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Chapter 5

Did the Germans Learn from Goddard? An Examination of Whether the Rocketry of R. H. Goddard Influenced German Pre-World War II Missile Development*

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Abstract

Ever since a few months before the death of American rocket pioneer Dr. Robert H. Goddard, on 10 August 1945, it has been widely claimed he was the true source of the development of the infamous V-2 rocket of World War II—the world’s first large-scale liquid-propellant rocket. It is thus alleged that the German developers of the V-2 had “*stolen*” ideas from Goddard to create the V-2 which was also the forerunner of the world’s first space launch vehicles. The question of the validity of this claim thus becomes far more significant than first appears and is the subject of this chapter. But we must first briefly examine other popular conceptions, or rather, *misconceptions*, about Goddard in our own Space Age. This helps establish a “bigger picture” that identifies some of the problems in overall misinterpretations of Goddard that also applies to his supposed role in the development of the V-2.¹

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I. Background

Goddard is so-well known in the literature we hardly need to review his career, except for several points. First, in 1919, he produced his classic treatise *A Method of Reaching Extreme Altitudes* published by the Smithsonian Institution and released in January 1920. This work immediately created a worldwide sensation. This was not because he had proposed a solid-propellant upper atmospheric sounding rocket, but as a purely mathematical demonstration to show further possibilities of the rocket, he also laid out a plan for a theoretical multi-stage solid-propellant rocket that could reach the Moon. In short, as detailed in an earlier IAF paper by the author, Goddard had unwittingly proposed a revolutionary idea—the *space rocket*. For centuries prior to this time, the rocket was little more than a simple firework, a crude weapon, or conveyor of signal flares.²

Goddard thus implanted the idea of the space rocket into the public consciousness—at least in the West.*



Figure 5–1: Robert H. Goddard (1882–1945), is often called “The Father of American rocketry” and even “The Father of the Space Age.” However, these claims, first made early in the Space Age (from 1957, after *Sputnik 1*), were based upon presumption. It was presumed that since he devoted his life towards the development of the rocket, especially liquid-propellant types, this work led to the development of the rocket toward spaceflight. But closer study reveals that his work did not impact mainline rocket technology development. Credit: courtesy National Air and Space Museum, Smithsonian photo A-267.

* The Russian Konstantin E. Tsiolkovsky predated Goddard in proposing the rocket as a means of penetrating space as early as 1903. Yet, due to language problems, the political and social isolation of Russia at the time, besides the very limited circulation of his works in his own country, Tsiolkovsky’s concepts were hardly known even in Russia and he only started to become known in the West much later, in the 1920s. Consult, Frank H. Winter, “The Silent Revolution,” in *History of Rocketry and Astronautics*, AAS History Series, Vol. 35, cited in Reference 2, pp. 6–7, 38, for more on these important points.

Goddard, always shy and sensitive by nature, must have been virtually traumatized by the unexpected publicity he received in January 1920, a lot of it ridicule, some newspaper editorials labeling him the “Moon professor,” and so on. The cumulative effect may well have made him even more cautious to the point of being wholly closed and extremely guarded about his rocketry work from then on.

Then, in 1923, another classic work on spaceflight appeared, the book *Die Rakete zu den Planetenräumen* (*The Rocket into Planetary Space*) by Hermann Oberth, published in Germany. But there was a stark contrast between the works of Goddard and Oberth. Goddard’s treatment was limited to the *unmanned* solid-propellant rocket, including his theoretical Moon rocket. But Oberth boldly detailed the many possibilities of *manned* spaceflight by liquid-propellant rocket, which he said was entirely feasible based upon then, current technology.

The impact of Oberth’s work was thus far greater than Goddard’s and, with the help of popularizations of his work by others, notably Max Valier, Oberth’s contribution led to the spaceflight and rocket “fad” of the late 1920s that was particularly strong in Germany. For example, in 1927 the Verein für Raumschiffahrt (VfR), or Society for Space Flight, was formed and led to similar groups in other countries. From 1930, the VfR began their own experiments with liquid propellant rockets, while throughout the 1920s–1930s, there were also private experimenters with both solid and liquid-propellant types. Goddard remained aloof and ever more secretive from these activities. But by the 1940s, public interest in Goddard and rocketry in general had waned. From here, we jump to the Space Age itself, which opened on 4 October 1957 with the launch by the Soviet Union of *Sputnik*, the world’s first artificial satellite.³

II. Modern Perceptions of Goddard

Upon the launch of *Sputnik*, a remarkable transformation took place. In America, Goddard became a sudden and “rediscovered” national celebrity. He became variously hailed in newspapers and other U.S. media not only as the “Father of Rocketry,” or “the “Father of American Rocketry,” but even the “Father of the Space Age.” Indeed, a year after the establishment of the National Aeronautics and Space Administration (NASA) in 1958, NASA founded on 1 May 1959, its first space research laboratory in Greenbelt, Maryland, and named the facility in his honor as the Goddard Space Flight Center.

Ten years later, NASA produced an official history of the facility titled, *Venture into Space—Early Years of the Goddard Space Flight Center* (1968). In the Foreword, Esther C. Goddard, the widow of the rocket pioneer, wrote that the

Goddard Center had "...already made many significant contributions to man's knowledge of...outer space—the precise goals of my husband's life. Through its televised tracking activities the name of Goddard has become commonplace in the American home." The latter was accurate in more ways than one, including the acceptance not only by NASA, but in many American homes, of unexamined beliefs or premises of a Robert Goddard–Space Age "connection." We will now identify one of these premises that was assuredly a myth.⁴

In the opening chapter of this work, the author, Alfred Rosenthal, the NASA official Historian of the Goddard Space Flight Center, declares that Goddard the man is "recognized" as the "Father of American Rocketry." There then follows the lengthy section, "The Life of Dr. Goddard." This naturally includes his launch of the world's first liquid-propellant rocket on 16 March 1926, but Rosenthal adds the remark: "It was an event comparable to Kitty Hawk in its significance." Rosenthal liked this parable so much he repeated and reemphasized it in the beginning of his section "The Goddard Legacy" in which he says: "Robert Hutchings Goddard's rocket research was perhaps as fundamental to the opening of the Space Age as was the Wright Brothers' research to the Air Age."⁵ *

Yet, while it is a very tempting and dramatic analogy (both Goddard and the Wrights accomplishing very brief, yet truly momentous and history-changing feats, and each at a remote place with less than a handful of witnesses), it is a false analogy in several respects. For one, after *his* version of the parable, Rosenthal added: "Not a word [of the Goddard launch] reached the newspaper[s]." This, in itself, negated the similarity between the Wrights and Goddard. Other reasons follow.

Right after the successful series of the four airplane flights made by the Wrights at Kitty Hawk, North Carolina, on 17 December 1903, Orville Wright sent a telegram to his father back in Dayton, Ohio, briefly summarizing their successes and concluded with the simple, two-word instruction: "Inform [the] Press...." Thus, very quickly, the world knew the Wright brothers had accomplished the world's first powered, manned controlled flight which led to the beginning of modern aviation. Yet, the same simply did not happen on the rocket side; Goddard *never* informed the press on his successful first liquid-propellant rocket flight. In fact, he kept this flight entirely secret from the public for exactly one decade. It was only briefly mentioned in his second Smithsonian publication, *Liquid-Propellant Rocket Development* published on 16 March 1936. This singular act by Goddard typifies and underscores his lifelong secrecy. More impor-

* The same parable is so dramatic and appealing regarding Goddard it has been frequently used by others, and even appears in other official U.S. government documents. A few examples are cited in Reference 6.

tantly, this kind of stark secrecy, as we will argue, is linked directly to helping to answer the question, “Did the Germans learn from Goddard?”

