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Chapter 3

A Background of Memories of Working with Dr. Wernher von Braun, Krafft Ehricke and Other Members of the Peenemünde Group*

George S. James†

Abstract

In this chapter the author recalls some of the experiences in having the great opportunity to work with Dr. Wernher von Braun, Krafft Ehricke, and other members of the Peenemünde Group, beginning in September 1951, who were developing the Redstone liquid propellant rocket at the Redstone Arsenal, Huntsville, Alabama.

I. Introduction

My opportunity to work with Dr. Wernher von Braun and members of the Peenemünde group began in September 1951, when through an extraordinary set of circumstances, I reported to the U.S. Army 9330 Technical Service Unit, stationed at Redstone Arsenal near Huntsville, Alabama. The 9330 TSU included a group of one hundred or so recent U.S. Army draftees, during the Korean War,

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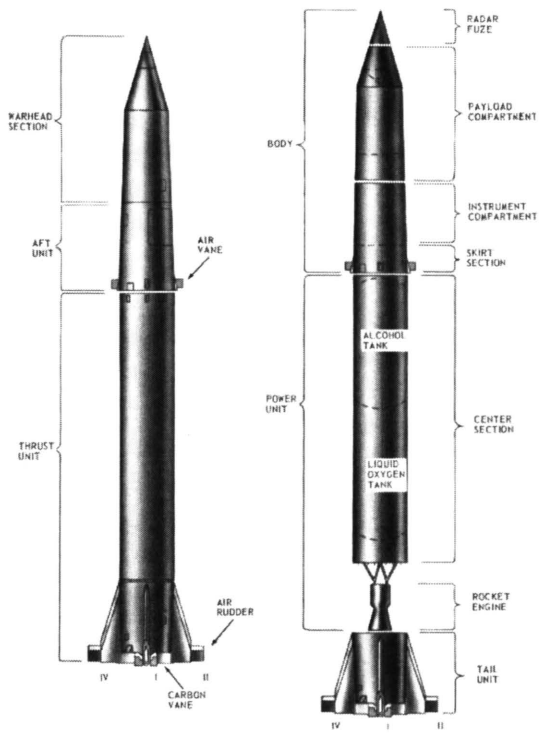
who as "Army Special Personnel" were brought to Redstone Arsenal to work on highly classified missile development.

We, as enlisted men, along with a number of Army reserve officers called back to duty and a small group of government civil servants, worked at the Arsenal's Army Ordnance Guided Missile Center (OMGC) Development Operations Division of which Dr. von Braun was the Technical Director, under the Army command structure.

In late 1950, the Hermes C-1, a ballistic missile planned for development with a 500-mile range, was transferred from General Electric to Redstone Arsenal. To differentiate from the earlier Hermes C-1, the new missile's name unofficially first became Ursa then later, the Major. Finally on 8 April 1952, to clarify this situation, the name officially became the Redstone. Also, the Redstone's range was reduced to 200 miles because of the weight of the intended nuclear warhead and the thrust level of the chosen available Rocketdyne liquid propulsion systems.



Missile Structure

Figure 3–1: The Redstone, 69.3-feet high, 5.8-feet in diameter, designed for a 200-mile range carrying a 6,000-lb nuclear warhead. First static test early in 1953. First flight test 20 August 1953. Declared operational in 1958. Initial propellants were liquid oxygen and alcohol. Credit: Rocket Research Institute, Inc., Archives.

The Redstone was the first large liquid rocket developed in the U.S. based on German V-2 technology. The basic Redstone was 69.3 feet long and 5.8 feet in diameter. Initial propellants were liquid oxygen and alcohol.[1]

The Redstone, through subsequent upgrades, launched the first U.S. satellite, *Explorer I*, on 31 January 1958;[2] the first American astronaut, Alan Shepard, on a sub-orbital flight into space on 5 May 1961; and a second American astronaut, Virgil Grissom on 21 July 1961.[3]

Following is the chronology which explains how the opportunity to work with Dr. von Braun and members of his team began well over a decade earlier.

II. My Decade before Huntsville

In my growing up years, the Sunday newspaper comic strip, "Buck Rogers in the 25th Century," during the late 1930s and early 1940s had created a fascination with the use of rockets as a means of transportation through space and on Earth. In 1942, as a 9th-grade student, I built a small-scale model of a Buck Rogers rocket ship as a science project at Clark Junior High School in La Crescenta, California.

My father, Serge V. James, looked at my rocket ship model, and wishing to give me a hopefully more scientific approach to my project, borrowed from the Glendale, California, public library the only book they had on astronautics: *Rockets through Space*, by P. E. Cleator, written in 1936.[4]

Suddenly, the forecasts of rocket travel in the 25th century came back down to Earth with Mr. Cleator's accounts of 20th-century research by rocket pioneers, Robert H. Goddard, Robert Esnault-Pelterie, and Hermann Oberth, as well as the subsequent early interplanetary societies, the Verein für Raumschiffahrt (VfR, German Society for Space Travel), the British Interplanetary Society, and the American Rocket Society.

Consequently, in early 1943, inspired by Mr. Cleator's book, I, and five equally young colleagues at Clark Junior High School, John Cipperly, Charles Payne, Jim and George Fox, and Jim Hess founded the nucleus of today's Rocket Research Institute, Inc. (RRI), under the name of Southern California Rocket Society (SCRS). We quickly changed the name to Glendale Rocket Society (GRS) because we learned that earlier Bernard Smith and Robert Gordon had formed the California Rocket Society in 1940. I had been motivated to form our organization by the fact that private non-governmental organizations and individuals were now actively pursuing rocket propulsion systems development without waiting for the 25th century.

It was ironic that I and my associates formed our organization without the slightest knowledge that almost exactly three months earlier, 3 October 1942, the first completely successful experimental A-4 (V-2) had been launched at Peenemünde.[5] And perhaps even more ironic was that nine years later, I would be working with the same individuals who had conducted the 3 October 1942, completely successful A-4 launch.

The American Rocket Society publicized our student rocket society in *Astronautics, Journal of the American Rocket Society* (ARS)[6] and I also joined the ARS as Junior Member Number 54 in 1945, with the encouragement of G. Edward Pendray, one of the founders of the ARS, and Cedric Giles, then former ARS President.

In reading *Rockets through Space*, I had been particularly intrigued with the mail-rocket research of a young Austrian engineer, Friedrich Schmiedl (1902–1994).[7] On 2 February 1931, Mr. Schmiedl had launched the first "public" demonstration of rocket mail from the Schoekel mountain plateau in Steirmark, Austria, to the town of Radegund with his "V-7" rocket that carried 102 covers and cards. This demonstration helped increase public awareness of a peaceful vision of the future with large mail-cargo carrying rockets, at a time long before intercontinental ballistic missiles.

This experiment also raised funds for his research program, which continued until Austria was annexed by Germany. With similar fundraising in mind for training and research, the RRI, from 1947 to the present, has conducted 52 rocketpost demonstrations for its research and education programs, carrying a total of over 77,000 commemorative envelopes for astrophilatelic collectors.[8]

In the summer of 1950, I first met Konrad Dannenberg of the Peenemünde group when I went to work at the North American Aerophysics Laboratory (NAA) in Downey, California. Imagine my surprise and pleasure to be working on the U.S. Air Force MX-770 Navaho project with an engineer from Peenemünde[9] who actually helped develop the V-2, one of my great interests.

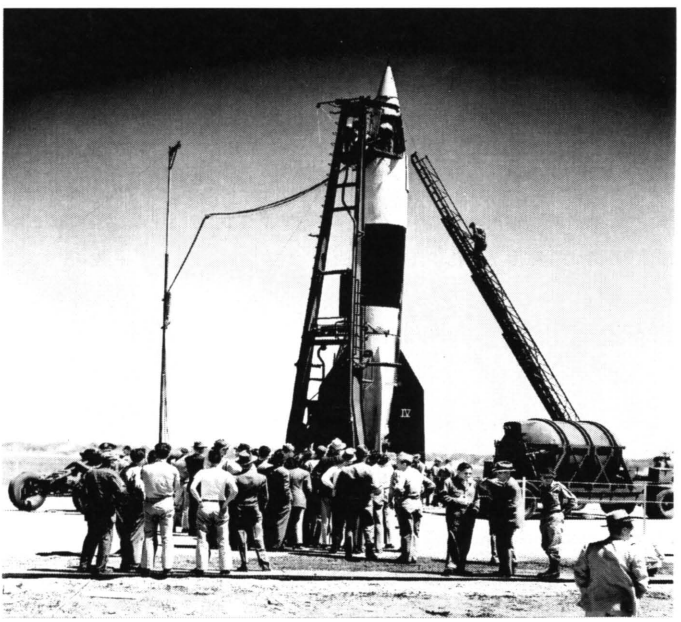
As Mr. Dannenberg had belonged to a German student rocketry group in the late 1930s[10] and because I had been involved with the Rocket Research Institute since 1943,[11] we also shared a common thread of enthusiasm for supervised student experimental rocketry.

Four summers earlier, in 1946, I had been fortunate to have a summer job at the Caltech GALCIT Jet Propulsion Laboratory, through the assistance of Dr. Theodore von Kármán and Dr. Frank Malina. I became a JPL summer intern assistant test pit mechanic. I worked mostly on tests of the liquid monopropellant Nitromethane. However, I did spend several weeks with Charles Bartley's staff at

the solid propellant test bay where they were testing the first room temperature castable solid propellants made from Thiokol LP-2 liquid polymer.[12]

I still remember spending many a lunch hour at JPL examining the complete V-2 that was placed on its side near the large oak tree located close to the JPL liquid rocket test area. Now in 1950, at NAA, I was actually working with an engineer who had helped develop that V-2 rocket engine.

