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Chapter 14

The Experience of Hermann Oberth*

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Introduction

This paper examines Oberth's experience of his own life. What was it like for this man to be the "father of space flight."

His childhood encounter with Verne showed his intellectual traits. Years of struggle with a narrow-minded establishment contrasted with loving support from his family. Lifelong interests in philosophy, religion, and occultism paralleled and eventually subsumed his interest in spaceflight.

Oberth's ideas succeeded by an unexpected route. *Die Rakete zu den Planetenräumen* [The Rocket Into Interplanetary Space] failed to convince professionals but had an unexpected, historic impact on amateurs. This book, and *Wege zur Raumschiffahrt* [Ways to Travel in Space] reflected Oberth's personality. He gained colleagues and experienced frustrations.

Oberth's historic role ended in the early 1930s. This showed when he was left out of the V-2 development. He lost much in the 1940s: his parents, two children, two major manuscripts, and his hope of remaining important to rocket development.

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Space historians tend to ignore the rest of his life. He watched spaceflight succeed without him; received honors with indifference; expanded his range of inquiry, defended unpopular ideas, as he had always done; and investigated the problems posed by his own experience in relation to this century's history.

Books do not write themselves and rockets do not build themselves. Space history is too often the chronicle of results cut off from their true causes. Those causes are conscious people, each one of whom experiences his or her life from the inside, and from beginning to end. History without the individual conscious experience is like a description of planetary orbits without mention of gravitation; it may be true, but it's incomplete.

We know what Hermann Oberth did, but what it was like for him to be doing it? We know what he was like, but what it was like for him to be himself? If we don't know those things, we don't know half of what really happened when the Space Age was born.

Early Intellectual Development

Standing with Neil Armstrong on the Moon, looking back down the chain of events that put him there, we see Oberth as a boy, reading Jules Verne's *From the Earth to the Moon*. Depending on the account, it is either the winter of 1905-06, when he is eleven, or sometime after June of 1906, when he is twelve.[1]

Oberth was born in 1894 in German-speaking Transylvania, then part of the Austro-Hungarian Empire. He was a very smart child, particularly good in mathematics, for which he took a prize when he graduated from high school in 1912.

Young Oberth learned more than facts. He learned to demand proof. He names logic as one of his "true talents," along with mathematics, physics, and technology.[2] Naturally, his battles with school authorities began early:

> Like most intelligent and lively boys, I hated going to school . . . Yet our backward school system also did me something good. I became quite immune against the sayings of so-called authorities who were of a different opinion than my own. It was quite impossible that somebody could succeed with me in producing such arguments as, "Yet, the Privy Councilor so-and-so states that you are wrong" or "This is in contradiction to accepted scientific standards." But he who wanted to argue me out of my opinion, first had to prove that I was wrong.[3]

He held himself to the same standard. Before expecting the world to believe what he had to say, he would prove it rigorously. This is the stance that defined his impact as "the father of space travel."

Oberth was born just in time to greet the new century's parade of technological wonders. Electric light arrived in his town in 1902, followed by the telephone and automobile in 1904. Even bicycles were new; much more common were horses and oxen. "It was the railway station at the foot of the hill which interested me particularly. The railway station was about the only thing linking our town with the big world of industry and engineering, . . . I had been eager for engineering and progress. I had been particularly interested in anything moving and not requiring it be driven by men or drawn by animals—a means by which one could travel along, the quicker, the better. I designed fantastic projects for locomotives, airplanes, and spaceships."[4]

This was the boy reading Verne. *From the Earth to the Moon* opens in Baltimore on the evening of October 2, 1865. The American "War of the Rebellion" had ended in April, leaving the members of the Gun Club bored and frustrated.

It wouldn't have taken long for a boy like Oberth to like this book. A natural mathematician, he would have enjoyed reading that "the estimation in which they [members] were held, according to one of the most scientific exponents of the Gun Club, was proportional to the masses of their guns, and in the direct ratio of the squares of the distances attained by their projectiles."[5] It's also likely he toyed with the several possible physical interpretations of Verne's statistics concerning the Gun Club's members: "It was calculated by the great statistician Pitcairn that throughout the Gun Club there was not quite one arm between four persons, and exactly two legs between six."

And all this was only in chapter one! In chapter two, the boy may have enjoyed the German geometrician who proposes to communicate with the Selenites by inscribing the Siberian steppes with gigantic representations of geometric theorems.

At the end of chapter two, the club is galvanized by the unexpected proposal of its president, Impey Barbicane:

> You know what progress artillery science has made during the last few years, and what degree of perfection fire-arms of every kind have reached. Moreover, you are well aware that, in general terms, the resisting power of cannon and the expansive force of gunpowder are practically unlimited. Well! starting from this principle, I ask myself whether, supposing sufficient apparatus could be obtained constructed upon the conditions of ascertained resistance, it might not be possible to project a shot up to the moon?

Now for Barbicane's final summation:

> I have looked at the question in all its bearings, I have resolutely attacked it, and by incontrovertible calculations I find that a projectile endowed with an initial velocity of 12,000 yards per second, and aimed at the moon, must necessarily reach it. I have the honor, my brave colleagues, to propose a trial of this little experiment.

The echoes of this passage are audible in the passage with which Oberth begins his own book some seventeen years later, a passage which proved to be the opening lines of the Space Age.

Oberth was utterly captivated by the possibility of space travel, by vehicles which would travel farther and faster than any known, entirely under their own power. He read the book and its sequel, *Around the Moon*, five or six times, committing much of them to memory. But many readers had been captivated by Verne. It was what Oberth did next, and how he did it, that made him the Oberth who matters to history.

Verne wrote with compelling precision, but he didn't prove what he said. So Oberth checked Verne's calculations:

> With my knowledge in mathematics, still rather deficient at that time [he hadn't learned calculus yet], I was able, however, to find out so much at any rate, that the escape velocity of 11,000 m/sec was roughly correct. At school we had learned the laws of gravity, so that I could derive by myself at least the formula $v = v_0 + \sqrt{2gh}$. Furthermore, our young and clever teacher in physics, Ludwig Fabini, managed to make us understand that the attraction of gravity exerted by the earth would decrease in proportion to the square of the distance from the earth center. So I divided the trajectory of the missile up to the moon into sections—smaller ones down toward the earth and larger ones up toward the moon—assuming for the gravitational acceleration in each section a mean value. For the first two sections I took the final velocity of the preceding one as the initial velocity of the next one, and finally I discovered that for the rest it was for me simpler to calculate $v = \sqrt{2g_1h_1 + 2g_2h_2 + \cdots}$ so that I had to extract the square root only once.[6]

In this encounter with Verne we can see some of the traits that enabled Oberth to play the role he did in the history of space travel. Foremost is his insistence on rigorous proof. As he put it, "I was fascinated by the idea of space flight, and even more so, because I succeeded in verifying the magnitude of the escape velocity."[7]

I asked Oberth if he would have devoted himself to space flight if it had not proven to be mathematically sound right from the start. He said he would

not have.[8] Space travel was immediately appealing, but it still had to pass the test. "My formulas showed me what to pursue and what to ignore."[9]

Not only did Oberth demand proof, but he preferred to provide it himself if he could. I suspect that part of his attachment to the idea of space flight, after reading Verne, was a sense of ownership, since he himself had provided the proof. This sense of ownership remained an important part of his research. "I derived all equations in all my books; at the time when I wrote them, there were no publications where these derivations could be found."[10]

Some forty years later, Oberth would advise his son, Adolph, to learn mathematics by taking possession of the proofs presented in the text:

> Bear in mind that it is very important not only to read what's in the book, but also to redo the calculations and exercises in writing, and finally to write them down in a notebook.[11]

We also see perseverance and ingenuity in young Oberth's derivation of the escape velocity. His lack of the proper mathematical tool (calculus) did not stop him; he made do with a more labor-intensive numerical method. But he was also quick to notice a short cut which avoided much of the labor.

But if Verne's escape velocity was correct, then there was a serious problem. Verne protects his travelers from the pressure of such acceleration with a volume of water which absorbs the shock.

> This did not satisfy the young man, already a competent physicist, and he set to work to answer the question with his slide rule. . . . When Oberth had finished, the result of his working was almost unbelievable: for the inmates of Jules Verne's projectile to avoid being flattened, they would have needed a cushion approximately 1,055 miles thick![12]

By its nature, then, a cannon would never do. It would always have to impart too much velocity too quickly. How then to impart velocity more slowly? How to maintain a lesser acceleration for a much longer time? For two years, Oberth concocted ingenious schemes, and proved each of them faulty. Then it turned out that Verne himself had provided the answer without saying so. The projectile was fitted with small rockets with which to change its direction in space and brake its descent toward the Moon.

Here we see another key trait of Oberth's. From an early age, he could see through particulars to the underlying principle. In Verne's day, and in Oberth's childhood, "rockets" were no more than flares or fireworks. But Oberth was not deceived by the paltriness of existing rockets. "I gradually realized that reaction propulsion actually offered the only means of achieving space travel and that

giant rockets would be used as spaceships of the future, even if they lost in appearance any resemblance to our fireworks."[13]

At age fifteen, Oberth gave a very impressive demonstration of this ability. He had been swimming underwater in the town pool when he became disoriented, confusing the bottom with one of the walls:

> On my way home I thought about the incident and concluded that we are informed about our orientation in space by (1) the Venier particles in the vestibule of the inner ear, (2) tensions in the muscles and tissues of our body, and (3) the parts of skin against which the ground exerts a pressure.
>
> Because of the cold water in the pool, and the excess of carbon dioxide in my blood, my equilibrium sensors had become insensitive. For the same reason, the sensing of the muscles was not entirely effective any longer; and there was no surface at all touching the body since it was floating free in the water. Though the Kantian category of "above" and "below" was not ineffective, the feeling for the direction of a perpendicular line was lost.
>
> This meant I had undergone the psychological experience of weightlessness! It was not a dramatic experience such as jumping off a trampoline and experiencing a sudden fall. Rather, it was experienced gradually by a numbing of the senses.
>
> In order to examine psychological effects, it is not necessary to create situations by real causes. It suffices to feign it to our senses.[14]

This incident also reveals how preoccupied Oberth had become with solving the widely varied problems of space travel, from engine design to human factors. "At first, all this was nothing but a hobby for me, like catching butterflies or collecting stamps for other people, with the only difference that I was engaged in rocket development."[15]

But that wasn't the only difference. Oberth had remarkable powers of concentration and penetration for such a young person. He also had the ability—in fact, the need—to work alone. He didn't tell family or friends about his ideas. "I didn't speak much." He felt special, knowing that he knew better than others.[16] Oberth's need to work alone is touchingly reflected in his proposal that scientists use study rooms in space, where it would be perfectly quiet.[17]

Oberth remained preoccupied for the rest of his life, if not with astronautics, then with other interests. Gartmann reports that "one of his most characteristic traits was a habit of suddenly breaking off a conversation in the middle and becoming quite oblivious to his surroundings—a sign that his restless mind was on the track of a new idea."[18]

As a medical student in Munich, Oberth spent less time on his medical studies than he did attending such classes as aerodynamics and physics and teaching himself whatever else he needed to pursue his space travel research. As a high school teacher, if he got a good idea during class, he would give his students some work to do so he could think.[19]

When Oberth became a husband and father, his wife, Mathilde, made it possible for him to devote himself entirely to his work. As their daughter, Erna, remembers, "She managed almost everything for the family. When [my father] came home [from teaching high school], he went into his study and closed the door from inside, and you didn't see him until dinner in the evening. . . . My mother cared for everything else." Ernst Stuhlinger, one of the Peenemünde team, put it this way: "He lived in his own higher regions . . . He wanted to be left alone, and she made it possible."[20]

None of the characteristics I have mentioned is unique to Oberth. But they are the ones that enabled him to play the role he did.

Oberth transformed his "hobby" into a research program into the exploration of space by both humans and machines. He derived the basic equations of rocket flight and then elaborated on them. He realized the need for liquid fuel rather than solid fuel, and the need for multistage rockets, and he designed increasingly ambitious spacecraft. He conducted ingenious experiments in the physiology of space travel. "In this way, I had made headway into an entirely unknown province, never seriously approached by anybody before me."[21]

But he neither built rockets nor sought companions. Even as his greatness flowered, his limits began to show.

Oberth Passes on the Idea

In 1923, Oberth published a short book, *Die Rakete zu den Planetenräumen*. As a result, he became the intellectual leader of an international space travel movement.

How did he come to play this role, in what fashion did he play it, and what was it like for him to do so?

Oberth was lucky. Tsiolkovsky had been theorizing for some fifty years and Goddard had been building and launching rockets for almost twenty. But neither had made an impact on the world. Third in line, Oberth could still be the first to matter. I don't know whether he felt the relief I can imagine him feeling when he learned that others had beaten him to the basic idea, but that they had not developed it nearly as fully as he had.

He was also lucky to be born into German culture, although he was not a German citizen until 1941. Germany had a tradition of science and technology;

German books and journals were far more likely to be read, translated, and circulated throughout Europe than the Russian journals in which Tsiolkovsky published.

Michael Neufeld describes three other facets of Weimar culture which contributed to the fad for rocketry and spaceflight: "nationalism, a widespread belief in technological progress, and the growth of a very modern 'consumer culture' that was indeed in some aspects escapist."[22]

Some Germans had already gotten the space bug from Kurd Lasswitz's 1897 novel, *Auf Zwei Planeten* [On Two Planets], which portrays the encounter between humanity and the much older, wiser, and more technologically advanced Martian race.

Rom Landau, sampling the German intellectual and mystical scene after World War I, noted that Germans "had not been able to travel for five years, and few nations travel with greater enthusiasm than the German. . . . The German frontiers had remained closed since 1914, and the country had been reduced in size."[23] If, as Landau observed, the prospect of traveling abroad again was thrilling, how much more so, at least for some, was Oberth's prospect of space travel?

Konrad Dannenberg, one of the Peenemünde team, suggests that the vast unemployment in Germany at that time also helped. Young men like him wondered what to study, what to do with their futures. Technology was advancing dramatically, aviation in particular. So perhaps space technology would also succeed and offer the prospect of a good living.[24]

Such was the stage onto which Oberth stepped. What propelled him there? In 1917, Oberth submitted to the German War Department a proposal for a long-range missile. "In the appendix, I expanded the principles mentioned in the text and proved them mathematically. In spring 1918, I received my manuscript back. The reviewer apparently had not read the appendix at all, for he only answered: 'According to experience these rockets do not fly farther than 7 km, and taking into account the Prussian thoroughness which is applied at our missile post, it cannot be expected that this distance can be surpassed considerably."[25] Oberth had in fact explained why existing rockets hadn't done any better than they had, but the reader apparently skipped or disregarded much of the manuscript. Further attempts to interest the authorities also failed.

In 1922, he submitted his work on space travel as a doctoral dissertation in astronomy at Heidelberg University. It was rejected. Hans Barth says it was deemed "too fantastic."[26] Oberth claims that one of the readers was an astronomer who rejected it "because it dealt mainly with physical-medical subjects."[27] Elsewhere, he says, "I refrained from writing another one, thinking to myself:

Never mind, I will prove that I am able to become a greater scientist than some of you, even without the title of doctor."[28]

But Oberth still hoped to get his message through to academic and professional scientists and engineers. Who else was going to build the rockets? These were his intellectual peers, the cream of a nation whose citizens had won 20 of the 66 Nobel Prizes awarded in science between 1901 and 1922. "Up to that time," Oberth recalled, "I had envisioned a kind of worship of scientific research; and I had considered German scientists as absolutely the best."[29]

He had his own career in mind, as well. He asserted in the opening of *Die Rakete* that space travel could be profitable, and he meant to profit. Despite *Die Rakete*'s detailed presentation, certain things were left out, "because I did not want to be superfluous in the future development of rockets. I wanted to work as a technician and consulting engineer."[30] He withheld "what appear to be fortunate technical solutions" because they weren't protected by patents.[31]

He shopped his manuscript around but found no publisher. The contents were too technical for the public and too outrageous to safely be published as serious science. R. Oldenbourg finally agreed to publish it, with most of the cost paid by Oberth. "I finally published my thesis paper . . . thinking to myself that, in taking this roundabout byway of publicity, scientists might be induced to engage in this problem finally."[32]

Thus, Oberth entered the large public stage because the smaller professional stage he had in mind would not accept him and he would not give up.

Because the historically significant part of Oberth's life is easily characterized as a struggle against hard-headed resistance, it is important to note how much emotional reinforcement Oberth had. He was well-loved by his parents and wife.

His mother, Valerie Emma Krassner, was a very intelligent woman who kept up with natural science and new developments, wrote about them in her letters, and talked about them with her son. It was she who handed young Oberth her copy of Verne.

His father, Dr. Julius Gotthold Oberth, was a successful surgeon. Oberth had a brother, Adolph, who was killed in World War I. That left Hermann an only son, and his parents seem to have been so grateful to have him alive that they didn't push him to take up his father's profession, though that was their wish.[33] In fact, Oberth's father supported him and his family through much of his early struggle, strange as that struggle must have seemed to the senior Oberths.

In 1918, Oberth married Mathilde Hummel. By all accounts she was a lovable woman, devoted to her husband and children.

Mathilde lacked the education to understand her husband's work and does not appear to have been bothered by that. She had unshakable faith in him. It was she who made it possible for him to publish *Die Rakete*. She had been putting aside some of their household money (the support from Oberth's father was generous enough that she could buy what was needed and save as well!) and suggested Oberth use it when he was left with no option but to publish at his own expense.

Here is Mathilde Oberth describing her life in a letter to Ernst Stuhlinger in 1963:

> . . . I had to stay two years in Transylvania while my husband fulfilled his contract [as a technical consultant in Berlin in 1929]. Then he wanted to stay in Germany, to pursue his experiments further, but he lacked the means, and so he came back once more to his school and practiced his profession as a physics and mathematics teacher at the Mediasch high school.
>
> I was glad that he was at home again, because for a long time he had only rarely written to me and I often thought he had lost his life in his dangerous experiments. After that, I never let him go off alone. . . .
>
> There were many strains, advances, bright spots, but also many disappointments in our long life. I always had to give my husband courage, because I have firm faith in his work and his wisdom. Sometimes I was also very annoyed and jealous of his hobby, when he neglected his family for it. I had to take care of everything. The children's upbringing was left entirely up to me, and if I hadn't had such good parents-in-law, who supported us financially, we would have had to lead the wretched existence of an inventor.
>
> Thank goodness, at least my husband has finally received proper scientific recognition for all his selfless labors. . . . Let it be understood that my part in this was that I believed in him and was a devoted wife and mother to his children.[34]

She then tells about a ceremony in which Oberth and von Braun were awarded honorary degrees:

> The rector, Professor Köbl, also honored me with a beautiful bouquet of carnations and thanked me, on behalf of everybody there, for my loyalty to my husband. Also, Professor Dr. Sänger said to me, "Take good care of your genius!" Well, I will do my best. If the good Lord grants us long life and health, we will be content.

Would Oberth have carried on without such support from his family? History is what happened, not the minimum that need have happened to produce the same result. The accomplishment of space flight did not begin with a man battling the world alone, but with a man whose parents stuck by him and whose wife believed in him all the way.

Die Rakete is like its author. It is an expression of his nature as well as of his ideas about space travel. It begins:

> (1) The present state of science and of technological knowledge permits the building of machines that can rise beyond the limits of the atmosphere of the earth.
>
> (2) After further development these machines will be capable of attaining such velocities that they—left undisturbed in the void of ether space—will not fall back to earth; furthermore, they will even be able to leave the zone of terrestrial attraction.
>
> (3) Such machines can be built in such a way that they will be able to carry men (probably without endangering their health).
>
> (4) Under certain conditions the manufacture of such machines might be profitable. Such conditions might develop within a few decades.
>
> In this book I wish to prove these four assertions.

There is no appeal to glory or wonder. Instead, propositions are stated with mathematical precision. A subset of the familiar set of "machines" is defined in terms of a reasonably well-defined expression, "beyond the limits of the atmosphere of the earth" rather than the ill-defined term, "space." The phrase, "left undisturbed in the void of ether space" echoes Newton's First Law of Motion. Stuhlinger notes: "In his discussions of technical and scientific aspects of rocketry . . . Professor Oberth appears to be without emotions, except for his passion for honesty."[35]

Clear exposition was one of Oberth's strong points. Stuhlinger called him:

> a born teacher; his statements are always very clear and persuasive. Many of his arguments begin with the simple words, 'as we have learned in school . . .' and then he continues quoting basic facts of physics which lead quickly to the point he wishes to make.[36]

Characteristically, Oberth offers solid proof, not compelling enticement. Yet the passage echoes the conclusion of Barbicane's address to the Gun Club, surely among those Oberth had once memorized.

In *From the Earth to the Moon*, