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Chapter 6

Albert Püllenberg and the GEFRA: A Memoir*
(Gesellschaft Für Raketenforschung)

Konrad K. Dannenberg and Mitchell R. Sharpe†

Introduction

Albert Werner Helmut Püllenberg was born on July 3, 1913 in Ulm/ Donau. His father was Albert Püllenberg, a master sergeant in the 48th Artillery Regiment, which was stationed in the city of Ulm. Upon his father's release from the German Army, the family moved in 1919 to Hannover, where his father became a postal inspector.

His son, Albert, attended the Hindenburg School and worked for 2-1/2 years as a "practicant" (engineering apprentice) at the Hanomag, a major industrial producer of tractors, farm machinery, and other heavy equipment. There young Albert learned about welding, soldering, casting of iron and aluminum, forging and heat treatment of metals, and other technical skills. Albert was already interested in rocketry and realized that he would need these talents in his experimentation in future years. At the age of 15, while still in high school, he made a layout for a spaceship with jettisonable booster propulsion for the launch, and with folding wings for the return to Earth.

In the mid-1920's, Albert Püllenberg, Hans Lampe (a future GEFRA-member), and the first author (Konrad Dannenberg) were all members of the YMCA (Young Men's Christian Association) in Hannover. The group organized a summer vacation trip to a small summer resort on the Baltic Sea, close to the

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† U.S. Space and Rocket Center, Huntsville, Alabama.

well-known city of Heringsdorf. Much of our discussions at that time centered around spaceships and rockets. We all had read such rocket books as Oberth's *Die Rakete zu den Planetenräumen* (Rocket into Interplanetary Space), Max Valier's *Der Vorstoss in den Weltraum* (Thrust into Space), and even Robert H. Goddard's "A Method of Reaching Extreme Altitudes." The prospect of space travel was exciting. After all, airplanes and the huge Zeppelins were crossing the Atlantic. Hot air and gas-filled balloons were obtaining greater and greater altitudes! Friedrich Schmiedl was launching rockets in Austria for postal deliveries. Max Valier, Fritz von Opel and Friedrich Sander demonstrated rocket propulsion by using it on automobiles, railroad cars, airplanes and ice-sleds. These pioneers had created the climate for applying rocket propulsion for trips into outer space!

The release in 1929 of the Fritz Lang science fiction film of a manned trip to the Moon, (*Die Frau im Mond*) boosted interest in space travel all over Europe. Our group of rocketeers in Hannover was excited. We were aware of rocket firings which took place in Reinickendorff near Berlin. Rocket pioneer Max Valier presented in Hannover the possibility of a trip to Mars with rocket-propelled space vehicles, which impressed the group more than any other event! Valier also mentioned plans for rocket test demonstrations with automobiles, airplanes, sleds, and rail vehicles, to convince the public that rocket propulsion could be applied to various transportation systems, especially for trips into space.

On June 23, 1928 Fritz von Opel ran three tests with the specially-built railroad cars Opel Rak III and 0pel Rak IV on a perfectly straight and level railroad track from Burgwedel to Celle (near Hannover). Propelled with a battery of 10 rockets it reached a speed of 180 m/h. The first author observed two of these tests with his friend Hans Lampe. They had bicycled to the location, which had been announced in the newspapers. The outcome of the second test with 30 rockets was even more impressive because of a huge explosion due to a malfunction. But it greatly amplified our interest in rocket propulsion as a prerequisite to space flight. It is not recalled if Püllenberg also attended these test demonstrations. He did not mention them in his "Raketenchronik," published in 1973. But he certainly must have heard or read about them, thereby increasing his desire to continue his rocket design and research with liquid propellants.

Early Experiments (Hannover & Bremen)

These events motivated a few space travel enthusiasts to start experimentation with rockets. "Konni" Dannenberg was one of them. Solid propellants were used initially, since they could be obtained from commercially available fireworks rockets. To increase performance these commercial rockets were repackaged into larger units which used as container curtain rods which were inexpen-

sive and could be bought at department stores. These rockets were therefore often referred to as Gardinenstangenraketen (curtain rod rockets). This work was done entirely unsheltered in backyards or on empty lots in the neighborhood. Since frequent explosions and mishaps occurred, the neighbors voiced many complaints. This led to the realization that special provisions would be needed to conduct further testing and development under enhanced safety conditions.