Moreover, through another lucky surprise, less than a month into my JPL summer intern job, I had to request a week-long leave because, through a letter I had written to the Army as the representative of our young student rocket society, I had received an invitation from the U.S. Army to witness the launch of V-2, S/N 6, on 27 June 1946, at White Sands.[13]



NEWSMEN AND PHOTOGRAPHERS VIEW FINAL PREPARATIONS FOR FIRING OF V-2 10 MAY 1946
U.S. ARMY ORDNANCE PROVING GROUND, WHITE SANDS, N.M.

Figure 3–2: White Sands Proving Ground, Las Cruces, New Mexico, 10 May 1946. Preparations of S/N 3-V-2 for high altitude research. It reached 122.6 miles. The author witnessed the launch of V-2-S/N 6, from exactly the same site on 28 June 1946. It reached an altitude of 107.8 miles but had nose separation failure. Credit: Rocket Research Institute, Inc., Archives.

Through a non-inspiring bus trip from Los Angeles, I arrived in Las Cruces on the morning of 27 June and was met by an Army public relations officer. After his surprise of meeting a teenager, he drove me to the White Sands Proving Grounds Base Headquarters where I joined the other invited visitors.

After lunch in the officer's mess, we were told that the launch had to be delayed until the next day because the pump on the liquid oxygen truck had broken and it would not be possible for another truck to arrive from El Paso before then.

That evening, I had an opportunity to meet a number of individuals who had come to witness the launch, including Robert Young of Aerojet, with whom I would work in years to come.

Early on the morning, of the 28th, without any escort, I walked over to the assembly hanger for the V-2s and marveled at the numerous V-2 bodies opened in half, like giant sea shells.

In the afternoon of 28 June, everything proceeded according to plan. The launching site was six miles from the base headquarters and consisted of a concrete platform for V-2 launchings, the WAC Corporal launch tower, and a concrete blockhouse control room.

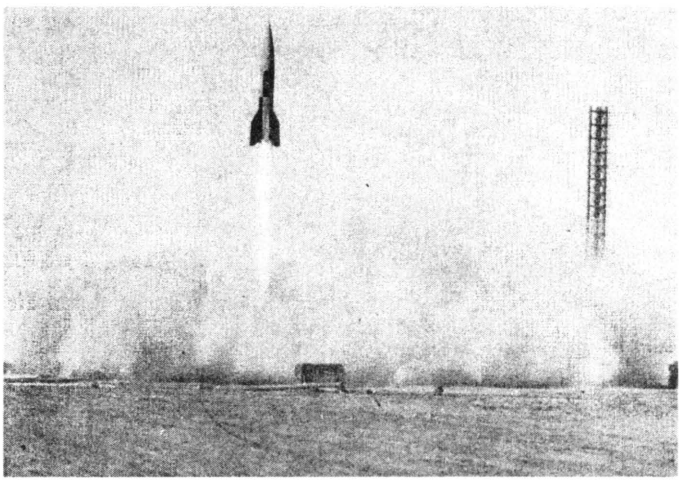


Figure 3–3: Typical Early 1946 V-2 launch from White Sands. At right is the tower for then JPL Director Frank Malina's successful 22 May 1946, WAC Corporal sounding rocket launch to an altitude of 50 miles. Credit: Rocket Research Institute, Inc., Archives.

Our group was allowed to view the pre-launch operations of the V-2 from about 100 feet away as it stood on its platform. All the conversations I could hear from the team working on the rocket were in German. This was my first opportunity to see, from a distance, members of the Peenemünde group. When I mentioned the lack of English being spoken to my military escort, his comment was, "Well, we have to do something with these Germans." Obviously, this military attitude changed with the start of the Korean War on 25 June 1950. By October 1950 Dr. von Braun and his team had been transferred to Huntsville, Alabama, to develop the Redstone.[14]

After a red smoke flare on the blockhouse, 300 feet from the V-2, indicated that twenty minutes remained before the launching, I and the other spectators were asked to move back "behind the fence" only 1,000 feet from the V-2.

Two red stars fired from the blockhouse indicated that five minutes remained before launching. As the rocket started, a large orange flame emerged from the combustion chamber and enveloped the fins. The control cable dropped from the V-2 and the rocket slowly began to rise majestically, with an ear shattering roar.

By the time its sixty-foot flame had cleared the ground, the V-2's speed had greatly increased. In a matter of seconds, it was a mere orange speck leaving a large curly snow white vapor trail into the clear blue New Mexico sky. It reached an altitude of 107.8 miles.

A green flare, five minutes later, from the roof of the blockhouse, indicated that the rocket had hit. Immediately small scout planes took off from the large paved highway connecting the camp with the launch site. The remains of the missile were located in a dry lake bed 47 miles away. This awe-inspiring launch was an event that I will never forget.

Moving forward to the summer 1950, I joined North American Aerophysics Laboratory (NAA), in Downey, California, during a summer break from my studies at the University of California at Los Angeles, (UCLA). I quickly learned that Konrad Dannenberg and Walther J. Riedel were both among the 117 engineers and scientists from Peenemünde.

They were part of the NAA team responsible for evolving from the 56,000-lb thrust V-2 rocket engine system to a brand new design of 75,000-lb thrust for the MX-770 Navaho missile.

By this time at NAA, initial full-scale static firing tests of the new engine were already been conducted at the Santa Susana facility. Subsequently, this engine became the propulsion system for the Redstone because an even higher thrust engine was required for the scaled-up MX-770 Navaho.

My joy of working with "real rocket engine engineers" at NAA came to a temporary halt when, on 22 September 1950, I was drafted into the U.S. Army for the Korean War.

After basic training at Fort Ord, California, I was fortunate to be assigned to the Army's Special Professional Personnel Program and in early January 1951 reported to the Army Chemical Center in Edgewood, Maryland.

In May 1951, on my subsequent convalescent leave back to my home in Glendale, California, from the Army Chemical Center, having successfully recovered from spinal meningitis, I stopped by the NAA to visit with Konrad Dannenberg. In the course of our conversation, he mentioned that the Fort Bliss

Peenemünde group had been transferred to Redstone Arsenal in Huntsville, Alabama, and they could use a good technical editor.

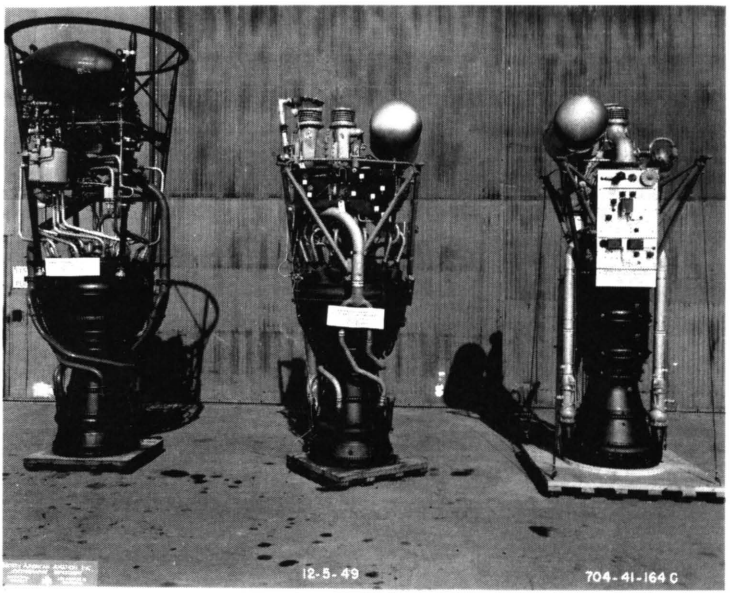
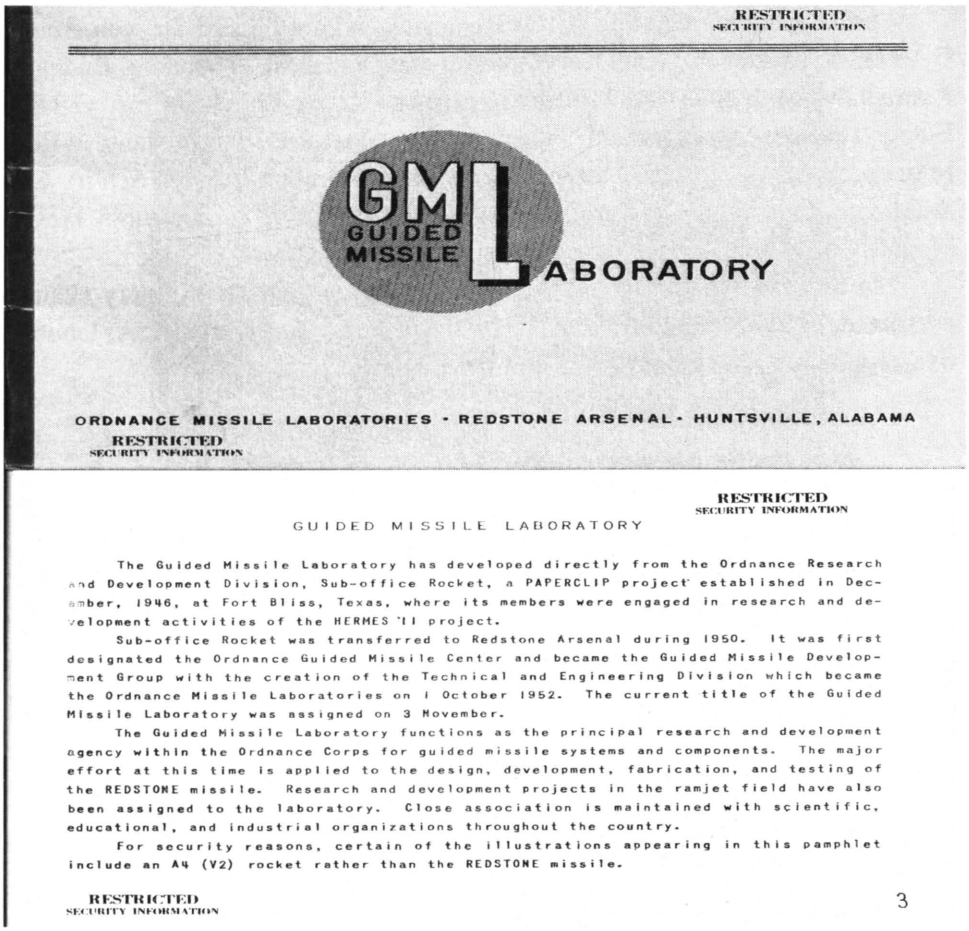


Figure 3–4: (left to right) Original Peenemünde V-2 engine; Replica V-2 engine developed by North American Aerophysics Laboratory (NAA); and 75,000-lb thrust original NAA Navaho engine subsequently used for Redstone missile. Credit: Rocket Research Institute, Inc., Archives.

With his suggestion, and the help of a number of other individuals, in September 1951, I was extremely fortunate to report to the U.S. Army, 9330 Technical Service Unit at Redstone Arsenal.

Figure 3–5: 1951 Entrance to Redstone Arsenal. Credit: Rocket Research Institute, Inc., Archives.



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SECURITY INFORMATION

GUIDED MISSILE LABORATORY

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GUIDED MISSILE LABORATORY

The Guided Missile Laboratory has developed directly from the Ordnance Research and Development Division, Sub-office Rocket, a PAPERCLIP project established in December, 1946, at Fort Bliss, Texas, where its members were engaged in research and development activities of the HERMES II project.

Sub-office Rocket was transferred to Redstone Arsenal during 1950. It was first designated the Ordnance Guided Missile Center and became the Guided Missile Development Group with the creation of the Technical and Engineering Division which became the Ordnance Missile Laboratories on 1 October 1952. The current title of the Guided Missile Laboratory was assigned on 3 November.

The Guided Missile Laboratory functions as the principal research and development agency within the Ordnance Corps for guided missile systems and components. The major effort at this time is applied to the design, development, fabrication, and testing of the REDSTONE missile. Research and development projects in the ramjet field have also been assigned to the laboratory. Close association is maintained with scientific, educational, and industrial organizations throughout the country.

For security reasons, certain of the illustrations appearing in this pamphlet include an A4 (V2) rocket rather than the REDSTONE missile.

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Figure 3–6: 1952 Guided Missile Laboratory classified visitor's brochure. Credit: Rocket Research Institute, Inc., Archives.

III. My Opportunity to Work Directly with Dr. von Braun

My assignment, as Corporal under Captain Hoy and Captain Merchant, was assistant technical editor and engineering liaison with my office directly next to Dr. von Braun.

Here I worked with Dr. von Braun and a number of his colleagues, including Kurt Debus, Eberhard Rees, and Hans Heuter on virtually a daily basis, in compiling and editing Redstone reports and other materials to ensure the technical and editorial integrity of the final manuscripts for progress reports submitted to Mr. Hoffman Burney, our chief editor, who formerly was with the *New York Times*.

I also worked, although not as frequently, with others of Dr. von Braun's German scientific and engineering associates including Theodore Buchhold, Konrad Dannenberg, Gerd Wilhelm De Beek, Krafft Ehricke, Ernst Geissler, Walter Häussermann, Gerhard Heller, Helmut Hoelzerer, Hans Maus, William Mrazek, Walther J. Riedel, Ludwig Roth, Martin Schilling, Helmut Schlitt, Ernst Stuhlinger, Johann G. Tschinkel, Adolf Thiel, and Dr. von Braun's brother, Magnus von Braun.

In addition, as requested by Dr. von Braun through the military chain of command, I was the research liaison between the engineering offices, laboratories, test areas and manufacturing facilities; and organized tours.

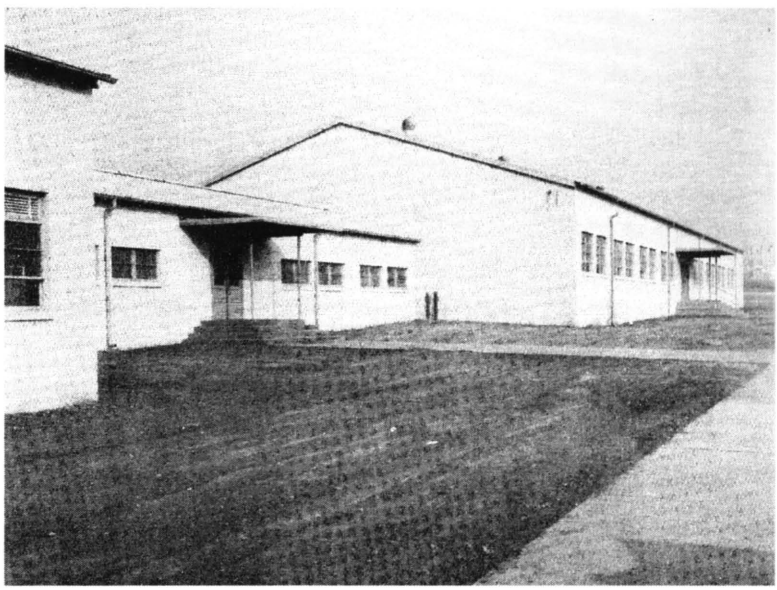

Figure 3–7: 1952 Headquarters Building for Dr. von Braun and Redstone engineering staff. Credit: Rocket Research Institute, Inc., Archives.

Dr. von Braun had a keen interest in all aspects of rocket propulsion. On one occasion, Friday, 4 June 1952, I accompanied him and several other members of his staff to Thiokol's Redstone Division, also located on a portion of the huge Redstone Arsenal. Thiokol had invited Dr. von Braun to witness one of the series of static test firings they were conducting in development of the RV-A-10 solid rocket motor.

The Thiokol project manager was Larry Thackwell, a former associate of JPL's Charles Bartley. Thackwell was continuing Bartley's 1945 JPL discovery and subsequent development of solid rocket propellants using Thiokol's LP-2 polysulfide compound as a binder and fuel.

Figure 3–8: General Medaris, Dr. von Braun, and General Toftoy who succeeded in bringing the Peenemünde team to the U.S. Credit: Rocket Research Institute, Inc., Archives.

In 1952, the RV-A-10 was the largest solid rocket motor under development. It was 31 inches in diameter, had an overall length of 14 feet, 4 inches, contained almost 5,000 pounds of propellant, and produced 32,000 pounds of thrust. This particular test firing was a great success.

We were all impressed. Dr. von Braun noted that this could well be a step in developing solid rocket motors for future space launch applications once thrust vector control and other guidance problems had been solved.

There had been doubts up to that time, among the U.S. military services that it was not practical to build large solid-fuel rocket grains, but the RV-A-10 proved beyond doubt that it was possible.

I was amazed at the amount of progress in the six years since my summer intern, assistant test mechanic, job at JPL. I had worked some of the time with Charles Bartley's staff in testing Thiokol polysulfide propellants, but then the maximum diameter of end-burning grains was perhaps six inches.

The RV-A-10, with its almost 31-inch diameter star-core grain, subsequently led the way to the much larger grains for missiles, such as the three-stage Minuteman ICBM, which were 5 feet, 5.7 inches in diameter and 244 inches long.

Back to the Redstone and our Peenemünde team. I was amazed at their sense of dedication to the job at hand. Even as division directors, if a test could only be scheduled late at night they were there. I remember late one evening ac-

companying Hans Maus, head of manufacturing, to some of the early aluminum welding tests for the Redstone body.

It also impressed me that many of the Germans, in addition to their engineering or scientific educational backgrounds, were also skilled musicians. If the workload allowed, on weekends they would have their own chamber music concerts at the Russell Erskin, Huntsville's only hotel.

It was enlightening to observe Dr. von Braun's managerial style during the weekly staff meetings at which I sat as an observer. Dr. von Braun would ask each of his division directors to briefly report on their progress and any problems that may have been encountered. After each had spoken, Dr. von Braun would begin discussing with each individual, in the order they had spoken, what that individual had reported and would suggest a possible approach to the problem so skillfully that the individual virtually thought that it was his own idea.

These meetings were a help to me in checking the technical completeness of the Redstone progress reports because having heard the discussions, when I was assembling the contributions to the monthly report from each division, I could always call the contributor of a specific section and suggest that he may have "forgotten" to mention a particular problem or solution that he and Dr. von Braun had discussed at the earlier staff meeting.

These staff meetings also were a help in producing the guide books and other special documents for the Guided Missile Laboratory as well as helping as an "on-the-job consulting editor" (using my American engineering and editing experience) for several of the Peenemünde group scientists and engineers in helping them prepare technical papers.