But the oft-used Wright brothers-Goddard analogy is also false reasoning in two other important respects simply because it presupposes that Goddard’s 1926 flight unequivocally led directly to the initiation of the development of: (a) “modern” post-war rocket technology, and (b) the initiation of the use of such technology to achieve spaceflight. There simply is no evidence to support either case.^{6 *}

In “The Life of Dr. Goddard” section, when speaking of Goddard’s work just before and during World War II, Rosenthal also writes:

Dr. Goddard’s repeated efforts to convince the American military of the potential of the rocket were to no avail... The Germans, however, had not neglected their rocket technicians as had the Americans. When details of the V-2 reached Annapolis [Maryland], where Dr. Goddard was working in the Navy’s research laboratories [on JATOs, or Jet-Assisted-Take-Off units for heavily-loaded Navy airplanes], he noted the similarity between the German missile and his own liquid-fuel rocket. Although the 4 1/2-ton [Note: the V-2’s actual weight was 13.1 metric tons, or 28,880 lb or 13,100 kg] V-2 was much larger than anything that Dr. Goddard (or anyone in the U.S.) had ever constructed, the two rockets were almost identical in basic design. Out of this similarity arose a controversy over the extent to which the Germans may have worked from Goddard’s patent designs.

Rosenthal did not explain matters further. Nonetheless, his statement helps lay out the basic V-2/Goddard issue.

It is also noted that the leading supporters of Goddard’s legacy have been the principle players in both generating and circulating these beliefs. For example, the leading aerospace journal *Astronautics & Aeronautics* for October 1964 announced the posthumous award of the Guggenheim Medal for 1964 to “the Father of the Space Age,” yet without any mention of a rationale for this claim, while an earlier issue of the journal, then renamed *Astronautics*, for June 1959, described six other posthumous honors to the “quiet, dedicated man who has become famous as the father of modern rocketry.” There is a host of similar, vague generalized claims, even a very recent one made in 2014 by Amy Pastan, in *The*

* Here, we must add that the “beginnings of modern aviation,” opening with the release of Orville Wright’s telegram of 17 December 1903 to his father, instructing him to “inform [the] press” was not so simple as first appears. The Wright brothers too, were very secretive in their own way, particularly concerning the protection of their patent rights. Consequently, this led to complicated and prolonged legal fights against a number of challengers, especially the American aviation pioneer Glenn Curtiss. Consult, Lawrence Goldstone, *Birdmen: The Wright Brothers, Glenn Curtiss, and Battle to Control the Skies* (New York: Ballentine Books, 2014) and similar works on this contentious phase of the early history of aviation.

Smithsonian Book of Air & Space Trivia, who writes, Goddard's work "paved the way for future rocket-propelled vehicles and heralded the space age."⁷

The validity of these laurels was simply never questioned at the time and up to the present, and are far too simplistic. Again, on closer analysis, the laudatory claims of Goddard as "the Father of American Rocketry," the "Father of the Space Age," were evidently arrived at only by *assumption*. That is, they appear to have been *assumed*, and were based solely upon the indisputable huge amount of work in rocketry accomplished almost single-handedly by Goddard in his lifetime—but were *not* based upon what may have actually happened insofar as his true impact upon mainstream rocketry is concerned as we will explore further, below.

It is similarly clear from the 52 posthumous awards, exhibits, and memorials and other honors accorded to Goddard as listed as an appendix in *The Papers of Robert H. Goddard*, published in 1970, that these posthumous honors were largely bestowed during the early U.S. space program—at a time of great euphoria and national pride in America's new space accomplishments. This was also at the height of the Space Race with the U.S.S.R. and it is understandable the U.S. needed its own monumental "space pioneer" to compare with the posthumous honors and publicity vigorously generated by the Soviet Union about their own national iconic space pioneer, Tsiolkovsky, who was acclaimed as the "Father of Cosmonautics."⁸

Once more, this pattern of a lack of analysis of Goddard's true impact largely persists today and applies as well to interpreting any possible V-2-rocket connection he may have had. We therefore now begin to focus specifically on the question of his alleged connection with the V-2, starting with the earliest such claim.

III. Laying Out First V-2 Claims

The earliest *public* claim that the Germans "stole" Goddard's ideas to arrive at the V-2 appeared in the 19 January 1945 issue of the *National Geographic News Bulletin*. It is an item by McFall Kerbey, one of their staff writers, and is provocatively titled "Germany's Vengeance Bomb Follows American Prewar Rocket Design." "So closely do the mechanical features of the V-2 parallel the American projectile [of Goddard]," reads the *Bulletin*,

that some physicists think the Germans may have actually copied most of the design. Most of these features were patented by Dr. Goddard between 1914 and 1932. The captured V-2 contained all the elements of Dr. God-

dard's rocket, and even the arrangement inside the shell [interior of the hull of the rocket] was the same.

The story then became widely circulated, starting with the *Washington Times-Herald* (Washington, D.C.) and the *Worcester Telegram* (Worcester, Massachusetts) on the same day.⁹

How did Kerbey arrive at his conclusions? Who were the "physicists" he was referring to? What were the patents and other elements of Goddard's earlier rockets? These are but some of the questions we logically may ask. The first is easier to answer.

First, Goddard had a few, although very staunch and powerful supporters, both financially and spiritually, in carrying out his years of rocketry experimentation. As is also well documented, he was supported by several successive grants. Initially, he received a \$5,000 grant from the Smithsonian in 1917; there were also smaller grants from the Carnegie Institution and the American Association for the Advancement of Science. But by far, his greatest support came from the Guggenheim Fund for the Promotion of Aeronautics that lasted, with one economic Depression time interruption, from 1930 to 1942 and permitted him to carry out most of his experimentation at Roswell, New Mexico. As detailed in another paper by the author, Goddard was introduced to the Guggenheims, Daniel, and also his son, Harry F. Guggenheim, by the world-famous aviator Charles Lindbergh.¹⁰

Naturally, Goddard was obligated to regularly submit detailed reports to his supporters on what he had accomplished and additional funding he would need. Yet, as found time and again in the three-volume *Papers of Robert H. Goddard*, Goddard habitually requested his sponsors to refrain from releasing details of his work to the general public. Some of his rationales are presented below.

By July 1939, Lindbergh attempted to persuade Goddard to become more public in his work. According to Milton Lehman, the writer of the authorized (by Esther Goddard) biography of Goddard, *This High Man*, "...at Lindbergh's urging, Goddard had reluctantly agreed to collaborate with the *National Geographic Magazine* in a popular account of his experiments." Yet, this publication never came about. *Geographic's* staff writer Kerbey and a staff photographer had arrived at Roswell on 29 January 1940 for Goddard's first attempt to launch a pump-driven rocket (in his so-called P series), but inclement weather did not permit a launch; in the second attempt on 9 February (for test P-15), a pump explosion also prevented a flight. Following this abort, the *Geographic* staff simply left.¹¹

Years later, and not long after the V-2 had become deployed during the latter part of the war, Goddard wrote to Harry Guggenheim on 15 December 1944:

There is some talk of having me...serving as a consultant with the [U.S.] Army Ordnance on developments in this country paralleling the German V-2. The latter weapon is reported to be almost identical with the rocket we are working on in New Mexico...except that it is larger... I would like to talk [this] over with you within the next few weeks...

The Papers also show that soon after the first V-2s were deployed, Goddard expressed a fascination with them, but he was cautious. In his diary entry for 5 November 1944, for instance, he wrote: "V-2-type rocket appears to be of interest," while on 7 December he informed Sherman Price of Filmedia, then making a documentary movie on rockets, that he [Goddard] had conducted "...the first tests, at least in the United States, of a liquid-oxygen rocket of the V-2 type...[but it] was designed for meteorological purposes."¹²

Yet when Goddard next met Guggenheim, on 28 December 1944 at Mercer [Army Air Corps] Field, New Jersey, Goddard presented him with a photo of his 1941 pump-driven flight rocket, whereupon Guggenheim asked him to write an appropriate inscription on the back pointing out the V-2 similarities. The inscription runs as follows: "Rocket produced in New Mexico in the spring of 1941, under the Daniel and Florence Guggenheim Foundation. It is practically identical with the German V-2. Robert H. Goddard, Mercer Field, December 28, 1944." At the same time, Goddard also gave Guggenheim a memorandum with side-by-side lists of more specific comparisons of the two types of rockets. The features included: "Fuel," "Fuel-injection means," "Pump drive," "Turbine drive," "Layout, front to rear," "Stabilizer," "Guiding means," and "Rocket motor cooling, general plan."

However, it should be emphasized that Goddard's basic statement of comparison between his "1941 pump-driven rocket" and the V-2, besides his list, hardly constituted genuine "proofs" that the Germans had in any way copied his work; yet, it was his own sincere *presumption* that they did. At the very least, at this juncture, these new documents generated by Goddard could only mean there were *some* interesting similarities between the two types of rockets, particularly Goddard's rocket pump. On the other hand, it was wholly *logical* for any large rocket to have *needed* a very high pressure pump to move and inject fuel at high rates.

