History of Rocketry and Astronautics

Proceedings of the Thirtieth History Symposium of the International Academy of Astronautics

Beijing, China, 1996

Hervé Moulin and Donald C. Elder
Volume Editors

Donald C. Elder, Series Editor

AAS History Series, Volume 25

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 16

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

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

First Printing 2003

ISSN 0730-3564

ISBN 0-87703-498-2 (Hard Cover)
ISBN 0-87703-499-0 (Soft Cover)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198
Web Site: http://www.univelt.com

Printed and Bound in the U.S.A.

Chapter 2

The Legacy of the Oberth Rocket of 1935*

Karlheinz Rohrwild†

Introduction

In 1933 Werner Brügel published the book *Men of the Rocket* (Publisher: Hochmeister and Thal, Leipzig). It was a treatise about the young science of space-travel written by their creators. Hermann Oberth was also among the contributors. His article contained the sketch of a new experimental rocket, whose function was briefly described, but details were not given.[1]

Another 50 years passed, before Hans Barth, in his biography of Oberth, again mentioned this rocket. Barth cites a 1933 letter to Otto Wiemer in Germany, in which Oberth writes about a "half-completed" model of a rocket. He also reports that Oberth in 1948 had written to Willy Ley that he had flown his first small liquid rocket in 1935.[2] Ley basically ignored this short statement of Oberth, with the result that little was known of this rocket.

Back in Romania

After his bad experiences with the German "Society for Space Travel" Oberth relinquished his presidency and canceled his membership. From that point on little was heard from Oberth. In 1931 the Romanian King Carol II gave Oberth an audience in Bucharest, and offered the facilities of the military

---

* Presented at the Thirtieth History Symposium of the International Academy of Astronautics, Beijing, China, 1996.

† Herman Oberth Space Museum, Feucht, Germany.

airport in Medias, to continue his experiments. Oberth accepted and started experimental work.

All the hardware that had been built previously had remained in Berlin. Nebel used Oberth's rocket engine at the rocket test field (Raketenflugplatz) in Berlin. Oberth repeatedly demanded the return of his hardware but without any success. Thus he had to start from scratch.[3] The first thing he needed was a new rocket engine. Now he had time, because the UFA was not pushing him. So he designed a little rocket whose nozzle was at the top of the aggregate to avoid stability problems that he had experienced with the UFA rocket. Oberth was well aware of the advantages and disadvantages of this method of propulsion, but now he was in Transylvania and not in Berlin. Therefore, the rocket had to be simple and reliable. Obviously, after the mishap at the UFA, he wanted to be successful this time.

Oberth first build a wooden model of the chamber to study flow in a subsonic water tunnel in order to find the best position for the fuel injector nozzles. With the design completed, the rocket engine was cast out of brass by Benckar & Jickeli, Sibiu, in 1931.[4]

In November of 1931, Oberth wrote an article for the French journal *La Science et la Vie* which on page 392 read as follows:

> "(1) avec un tuyére d'essai pesant 1200 grammes, j'ai obtenu, par example, pour une consommation de combustible de 500 grammes par seconde (420 grammes d'air liquide et 50 grammes d'essence), une réaction de plus de 80 kilogrammes."

The rocket-engine weighed 1200 grams and developed a thrust of 80 kilograms and consumed 500 grams fuel per second (80 grams gasoline and 420 grams liquid oxygen).[5] Oberth had intended to build a light-weight chamber from an aluminum alloy, but no metal shop in Transylvania was set up to fabricate such a thing, so he lightened the weight of the chamber by filing away excess brass.[6]

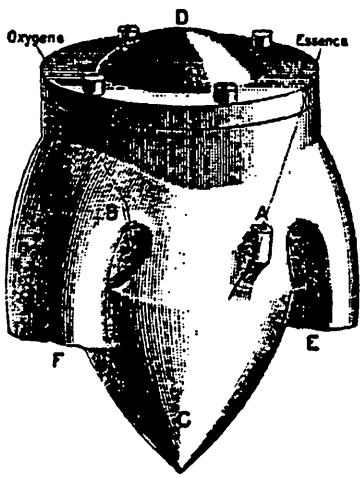

Figure 1 Drawing of the new rocket motor.