I particularly remember the discussions Krafft Ehricke and I had in the evenings when he visited my family at our Huntsville off-base home, while preparing his papers for astronautical journals, such as *Rocketscience*, *Journal of the Detroit Rocket Society*, and the publications of the British Interplanetary Society. As Marsha Freeman's excellent biography, *Krafft Ehrick's Extraterrestrial Imperative*,[15] mentions, Ehricke was Chief of the Gas Dynamics Section and carried out research on supersonic air-breathing propulsion systems at Redstone.[2]

Later in 1952, when the initial Army contract with the Peenemünde team expired and before the members of the team had the opportunity to became Army civil servants, Krafft Ehricke left Redstone to work at Bell Aircraft Company, in Buffalo, New York, with Walter Dornberger, the Peenemünde team's former commanding officer, on research for an early design for a space shuttle.

In 1954, Krafft Ehricke moved to Convair in San Diego where he worked on the Atlas intercontinental ballistic missile project and in 1957 designed the Centaur, the first liquid hydrogen/liquid oxygen upper stage rocket vehicle ever

to be constructed.[16] The Centaur, after an initial launch mishap, demonstrated in subsequent satellite launches aboard an Atlas first stage, the high energy advantages of liquid hydrogen as a rocket propellant, as had been predicted by the early space pioneers Tsiolkovsky, Goddard, Oberth[17] as well as the French pioneer, Esnault-Pelterie[18] thus confirming the early Pre-World II static test results conducted at Kummersdorf (pre-Peenemünde) by Walter Thiele;[19] the 1945–1950 Aerojet static tests and liquid hydrogen production developments[20] for a proposed U.S. Navy single stage to orbit satellite program;[21] and the Ohio State/ NACA liquid hydrogen research activities.[22,23] In preparing this paper I was pleased to learn that my fellow Korean War Redstone draftee, Dan Heald, following Redstone development, joined the Centaur development team at Convair.[24] In 1965 Krafft Ehricke moved to North American Aviation as chief scientist in the Space Systems Division and in 1979, he founded Space Global, a firm to pursue his advocacy of colonizing and industrializing the Solar System.

After I had returned to Aerojet, I heard several of Krafft Ehricke's enthusiastic public presentations in the San Francisco area in the late 1960s. I was impressed by the freedom that North American had given him to present lectures to technical and sold-out public audiences on space science, engineering, and his concept which he called the "Extraterrestrial Imperative," humanity's evolutionary need to explore space and ultimately establish space colonies and outposts on other planets in the Solar System.

When I expressed my enthusiasm after hearing one of Krafft Ehricke's talks, Rudi Beichel, a Peenemünde team member who joined Aerojet in 1956, said to me, "Most people talk about going to space. Krafft is in space."

My last opportunity to see and speak with Krafft Ehricke was 31 October 1984. I was working in Washington, DC, and attended the conference, "Lunar Bases and Space Activities in the 21st Century," sponsored by NASA and hosted by the National Academy of Sciences.

Although gravely ill from leukemia, Krafft Ehricke had flown to DC from his home in La Jolla, California, to give his presentation, "Lunar Industrialization and Settlement—Birth of a Polyglobal Civilization."[25] In that one speech he skillfully summarized, without having been there, what had been discussed in the previous two days. As he concluded, there was a standing ovation.

As he was getting into the car taking him back to the airport, he turned to me and said, "Mr. James keep working with young people," in regard to the student programs of the Rocket Research Institute. He passed away six weeks later on 11 December 1984—the loss of a great visionary and friend.

Going back to 1952 and the Redstone program, the high priority, secret classification, and planned expedited production schedule of the Redstone were

very necessary. In the second year of the Korean War complete air superiority over Korea could no longer be assured. "Loaned" Russian MIG fighters changed the balance. Consequently, if the delivery of a nuclear weapon were to have been authorized, the Redstone would have been the absolutely "MIG-Proof" method of doing so. All of us prayed in our hearts that such a need for the Redstone would never be necessary.

Among my outstanding memories of those days are those associated with the dynamic and inspirational leadership of Dr. von Braun in the day-to-day management of the Redstone program; his visions of the necessity of space exploration; and also of his interest, along with that of his colleagues, particularly Konrad Dannenberg, and Ernst Stuhlinger, in the extracurricular RRI student training and experiential rocket safety education programs. These brought back memories of their own youthful memberships in private rocket enthusiast groups long ago in their pre-war homeland.

Back in 1950, Dr. von Braun, soon after being transferred to the Redstone Arsenal for development of the Redstone, had decided not to develop a new liquid rocket engine, but instead, so as to save development time and funds, to purchase an engine already being tested at the North American Aviation (NAA) Aerophysics Laboratory Division (renamed Rocketdyne in 1956). This engine was being developed for the Air Force MX-770 Navaho missile by Walter Riedel, Konrad Dannenberg's former boss at Peenemünde, who joined NAA for this project.

This was why Dannenberg had become Redstone Liaison Engineer between Redstone and NAA's Rocketdyne Division. After the first Redstones had been produced at Redstone Arsenal, he was also responsible for production of the Redstone and Jupiter missile systems for the ABMA at the Chrysler plant in Detroit, Michigan.

Initially Redstone Arsenal lacked many test facilities. I well remember how Corporal Dan Heald (mentioned above), a fellow enlisted man and draftee, assigned to work with Konrad Dannenberg, would, on liaison trips back to NAA, slip experimental carbon jet vanes for the Redstone in his luggage. When back at NAA, those vanes, unbeknownst to the Santa Susanna test stand operators, would be tested under the exhaust of experimental Air Force engines.

Also Dr. von Braun, whose exposure to the United States had been quite limited principally to Fort Bliss, Texas, and Huntsville, Alabama, was very pleased to be met at LAX in Los Angeles by Rocketdyne representatives, particularly Sam Hoffman, Rocketdyne President for planning meetings.

In 1960 Dannenberg became Deputy Manager of the Saturn program at NASA's newly established Marshall Space Flight Center. There, even though in the midst of Saturn development, he still had time to encourage young people.

As one example, he reviewed and helped Richard Bennett, a summer-intern student at Marshall, forward Richard's own proposal to NASA Headquarters. Richard's 1966 proposal was for development of a nationwide series of supervised static rocket test sites for students, similar to the RRI Perkins Rocket Safety Test Center near Sacramento. Richard, a former president of the RRI Sacramento Rocketeers, had won his summer job at Marshall through being a National Science Fair Winner.

Mr. Dannenberg received the NASA Exceptional Service Medal in 1973 "for successfully initiating development of the largest rocket ever built, the Saturn V, which took the first human beings to the Moon." Upon retirement in 1973, he became an Assistant Professor of Aerospace Engineering at the University of Tennessee Space Institute, UTSI, in Tullahoma, Tennessee.

He passed away on 16 February 2009. As part of the tribute on his passing, the *Huntsville Times* said:

> He helped create the Moon rocket, but was most proud of teaching kids. Yes Konrad played a huge role in creating the rocket that took man to the Moon. But he served an equally important function in motivating future engineers and astronauts as a lecturer at Space Camp for years after his retirement from NASA.

Figure 3–9: Copy of *Collier's*, 22 March 1952, cover with painting by Chesley Bonestell. Credit: Rocket Research Institute, Inc., Archives.

Occasionally, Dr. von Braun and I would discuss the problems of increasing the enthusiasm of the American public in regard to the potentials of space and its exploration. My office was on the other side of a glass partition from von Braun's. Sometimes, I would see him on the phone with *Collier's* magazine. They had to call him because our Army phone budget was so limited that we could not call out without special permission from Redstone Headquarters.

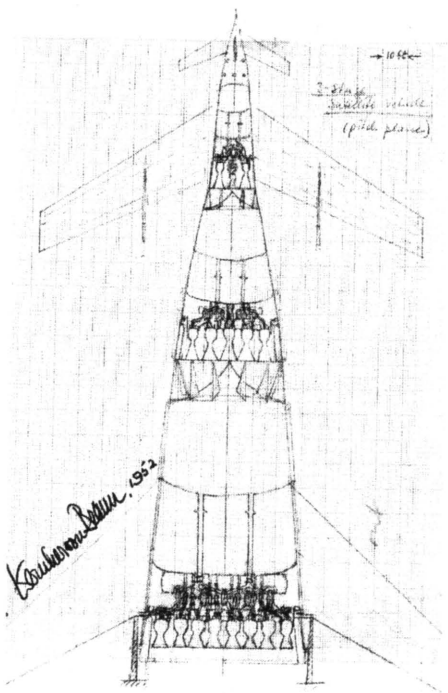

Figure 3–10: Dr. von Braun's sketch, early 1952, prepared during non-office hours. Credit: Rocket Research Institute, Inc., Archives.

On 22 March 1952, the first of Dr. von Braun's famous series of articles appeared in *Collier's*, "Man Will Conquer Space Soon." However, the immediate reaction to this monumental issue of *Collier's* on 1952's agriculture-oriented Huntsville's community of readers was minimal to say the least. Dr. von Braun was discouraged that such an extensive publication effort met with so slight an immediate response on the part of the "local American public" in Huntsville and also in some other non-aerospace parts of the country.

With his concurrence, quick assistance from the RRI Headquarters staff in Glendale, California, as well as support from the Redstone Arsenal photo lab, and Mr. de Beck, head of the Redstone engineering graphics section, I helped organize on 26 March 1952, a public meeting of the Alabama Section of the

American Rocket Society as sort of a "morale boost." With Dr. von Braun in attendance, I gave, at his suggestion, a paper and slide and motion picture presentation, "Space Travel and the Rocket Society," based on many of his and my earlier discussions.