An explosion during the loading of a solid propellant rocket in a garage used for such a procedure caused an extensive study of available literature which in turn led to the decision to switch to liquid propellants. It was found that liquid oxygen is the most efficient oxidizer. The young experimenters were fortunate to be able to procure this normally unavailable chemical through the assistance of a sponsor and mentor, Professor Dr. Arthur Pröll, who taught aviation sciences (Flugzeugwesen) at the Technische Hochschule in Hannover. He knew of a local company which produced high-pressure bottled gas. The proposed fuel was either gasoline or later on diesel fuel.

The gasoline was usually "organized" from the tanks of the automobiles owned by the richer parents of GEFRA members. The car owners were always surprised by the high fuel consumption of their automobiles. Therefore this source soon became unavailable, and Püllenberg switched to the cheaper diesel fuel, which had to be purchased at filling stations. A bicycle repair shop in the city assisted with welding of such components as propellant tanks and feed lines without charge. Material for propellant tanks was also made available at no cost by a Mannesmann production plant located in the vicinity of the Raketenflugplatz. The company manufactured steel tubing with larger wall thicknesses, permitting higher tank pressures for a more efficient propellant feed.

Püllenberg was by far the most active member of the group and became the undisputed leader. He started out in 1927 with solid propellant rockets. But after the above-mentioned accident he designed and built in 1928-1929 the first liquid-propelled rocket, the V.R.-1 (Versuchs-Rakete #1, Test Rocket #1). It was still a Gardinenstangenrakete, but now the curtain rods served as containers for liquid oxygen, gasoline, and pressurized nitrogen. A model of this first design is on display at the German Museum in Munich. The V.R.-1 was launched in the Fall of 1929 from an empty field near the village of Engelbostel. The V.R.-1 impacted close to the launching site after a few loops and several explosions during flight. By the end of 1932 Püllenberg had finished rocket V.R.-2, which exploded during a static firing attempt in the backyard of the furniture company Dyes in Hannover, where it had been built.

On the basis of these mishaps Püllenberg recognized the need for systematic research and testing. He established therefore in 1928 the "Raketenwerft Hannover," which later on became the GEFRA. He constructed a simple wooden static firing facility which supported much of the early research. Albert conducted static firing tests with different propellants. He studied various rocket motor designs to improve propellant injection, combustion and cooling methods

of rocket chambers for continuous operation; he also spent a lot of time developing an intermittently operating rocket motor.

Manufacturing tools and some measuring instruments were eventually obtained from the Hannover county jail, where these items were being sold by the pound. This was of tremendous help and permitted the installation of a more advanced static-firing facility where thrust could be measured, as well as a number of pressure levels in the rocket motor and in the propellant tanks. All this material, and any rocket motor and tanks which had been built in the city, had to be carried out to the launch site, a trip of about 15 km, with a hand-drawn, four-wheeled cart, or often carried on the bicycles, which everyone used for transportation.

The existence of the "Verein für Raumschiffahrt (VfR)" in Breslau was known. Also known was that Prof. Robert Goddard was conducting tests in the USA. Rumors also existed about a Russian group in Moscow. To follow suit, the 18-year-old Püllenberg founded on November 18, 1931 the GEFRA (Gesellschaft für Raketenforschung - Society for Rocket Research). The official ceremony took place in downtown Hannover, in a restaurant most aptly named "Zur Rakete." The time was as opportune as the name of the founding site.

The Vahrenwalder Heide also had an airfield, where the student group AKAFLIEG of the Technische Hochschule under the sponsorship of Professor Dr. Arthur Pröll conducted training of student pilots. Since they usually spent the entire day at this facility, they operated a kitchen to feed the students. Püllenberg and some of his coworkers went there quite often in order to mooch ("schnurren") a meal.