The article gives the first indications about Oberth's work in his homeland of Transylvania. It reveals that he must have conducted numerous tests with this engine, as he describes various responses under different test conditions. For example, he discusses running the motor with a deficiency or an excess of oxygen, observing the cause of pulsating combustion, etc.

Correspondence With Otto Wiemer in Essen

On the 15th of February Oberth received his first letter from Otto Wiemer. The young man wrote that he was very interested in space travel, and would very much like to work in that field. He also wanted to see to it that Oberth would get a position at Krupp in Essen in order to continue his research. Unfortunately, nothing came of it.[7]

In his third letter of April 16, 1933 to Wiemer Oberth wrote:

> "Presently I am working on a rocket whose combustion gases are exhausting at the top. With the help of the Lord the nozzle should not cause any unexpected surprises. At a later date, I shall write to you in more detail about how it functions, and our experience with it. Presently, I am in possession of a half-completed experimental model, which has a length of 1400 mm and a diameter of 142 mm at its widest section."

Oberth continues:

> "My present combustion-chamber is cast of brass, whose interior is insulated with STEMAG Kitt. Therefore, it is rather heavy, although I have filed away everything not required. One should find a company, that could cast the chamber out of light-metal."

Figure 2 Rocket.

Oberth's 4th letter to Wiemer on July 10, 1933[8] gives further information about the new combustion chamber:

> "The chamber "E" has the form shown in Figure 3: At "b" gasoline, at "s" oxygen is injected. Both streams meet and burn at the top. The combustion gases exhaust into the atmosphere through the nozzles "d." The functioning of the combustion chamber is best told by the attached copies of the German patent Number 549 222."

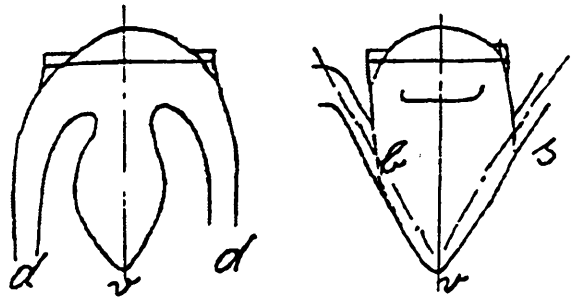

Figure 3 Drawing of Oberth's new combustion chamber.

Oberth's Article in *Männer der Rakete* (Men of the Rocket)

In this paper[9] Oberth, for the first time, describes the particular design features of his new experimental rocket:

> "Figure 6 is a sketch of my new experimental rocket. One can see how simple it is to incorporate the nozzles, combustion chamber and the compartment for the parachute into the gasoline tank and how easy it was to accomplish the design features enumerated below:
> a) An aerodynamically satisfactory shape for the whole aggregate;
> b) Exhaustion of the gases closes to the top;
> c) Surrounding the conical top of the chamber, where most of the combustion occurs, until the last moment with a cooling liquid;
> d) Complete utilization of the available space;
> e) Shifting the center of mass to the top, i.e. to make the top heavier than the bottom."

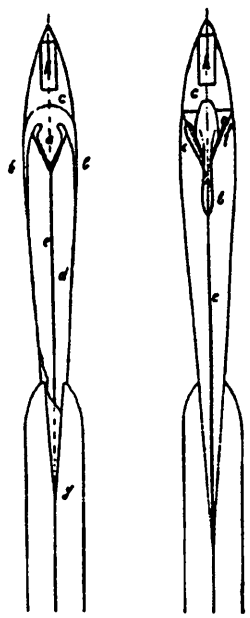

Figure 4 Oberth writes the following about this drawing.

Frontal and side views of Oberth's new experimental rocket. A) Combustion chamber; b) combustion gases; c) Link for gasoline; d) tank for liquid air; c) tube for liquid air; f) tube for gasoline; g) Fins, they must be visualized at a 45° angle to the plane of the page.

This model has no fuel pumps. Therefore, the liquids must be under a higher pressure than the pressure in the combustion chamber, and the tanks must be accordingly strong and heavy. Because of this, the mass ratio is unfavorable and the apparatus will not reach great heights. This would anyhow not have been possible on account of its short length of 142 cm. The drawing is only a rather simplified schematic. Screw joints, parts to stiffen the aggregate, closures, gas generators, safety valves, etc., are omitted.

Both the letters to Wiemer and his article in *Men of the Rocket* prove that Oberth was then working on an experimental rocket. This rocket was half-completed on April 1 1933.

The names of his co-workers are also known. In the letter of 31 July 1964 to Ciples Licinius one reads:

> "From 1932 till 1937 I worked with first lieutenant Alexandru-Hot, the carpenter Untsch with the rank of a corporal and a mechanic, who, also with the rank of a corporal instructed students at the military flying school of Medias. I don't remember the name of the latter. The commander of the flying school was colonel Celarenn. After my emigration to Germany, I lost the contact with these gentlemen."

Function of the Rocket

Oberth provides no clear and complete description of his work on this rocket, but many of his articles and letters contain fragmental descriptions and references to it. The reasons for the lacking evidence can be gleaned from the letter to Ciples Licinius:

> "Unfortunately, there are few sketches and photographs of my work at Medias left. I stored these Documents in a bunker at Geretsried in upper Bavaria. In the winter of 1945 it was occupied by Russian POWs, who used those papers to kindle a fire."

Also, Oberth had lost many of his papers, including the ones about his work at the UFA labs, dealing with the ignition of the stream of liquid oxygen. The air raid on Peenemünde in the summer of 1943, destroyed these papers; they burned in house No. 20, the quarters of the "bachelors."[10]

However, from Oberth's article of May 1949 entitled "What would be different today in my book *Means to Space Travel*,"[11] we can obtain many details about the construction of the rocket ejected under a pressure of 80 to 100 bars:

"Combustion Chamber and Pressure Generation:

Since it is difficult to get complete combustion in very small chambers, I positioned, at that time, the rather heavy brass chamber, that had been insulated with a ceramic material, in the top of the rocket (in small rockets a higher inert weight is not necessarily a disadvantage, if one considers the "passive flight" after burn-out). The combustion gases were turned around and streamed down along the side of the rocket, while the fuel tanks were hanging below (Figure 9a). This design permitted a long, thin shape, which is particularly advantageous in small rockets. During the re-routing of the exhaust jet the unburned liquid particles were flung against the upper wall where they either burned or were reflected back into the combustion chamber. This chamber yielded an effective exhaust velocity of 1600 m/sec (compared to 950 m/sec for the chamber shown in figure 9). [However, gasoline yields a lower exhaust velocity than ethanol, i.e., at best, 1750 m/sec under normal operating conditions, compared to 2000 - 2400 m/sec for alcohol.] Since small rockets are not supposed to fly long distances, one can tolerate the reduced efficiency in favor of the simpler construction.

According to the principle, study almost everything and then pick the best version, I also developed cartridges, which, besides gasoline, contained pressurized carbon dioxide or nitrogen, which pushed the fuel in a thin stream into the liquid oxygen, where it burned. The closure (of the cartridge) was effected by a screw positioned in front of the nozzle which had a diameter of 6 mm on top and sat above a conical hole of 3 mm (Cf. Figure 12). The latter was clogged up with moistened "flour" (see below), which, after drying, was protected from the liquid by a lacquer of Zellon or Wood's metal. On ignition, the black powder burned off, whereupon the liquid was ejected under a pressure of 80 to 100 bars.

I would use this gas only for the generation of pressure in fuel tanks, but not for driving pumps."

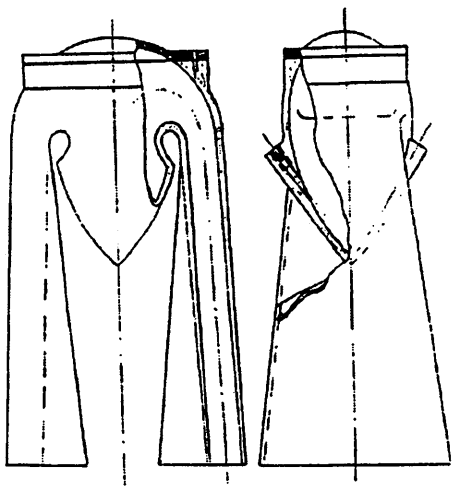

Figure 5 Figure 9a: 1949 drawing of Hermann Oberth of his combustion chamber. Figure 9 refers to his "conical nozzle."