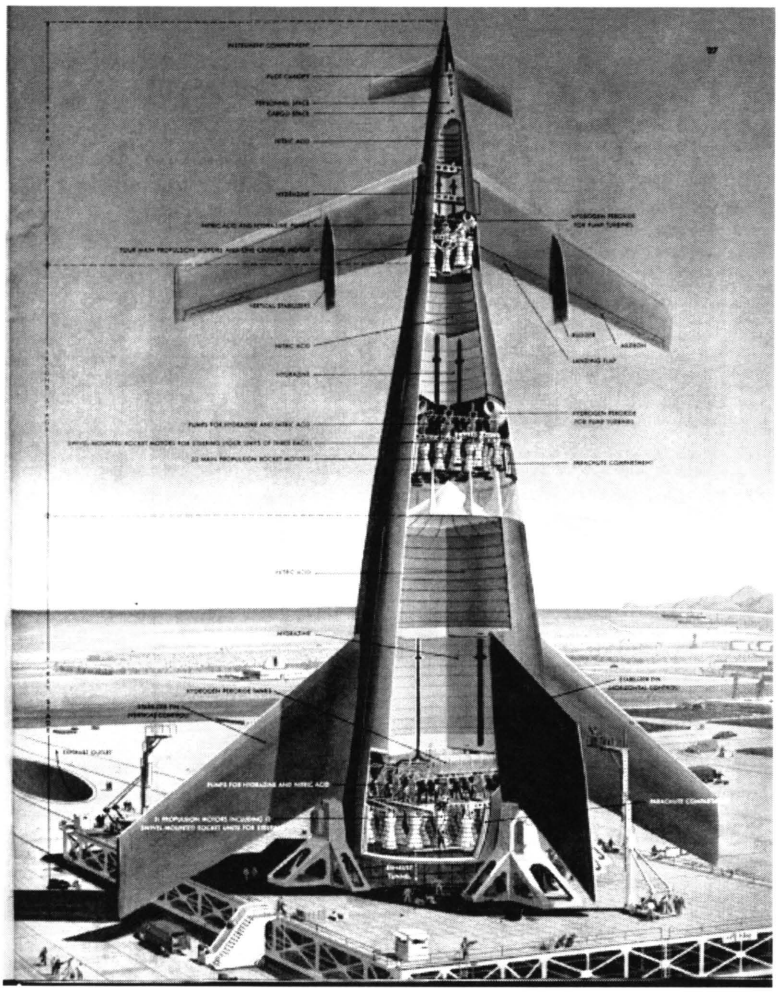

Figure 3–11: Rolf Kleps interpretive painting for *Collier's*. First stage 14,000-ton thrust. Rocket 265-feet high. It would deliver 36.5 tons of payload to orbit. Credit: Rocket Research Institute, Inc., Archives.

My presentation advocated that, based on the early work of the American Rocket Society and the Rocket Research Institute,

> The present dozen or so civilian rocket societies must be supplemented by hundreds of additional rocket societies which can act as centers of space flight information and education throughout the country.

These groups should further the excellent start given Dr. von Braun's "Project Satellite" in magazines by holding meetings devoted to space travel; by arranging exhibits with museums and planetariums; by conducting night-school classes in which the fundamentals of rocketry, space travel, astronomy, and related subjects are taught; and by carrying out student-level small scale supervised rocket research training programs.

By means of these programs, the Nation's future rocket scientists and technicians, today's high school and college students, will have an opportunity to apply what they are learning in school to the design, construction, and launching of small liquid and solid propellant rockets. By the time students in these programs are ready to begin their careers at the rocket research centers in the United States, they will have the substantial practical as well as the theoretical background so necessary for this new science.

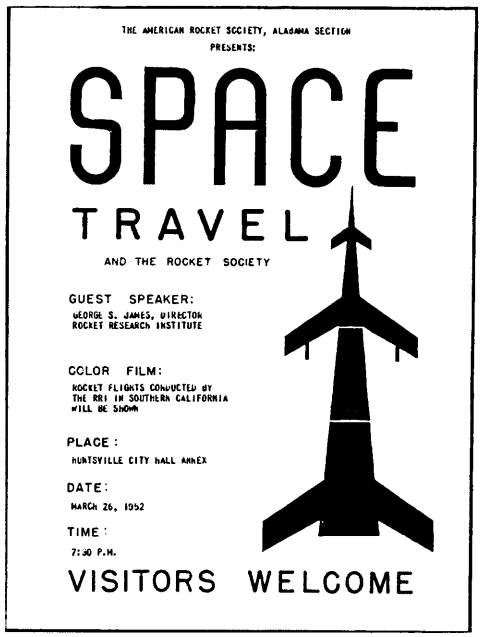

Figure 3–12: Poster for the Alabama Section of the American Rocket Society, March 26, 1952, meeting organized with the concurrence of Dr. von Braun to build upon his concepts. Credit: Rocket Research Institute, Inc., Archives.

Now, over 60 years later, some of these concepts are common practice in organizations such as the National Space Society (founded by Dr. von Braun as the National Space Institute); the NASA Science, Technology, Engineering, and Mathematics (STEM) educational programs; the Rocket Research Institute's Advocacy for Space Research and Education program; and many other space-science-related education programs throughout the world.

Page 3—THE HUNTSVILLE TIMES—Sun., Mar. 23, 1952

SHOW CALVES — Mary Emily Reynolds (above), of Madison Cross Roads is shown with calves she will show in the county and district events here in April. The Hereford calf was won as a prize for her showing of the champion last year. She is a 4-H club member.

Congress To Pass Aluminum Pacts

Body Must Approve Any Long-Term Agreement, Declares Fleischmann

WASHINGTON, March 22 (AP)— Any long-term agreement to buy aluminum from Canada will be submitted to Congress for approval, says Manly Fleischmann, Defense Production Administrator.

Sen. Fulbright (D-Ark.) who questioned Fleischmann about the aluminum program, called this statement reassuring.

Fleischmann yesterday was before the Senate Banking committee which is studying an extension of the Defense Production Act, when Fulbright brought up the subject of aluminum.

Fleischmann said two propositions were under consideration: (1) A further expansion of domestic production and (2) a long-term agreement to buy aluminum from Canada.

Meanwhile, he said, "We haven't made any commitment of any kind to Canada."

Fulbright asked whether any long-term agreement would be entered into to buy aluminum from Canada without Congress first approving it. Fleischmann said both he and Defense Mobilizer Charles E. Wilson felt any such agreement should be submitted to Congress.

The Aluminum Company of Canada (Alcan) has offered to ship 1,764,000 tons in the years of 1953-59. Under the proposal, this country would have a call on a specified percentage of the company's production when the metal is in short supply.

Decatur Man Is Named Broadcasting Director

BILOXI, Miss., March 22 (AP)— New officers were elected today by the Alabama Broadcasters Association at its annual convention here.

Thomas Martin Montgomery was named president. Malcolm Street, Anniston, was chosen vice-president and Mrs. Wilhelmina Doss, Tuscaloosa, secretary.

New directors are Frank Wisenant, Decatur; Robert Davidson, Talladega, and Joseph Matthews, Montgomery.

The group announced it will hold its Autumn meetings at the University of Alabama.

In Arctic rescue work, the Air Force has successfully parachuted dogs in tests to aid "stranded" men.

The Manchus conquered China in the 17th Century.

George James Set For Rocket Talk

Von Braun's Assistant To Describe Civilian Role In Space Travel

The part civilian organizations must play in bringing about space travel will be described by George S. James, director of the Rocket Research Institute, and illustrated with color movies and slides at a meeting of the American Rocket Society to be held on March 26th at 7:30 p.m. at the City Hall annex.

Mr. James will point out that, although the government and industry can finance a satellite station program, civilian rocket societies must accept the task of giving preliminary training to the thousands of new technicians necessary for the projected "Project Satellite" outlined in March 22, 1952 issue of Colliers magazine by Dr. Wernher von Braun, technical director of the Army Ordnance Guilded Missile Development Group in Huntsville.

On leave of absence as director of the RRI, Mr. James is serving a two year hitch in the U.S. Army and is assistant technical editor of Dr. von Braun's group.

"The present dozen or so civilian rocket societies must be supplemented by hundreds of additional rocket societies which will act as centers of space flight information and education throughout the country. These groups should further the excellent start given "Project Satellite" in magazines.

"When the American public know as much about rockets as it now knows about airplanes, space travel won't be far off," Mr. James said.

By means of slides, Mr. James will trace the history of the rocket engine from the early efforts of the American rocket pioneer, Dr. Robert H. Goddard, through the second World War to the present, where a sufficient rocket engine technology exists to construct a space station.

Color films will be shown of the activities of the Rocket Research Institute.

George S. James was born in Los Angles, California and is 23 years old. He studied chemistry at Glendale college and the University of California at Los Angles. He is married and has two children. Prior to being inducted into the armed forces, he was employed at the Aerophysics Laboratory of

U. S. Army Photo

ROCKET LECTURER—George S. James, assistant technical editor at Redstone arsenal, will speak on the part civilian societies will play in the conquering of space. He is on a leave of absence as director of the Rocket Research Institute, which is the outgrowth of a small Southern California rocket society, founded in 1943 by Mr. James.

Kiwanis Program About St. Patrick

A St. Patrick's program was given Friday night at the meeting of the Kiwanis club at the Russel Erskine hotel.

Lester Sparks, member of the extension committee, told the history of St. Patrick. Mrs. Kenneth Thomas sang two Irish songs. Boyd Turner and the Rev. O. B. Sansbury of Scottsboro both gave humorous talks.

Guests were two visiting Kiwanians, Frost Dennis of Martinsburg, W. Va., and Ed Demasky of the Ferndale club in Detroit.

The meeting next week will be at the Central Presbyterian church, and the program will be in charge of the vocational guidance committee.

