operation by the Adjutant General for the purpose of requisitioning on any depot of any technical service.

As work progressed on the project, significant contributions emerged. Without attempting to order these as to importance the following are included:

The V-2 had established the feasibility of inertial guidance. Under the direction of Steinhoff (now with AVCO) and later, Buchhold (now with G.E.) new stabilized platforms were developed. The first task was to improve the gyroscopes. Various types of fluid bearings were tested. From these experiments the feasibility of air bearings was established. This work, performed primarily by Mueller and Angele, came to fruition in the Redstone Jupiter and Explorer Missiles.

Accelerometers for the stabilized platform was another serious problem. All avenues of attack were considered; chemical, mechanical, and electrical accelerometers were

designed and tested. The present capability of our systems to perform precise double integrations and thereby attain accurate guidance is credited primarily to Schlidt and his coworkers. Hausserman should be credited for bringing together the components which make the present day guidance and control system function.

There were by-products of Hermes II work which should be mentioned. The work of Michel (now with I.G. Farben) in the area of rust inhibition in fuel tanks is typical.

In a joint effort with JPL and G.E. the Bumper project was fired. The altitude and velocity records set by this missile (approximately 243 miles and 5,000 mph) remained unchallenged for many years.

The V-2 had enabled the U. S. to cheaply implement its upper atmosphere research. It was Moore, an American civilian employee of the organization, who flew fruit flies in a V-2 for mutation studies.

The German team assisted Dr. Van Allen and his upper air research group obtain new high altitude scientific data on the atmosphere through vertical V-2 flights.

In 1947 plans were formulated by Hamill and Von Braun and Rees to develop a 200-ton thrust rocket motor to serve as a first stage of a proposed scaled up version of Hermes II. The project was disapproved because of a shortage of funds and lack of an official requirement for large rocket motors.

The organization continued to grow and because additional facilities could not be made available at Ft. Bliss, the entire organization was moved to Redstone Arsenal during the period April - October 1950.

Existence as an Ordnance Class II activity on a Class I installation proved to have welded a heterogeneous group of officers and enlisted men, Civil Service and Department of Army Special Employees (Germans), G. E. engineers and technicians into a tightly knit entity.

The facilities of the Huntsville Arsenal portion of Redstone were made available and the organization became known as the Ordnance Guided Missile Center.

Late in 1950 the group was requested to submit a design for a guided missile capable of carrying a 6900 lb. payload to the maximum possible range, and utilizing existing

components where feasible. Riedel (now in Germany) had left the group for North American Aviation Company in approximately 1947. North American had been developing a LOX-Alcohol rocket engine for several years and had on hand several experimental power plants based on scaled up versions of the V-2. The decision was made to utilize this 75,000 lb. power plant, and when coupled with the payload weight, fixed the design of the Redstone. Provision was made to make the design flexible enough to later accommodate a 120,000 lb. motor when it became available.

This proposal then formed the basis for the development of both the Redstone and Jupiter Missiles.

On 22 February 1951 after a presentation on the proposal, Mr. K. T. Keller gave the go-ahead to the Redstone missile program. One of the most difficult technical problems associated with the Redstone design was whether to separate the warhead or to bring the entire missile onto the target. The decision was to separate, and in the minds of project personnel, this decision was not purely a technical one; separation might well provide a stepping stone for a later two-stage Redstone. There was that further possibility

which to many seemed remote in 1951 that a separating type of nose cone might some day become a satellite or fly off into space.

During the period of planning the Redstone, Geissler, who possessed an excellent mathematical background, emerged a polished aerodynamicist and his theoretical calculations provided the numerical basis for Redstone design computations.

An American who developed rapidly during this period was Fagan, who had come to Bliss as a Private after having been a P-4 in OCO, and remained as a civilian. Fagan rapidly gained stature and his understanding of missile system design, coupled with his knowledge of American component development, contributed much to the Redstone project.

Some of the most significant technical achievements made by the German group during the development of the Redstone included the following:

1. First accurate and reliable inertial guidance system.
2. First demonstrated solution to the reentry heating problem.
3. First to demonstrate a statically unstable missile could be flown successfully by proper automatic sensing and control.

4. Great reduction in use of electronic tubes through development and practical application of magnetic amplifiers.

5. Design and development of a new type, small size, high speed instantaneously reversible electric motor for actuation of guided missile control surfaces.

6. Phenomenal development firing record; no postponements of scheduled firing dates and highest record of successful ~~landings~~ ^{launchings}.

7. Original plan which resulted in successful launching of Explorer I satellite.

8. As an avocation convinced the world satellites and space exploration were feasible.

In 1952 with the establishment of the Ordnance Missile Laboratories at Redstone Arsenal, the organization developing the Redstone missile became the Guided Missile Development Division of the new OML.

On 1 February 1956, the Guided Missile Development Division of OML was established as a separate Class II activity and renamed the Army Ballistic Missile Agency with mission assignment of the expedited prosecution of the IRBM Jupiter and fielding of the Redstone.

At first they had no official status because they were enemy aliens in the United States under military custody. It took five years before the Government established immigration quotas for Germany and permitted them to reenter the country as bona fide immigrants.

For this reason it took the original group ten years instead of five to become citizens of this country, yet they never complained.

Originally they were paid \$6.00 a day per diem, the remainder of their salaries was paid to their families in Germany from war reparations.

The majority became civil service employees in 1952 and 1953 with credit retroactive to original employment in the U. S.

At present many former Paper Clip personnel are on committees of National Agencies such as NASA and the National Academy of Sciences.

Most of the present key technical personnel and laboratory chiefs of ABMA were members of the original Paper Clip group. This includes Von Braun, Rees, Boehm, Debus, Fichtner, Geissler, Gruene, Haussermann, Heimburg,