In the same article Oberth explains the function of the "flour" as follows:

"The word 'flour' means a mixture of saltpeter, sulfur and powdered charcoal which comes from the rolling mills, hence common black powder, which has not yet been granulated and polished."

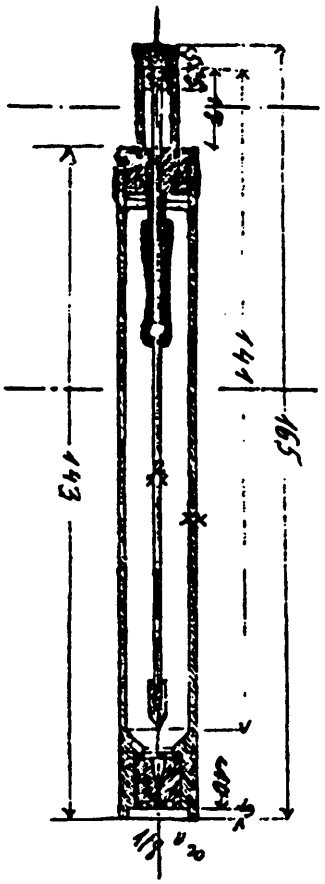

Figure 6 Figure 12 no longer exists. The sketch shown above is an original drawing of the apparatus, used in 1935, to generate pressure. It was used in the rocket.

Continuation of the Work from 1931 to 1935

Responding to an order of King Carol II, starting in the summer of 1931, Hermann Oberth again worked on rockets. In the fall of 1931 he had already developed a functioning rocket engine which generated a thrust of 80 kg, and in the spring of 1933 a half-finished model of his new rocket, which, according to him, was launched in 1935.

Why had so much time elapsed between the beginning of the work in 1931 and its completion in 1935, since he had the engine already in the fall of 1931? To answer this, one reads in a letter to Wiemer:

> "With the help of the Lord, the nozzle will not produce any more unpleasant surprises."

Hence, there were considerable difficulties to overcome until the nozzle functioned satisfactorily. It appears that Oberth spent a lot of time on this problem. In April, the rocket was half finished. From the letters to Otto Wiemer we learn that thereafter he experimented with the feed system for the fuel.

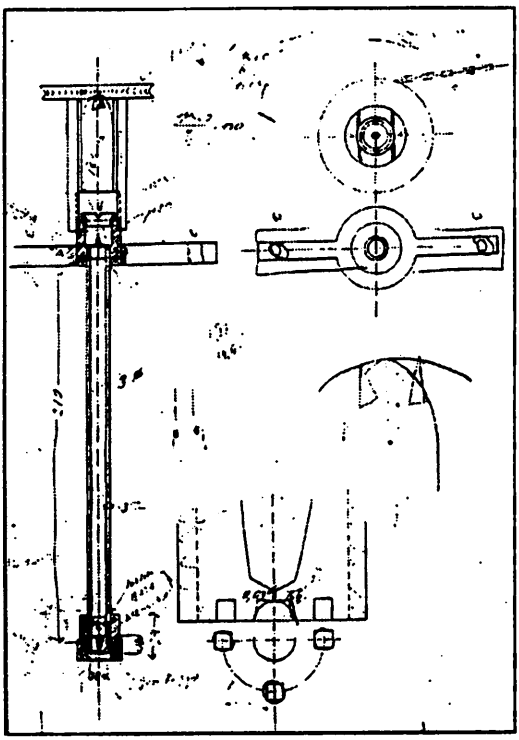

Figure 7 Drawing of an experimental apparatus for the generation of pressure for the fuel feed system of 1931.

In the German Museum at Munich there is a file on Oberth. This file predominantly contains drawings from the time period 1930 until 1935. From these drawings one gets some additional hints of Oberth's work in Romania. There are some pages of his notebook which have survived that describe experimental results. Surviving notes, dating from Dec. 7 1930 to Dec. 11 1930, refer to experiments No. 2324 to No. 2333. From the text, in "Gabelberger" shorthand one learns that Oberth intensively studied the method of pressure generation. This is not too surprising, as the experiments at the UFA labs failed because of this

problem. From the drawings, some of which have not been dated, it can be seen that Oberth had experimented with various nozzle designs for these devices (Cf. Figures 6 and 7).