North American Aircraft, Inc., Downey, California and worked on military rocket projects. He is the author of the handbook "Rocket Building for Modelers".

Figure 3–13: The *Huntsville Times,* March 23 Announcement of American Rocket Society Meeting. Credit: Rocket Research Institute, Inc., Archives.

However, because of today's present global security situation, the U.S. Department of Homeland Security has virtually eliminated one of Dr. von Braun's and my enthusiasms: that of adult-supervised student rocket propulsion development programs and has limited experiential activities to the launching of commercially manufactured model rocket and high-power rocket motors.

It was very fortunate that the *Collier's* series did catch the attention of Walt Disney and his associates. As a result, Dr. von Braun served as technical advisor

on three space-related television films that Disney produced in the 1950s. Together, Dr. von Braun and Disney used the new medium of television to illustrate how high man might fly on the strength of technology and the spirit of human imagination. According to Wikipedia, when the first film "Man in Space," was broadcast on 9 March 1955, it drew 42 million viewers and unofficially was the second highest-rated television show in American history up to that time.

On 22 September 1952, I received my honorable discharge from the Army and switched my same job to the U.S. Civil Service. With this change in my status from an Army Corporal to a GS-9 civil servant, I was given much more responsibility and I received far more engineering liaison assignments directly from Dr. von Braun.

Initially, when the bidding process started for the production of the Redstone, I noticed that we always had a British person there. I quickly learned that this was Dr. von Braun's brother, Magnus who had such an "English accent" when speaking "American."

The military procurement process was finally completed and Chrysler was awarded the prime production contract for beginning Redstone missile and support equipment production at the newly renamed Michigan Ordnance Missile Plant in Warren, Michigan. However, the first Redstones still had to be constructed at the Arsenal because of delays in converting the Chrysler Michigan plant.

In 1955, Magnus von Braun left Huntsville and began a career with Chrysler—first in the Redstone production division in Michigan and then in the Chrysler automotive division. After living in Michigan, he relocated to the UK, working in London and Coventry as Chrysler UK exports director. He retired from Chrysler in 1975 and settled in Phoenix, Arizona. He passed away on 21 June 2003.

In December 1952, our first Redstone was about to be completed and needed to be statically tested at the Arsenal. This event was not to be as straightforward as we had thought. Army Ordnance still had a V-2 static test stand at White Sands and was insisting that the first Redstone be trucked to White Sands for static firing tests.

Dr. von Braun succeeded in having the Army Ordnance request overturned. So, all of us were now looking forward to seeing the first static test of a completed Redstone on the interim jury-rigged static test stand then under construction by Arsenal personnel.

I was not to see that first static test. Early in December 1952, I received an unexpected notice. My scholarship had been accepted to study with the American architect Frank Lloyd Wright at his School of Architecture near Phoenix, Arizona.

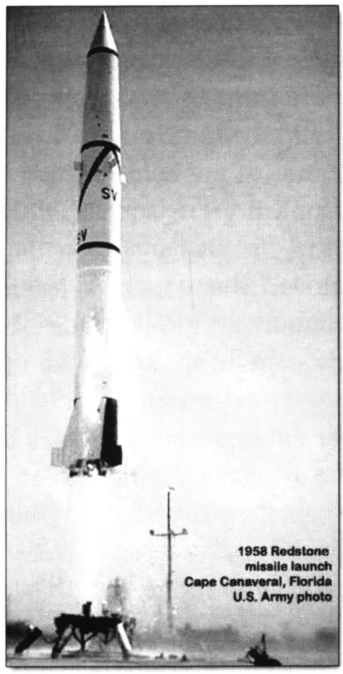

Figure 3–14: Typical Lift-off of Redstone. Credit: Rocket Research Institute, Inc., Archives.

Figure 3–15: Redstone missile following deployment in 1958. Credit: Rocket Research Institute, Inc., Archives.

Earlier in 1950, I had heard Mr. Wright speak at UCLA. I was fascinated to learn how he was uniquely applying modern technology to create residences that were in harmony with nature (now called sustainable) for families in beautiful environmental settings. Obviously in early 1950, I had no idea of the coming Korean War, starting in June, nor of my being drafted in September 1950. Consequently, I optimistically applied for a scholarship from Mr. Wright's unique school.

It was a very difficult decision to make in leaving such a dedicated and devoted team consisting of not only the Peenemünde group but also my fellow military and civil service workers to begin study with Frank Lloyd Wright, considered by many the greatest American architect.

My decision to leave the Redstone team was upsetting to Dr. von Braun, "Why do you wish to leave us to study with such an old man?" Mr. Wright was then 84 and was still designing and constructing some of his most significant buildings, such as the Guggenheim Museum in New York City, the Price Tower in Oklahoma, and a great number of residences.

Later, after receiving my letter of recommendation from Mr. Wright at the conclusion of my scholarship, I returned to California and went back to work at Aerojet, with the encouragement of Dan Kimball, the Aerojet President, who remembered me from the summer job I had there in 1949.

However, I continued working, as spare time allowed, with Mr. Wright on some of his California construction projects until his death in 1959.

Years later, I saw Dr. von Braun at a meeting. He was quite friendly and said, "I now understand, Mr. James; we will need architects on the Moon."

In 1956, Aerojet, in the Sacramento area, was in the midst of an industrial rocket expansion effort with the development of both liquid and solid propellant systems for ICBM and IRBM programs. Hundreds of newly graduated engineers were being hired, none of whom had any rocket engineering experience.

The RRI, with the approval of Aerojet, began an extracurricular SPARK (Special Project Altitude Rocket Knowledge) liquid rocket training program[26] for these engineers to develop a 400-lb thrust liquid oxygen/alcohol rocket flight vehicle, under the after-hours guidance of Ed Neu, who was heading one of the Titan I tubular thrust chamber development groups. Ed came to Aerojet from Reaction Motors, (RMI), and while there, had developed the liquid rocket engine for the X-I supersonic aircraft that first broke the sound barrier.

However, by spring 1957, we realized, because of the high work priority of the Titan ICBM program at Aerojet,[27] and consequently the lack of sufficient off-hours spare time by those also participating in the after-hours SPARK development program,[28] that the RRI could not commemorate the start of the extremely

significant International Geophysical Year (IGY) with the SPARK's launch as planned. We had optimistically announced this in 1956 at the International Congress of Rockets and Guidance in Paris, France.[29] However, we still could commemorate the 1 July 1957, IGY with a rocket mail fundraising flight, as the RRI had done previously.[30]

In preparing the publicity campaign for this rocket mail demonstration, we found that the non-governmental launching of cargo carrying rockets was no longer quite the news-making event as had been the case for the previous RRI demonstrations in 1947, 1948, and 1950. Public interest in rocketry and space had not even been raised by the 11 June 1957, *New York Herald Tribune Service* article, "Russ 'Moon' Launching Due Soon. The Soviet Union plans to launch its first earth Satellite in the next few months."

Consequently, I wrote a letter to Dr. von Braun at Redstone. By 1956 his organization had become the Army Ballistic Missiles Agency (ABMA). I commented on the decreased public interest in rocket flights and included some publicity sheets on our planned RRI rocketpost. He graciously replied:

> Dear George: I have your letter telling of the rocket flight from Nevada to California jointly commemorating the start of the International Geophysical Year and American School Teachers. The descriptive pamphlets and order forms for Commemorative Rocket Flight IV were disseminated to various members of our staff here. Thank you for your interest and good luck with your venture. Sincerely yours, Wernher von Braun, Director, Development Operations Division.

At the start of the IGY, Monday, 1 July 1957, a total of 5,000 commemorative envelopes were flown by five RRI Micrograin cargo rockets a distance of one-and-one-quarter miles from Douglas County, Nevada, to Topaz, Mono County, California, in what was, at the time, the world's largest transport of rocket mail.[31] Each 120-pound, fourteen-foot long by three-inch diameter rocket carried 1,000 special covers in its three fins for astrophilatelic collectors. We received a good amount of newspaper coverage of this rocket mail event.

It came as a surprise six weeks later, when an Associated Press article on 13 August 1957, said the following: "Report Says Army Sends, Receives 'Rocket Letter.'" The account went on to say:

> The Army is reported to have sent and received the first letter ever carried by rocket. Army officials said they could not confirm or deny the report. The mail carrying rocket had taken off from Patrick Air Force Base, Florida, last Friday, ascended to an altitude of several hundred miles and landed in the ocean about 1200 miles from the mainland. A small cylinder holding the letter was reported to have been ejected toward the end of the rocket flight and to have landed near where Army technicians had predicted it would land.

The letter was reportedly retrieved from the cylinder and flown back to the mainland. Asked for details, an Army spokesman said, "no comment," adding that a Defense Department order prohibits any service from officially reporting the performance of new missiles launched from the Florida test base.

The purpose of the test was reported to be a demonstration of the accuracy and control of the Jupiter ballistic missile, which the Army had been testing for many months.

The letter was said to have been addressed to Major General John B. Medaris the Army's Ballistic Missiles Chief. Medaris was reported to have endorsed it after it was retrieved and forwarded the cover to General Maxwell D. Taylor, Army Chief of Staff.

Years later more information was released. The rocket mail letter had been flown on Jupiter C-40. It was addressed to Major General Medaris and had been signed by Dr. Kurt H. Debus,[32] with whom I worked during my tour of duty at Redstone, and who was Dr. von Braun's "right-hand man."