Püllenberg claimed in his "Raketen-chronik" that he had an offer from the American Fred Wolf to come to the United States and to continue his research there with better means and greater financial support. He would also be able to complete his education and to obtain an engineering degree. He declined this offer and soon moved to Bremen to continue his rocket work and to take up studies in mechanical engineering. He eventually was awarded the degree of "Ingenieur" from the Technikum in Bremen.

During the late 1920s and early 1930s many people were unemployed, had time on their hands, and became interested in rocketry. The Machtübernahme (Take-over) by Adolf Hitler in 1933 changed this situation, and many supporting members became less and less interested, since regular jobs were again readily available. But for Albert Püllenberg the years 1933 and 1934 showed the greatest progress and successes.

In the Summer of 1933, Püllenberg designed and built, in Bremen, the Diesel-F.T. Rak III. A Mr. Lehnert, owner of a radiator shop in Bremen, helped with the manufacture. After completion, Albert had to transport the rocket back to Hannover, since the "Raketenflugplatz" was still at his disposal for static firings and launchings under relatively safe conditions. The Diesel-F.T. Rak III

was 3.5 m tall, had a diameter of 0.28 m, weighed 15 kg and could produce a thrust of about 25 kg, resulting in a take-off acceleration of about 0.67 g's.

Püllenberg had organized a display booth at the DELA (Deutsche Luftfahrtausstellung) which opened on March 3 and ran through March 18, 1934. The main exhibits were the Diesel-F.T. Rak III and a mobile test facility. He also displayed solid and liquid propellant rocket models, a future space station and a high-pressure motor designated R.V.M.4. His booth operated under the title "Gesellschaft für Raketenforschung." Püllenberg also announced at the Fair the official opening of the world's second "Raketenflugplatz" on March 27, 1934. A few days later, the Diesel-F.T. Rak III exploded during a launch attempt. On June 29, 1934, Püllenberg launched a follow-on model, V.R.4. It obtained an altitude of about 15 m, which Püllenberg considered a success.

No doubt, the publicity about these events helped. The German Army was willing to rent to the GEFRA for 1.00 RM per year a sizable area on the Vahrenwalder Heide for static firing tests and launchings of rockets. This facility was located about 15 km north of the city, beyond the Mittelland Kanal and inside a large area of empty ammunition storage bunkers. The Army made two sheds for assembly of rocket components available. Also the deactivated ammunition bunkers were available to serve as safety shelters for protection from the debris of exploring rockets during static firings. The frequent mishaps had led to the conclusion that it is mandatory prior to a launch to conduct a static firing where the rocket is tied to the test stand and will not be released, as in a launch. These firings could now be conducted just outside of the bunker with an improved Test Stand #III and provided good protection from explosive debris. Construction and manufacture of rockets still took place in the city in rented or borrowed facilities. Although it had been in use before, the official opening of the "Raketenflugplatz Hannover" took place on March 27, 1934.

Things were really looking up when sailplane pilot Gottlieb Espenlaub in 1934 indicated an interest in obtaining a liquid-propelled and controllable rocket propulsion system for his glider, the Ente (duck). He had flown it already with solid propellant motors, but he desired better controllability and propulsion cut-off in case of emergencies. Püllenberg therefore decided to develop larger rocket motors with several hundred kilograms of thrust. One of the first models was the RVM4, which could be static-fired on the new Test Stand III, just outside of the bunker. Unfortunately, at this time the money ran out; both parties agreed to cancel this challenging project, which might have become the first profit-making, liquid rocket project.

In spite of all these problems, Püllenberg had completed the first liquid-propelled postal rocket. He announced its launch for September 19, 1934 in a public demonstration. The rocket was known as VR.5. It carried 30 postcards which after a successful launch and recovery were taken by motorcycle to the main post office in Hannover for mailing. The rocket VR.5 had been static-fired on August 20, 1934 next to the bunker. The use of rockets for postal deliveries

was one of the primary purposes visualized for rocket vehicle application. Others uses were the propulsion of gliders, take-off assist for overloaded commercial airplanes, altitude research, and others. All these efforts were merely considered precursors to space flight for the exploration of the solar system.