In the month before (November) Oberth had worked on the so-called "tail-rocket." This rocket was inspired by a 15 m tall mock-up which had been exhibited at Berlin. From this, the scaled-down experimental model of 1.5 m length was developed.[12]

Oberth and the Army Ordnance Department

In his article in *Men of the Rocket* Oberth also considered the possibility of using the rocket for military purposes. Already in 1917 he had proposed a long-range rocket.

About this Oberth writes[1]:

> "6. The point of impact of rockets, that are not supposed to land with a parachute, can be predicted with great precision (Ways for Space Travel, Chap. 13). The devices for controlling (the trajectory) have already been designed and some of them been fabricated. If they perform as well, as they promise on the test stand (and here we have little reason to doubt) the accuracy should be within 1/10.000th of the range. This means, e.g if we wish to shoot from Berlin to New York, we should not deviate more than 700 m from true aim. This portends terrible perspectives for a future war. It will be possible to destroy a complete town of the enemy with a single, huge rocket, and all our present defense systems will be powerless against it. However, perhaps the aspect of such a terrible weapon will finally bring reason to mankind."

Oberth felt closer to Germany than Romania. He wanted to work for Germany. On July 10th 1934 he submitted, through Wilhelm von Pochhammer of the German embassy in Bucharest, a proposal entitled "Control of the Trajectory of Rocket-Missiles" to the ministry of economics of the Reich.[13,14] By some detours the documents reached the Army Ordnance Department. This is the reply of Sept. 19th 1934:

> "The Army Ordnance Department wishes to thank you for the principally useful suggestions about controlling devices of future rocket-missiles. Unfortunately, there exist presently no possibility to test or to apply them, as the prerequisite—an airworthy rocket missile—is not available."

All his documents were returned on November 29th 1934 by the postal service. However, as a precaution, the Army Ordnance Department had made copies of Oberth's proposal.[15]

Already in December 1934 Oberth again sent documents to the Ministry of Economics, using either the German embassy or the ministry for foreign affairs for transmittal. Through the postal service the Army Ordnance Department

received Oberth's work on January 4th, 1935, with the following accompanying letter:[16]

> "Enclosed are papers describing a liquid fueled rocket, which was designed particularly for military application.
>
> From the documents the historical development of my rocket and the present status of the technology may be ascertained. For the completion of the design the tests and/or experiments indicated in the description must be performed.
>
> I am asking for the reward of a developmental contract. The work is to be conducted in Germany in collaboration with my representative Dr. Ing. Helmuth Stark, Berlin-Charlottenburg 2, Carmerstr. 9 IV, Tel. 81 Steinplatz 2616."

Besides Oberth's "Umkehrofen" (retro-thrust chamber), pumps, and other papers, there was also a drawing, scale 1:1, with the measurements of his rocket.

On a personal note, in a conversation I had in 1993 with Rolf Engel, the latter belittled this rocket as nonsense, since at that time the Department of the Armory was already working on the "real thing," and who would be interested in a rocket with a range of 7 km? Engel was in possession of a photograph of the rocket from *Men of the Rocket*, and also of a picture of the retro-thrust chamber that Oberth had sent to the Department of the Armory.

The Army Ordnance Department refused to give the documents to Oberth's representative Dr. Stark, because the latter was an Italian citizen.[17] The Department of the Armory took the following position with respect to a collaboration with Oberth. This is revealed by a note in their files:[18]

1. On the rocket sector Prof. Oberth is well versed and imaginative. The command of physics predominates, while he is lacking the practical technical knowledge, that is of decisive importance in realizing his ideas.
2. With respect to his character it can be said that Prof. Oberth tends to blame others for his own failures. He does not perceive his own shortcomings. It is difficult to negotiate with him. A collaboration with an authority would doubtlessly lead to many frictions.
3. Prof. Oberth has Romanian citizenship. As a principle, it is considered not appropriate to give foreigners an inside view on the development of the liquid rocket.
4. After due examination of the recently submitted documents and consultation with Dr. von Braun, who knows Prof. Oberth from times past, the ministry of defense must decline any collaboration with Prof. Oberth.
   The main reasons are:
   1. The development so far has shown, that anyone who seriously works on the problem will perceive a large number of ideas. The difficulty lies more in recognizing, which of these ideas provides the simplest and best solution considering the available means and facilities, and to find the correct means for their realiza-

tion. Important contributions for the further development cannot be expected from Prof Oberth at the present state of affairs.

2. His character is not well suited for a trusting collaboration with superiors, as he lacks the necessary modesty in judging his own abilities.

3. Prof. Oberth is a foreigner, and has many international connections. Besides, he is well known in the public as an inventor of rockets. That makes him totally unsuitable for military rocket development, in which the strictest maintenance of secrecy is an absolute requirement.

The documents were returned to Oberth in March of 1935 through the foreign office. The Ministry of Armaments made copies of the letters of Oberth to the ministry, the letter to Major Dickhuth-Harrach, the drawings of the pump, the retro-thrust chamber, and the rocket. Regarding the further fate of these documents, no copies were made.

On June 18th 1935 Oberth's confidant Dr. Stark went to the Ministry of Armaments and talked with Mr. Schneider. The latter comforted Stark by saying that:

> "at present there was, for various reasons, no interest in Oberth's proposals, but at a later date, at a more opportune time, there would be a good chance to fall back on them."[19]

In Dec. 1934, shortly before Christmas, Wernher von Braun successfully launched rockets of the type Aggregat 2, in short the "A-2", nicknamed "Max" and "Moritz," at the north-sea island of Borkum. They reached a height of about 2 km.[20] Therefore, the Army Ordnance Department did not need Oberth's rocket. It would be a competition to their own designs.

Herewith, there was, at least at the present, an end in the negotiations between Oberth and the Army Ordnance Department. No more was heard of his rocket. Figures 8-10 represent fragments from drawings of the rocket which survived.

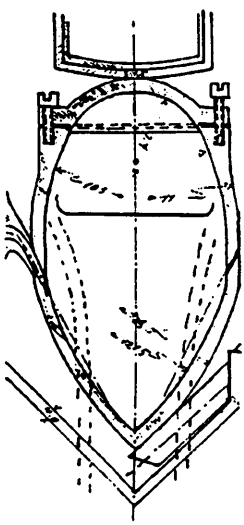

Figure 8 This drawing shows the combustion chamber turned by 90°.

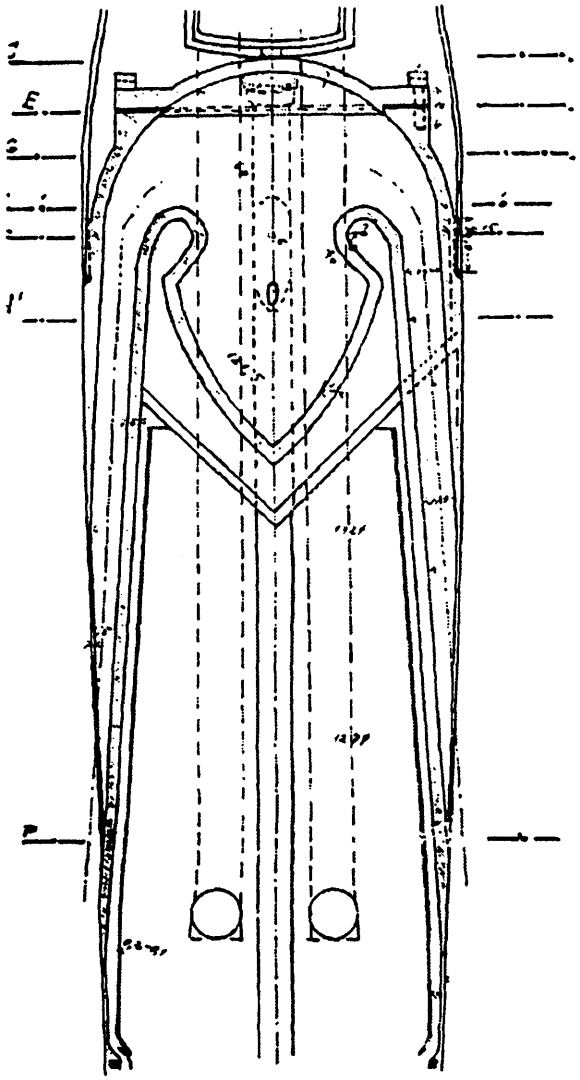

Figure 9 The drawing gives a cross-sectional view of the upper part of the rocket with the combustion chamber.