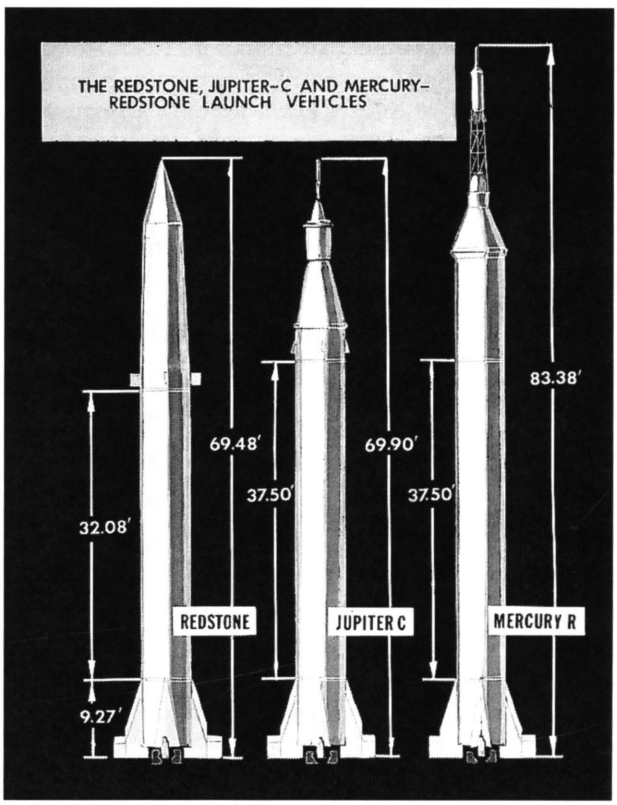

Figure 3–16: Redstone and Follow-on Jupiter-C; and Redstone Mercury. Credit: Rocket Research Institute, Inc., Archives.

Somehow, I never took the time during my years at Aerojet to follow up on the newspaper account and ask Dr. von Braun if perhaps my letter and announcements of our 1 July IGY flight had sparked the memory perhaps of some of his team to remember Friedrich Schmiedl's experiments which took place at the time many of the Peenemünde Group were students in Germany, and consequently they had decided to add a rocket mail letter to the Jupiter.

On 4 October 1957, *Sputnik*, the first artificial satellite, was launched by the then U.S.S.R. Soon, American newspaper and magazines began publishing accounts about how great numbers of students, nourished by the excitement and controversy accompanying the launch of *Sputnik*, had begun rocket and space projects of all descriptions.

Suddenly, literally hundreds of high school and college "rocket societies" were being founded throughout the United States and other nations. The civilian rocket societies Dr. von Braun and I envisioned, during my Redstone time had begun to form.

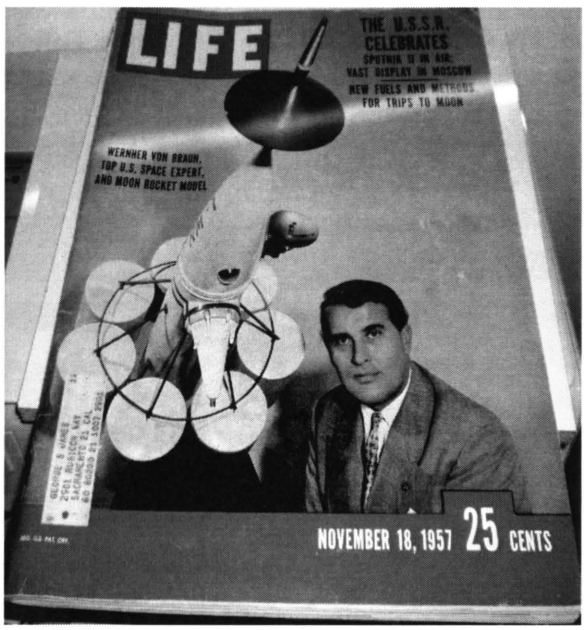

Figure 3–17: Copy of 18 November 1957, *LIFE* Magazine Cover showing Dr. von Braun with Moon rocket model. Credit: Rocket Research Institute, Inc., Archives.

Unfortunately, many of these groups were starting experimental rocket propulsion programs without the properly qualified supervision, guidance, equipment, and facilities that I had called for in my paper five years earlier.

Tragically, some of these new groups had the catastrophic accidents that the word "amateur" implies in its most negative connotation.

These accidents prompted the RRI in December 1957, to begin the National Rocket Safety Registry Program (NRSR), for safety guidance. This creation of the NRSR service was a logical evolution of the Institute's preceding 14 years of safety and educational training device and program development. The Aerojet-General Liquid Rocket Plant provided great assistance and support in the first decades of the NRSR program. Few other aerospace companies had as great an understanding as Aerojet of the need among young people and educators for adult-professionally-supervised extra-curricular safe experiential activities.[33,34]

For education programs to be successful, the educator most knows more than the pupil. In the first months of the Space Age, in many cases, this was not so. Youngsters were complaining that their high school instructors "do not know enough about rockets to help us."

Consequently, on 1 March 1958, the RRI conducted the first rocket safety workshop in the United States to supplement teacher's basic understanding of the rocket sciences, at Elk Grove High School in Elk Grove, California. It was sponsored by the school districts of Sacramento and San Joaquin Counties with the encouragement of the California State Department of Education. Over 100 science teachers attended this all-day event.[35]

Typical of Dr. von Braun, regardless of how busy he was, he never ceased reaching out to inspire young people interested in space exploration. Throughout his life he maintained his interest in RRI's student activities. During the happy and hectic time immediately after the *Explorer I* launch, on 31 January 1958, he approved the use of a letter he had written to Robert Gliebe, a member of the RRI-sponsored Sacramento Rocketeers, "Preparation for a Career in Astronautics,"[36] to be included in the 1958 RRI training manual for the Elk Grove rocket safety workshop.

The new RRI safety manual, *Rocket Building for Students*, specifically prepared for the workshop participants, was based upon the Institute's background of safety procedures and training device development. The lectures, demonstrations, and launchings of rockets assembled by the teachers were enthusiastically received. Some of the demonstration devices, such as the small carbon dioxide "seltzer bottle" cylinder guideline racers, were constructed by the teachers.

On 1 July 1960 ABMA was transferred to the newly established NASA. Dr. von Braun was appointed Director of the now named NASA Marshall Space Flight Center and continued the development of the Saturn.[37]

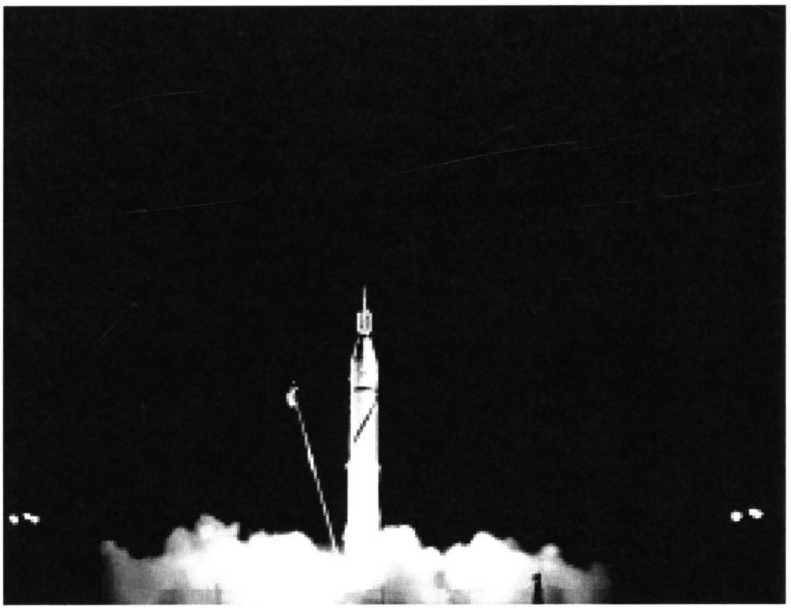

Figure 3–18: Night launch photo of *Explorer I* on 31 January 1958. Credit: Rocket Research Institute, Inc., Archives.

Figure 3–19: (left to right) Dr. William H. Pickering, Dr. James Van Allen, and Dr. von Braun celebrating launch and orbiting of *Explorer I* holding replica in Washington, DC. Credit: Rocket Research Institute, Inc., Archives.

At Rice University in Houston, Texas, on 12 September 1962, President John F. Kennedy delivered his speech on the "Nation's Space Effort," or better known simply as the "We choose to go to the Moon" speech. It was one of President Kennedy's earlier speeches meant to persuade the American people to support the effort of NASA to send a manned spaceflight to the Moon.

I was pleased that Aerojet's contributions to the NASA Apollo program would include, for each Moon launch vehicle, the AJ-137 storable liquid rocket 20,000-lbf service module propulsion system, SPS, along with sixteen 100-lbf bipropellant reaction control system (RCS) thrusters on the LEM and sixteen on the service module.[38]

Figure 3–20: Author examining replica of Jupiter-C upper stages and *Explorer 1* in lobby of von Kármán auditorium at JPL. Credit: Rocket Research Institute, Inc., Archives.