*Rocket produced in New Mexico
in the Spring of 1941, under the
Daniel and Florence Guggenheim
Foundation.*

*It is practically identical
with the German V-2 rocket*

*Robert H. Goddard
Meriden Field
December 28, 1944*

Figure 5-2: Soon after the appearance of the V-2, Goddard wrote a signed note, on 28 December 1944, on the back of a photo of his 1941 P, or pump series rocket. In the note, Goddard claims the rocket was "...practically identical with the German V-2 rocket." However, this note does not constitute "proof" of Goddard's claim. The two rockets appear to be similar to the layman, but both the Germans and Goddard used similar and logical engineering approaches—like the need for an on-board pump to transfer liquid propellants into the combustion chamber. Credit: courtesy National Air and Space Museum, Smithsonian photo 82-2156.

Also on this very important point, Goddard's fully developed pump type (P series) rockets—the most sophisticated of all his flight rockets—were not tested until October 1938 to July 1941, while his first (of two) flights with pumps was made on 9 August 1940. (In both flights, the P series rockets just went up to 250 ft, or 76 m.) But by that time, the A-4 (V-2) had been under development for some years. Indeed, according to Neufeld et al., the basic design characteristics of the A-4 were laid out by late March 1935, while calculations for the rocket's projected 55,000-lb thrust (244,652 N) engine were made by late 1935. Walter R. Dornberger, the former World War II German general who then commanded the military rocket program, also specifically described the challenges faced by the Germans in developing the A-4's large-scale pumps in 1936. Moreover, the German team had already laid the groundwork for their own liquid propellant rocketry developments since their A-1 series from 1933. None of this background on the A-4, of course, was *ever* known by Goddard due to high secrecy imposed by the Germans. Thus, it is most ironic that Goddard and the Germans (i.e., the German Army's Ordnance Department) undertook rocket research and development more or less simultaneously under the strictest secrecy—on both sides.)¹³

Nevertheless, says Clary, upon the appearance of the V-2 on the scene, "Goddard was plainly at a loss as to how to confront this blatant challenge [the V-2] to his and the Guggenheims' investments in rocketry." Guggenheim, like Lindbergh, urged Goddard to "get the word out" and sent Goddard to the National Geographic Society. On 4 January 1945, he met Kerbey again. Now, all agreed on Kerbey doing a new piece on Goddard, but for the Geographic's *News Bulletin*.

A few days later, Kerbey sent Goddard a draft and on 8 January he informed Kerbey he was pleased with it and conveyed the same to Guggenheim, although he now backed it up with a much more meaningful list of "U.S. [i.e., Goddard's] Patents [by specific patent numbers]... Relating to Features of the German V-2 Design." These patents range from his first two basic ones of 1914 (No. 1,102,653 and No. 1,103,503), up to a later patent on a combustion chamber, No. 2,217,649 of 1940.

Consequently, Kerbey's piece was the article claiming that the V-2 was a theft of Goddard's designs and was subsequently published, although without citing the patents.* It is thus abundantly clear Goddard himself was behind the first of the Goddard/V-2 connection articles—whether the claim was valid or not.¹⁴

As for the specific patents in Goddard's list, he did seem to build up a stronger "case" for himself. Yet, there are questions. For one thing, Goddard remained in the speculative mode that the Germans "stole" his ideas, and the list of patents still do not constitute "proof" since each one must definitely be *proven*. Second, patents convey ideas, but not *how* things are made, or know-how. Third, and most importantly, we have to look at the German side of the whole issue of whether Goddard—and his supporters—ever had a "case." But the patent side of the Goddard/V-2 connection is extraordinarily complex by itself and may thus be the subject of a further paper by this author.

Nonetheless, apart from Goddard's own persuasive "lobbying" on his side and the Kerbey piece, there was the unquestioning faith in his claims by his powerful supporters, especially Harry Guggenheim, and was soon joined by General James "Jimmy" Doolittle of World War II fame. Goddard's widow, Esther Goddard, was always his supporter, and following her husband's death, she notably pursued her husband's patent claims cases and was able to secure some 166 additional posthumous patents in his name to add to the 48 he had obtained in his life time, for a total of 214; besides this, she also bolstered the Goddard/V-2 connection story, for example, in arranging the "authorized" publication of his biography, *This High Man*, which supports that position.

* As for the mention of "some physicists" in Kerbey's piece, Clary says that the "*they*" was "actually Goddard."

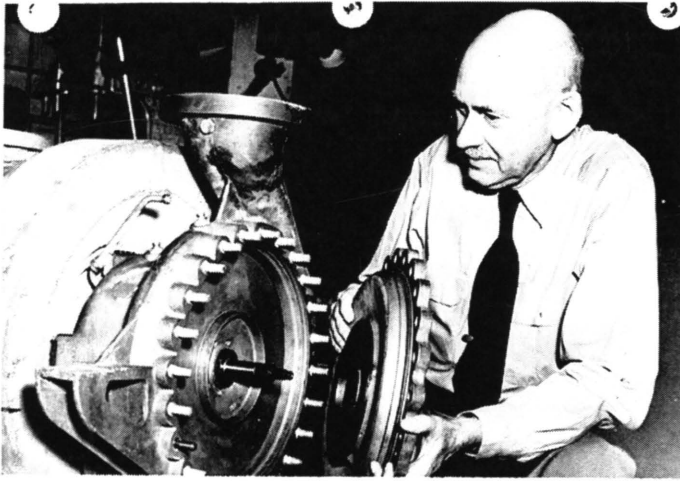


Figure 5-3: On 23 March 1945, Goddard examined captured V-2 rocket parts, including its large-scale rocket pump, as shown here at Annapolis, Maryland, while he worked on the development of JATOs (Jet-Assisted-Take-Off) units to shorten the take-offs of heavily loaded Navy seaplanes. Unfortunately, his report to the Navy on his findings on the V-2 parts have not been found. Nonetheless, there is sufficient evidence to conclude that the V-2 development did not originate with Goddard's work and was undertaken completely independently of Goddard. Credit: courtesy National Air and Space Museum, Smithsonian photo 73-1278.

On 23 March 1945, five months before he died, Goddard was able to personally examine V-2 rocket engine parts at Annapolis, Maryland, that had been recently captured; on 28 March, he additionally "Saw the V-2 pumps," according to his diary. Most unfortunately, the reports of his findings cannot be located, either in the U.S. National Archives or in the extensive Robert H. Goddard Collection in the Robert H. Goddard Library at his alma mater, Clark University, at Worcester, Massachusetts. In any case, it is believed there is still sufficient other documentation to present this paper, although Durant and Sharpe, who did manage to read the turbopump report, were both disappointed in it. The nine-page Goddard report, wrote Durant, "is a careful, accurate, descriptive account of the parts and function of the V-2 turbopump." "Rather disappointingly," Durant added, "it is not a critical evaluation." Sharpe merely echoed this comment that the report "was disappointing."¹⁵

Kerbey's 19 January 1945 piece in the *National Geographic News Bulletin* led to many similar articles. Among these are: "Nazi's Rocket Called American Invention," in the *New York Times* for 14 February 1947; and Curtiss B. Fuller, "Uncle Sam 'Discovers' the Rocket," in the magazine *Flying*, for March 1947. Other newspapers across the country picked up the story.