In late 1934, Püllenberg tested improved rocket motors on an advanced, mobile Test Stand II. He also tested alternate fuels and oxidizers. On January 27, 1935, he launched successfully the VR.6a and made a 16 mm movie to record this flight. Further work was done on rockets VR.7, VR.8, VR.9 and intermittently-operating rocket motors. Based on all these successes Püllenberg published a research report entitled "Raketenflugplatz Hannover" and had 5000 copies printed., Later that year a test demonstration before Prof. Pröll and other University authorities went wrong due to malfunctioning components.

On July 16, 1936, Captain Walter Dornberger and Klaus Riedel from the Heereswaffenamt (Army Ordnance) paid a visit to Albert Püllenberg and the Raketenflugplatz in Hannover. They were not impressed by what they saw. Dornberger's advice, documented in his official report, suggested that Püllenberg resume his studies and obtain his engineering degree. He also reported that Püllenberg was then "without assistance from anyone and that his efforts were doomed from the beginning." Just two days later, Püllenberg was ordered to GESTAPO Headquarters in Bremen and was told to stop all rocket experiments, to dissolve the GEFRA, and to stop immediately any further distribution of the research report he had just completed and printed.

Püllenberg had started as early as 1933 some rocket development work in Bremen. He finally moved from Hannover to Bremen and began his studies in compliance with Captain Dornberger's advice. He attended the "Höhere Technische Staatslehranstalt" (State Technical Trade School) in Bremen from April 1935 to July 1937 and obtained an engineering degree. His study subjects emphasized mechanical engineering, aircraft and automobile design. For about a year thereafter he designed at the DESCHIMAG centrifugal pumps and steam turbines. He married in Bremen on August 13, 1938. His wife was the daughter of the owner of a materials supply company. This association permitted Püllenberg to continue his activities in secrecy, since he could obtain construction materials for work on rocket systems and test facilities at practically no cost to him or to the GEFRA.

His new test facilities for rocket research and development in Bremen had to be built from the ground on up. He therefore decided in late 1937 to relocate the test stand from the "Raketenflugplatz" in Hannover to Bremen. There he improved its usefulness by adding measuring instrumentation. After those modifications he installed it near a protective shelter which had been built for 2 people. Only his closest friends were still working with him on additional rocket developments. Since GEFRA members knew that a law or government directives prohibited rocket research he obtained only minor support from others. But Püllenberg continued uninhibited. He soon became the only one to continue the

work. In spite of these problems he designed and/or built during this time his intermittently-operating motors IMO-2 and IMO-3, a turbo-rocket motor without designation, and a series of liquid-propelled rockets V.R.10, V.R.11 and V.R.12, which were forerunners for his antiaircraft missile, the Flakrakete V.R.13. When he was drafted at the beginning of the war into the German Air Force and assigned to a Flak Bataillon, his immediate supervisors permitted him to continue work on the Flakrakete, apparently without any knowledge of their superiors. Before Püllenberg joined Peenemünde he applied on March 17, 1940 for a German Patent on this design, which was assigned the patent # P 80519 Ia/46g. The date preceded by just one day his transfer to Peenemünde. Püllenberg rushed it through in order to secure his mental property, as he expressed it in a letter to Willi Ley written in late 1949.

The Years in Peenemünde

Albert Püllenberg was invited ("dienstverpflichted") to join the Peenemünde development team. Most rocket enthusiasts working there at that time were interested in undertaking the first intermediate steps in rocket travel. They saw the need for a natural progression of rocket vehicle applications, initially for such benign purposes as a means of transportation to carry mail, freight, and eventually, people to remote destinations; to propel airplanes; to conduct high-altitude research; and to aid in communications and Earth observations. The realization of space flight was, of course, the final and ultimate goal. Almost everyone realized that many intermediate steps would be needed to build rockets powerful enough for trips into orbit, to the Moon, and eventually to the planets of the solar system. But in Peenemünde they could work on the first step toward the final goal. This line of thinking was typical of the early team members of Wernher von Braun in Peenemünde. Albert liked this mental climate very much and dove head-first into this new challenge.

He had also hoped that he could continue work on his Flakrakete. He made this proposal to Wernher von Braun, but it was turned down since anti-aircraft systems were developed and employed by the German Air Force; and he, on the other hand, worked for the German Army, which had no jurisdiction in this area. Since he was always a rather stubborn personality, he wrote a letter to Hermann Göring requesting such an assignment. Army officials learned of his action, of course, and he was in hot water for quite awhile.

Based on his experience, Albert Püllenberg's principal assignment was the testing and final development of the steam generator to supply the power to drive the turbine of the A-4 turbopump. An additional, but auxiliary, assignment was the testing and verification of the heat exchanger, which was to facilitate the pressurization of the liquid oxygen container during flight by gasifying a small amount of liquid oxygen and feeding it back into the liquid oxygen con-

tainer. This saved the heavy weight of high-pressure gas bottles, which otherwise would have been required for the LOX tank as well as for the fuel tank which for safety reasons could not be pressurized with oxygen.

The steam generator was to provide a sufficient amount of high-temperature steam from the decomposition of high-concentration hydrogen peroxide to drive the turbine. The basic principle had been established by Dr. Walter Thiel, von Braun's deputy. He was the responsible official for power-plant development which had already been conceived in Kummersdorf. He had decided to utilize the basic steam generator components developed by the Walter Works in Kiel and to adapt them to the specific requirements of the A-4 system. Püllenberg was responsible for demonstrating by a series of development tests the performance of the generator. He also had to verify the adequacy of future deliveries in an acceptance test. He was also free and encouraged to propose and test improvements in the system.

The steam generator had to provide about 3 kg/sec of steam during the mainstage operation. It had to start the turbine rapidly and reproducibly and had then to maintain the required flow for over 60 sec. The power was to be generated by hydrogen peroxide, which, mixed with potassium permanganate, would decompose and thus generate steam at about 375°C. For reasons of military secrecy components had code names which are as follows, and which will be used in the following description:

- T-stoff Container (hydrogen peroxide) 130 l "Treibstoff"—also known as "Thymiol"
- Z-stoff Container (potassium permanganate) 11 l "Zersetzer"—also known as "Rubid"
- Steam generator, P-stoff-battery, feed lines, pressure reducer, valves, and seven high-pressure cylinders.

The T-stoff container was egg-shaped, made from steel and carried about 126 l of T-stoff. It was protected on the inside and the outside with a temperature-resistant aluminum paint. Its wall thickness was 3.5 mm; the test pressure was 50 atm and the operating pressure was 30 atm. The Z-stoff container was cylindrical and carried approximately 9 l potassium permanganate and was also protected with temperature-resistant aluminum paint. The Z-stoff container was smaller and mounted underneath the T-stoff container.

The steam generator received the T-stoff and the Z-stoff. The catalytic effect of the Z-stoff decomposed the T-stoff into 375°C steam. The T-stoff was introduced through a spray nozzle, and the Z-stoff hit a wall which generated a spray that helped in the decomposition of the T-stoff particles, a design aimed to generate a rotating motion to extend the dwell-time in the generator and to give the T-stoff sufficient time for complete decomposition.

The P-stoff unit consisted of seven high-pressure bottles each containing 7 l of high-pressure nitrogen connected by a manifold into a unified high-pressure

supply. This unit provided all high-pressure nitrogen to the T-stoff container, the Z-stoff container, and to all valves of the A-4 engine system, including the steam generator.

The P-stoff bottles were charged from a ground source to 200 atm. A pressure reducer supplied 30 atm pressure to valves and also pressurized the T-stoff and the Z-stoff containers for approximately 60 sec. A 1.5 atm pressure contact assured that the Z-stoff entered first to avoid an explosion of large amounts of T-stoff entering first. To improve the cut-off accuracy, the 25-ton main valve closed, and an 8-ton valve opened for a decreased flow of propellants to operate the turbopump at a lower rpm level for the last approximately 3 seconds of engine operation. This generated a lower pressure level and a lower flow rate which reduced the engine to a lower thrust level for an improvement in cut-off accuracy.