New Evidence of a Rocket Launched in 1935

On December 24th 1948 Oberth wrote a lengthy letter to Willy Ley. In a short sentence he mentioned that he really had launched his rocket in 1935. Ley did not pay much attention to this claim of Oberth. Thus, the rocket remained unknown. A letter with a similar statement was written on January 24th, 1949 to Felix Linke.[21,22]

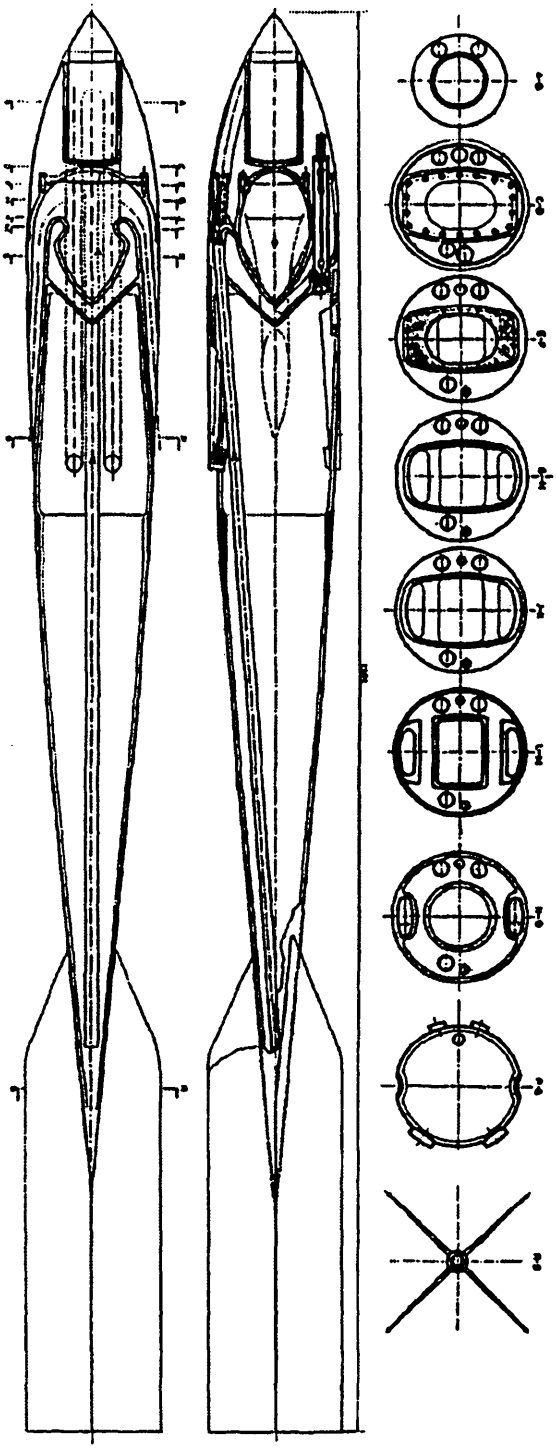

Figure 10 A copy of Oberth's original drawing is still to be found in the military archives of Freiburg. In the 1980s Otto Wiemer made this transparency of the original.

Verification of these claims did not come until 50 years later. In January 1995 the Hermann Oberth Spaceflight Museum received a letter from Mr. Togan of Medias, Romania, with the following message:

> "During the symposium at the flying-school, I intended to introduce Mrs. Elene Cirurescu from Foscani, a 76-year-old woman, who had lived in 1935 with her parents in a little house at the airport. The woman saw how Oberth launched his rocket and heard how the students of the Stephan Ludwig Roth school cheered 'Heil! Heil! Heil!' This woman was a schoolfellow of one of my sisters and visited me in the month of May. However she had to return one day before the 27th of May to Foscani. It would have been interesting, had she, as a visitor, told the attendants of the symposium how Oberth had flown his rockets in Medias!"[21]

This information was very intriguing. A witness to the launching of the rocket! A letter with many questions was sent to Romania. Its reply revealed new, hitherto unknown, facts:

1. Oberth launched his rocket in May 1935.
2. About 70 People witnessed the start. Among these were the commander of the flying-school, Lieutenant Colonel Celanu Constantin, Captain George Vasilius, the chief of the studio, First Lieutenant Alexandru, the mechanic Hasedeu Constatin, students of the flying school and of the Stephan Ludwig Roth Gymnasium.
3. The launching platform was build by the mechanic Willy Broos of the machine shop "Westen" in Medias.
4. Ignition was effected electrically.
5. Launch-site was the airfield of the flying school at the bank of the river Kokel, between the Hangar and the house of the gardener, Corporal Ioanu Olteanu.
6. It was a beautiful day with clear skies.
7. The rocket was fueled to reach a height of 7 km.

Unfortunately, all of this evidence is based on hearsay of people that knew some of the witnesses. No official protocol of the event has yet been found.

Conclusion

The letters of Mr. Togan clearly state that the rocket was launched. However, the author has only second or third hand information. Eye-witnesses are

missing. Additional research is necessary to find out how the rocket flew, how it landed, what was its condition after landing, etc.

Acknowledgments

The author wishes to express his thanks to Dr. Erna Roth-Oberth, Dr. Tanja Jelnina, Dr. Hans Barth, Dr. Heinrich Füßl, Mr. James Hagler and Mr. Fred Ordway, and particularly Mr. Otto Wiemer for helpful suggestions, and, last but not least, Mrs. Olga Sichling and Mrs. Roswitha Fries for the reading of the manuscript and Dr. Adolf Oberth for the English translation.

Nuremberg, June 1995
Karlheinz Rohrwild

References

[1]Brügel, W., "Männer der Rakete," Leipzig 1933.
[2]Barth, H., "Hermann Oberth," Feucht 1985.
[3]Letter Oberth to Dickuth-Harrach, 11.01.1934.
[4]Letter Oberth to Licinius, 31.07.1964.
[5]Oberth, "La Science et la Vie," Page 392, Nov. 1931.
[6]Letter Oberth to Wiemer, 16.04.1933.
[7]Letter Oberth to Wiemer, 15.02.1933.
[8]Letter Oberth to Wiemer, 10.07.1933.
[9]Letter Oberth to Licinius, 31.07.1964.
[10]Barth, H., "Hermann Oberth – Briefwechsel," Bucharest 1985.
[11]Oberth, "Was sich am Buch 'Wege zur Raumschiffahrt' heute ändern würde," 05.05.1949.
[12]Folder "Stiftung Oberth," Deutsches Museum.
[13]RH 1220, GD 600.6, No. 28.
[14]Letter Pochhammer to Oberth, 1978.
[15]RH 1220, GD 600.6, No. 29.
[16]RH 1220, GD 600.6, No. 33.
[17]RH 1220, GD 600.6, No. 30.
[18]RH 1220, GD 600.6, Wa Prw 1/I 67b 16/13 d/n, 28.02.1935.
[19]RH 1220, GD 600.6, No. 31.
[20]Bergaust, E., "Wernher von Braun," Düsseldorf 1979.
[21]Letter Togan to Roth-Oberth, 15.12.1994.
[22]Letter Togan to Roth-Oberth, 10.03.1995.

Sources of Figures:

1. Oberth, Drawing, "La Science et la Vie," Page 392 Archives, Space and Rocket Center, Huntsville, AL, Ordway Collection.
2. Letter Oberth to Wiemer, 16.04.1933 Archives, Hermann Oberth Museum, Feucht.
3. Letter Oberth to Wiemer, 16.04.1933 Archives, Hermann Oberth Museum, Feucht.
4. Brügel, "Männer der Rakete," 1933, Page 47 Hochmeitser & Thal Verlag, Leipzig 1933, Archives, Hermann Oberth Museum, Feucht.
5. Oberth, "Was sich am Buch 'Wege zu Raumschiffahrt' heute ändern würde," 05.05.1949, Archives, Hermann Oberth Museum, Feucht.
6. Folder "Stiftung Oberth," Deutsche Museum, Munich.
7. Folder "Stiftung Oberth," Deutsche Museum, Munich.
8. Folder "Stiftung Oberth," Deutsche Museum, Munich.
9. Folder "Stiftung Oberth," Deutsche Museum, Munich.
10. Folder Drawings, Otto Wiemer, Archives, Hermann Oberth Museum, Feucht.