There are also many passing references to the Goddard/V-2 “claim,” such as in the article “Rocket Ram-Jet and Pulse-Jet” by Hugh Harvey, in *Shell Aviation News* for August 1950 that states: “The work of Dr. Goddard in the United States was preeminent and the Germans drew heavily on his findings in their development of the V-2 rocket-propelled missile and the rocket motor used in the Me-163 interceptor.”¹⁶

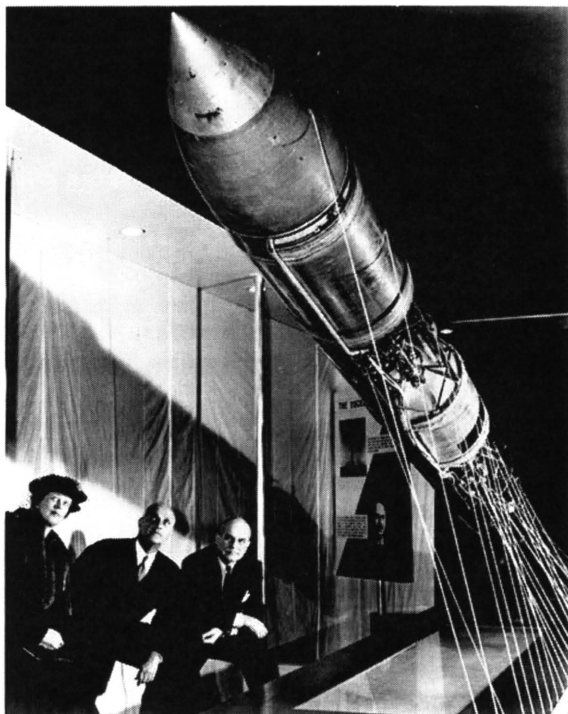


Figure 5-4: In 1948, the Guggenheim Foundation for the Promotion of Aeronautics, that had financially supported much of Goddard’s work, was also responsible for posthumous traveling exhibit of his rockets. This was the first time any of his rockets were shown to the public and hence, more details of his work became known. However, the exhibit also featured V-2 parts and thus played a role in spreading the notion that the Germans “used” or “copied” his work to arrive at their V-2, but we now know there was no historical foundation to support these views. At the left are Goddard’s main supporters—who also firmly believed that the Germans “stole” his work—Mrs. Robert H. Goddard, Harry Guggenheim, and Gen. James H. Doolittle. Shown here is Goddard’s circa 1941 P-series rocket, now in the National Air and Space Museum collections (as Cat. # 1985-01777). Credit: courtesy National Air and Space Museum, Smithsonian photo A-38958-D.

The alleged Goddard/V-2 connection story also appeared in public speeches, such as one by John F. McAllister, head of the G.E. rocket program, in 1947; in the literature of the Goddard professorships at Princeton and Caltech universities; and, in a museum exhibit. In the latter case, it was part of the travel-

ing Goddard Memorial Exhibit sponsored by the Guggenheim Foundation, that opened on 21 April 1948 at the American Museum of Natural History in New York City; then was shown at the Los Angeles County Museum from 4 February 1949; next, opened at the Smithsonian Institution in Washington, D.C., from 21 March 1949; and finally, was presented at the Institute of the Aeronautical Sciences in New York from 1 December 1950. "The exhibit," reported *Aeronautica* of the Institute of the Aeronautical Sciences, Inc., "is completed by a panel showing pictures of the German V-2s...The V-2's incorporate many of the ideas and basic theories of Dr. Goddard." Movies of the V-2 were part of the exhibit. Also, the photo plus its inscription by Goddard made on 28 December 1944 were included in the brochure, *A Pioneer Rocket*, published by the Guggenheim Foundation that accompanied the exhibit.¹⁷

During this period, in his connection with the Guggenheim-sponsored exhibit, General Doolittle added his considerable prestige to the supporters of the Goddard claim in delivering the dedication remarks. "Goddard," the General said, had "worked out the mathematical principles of rocket flight, which were copied by the Germans." Furthermore, in a lengthy front-page account of the exhibit opening featured in the *Christian Science Monitor* for 24 April 1948, Doolittle claimed Goddard was the: "Founder of a whole new field of engineering." In the same article, Guggenheim said the rockets in the exhibit were "to Dr. and Mrs. Goddard what Kitty Hawk was to the Wright brothers."¹⁸ *

But we will now look at another important element of Goddard's complex personality that has relevance to attempting to answer the question, "Did the Germans learn from Goddard?" namely, his secrecy.

IV. Goddard's Secrecy

Goddard's secrecy is expressed in many works about him. As well documented in *The Papers*, for instance he habitually had all of his employee assistants in his rocketry work sign oaths that they were not to reveal any details of his work, including off the job. But the "roots" of Goddard's "secrecy" are several.¹⁹ †

* Perhaps this quote was the origin of the later, although modified Wright brothers-Goddard analogy.

† One of these roots of his secrecy can be specifically traced back to 1917-1918, when Goddard had faced a bitter experience with one of his earlier assistants, Carl D. Haigis, who had indeed, attempted to take his inside knowledge of Goddard's work for his own potential financial gain, as described at length by Clary, pp. 70-71, 73, and in *The Papers*, Vol. I, pp. 226-232. But Goddard's solid-propellant work at that time was for the war effort (World War I) and both Goddard and his sponsor, the Smithsonian, well understood that utmost secrecy then had to be maintained and in this case it was justified.

Then, there is the story of Dr. Frank Malina's visit, when still a Caltech student, to Goddard at Roswell in August 1936. Accounts vary as to whether Goddard was "cooperative" or not in showing the young man his rocket workshop/laboratory. Goddard, recalled Malina, first showed him a copy of a negative editorial that had appeared in the *New York Times* in 1920 after the release of his *Method of Reaching Extreme Altitudes*. "He appeared," Malina continued, "to suffer keenly from such nonsense directed at him... This is the only evidence of Goddard's legendary hostility to the press."

"The second impression I obtained," he continued,

was that he felt that rockets were his private preserve, so that any others working on them took on the aspect of intruders. He did not appear to realize that in other countries were men who, independently of him, as so frequently happens in the history of technology, had arrived at the same basic ideas for rocket propulsion.

Goddard's own version, from his perspective, of what happened during the occasion of Malina's visit was briefly described much later, in a letter of 21 January 1939 to his long-time principal supporter at the Smithsonian, Dr. Charles G. Abbot:

Mr. Malina called here about two years...ago, and almost insisted that I present him with all the information that I had obtained, particularly regarding combustion chambers. I explained to him, however, that I naturally could not give anyone the results of nearly twenty years of work, prior to publication.²⁰

Goddard's competition (or rivalry) with Oberth is also well covered in the literature. He saw Oberth not only as his chief competitor, particularly regarding liquid-propellant rockets as applied to spaceflight. In addition, he was very likely utterly incensed that Oberth's *Die Rakete zu den Planetenräumen* had virtually triggered a spaceflight movement and rocket fad, that was especially strong in Germany.

In this regard, we cannot overlook the fact that for many years after World War I, there remained strong anti-German sentiments in America and elsewhere. By the same token, great interest in his work was shown by many Germans inquiring which, of course, he never revealed although these too must have created the greatest suspicions and further fueled his own secrecy and resentments.²¹

One flagrant and most revealing example of Goddard's feelings and how he conveyed these to the Smithsonian, is found in the report of 5 May 1926 addressed to Dr. Abbot of the progress of his rocket work:

...I would appreciate it if no public statement, such as recently suggested by Acting [Smithsonian] Secretary [Alexander] Wetmore of the Institution, were made [on his 16 March 1926 flight] before I had [the] opportunity to supply

such details... My reason is that the rocket work is being made almost a national issue in Germany, a novel having been written...in which Germany is urged to support the development of a German liquid-propelled rocket, which the readers are given to understand is a German idea. Nearly every day, I am in receipt of requests from Germany for information and details...

Another standard precaution that he repeatedly told his sponsors was that releasing details of his work was “far too premature.” Abbot respected these kinds of requests from Goddard, as did his later sponsor, the Guggenheim Foundation. Hence, details of his work remained known for many years by only a selected few, within both the Smithsonian and the Guggenheim Foundation.²²

Likewise, the Verein für Raumschiffahrt (as already cited, the VfR, or [German] Spaceflight Society), formed in 1927 could certainly learn nothing of his work. For instance, the July 1929 issue of their journal *Die Rakete* (*The Rocket*) ran a special “Bulletin” about his 18 July 1929 flight which then made the rounds of the world press as a sensational item, but all the reports lacked the basic detail on even whether it was even a liquid-propellant rocket or not, while in a special *Supplement* to the September 1929 issue of *Die Rakete*, was an item titled “New from Professor Goddard,” but it was not from Goddard but merely unusable misinformation about him dating to 1924.²³ [Figure 5–5]

Extra-Blatt

der Zeitschrift „DIE RAKETE“ :: Breslau, Juli 1929
 Offizielles Organ des Vereins für Raumschiffahrt E.V. in Deutschland

In letzter Minute geht die Nachricht ein, daß Professor Goddard in Worchester, Massachusetts, am 18. Juli 1929 eine Versuchsrakete von 3 m Länge und 70 cm Durchmesser abgeschossen hat, die eine enorme Höhe erreichen sollte. Die Rakete startete ordnungsgemäß, explodierte jedoch bereits in geringer Höhe mit mächtigem Knall, so daß die Fensterscheiben in der Umgegend zertrümmert wurden.