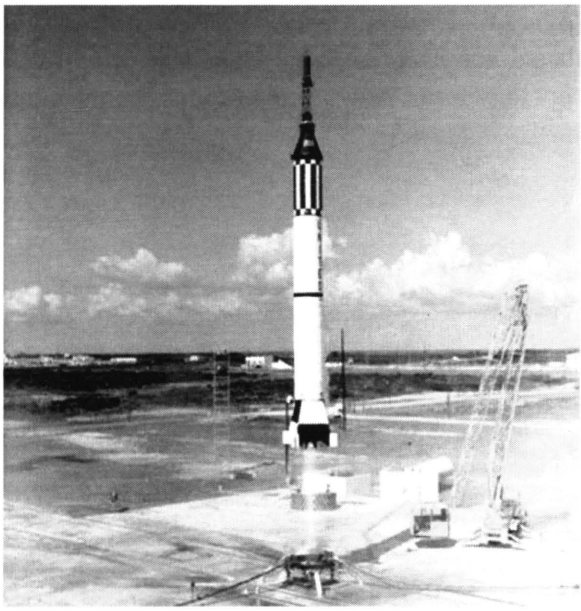

Figure 3–21: Launch of Alan Shepard aboard Redstone Mercury on 5 May 1961. Credit: Rocket Research Institute, Inc., Archives.

Figure 3–22: Circa 1968. Dr. von Braun holding Rocket Research Institute steam rocket at RRI Booth at Pan Pacific Auditorium, Los Angeles. The system was developed for student payload launches under a cooperative program with Robert Truax to develop safe rocket launch systems for students. Credit: Rocket Research Institute, Inc., Archives.

Rudi Beichel contributed to the Apollo Service Module engine and to other Aerojet engines including those for the Titan I and Titan II, in addition to the subsequent conversion of the Titan I engine to operate on liquid oxygen and hy-

drogen, and to Aerojet's large million-lb thrust M-1 engine. Rudi pioneered the high pressure staged combustion cycle, known as the "Beichel Cycle," which was the core technology for NASA's Space Shuttle main engines.

I remember Rudi for his direct but logical management style. Once, I attended a meeting in Rudi's office where he had invited two other engineers. For anonymity let's say Mr. Smith and Mr. Jones. Mr. Smith had been very actively proposing a revolutionary method for manufacturing injectors for liquid rocket engines. Rudi turned to Mr. Smith and said, "Mr. Smith, your injector concept is accepted and you are assigned to the project. However, Mr. Jones will be your project manager because you are an enthusiast." Rudi formally retired from Aerojet in 1978. However, he continued to serve as a consultant to Aerojet, the U.S. Air Force, and NASA until his death on 25 October 1999.

On 16 July 1969, the Saturn V launch vehicle launched the *Apollo 11* capsule, sending three American astronauts—Neil Armstrong, Buzz Aldrin, and Michael Collins—on their inaugural mission to the Moon. Four days later, on 20 July, Neil Armstrong stepped off the Apollo Lunar Excursion Module (LEM), known as *Eagle*, and declared those first footsteps "one small step for [a] man, one giant leap for mankind."

That evening, I and members of the RRI staff huddled in the dark at the edge of Pyramid Lake, near Sparks, Nevada, around a small portable television set watching Neil Armstrong make the first step on the Moon.

I thought how proud Dr. von Braun must have been and appreciative of the thousands of people who helped make his dream come true. As soon as Buzz Aldrin stepped down to also touch the Moon, we launched our 14-foot long, 3-in diameter RRI cargo rocket at 9:10 PDT, which carried 2,200 special envelopes to commemorate the successful landing on the Moon of *Apollo 11* for collectors.[39,40]

Dr. von Braun was transferred to NASA Headquarters in Washington on 1 March 1970, and was sworn in by NASA Administrator Tom Paine on 13 March. His new title was Deputy Associate Administrator for Planning.

In October 1971, as Chairman of the American Institute of Aeronautics and Astronautics (AIAA) National History Committee, I had another opportunity to assist Dr. von Braun, while I still was at Aerojet. I worked with Dr. Eugene Emme, head of the NASA History Office, to organize "Rocketry in the 50's," the history session that Dr. von Braun chaired at the 28 October 1971, of the AIAA Annual Convention at the Sheraton Park Hotel in Washington, DC.[41]

The speakers and their topics were: Milton W. Rosen, "Viking and Vanguard"; Samuel K. Hoffman, "Rocket Engines in the 1950s"; Admiral William F. Raborn and Admiral Thomas Rudden, "Polaris"; General Bernard A. Schriever, "Thor, Atlas, and Titan"; William R. Lucas, "Redstone, Juno, and Jupiter"; Wil-

liam H. Pickering, "Explorers and Pioneers"; General Samuel C. Phillips, "Minuteman"; and John L. Sloop, "NACA High Energy Thrust."

Figure 3–23: Rocketry in the 1950s. American Institute for Astronautics and Aeronautics Panel Discussion on 28 October 1971, AIAA Annual Convention, History Committee Session, Sheraton Park Hotel, Washington, DC, organized in cooperation with Dr. Eugene Emme, NASA Historian. Presenters and topics (left to right) William R. Lucas, Redstone, Juno, and Jupiter; Sam Hoffman, Rocket Engines of the 1950s; Admiral William Raborn, Polaris; George James; Chairman of the AIAA History Committee; General Bernard A. Schriever, Thor, Atlas, and Titan; Dr. von Braun, Panel Chairman; Dr. William H. Pickering, Explorers and Pioneers; Milton W. Rosen, Viking and Vanguard; Admiral Thomas Rudden, assistant to Admiral Raborn; and General Samuel C. Phillips, Minuteman. (Photo by Bruce Frisch). Credit: Rocket Research Institute, Inc., Archives.

In his introductory comments to begin the session, Dr. von Braun said:

> We are meeting here today for a special occasion. By asking leading men in various areas to speak freely about their unique experiences, we hope to deepen better understanding about the history of rocketry in the 1950's. It certainly does no harm in re-creating the seminal circumstances of the 1950's, which led us into the spectacular 1960's and the great concerns we now have for the 1970's.
>
> It is no historical accident that the so-called 'missile age' and the 'space age' came into being about the same historical time. The evolution of rocket technology advanced quickly in the 1950's. It seems difficult now to recall that 1953 was the first year that the United States government spent as much as a billion dollars on missiles.

The coming of the IRBM's, ICBM's, and Sputnik triggered an escalation of modest effort in which most of us had been involved in for many years. How did all this come about? What were the big problems? Who really made things move? And where could mistakes have been avoided? These are some of the questions that may get viewed today in a clearer light.

We are going to hear from each distinguished member of our panel who will try to capsule into a few words the highlights, problems, or other less well-known aspects of his particular experience in the historical evolution of rocketry.

Each, we hope, will give us a sense of how it really was before the families of practical boosters finally evolved. No one person knows the full story so that it is expected that each member of the panel will have further comment or questions after all gentlemen have given their initial presentations.

And I must say that personally I'm going to be very interested in what some of these chaps are going to say. Remember, several of them were my intense competitors at one time or another and we did not always candidly exchange views. But for me it is also a foregone conclusion that without the contributions of every one of them we would not have landed men on the Moon.

I see many old friends in the audience who may have further questions or comments to make from the floor which we hope to entertain before we conclude our program.

I would like to ask that each panelist confine his opening remarks to 10 minutes or so which, as I figure it, means that we have a total of about 80 minutes for the panel presentation, or about one minute per billion dollars.[42]

This was the first time that a public audience had heard in one session from all the leading individuals who had led the development of the United States missile and space systems that have lead to the Apollo Moon landings, the Space Shuttle, and the International Space Station.

A lively discussion followed the presentations including questions from distinguished members of the audience as well as the public.

This history session was the last time I had an opportunity to work directly with Dr. von Braun.

Two months later I was back in Washington, DC. Aerojet gave me a one-year leave of absence to work at the Smithsonian National Air and Space Museum, NASM, as Technical Coordinator, with Fred Durant and Mike Collins, the Director, on the "Feasibility Study of an Aerospace Museum in the Western United States" for the U.S. House of Representatives, Ninety-Second Congress and NASA. The California Congressional Delegation wished that the National Air and Space Museum should be in California rather than Washington, DC.

Figure 3–24: Dr. von Braun, as NASA Deputy Assistant Administrator for Planning, March 1, 1970. Credit: NASA.

Our study proved otherwise, and in 1976 the new NASM was dedicated by President Gerald Ford on Independence Avenue in downtown Washington, DC. Finally, the residents of the East Coast could see a complete V-2 engine, which Fred Durant had obtained from NASA for the NASM's "Precursors to Space Gallery." Also, in the Gallery were the Aerojet Titan engines and JATOs that I had assembled for Aerojet's Vice-President Bill Gore to donate in 1968.[43]

However, in March 1972, three months into the study, once again my future was changed. Aerojet called to say my leave had been cancelled because the contract for the Space Shuttle main engines had been awarded to Rocketdyne rather than Aerojet, "Lots of luck in Washington." After 18 years at Aerojet, employment ended with one phone call.

But, once I had completed the NASM study in 1973, luck did play a role. Friends at the NASM helped me get a job at the National Science Foundation with Jay Holmes, who in the early Apollo days had worked for Dr. von Braun at NASA.

Dr. von Braun resigned from NASA on 26 May 1972, and on 1 July 1972, became Vice President for Engineering and Development at Fairchild Industries, an aerospace company in Germantown, Maryland.

He died on 16 June 1977, of pancreatic cancer in Alexandria, Virginia. At his memorial service at the National Cathedral in Washington, I mourned the loss of this great visionary human being, among a number of the original Peenemünde group who attended the service. It brought back such memories to see Dr. Ernest Stuhlinger and Eberhard Rees and have them greet me as "Corporal James."

Memories of those days, working with such a forward-thinking and enthusiastic person as Dr. von Braun and also working with his associates, have remained with me as lifelong examples, enriching every subsequent position I have held in my career.

Dr. Stuhlinger later wrote in a memorial article, "Dr. von Braun was once asked, 'What does it take to travel to the Moon?' '**The will to do it,**' he replied."

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