When Albert Püllenberg was assigned to develop the steam generator, there were still problems which had to be solved. Many of the above-mentioned requirements had to be established and their adequacy proven by test results. Their solution was Püllenberg's main concern. In the earlier years there were also many improvement and development efforts going on. It was desirable, for example, to obtain a quick but highly reliable and reproducible start. The system mixed liquefied potassium permanganate with the hydrogen peroxide of 80 percent concentration. The high-pressure containers for this mixture increased the total system weight, and he had to test a proposal to use a pellet-type catalyst. Pellet abrasion became a problem, and this solution was finally rejected. Other potential catalysts would have been such metals as silver, platinum, or possibly cadmium, but none of these materials were readily available during war time.

Early designs also had a separator unit to eliminate solid contaminants possibly generated by the Z-stoff. Testing showed that this component could be deleted. This finding was made before the production design was developed and was therefore never a part of the final production drawings. After all components had been developed individually, a new package design had to be developed that would fit into the available space on top of the rocket motor, next to the turbopump.

Püllenberg's most challenging task was to work on a proposal to develop a small turbopump to centrifuge the T-stoff at the point where it came out of the low-pressure T-stoff tank. This system would obtain the initial starting power from a rather small high-pressure vessel. Its small size would accomplish the desired weight savings. The start of the T-stoff pump also required a much lower power level than the main turbopump, which had to pressurize a propellant flow rate of 125 kg/sec.

An alternate approach had been made by the propulsion systems group under Helmut Zoike. It proposed to mount the T-stoff pump on the shaft of the main turbopump. This would have necessitated a change of the pump design. It was also recognized that the power requirement to assure a rapid start would

have been extremely large. These two features were the main reasons that the introduction of this system was rejected.

Any one of these advanced methods would have saved much of the weight of the seven high-pressure bottles to pressurize the hydrogen peroxide tank to 30 psi, as well as the added tank weight due to the high internal pressure. There was, unfortunately, not sufficient time to develop either of these two complicated procedures which had to be intricately tied into the other components of the propulsion system. In spite of an all-out effort to develop these weight saving methods, both systems had to be finally rejected when the order was given to freeze the existing A-4 design. For the same reason a pellet or precious metal catalyst would have simplified the turbopump power supply greatly but did not become available in time prior to the design freeze order.

This design freeze also prevented many other improvements and performance enhancements of the A-4 system. Many engineers and scientists were therefore of the opinion that it was premature to start the mass production and subsequent deployment of the A-4. Von Braun reported this belief to General Dornberger. After some feelers had been extended, A-4 management realized that there was no way to delay the political decision to proceed with mass production and troop deployment of what they believed was an immature design. Most of the predicted shortcomings showed up in troop training firings and particularly during the tactical deployment against military targets. The design of the American REDSTONE missile corrected many of these shortcomings later.

Püllenberg reported in his "Raketen-chronik" that already in late January 1945 the artillery fire of the Red Army could be heard on the Island. The Peenemünde management had been directed to relocate into the Mittelwerk area in the Harz mountains. Three trains carried many people into the area around Bleicherode which had been spared bomb raids. Also design and manufacturing equipment, tools and materials were transported by train, truck and ship into the new area. Later on, an additional move into the southernmost part of Germany (Oberammergau, Garmisch-Partenkirchen) was conducted by about 500 key employees of the former Peenemünde facility.

For the remaining civilian population—and some workers who had been living there before Peenemünde was established—all the lights were out and all electricity was gone. But people were prepared and had kerosene lamps for this emergency. Püllenberg was sent on a business trip to Dresden and Leipzig on February 12, 1945, to negotiate with paper manufacturers there to build the A-4 propellant containers from reinforced and specially treated cardboard paper. He also picked up at that time from the manufacturer Otto Dunkel a completed turbodrive for his now defunct hydrogen peroxide turbopump system.

On arrival in Bleicherode, Mrs. Holst, a secretary to the relocated Peenemünde team divulged to him top secret information she had learned while she had been working for an SS-unit: SS Obergruppenführer Hans Kammler had given an order in case the war ended unfavorably for Germany to shoot all

people with secret knowledge to prevent its transfer to the enemy. The first author requested Püllenberg to travel with the rest of the team to Oberammergau in the "Vergeltungs-Train" (Püllenberg's terminology in his "Raketen-chronik"). But Albert had disappeared and was most likely on his way to Hannover, where his parents were living, or to Bremen, where his family was waiting for him. The SS had obviously issued an order to destroy all Mittelwerk equipment and to kill all workers and concentration camp personnel who had been working there. But most of the SS soldiers fortunately ignored these orders and preferred to join families, relatives, or friends.

Beyond the patent on a "Flakrakete," mentioned previously which had been submitted just before Püllenberg started work in Peenemünde, he submitted during his five years at the German Army's Research and Development Center an additional four patents:

- P 82590 Ia/46g; Rocket Motor with a Rotating Mechanism Inside – 4/16/41
- P 86429 Ia/46g; Rocket Motor with Intermittent Gas Expulsion – 7/2/42
- P 116621 IVb/Ri; Propellant for Heat-Engines – 7/7/43
- P 87420 II 65fi; Propulsion for Watercraft – 3/8/44.

Other patent proposals and ideas had been in preparation by Püllenberg but were for personal or timing reasons not submitted. Püllenberg was greatly disappointed that his project Flakrakete was never approved. He was very bitter about this rejection. His proposal had no influence whatsoever on the Peenemünde Project "Wasserfall," which was an antiaircraft missile. It was being developed at the Peenemünde Army facilities for the German Air Force. Its design provided for a much larger missile than Püllenbergs project "Flakrakete."

The Post-War Period

Püllenberg was not available to discuss a move to the United States. He was never contacted and stayed behind in Bremen with his family. He helped his father-in-law to build up again the business which had been completely destroyed in the last few months of the war. During this period he also resumed his liquid rocket design and development activities, concentrating on postal rockets to demonstrate the peaceful application of this new technology. He also tried in the early 1950s to merge all the then existing German rocket amateur groups. As a first step he contacted all former GEFRA members he could reach as well as some of his associates from Peenemünde. They were invited to assemble in the Hannover office of Heinz Ollmetzer who had been one of the most active members in the early 1930s. Püllenberg proposed that such a group should be headed by Professor Hase who had supported Peenemünde in measuring systems and applications. These merger efforts never succeeded, although

under the leadership of Dr. Friedrich August Staats a German rocket society was established, and whose successor organizations are still alive today.

Exactly 20 years after the foundation of the initial GEFRA, he reestablished on November 19, 1951 in Bremen the new GEFRA. This reorganized group was officially registered on February 28, 1952 in Bremen under the club registry # VR 1404 and could now carry the name GEFRA e.V. These efforts, however, never led to a new, revitalized organization. A part of this problem was the fact that Püllenberg had always been, and still was, very close-mouthed. It was difficult to discuss his ideas and thoughts with him. He kept all project plans to himself and was not open to discussions. In this respect, Püllenberg was a great deal like his contemporary and peer Dr. Robert H. Goddard, the American rocket pioneer. This attitude led many people to not wanting to participate in the GEFRA.

When Püllenberg wanted to visit the First International Astronautical Congress in Paris in 1950, his application for a travel visa was rejected. He managed however, to attend the next year, the Second International Astronautical Congress, in London, where he displayed an inflatable Earth satellite and a postal rocket with movable wings for a remotely controlled landing at the recovery site.

In 1952 Püllenberg conducted in Hespenbusch, at Wildeshausen, the first post-war launchings of postal rockets to demonstrate the potential peaceful use and application of rocket propulsion. His efforts, however, were frowned upon by the British occupation forces, and he encountered many political problems with further experimentation.

It was probably as a result of this situation that he tried in August 1952 to turn the direction of the GEFRA e.V. over to Dr. Friedrich August Staats, who for a variety of reasons did not accept such a transfer of responsibility. Dr. Staats founded instead on September 21, 1952 at the Bremen Airport the "Arbeitsgemainschaft für Raketentechnik," which later on changed into the "Gesellschaft für Weltraumforschung - GfW," which in 1956 became the "Deutsche Gesellschaft für Raketentechnik und Raumfahrt - DGRR," which then became the "Hermann-Oberth-Gesellschaft e.V. - (HOG)." It is today the "Internationaler Föderkreis für Raumfahrt - Hermann Oberth - Wernher von Braun - (IFR)." In 1993 it merged with an existing society and is now known as the "Deutsche Gesellschaft für Luft- und Raumfahrt Lilienthal-Oberth (DGLR) e.V." It is an associate member of the IAF. Dr. Staats does not consider these organizations to be successor groups of the GEFRA.

In September 1952, Püllenberg attended the "Erfindermesse" (Inventors Fair) in the city of Cologne and displayed GEFRA exhibits. In the same year, he moved to Hamburg and lectured extensively about the benefits of postal rockets. For economic reasons he had to reduce his experimentation with rockets. In the late 1950s he had a bad automobile accident which stopped his physical involvement in rocket development activities completely. For a while he lived in the

suburb of Kirchrode, near Hannover. When he moved from there to Weissenborn, in Bavaria, he turned all his rocket samples, exhibits, drawings, newspaper articles, and other items on June 22, 1961, over to the Hannover Heimat Museum, where his V.R.-12 rocket is still on display today. Other items of lesser interest are there in storage. Püllenberg kept his diary of the Vahrenwalder Heide rocket tests, some correspondence, and miscellaneous other files, since he intended to write a book about these events. To the knowledge of the authors such a book was never published.

On September 19, 1974 Püllenberg published a one page pamphlet in recognition of the 40th anniversary of his first postal rocket launch. This publication was reprinted in several local newspapers and included some background information on these early rocket tests. The Hannover Heimat Museum has one of his rockets displayed in a special exhibit.

Püllenberg was asked in 1982 to relate in the "VDI Nactrichten" under the category "Zeitzeugen berichten" (Time witnesses report) his earlier rocket development activities. Two issues of the "VDI Nachrichten" of February 26, 1982 and June 11, 1982, published his story.

He finally returned to Ulm, his place of birth, where he worked for Telefunken. In his later years he was greatly hampered by the results of an automobile accident which affected all his future activities. He even had to reduce his lecturing, and for these reasons not too much is known about his rocket activities during the later years of his life. It is assumed that he did no further rocket research, since neither his "Raketen-chronik" of 1960 nor his later publications in 1974 and 1982 mention any additional efforts in this field. It is also known that he spent much time in his later years in the hospital and at home in a wheelchair suffering from cancer and undergoing frequent radiation and chemotherapy treatments. Albert Püllenberg died on April 8, 1991 in Neu-Ulm, where he had been living with his family during his later years.

Conclusion

In conclusion, it can be said of Albert Püllenberg that he was one of the lesser-known pioneers of contemporary rocketry. However, his vision, his leadership, and engineering contributions to advancing the state of rocket technology certainly deserve to be recognized. His early work on turbopumps and especially their power supplies led over many incremental development steps to the modern turbopump technology as it is applied to most liquid-propelled launch vehicles. Even the highly advanced dual-turbopumps of the Space Shuttle system are based on the early development work which began in Peenemünde. There Albert Püllenberg was one of the key engineers to define the characteristics and specifications of one of the most critical elements of modern rocketry.

As a final item of interest concerning postal rockets it may be stated here that the first author visited during the 44th International Astronautical Congress in 1993 the well-known postal rocket proponent, Friedrich Schmiedl, in Graz, Austria. Schmiedl replied to the question of what he thought of the U.S. Space Shuttle and the Space Station programs, that both efforts were a waste of money and that they should be invested in the development of an effective postal mail delivery system. The first author believes that Albert Püllenberg might very well have provided a similar reply to the same question.

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