Es ist dies seit längerer Zeit ein neues Lebenszeichen von Goddard, das deutlich zeigt, wie auch drüben am Raumfahrtproblem intensiv gearbeitet wird.

Bei dieser Gelegenheit mag erwähnt werden, daß auch Fritz von Opel in den Flugzeugwerken der Gebrüder Müller in Griesheim einen Raketenstart mit einem Leichtflugzeug vorbereitet, und daß auch Max Valier mit den Gebr. Espenlaub in Düsseldorf ein besonders konstruiertes Raketenflugzeug fertiggestellt hat.

Figure 5–5: Goddard’s lifelong obsession with secrecy about his work is the key to understanding this brilliant and complex man. Typical is this notice on Goddard’s 15 July 1929 rocket flight, appearing as a “Special Notice” in *Die Rakete* of the Verein für Raumschiffahrt (the VfR, Society of Space Travel), of Germany. The notice offers no details of his work, only the vaguest information. Goddard was widely featured in newspaper and magazine articles in his lifetime, but these were all very general and invariably never provided engineering details at all. Credit: courtesy National Air and Space Museum, Smithsonian photo A-4315).

Nor could the American counterpart to the VfR, the American Interplanetary Society, formed in 1930 and from 1934 called the American Rocket Society, learn anything either, although Goddard felt, justifiably at the time, that they were amateurs in their experimentation. Again, he remained utterly aloof from the AIS/ARS.²⁴

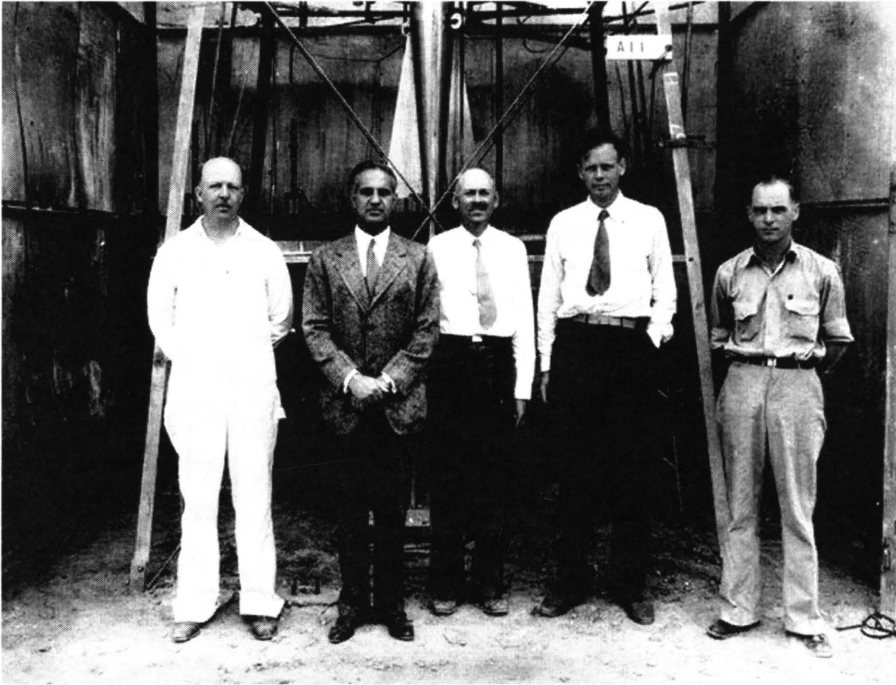


Figure 5–6: An earlier photo of Goddard, third from left, on 23 September 1935 in front of his launch tower at his test site at Roswell, New Mexico, during the visit of his sponsor, Harry F. Guggenheim, second from left, and aviator Charles Lindbergh, at Goddard's right, along with two of Goddard's assistants. To help maintain his secrecy, Goddard's assistants signed oaths not to reveal anything of his work. Also, in sending reports to his sponsors, he always cautioned them *not* to reveal details to the public since it was "too premature." But his real motive was to keep his work secret. Yet, these requests were always respected. Thus, only a handful of people—his sponsors—knew any real details. It was only years after his death, especially after the publication of *The Papers of Robert H. Goddard* (1970), that we came to know details of his enormous technical accomplishments. Credit: courtesy National Air and Space Museum, Smithsonian photo A-4968.

V. Goddard's Publications

One of the consequences of Goddard's secrecy affected his own publication output. We now know he wrote copious notes on his extremely considerable

work. Yet, his publications on his accomplishments were strikingly meager. Dr. Wallace W. Atwood, former President of Clark University, later recalled:

We urged him over and over again to publish more, but he was anxious to keep his work as secret as possible, for he knew others in distant lands [i.e., Germany] were working on the same problem and that it had great significance in military affairs.²⁵

Indeed, Goddard's only major works were: (1) his 1919 *A Method*, and (2) his second Smithsonian report, *Liquid-Propellant Rocket Development* of 1936.* Yet, the latter report ran but ten pages plus photos and was devoid of any engineering details. It is largely about his historical priorities, the most significant of which was his establishing his 16 March 1926 flight as the world's first for a liquid-propellant rocket. In essence, nobody, including the German Army, could learn much from his *Liquid-Propellant Rocket Development*.

Hence, paradoxically, virtually all the rocket enthusiasts of the 1920s–1930s, certainly knew *about* the gifted American physicist Dr. Robert H. Goddard and his experimentation in New Mexico, yet none knew or could get *any* details from him. Outside of his patents, there was virtually no open detailed information on his liquid-propellant rocket technology from which members of the German rocket program could have drawn upon to help them create the A-4/V-2. From here, we at last turn to the German-side.

VI. Start of the German Army Rocket Program

The German Army's rocket program started in the fall of 1929 when Lt. Col. Dr. Ing. (Doctor of Engineering) Karl Becker, head of the ballistics and munitions section of the Heereswaffenamt (HWA, or Army Ordnance Office), Weapons Testing Division, was granted permission from the Reichswehrministerium (Reich Ministry of Defense) to develop the rocket as a weapon. Due, in part because the rocket was not mentioned as an armament restriction in the Versailles Treaty, the rocket program was kept entirely secret. Becker was interested in the development of both solid and liquid-propellant rockets and at first concentrated on solids with the help of his subordinates, including Artillery Captain (later, Maj.-Gen.) Walter R. Dornberger.

In 1930, Dornberger was made head of the program. In 1932, he switched the emphasis to liquid-propellant types due, in part, to the well-publicized liquid-

* Albeit, the first of these publications was highly significant, covering his ground-breaking solid-propellant experiments, including his proof that the rocket can work in a vacuum, and he also showed the far greater efficiency with the adaptation of the de Laval nozzle, as well as optimum performance of rockets with multi-stages.

propellant rocket experiments of the VfR which began soon after the founding of their *Raketenflugplatz* (*Rocket Flying Place*) in Berlin in 1930, besides other liquid-propellant experimenters in Germany, such as Max Valier.*

Then, on 17 December 1930, in a conference on the “Rocket Question” in the Heereswaffenamt, Becker surprisingly concluded after a year of reviewing known experimenters of rockets of the period: “Of rocket research abroad we know very little. In America Prof. Goddard has been working on a rocket similar to the spin-stabilized Unge-torpedo. Launching of unmanned Goddard rockets for extreme altitudes has apparently until today only resulted in explosions close to the Earth’s surface.” Yet, this was absurd; “Unge” was the Swedish Artillery Lt. Col. Wilhelm Theodor Unge who had only experimented with solid-propellant rockets, never with liquids. In short, Goddard’s work with liquid-propellant rockets over the past ten years was still a total secret. In a follow-up meeting of 30 January 1932, Becker, could only repeat: “We know little about rocket research abroad. Our efforts to find out about this have failed. German [private] inventors in this field are more or less dreamers.” (Here, he was referring to people like the Austrian-born spaceflight enthusiast Max Valier, then experimenting in Germany, and the young, idealistic members of the VfR in general.)²⁶ †

Despite the ignorance by German Army Ordnance, at this juncture, of the true nature of Goddard’s rockets, Neufeld finds that as late as 1936, leaders of the German Army’s rocket team still cleverly exploited the *only* known fact—that Goddard was working on rockets—to their political advantage to advance their

* One of the often-cited reasons for the German Army in pursuing a rocket program in the first place is that the rocket (as a weapon) was not prohibited in the Treaty of Versailles, after World War I, but this is a wholly different matter and is not within the scope of this paper.

† Unge became interested in possibilities of the rocket in the late 1880s and began his experiments in 1892, then continued these throughout most of his life; he died in 1915. However, while he achieved notable results with the use of a greatly improved, more powerful ballistite propellant (smokeless, “double-base” type, utilizing nitrocellulose and nitroglycerine) besides another great advance of the de Laval nozzle as adapted to rockets by 1896–1897 (and probably unknown to Goddard), Unge never did use liquid-propellants.

According to Dr. Å. Ingemar Skoog, the foremost authority on Unge, his work in rocketry was discussed in the protocols of both meetings of the Heereswaffenamt (German Army Ordnance Office) of 17 December 1930 and 30 January 1932 [also given as 31 January 1932], respectively. These described the contacts and known information to the Germans on Unge’s rockets. The 17 December 1930 protocol contains 12 pages of a detailed overview of the Unge rocket system from 1897 to 1910, including patents, photos, and test results by the armament firm of Krupp that test fired Unge rockets at their firing range at Meppen in 1909–1910. The Army was also negotiating with one of Unge’s sons but his first name is not mentioned. Then, the negotiations were stopped in 1931 due to the too high financial claims by the son for the use of his late father’s results and patents.

On Valier, the VfR, and other private experimenters of the period, consult, Frank H. Winter, *Prelude to the Space Age* (Reference 24), and Willy Ley, *Rockets, Missiles, & Space Travel* (New York: The Viking Press, 1958 and other editions).

own program. Becker, says Neufeld, “probably argued that there was an international missile race in which the Germans had to stay ahead” (i.e., implying Goddard was part of that international competition, which was simply not the case). Now, whether Becker (and Dornberger’s) arguments along these specific lines in using Goddard’s name were persuasive or not in advancing their own rocket program within top German government and/or military circles is problematical, but they may have contributed.

Nonetheless, the multimillion Reichsmark and technologically advanced site of the Heeresversuchsanstalt Peenemünde (HVP, or Peenemünde Army Research Center), simply known as Peenemünde, was authorized and established in the same year. This is where the bulk of the development of the A-4 took place under the military command of Dornberger and under the technical direction of the youthful Dr. Wernher von Braun, a former VfR member who had been secretly hired by the Army late in 1932. The move of staff here was underway by 1937.²⁷ *



Figure 5-7: Launch of an A-4 (V-2) rocket of World War II. The German Army’s rocket program was also conducted in strict secrecy, the rocket finally appearing in action in September 1944. For different reasons, both Goddard and the German Army (Army Ordnance) undertook their respective rocket developments totally independently and secretly of each other. But the V-2 is acknowledged as the world’s first large-scale liquid-propellant rocket and the true origin of all “modern” large-scale liquid-propellant rockets, including space launch vehicles. Credit: courtesy National Air and Space Museum, Smithsonian photo 79-6557).

* The first work on the Army’s rocket program was conducted at the firing field of Kummersdorf, 25 km (15.5 mi) south of Berlin.

VII. German Spying on Goddard

It is true there had been German spying on Goddard but it was a farce. German-born Gustav Guellich, residing in the U.S., was instructed by the German military attaché in Washington, D.C., to spy on Goddard. Guellich subsequently wrote a memorandum on 7 January 1936 titled *Experiments with High-Altitude Rockets in the United States*, followed by other reports up to December. But his initial reports contained rehashes of useless articles from the open press about Goddard (and forwarded to German Army Ordnance) although Guellich also claimed to have once visited New Mexico and secretly witnessed a rocket launch. In truth, however, Guellich was ignorant about rockets and Clary finds that he simply “made up details.”²⁸

Hence, the Germans remained in the dark about real details on Goddard’s work. This is borne out by a Top Secret Memorandum of 13 March 1937 by Dr. Walter Thiel, a top contributor on von Braun’s team towards the development of the A-4 rocket motor, in which he discussed possible alternate liquid propellants and mentioned that: “Professor Goddard” had “already worked on...a high pressure explosion rocket with repeat loading.” But this was also ludicrous and strictly referred to Goddard’s circa World War I-era experimentation with solid-propellant repeating charges, *not* liquid propellants at all.²⁹

Clary also uncovered what he called a “sub-myth” about Goddard that surfaced in 1949. It was alleged that von Braun team members then in the U.S. were asked about their work and they supposedly responded, “Why don’t you ask your own Dr. Goddard?” But it seems the story only originated with Hollywood director Merian C. Cooper who had made up the dialogue himself, although the fictitious quote still made the rounds of magazine articles and other publications and further fueled the supposed Goddard/V-2 connection.³⁰

VIII. Testimonies By Ex-Peenemünders

Finally, we turn to von Braun and a few of some of his former team members for their own responses to our lead question: Was there really a Goddard “input” into their creation of the A-4 (V-2)? However, limited space permits only the briefest extracts of these quotes although they are revealing.

Most significantly, for instance, von Braun, wrote to Mrs. Davis R. Dewey, III on 11 May 1960 that:

...Before and throughout my association with...Peenemünde...we were not aware of the existence of Goddard’s publications...on his development work relating to liquid fuel rockets. Nor did we see a single Goddard pat-

ent... It was only in 1950...that I had the opportunity to see...Goddard's patents. I was [then] virtually overwhelmed...and found that many design solutions in the V-2 rockets were covered in the Goddard patents...

That is, there were many similar approaches—but not *copying* by the Germans. If anything, this very important quote (and similar ones by von Braun) speaks to the high probability of independently developed rocket systems and similar, logical engineering approaches by both the Germans and Goddard.³¹

Gerhard Reisig, a leading member of the von Braun A-4/V-2 team said: “We knew of the existence of Goddard but we had not the slightest idea what he did... After we came...here [to the U.S.], we found out that we had done a few things in parallel.” Reisig also characterizes his influence on the German V-2 work as “about nil” although, he adds, “We esteemed him very highly...”³²



Figure 5–8: Wernher von Braun (1912–1977), circa 1950s, holding a model of test version of the V-2, as test-flown at the White Sands Proving Grounds, New Mexico. The captured V-2s, now carrying scientific instruments, provided the U.S. experience in handling and launching large-scale liquid-propellant rockets that led to the development, under von Braun’s leadership, of the U.S.’s own large-scale liquid propellant rockets that led to the development of launch vehicles, including the Saturn V that sent men to the Moon. Von Braun, and others of his team, when questioned about possible input by Goddard in the V-2, maintained there was no input from his work. Credit: courtesy National Air and Space Museum, Smithsonian photo 76-13637.

Ernst Steinhoff, former head of the A-4/V-2 guidance and control system development, wrote:

We knew of three great pioneers at Peenemünde—Goddard, Tsiolkovsky, and Oberth—but Goddard was too secretive and lacked communicative abilities, whereas von Braun was just the opposite and this is why we succeeded with the V-2, and why Goddard's work was not used. The V-2 came from different roots [i.e., from Oberth].



Figure 5–9: Von Braun shown much later, left, on 28 January 1977, not long before his death, admiring the Goddard 1941 pump rocket then on exhibit at the National Air and Space Museum (NASM) in Washington, D.C. (The other man is unidentified.) Von Braun himself much admired Goddard but claimed he was only able to examine Goddard's patents in 1950. Credit: courtesy National Air and Space Museum, Smithsonian photo 2000-1564.

Arthur Rudolph, a key person involved in managing the fabrication of the A-4/V-2, responded that he simply “did not know” if there was any influence of Goddard at Peenemünde. Oscar Holderer likewise did not know about Goddard at all while at Peenemünde. Similarly, Dr. William Mrazek recalled that when he was at Peenemünde he knew “very little, very little” [*sic*] about Goddard. Eber-

hard Rees likewise says: "I heard only of Dr. Goddard after coming here [to the U.S.] But [at Peenemünde] I did hear much of Oberth." Dr. Kurt Debus also remembered:

We knew very little about his [Goddard's] work. In 1950 because of patent claims...[we] were permitted to examine the Goddard drawings and technical reports. We were astonished to learn [at that time, from 1950] that he had anticipated some of the fundamental solutions we arrived at in Peenemünde, including the gimbaling of engines, employing jet vanes and other basic principles.

In actuality, however, in the V-2, the jet vanes were directly *in the path* of the exhaust; but in Goddard's rocket the exhaust gases *bypassed* the vanes. There were, indeed, many other marked differences, but space does not permit presenting these engineering specifics and may require yet another paper.³³

Georg von Tiesenhausen, another leading member of the original von Braun team, answered:

To my knowledge none of the great technologies [of Goddard] were copied or used in developing the A-4 or other rockets. Much of his technology was not applicable anyway to the A-4... To my recollection his name was well known in Peenemünde, but rarely mentioned. We were too busy with what we were doing.

Hans K. Kaiser, a lesser known figure at Peenemünde who, at one time, ran their library, said of Goddard: "His name as a rocket pioneer, of course, was known at Peenemünde. His patents, however, were not known there and [were]...not utilized." Helmut Horn similarly said that no Goddard patents were used at Peenemünde. Dr. Walter Haeussermann, a major pioneer in the V-2 guidance system, said he "had not heard of the name of Robert H. Goddard until after the war."³⁴

Martin Schilling painted a similar picture:

As a single individual, [Goddard]...made...important [early] contributions...to the new art of rocketry. The German development efforts did not profit from his prolific work, and were actually carried out in almost complete ignorance of his achievements. This was the result not only of Dr. Goddard's strong inclination to secrecy...but also of the official disruption by Germany of the exchange of information in the field of national and international levels.³⁵

Admittedly, while these are the opinions of but thirteen from the thousands of former developers of the A-4/V-2 before and during the war, their names are largely representative of the key people of the von Braun team, although it is unfortunate this survey was not conducted far earlier, when many more of the von

Braun team members were still alive. Nonetheless, the pattern here unmistakably points to no known Goddard influence. To this may be added the fact that Goddard's name does not appear at all in the five volume, 1946–1948 *Accession List of German Documents Pertaining to Guided Missiles* compiled by U.S. Army Ordnance just after the war numbering 2,683 pages and comprising some 3,200 technical documents dealing with all facets of development of the A-4 and other German missiles of World War II.³⁶

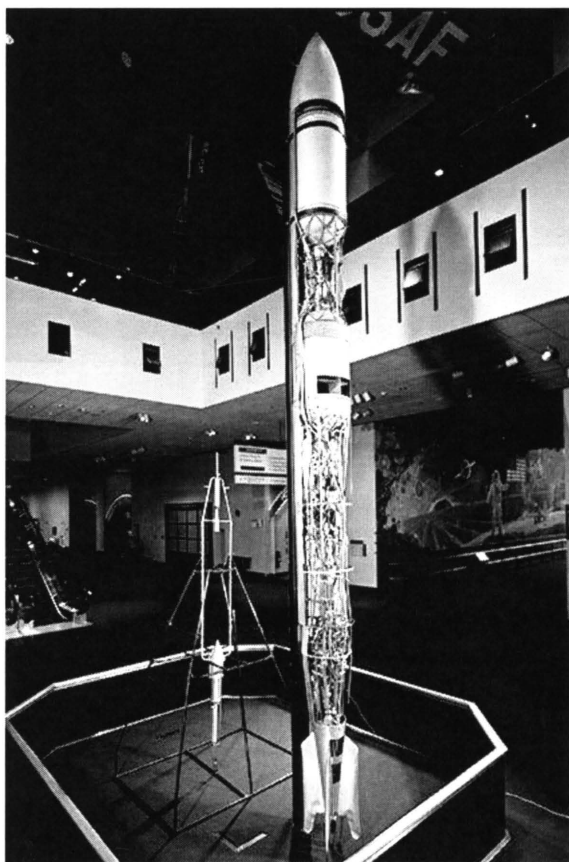


Figure 5–10: Closeup of the Goddard 1941 P-series, or pump rocket, formerly shown on exhibit in the “Milestones of Flight” Gallery of the National Air and Space Museum, next to a replica of the far smaller rocket Goddard flew back on 16 March 1926 that is regarded as the first flight in the world of a liquid-propellant rocket. Although a great achievement, due to his secrecy Goddard withheld news of his first launch for fully a decade when it was briefly described in his *Liquid-Propellant Rocket Development* of 1936, although this ten-page work offered no engineering details. Photo by Eric Long. Credit: courtesy National Air and Space Museum, Smithsonian photo 2005-17447.

XI. Conclusions

In conclusion: (1) It seems logical that since the German Army's A-4 (V-2) rocket program involved very sophisticated and costly equipment and scientific research facilities besides thousands of scientists and technicians of many disciplines connected with the very complex development of all the A-series vehicles that led up to the V-2, including many under contracts from Germany's leading universities, the work of Goddard was simply not needed, and was *not available* in any case. (2) The work of the German Army appears to have been wholly independent although in some respects, parallel with Goddard's work in that the bulk of the work on both sides was conducted in the 1930s and also that logical engineering solutions were naturally applied in both cases. (3) To the layman, the V-2 and Goddard's "pump" rocket *appear* to be alike and are outwardly similar, but are *not* truly identical although limited space in this chapter only permits the briefest mention of one, but an important example. Finally, (4) this paper is not meant to detract from the truly great pioneering work and remarkable single-handed accomplishments of Goddard who really did "lead the way." Rather, the main aim is to arrive at a clearer and, hopefully, more accurate historical perspective of the overall history of the development of the modern liquid-propellant rocket. The writer thus sincerely welcomes any additional substantiated supporting evidence—including evidence that may be *contrary* to the above findings and judgments.

References and Notes

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- ² Frank H. Winter, "The Silent Revolution: How R. H. Goddard Helped Start the Space Age," in *History of Rocketry and Astronautics* (Proceedings of the Thirty-Eighth History Symposium of the International Academy of Astronautics – Vancouver, British Columbia, Canada, 2004), Å. Ingemar Skoog, editor, AAS History Series, Volume 35, IAA History Symposia, Volume 24, (San Diego, California: Published for the American Astronautical Society by Univelt, Inc., 2011), pp. 3–54 (paper IAC-04-IAA.6.15.1.01 presented at the 38th History Symposium of the International Academy of Astronautics as part of the 55th International Astronautical Federation Congress, Vancouver, British Columbia, Canada, 4–8 October 2004).
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- ⁶ Marvin McFarland, ed., *The Papers of Wilbur and Orville Wright* (New York: McGraw-Hill, 1953), Vol. I, p. 397; [Wright brothers analogy], Robert H. Goddard, *Liquid-Propellant Rocket Development* (Washington [D.C.]: Smithsonian Institution, 16 March 1936), p. 2; [Wright brothers analogy], 91st Congress, 2nd Session, Committee on Aeronautical and Space Sciences United States Senate, Senate Document No. 90-71, *Congressional Recognition of Goddard Rocket and Space Museum — Roswell, New Mexico with Tributes to Dr. Robert H. Goddard Space Pioneer, 1882–1945* (Washington [D.C.]: United States Government Printing Office, 1970), p. 18; [Wright brothers analogy], James C. Winchester, “America’s Costliest ‘Goof,’” *New York Mirror Magazine*, 9 March 1958, p. 7; [Wright brothers analogy], Eugene M. Emme, ed., “Robert H. Goddard World Rocket Pioneer,” public information release (Washington [D.C.]: Office of Public Information, National Aeronautics and Space Administration, April 1960), p. 1, available on line.
- ⁷ Rosenthal, p. 9; “Two Additional Honors Accorded Dr. Goddard,” *Astronautics & Aeronautics*, Vol. 2, October 1964, p. 48; “It’s a Goddard Year,” *Astronautics*, Vol. 4, June 1959, pp. 37, 78. Other examples are: “The Man who Opened the Door to Space,” *Popular Science*, Vol. 174, May 1959, pp. 128–131; David M. Warren, “The Forgotten Father of Rocketry,” *Family Weekly*, 19 April 1959, pp. 20–21; Kenneth S. Davis, “Father of Rocketry,” *New York Times Magazine*, 23 October 1960, pp. 31, 33; and Amy Pastan, *The Smithsonian Book of Air & Space Trivia* (Washington, D.C.: Smithsonian Books, 2014), p. 10.
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- ⁹ Clary, pp. 3, 223, 291.
- ¹⁰ *The Papers*, Vol. III, p. 1557; Frederick C. Durant, III and Frank H. Winter, “Goddard and Lindbergh: The Role of Charles A. Lindbergh in the Rocketry Career of Robert H. Goddard,” in *History of Rocketry and Astronautics* (Proceedings of the Thirty-Sixth History Symposium of the International Academy of Astronautics – Houston, Texas, U.S.A., 2002), Michael L. Ciancone, editor, AAS History Series, Volume 33, IAA History Symposia, Volume 22, (San Diego, California: Published for the American Astronautical Society by Univelt, Inc., 2010), pp. 31–59 (paper IAC-02-IAA.2.1.02 presented at the 36th History Symposium of the International Academy of Astronautics as part of the 53rd International Astronautical Federation Congress, 2nd World Space Congress, Houston, Texas, U.S.A., 10–19 October 2002).
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- ¹² *The Papers*, Vol. III, pp. 1540, 1548, 1550, 1552–1554.
- ¹³ Raymond Schuessler, “How American Muffed Space Supremacy,” *American Mercury*, Vol. 90, May 1960, p. 30; *The Papers*, Vol. III, pp. 1556–1557, 1668–1670; Walter Dornberger, *V-2* (New York: The Viking Press, 1958), pp. 47–49; Michael J. Neufeld, *The Rocket and the Reich* (New York: The Free Press, 1995), pp. 35, 51–52, *et. seq.*

- ¹⁴ Clary, pp. 222–223; *The Papers*, Vol. III, pp. 1561–1562, 1564–1566 [reprint of Kerbey’s article].
- ¹⁵ *The Papers*, Vol. III, p. 1583; Letter, F. C. Durant, III to Mitchell R. Sharpe, 14 November 1974; Letter, Esther C. Goddard to Mitchell R. Sharpe, 19 April 1965; Letter, Mitchell R. Sharpe to F. C. Durant, III. 22 November 1974, all in “Goddard, Robert H., Correspondence” file, NASM.
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- ¹⁹ Clary, pp. 73, 107–112, 155–158, 178; Neufeld, *Von Braun*, p. 45; Clary, pp. 70–71, 73; *The Papers*, Vol. pp. 195, 213, 215, 218–219, 225–233, 236, 287. See also, Peter van Dresser, “The notes of Robert H. Goddard, the reticent pioneer of high-altitude rocket development,” in *Scientific American*, Vol. 178, 1 April 1949, pp. 57–58. Re: Goddard’s oaths for employees, see, for example, *The Papers*, Vol. I, p. 548.
- ²⁰ Clary, pp. 178–180; Lehman, p. 235; *The Papers*, Vol. III, pp. 1012–1013, 1027, 1089–1091, 1144, 1159, 1230. For Theodore von Kármán’s version of the Malina story and his (von Kármán’s) sharp assessment of Goddard, see Michael H. Gorn, *The Universal Man — Theodore von Kármán’s Life in Astronautics* (Washington, [D.C.]: Smithsonian Institution Press, 1992), pp. 75, 77–78.
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- ²² *The Papers*, Vol. II, pp. 589–590.
- ²³ “Extra=Blatt der Zeitschrift ‘Die Rakete,’” July 1929, n.p.; Hans Grimm, “Neues von Professor Goddard,” in “Unterhaltungsbeilage zur Zeitschrift ‘Die Rakete,’” September 1929, p. 19.
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- ²⁷ Neufeld, *The Rocket and the Reich*, pp. 45–46, 53, 130; Clary, p. 227; Dornberger, *V-2*, p. 66. Dornberger continued to exploit the alleged “international missile race” ploy again in 1938 in his fight for higher priority of the A-4 program. Dornberger himself, also relates his meeting with Hitler in March 1939 when the Fuhrer visited Kummersdorf during which Dornberger invoked Goddard’s name in seeking higher priority for the rocket program in stating that: “Valier, Oberth, Goddard, and others...were to space travel what [the 1890s German aviation pioneer Otto] Lilienthal had been to the airplane...” If anything, this statement is perhaps additionally revealing of Dornberger’s lack of true knowledge and indeed, his underestimation of, Goddard’s progress in rocketry at this point.
- ²⁸ Ladislav Farago, *The Game of Foxes—The Untold Story of German Espionage in the United States and Great Britain During World War II* (New York: David McKay Co., 1971), pp. 34–35; David Kahn, *Hitler’s Spies* (New York: Collier Books, 1978), p. 77; Clary, pp. 226–227; Neufeld, *The Rocket*, p. 53.
- ²⁹ Dieter K. Huzel, Interoffice Letter, Rocketdyne, titled “Liquid Rocket History,” 11 October 1960, with typed English translation of Thiel Memo, “On the Practical Possibilities of Further Development of the Liquid Rocket...,” copy courtesy Huzel, in “Dieter K. Huzel” file, NASM.
- ³⁰ Clary, pp. 224–226. For examples, see Milton Lehmann, “The Strange Story of Dr. Goddard,” *Reader’s Digest*, Vol. 67, November 1955, p. 147; and T. D. Dungan, *V-2 — A Combat History of the First Ballistic Missile* (Yardley, Pennsylvania: Westholme Publishing, 2005), p. 204.
- ³¹ Excerpt of letter by Wernher von Braun to Mrs. Davis R. Dewey, III on 11 May 1960, in “Wernher von Braun” file, NASA History Office, NASA HQ, Washington, D.C. For a similar statement by von Braun, see, Erik Bergaust, *Wernher von Braun* (Washington, D.C.: National Space Institute, 1976), pp. 518–520.
- ³² Interview, Dr. Gerhard Reisig by Dr. David DeVorkin and Martin Collins, NASM, 27 June 1985, Transcript, p. 23.
- ³³ Interview, Dr. Ernst Steinhoff by Frank H. Winter, 31 September 1983, typed notes in “Ernst Steinhoff” file, NASM; Interview, Arthur Rudolph, 4 August 1989, transcript, pp. 63–64, NASM; Telephone interview, Oscar Holderer, Frank H. Winter, 8 October 2013; Interview, Dr. William Mrazek, by Thomas Ray, 6 April 1973, transcript, p. 34, in “William

Mrazek" file, NASA History Office; [Rees quote], Paul H. Satterfield and David S. Akens, *Historical Monograph — Army Ordnance Satellite Program* (Huntsville, Alabama: Army Ballistic Missile Agency, 1 November 1958), unpublished, p. 3; Dr. Kurt A. Debus, "From A-4 to Explorer 1," in *History of Rocketry and Astronautics* (Proceedings of the Seventh and Eighth History Symposia of the International Academy of Astronautics — Baku, U.S.S.R., 1973; Amsterdam, The Netherlands, 1974), Kristan R. Lattu, editor, AAS History Series, Volume 8, IAA History Symposia, Volume 3 (San Diego, California: published for the American Astronautical Society by Univelt, Inc., 1989), p. 216 (paper presented at the 7th History Symposium of the International Academy of Astronautics as part of the 24th International Astronautical Federation Congress, Baku, U.S.S.R., 7–13 October 1973).

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- ³⁵ Martin Schilling, "The Development of the V-2 Rocket Engine," in Th. Benecke and A. W. Quick, *History of German Guided Missiles Development* (Brunswick, Germany: Verlag E. Appelshans & Co., 1957), pp. 281–282.
- ³⁶ Ordnance Department, [U.S.] Army Service Forces, Foreign Document Evaluation Section, Development and Proof Services, Aberdeen Proving Ground, Maryland, *Accession List of German Documents Pertaining to Guided Missiles* ([U.S.] Ordnance Department Army Service Forces: [Aberdeen Proving Ground, Maryland, 1946–1948], Vol. III, [the Index] of the original three volume version of this work, appearing in 1946, p. 1.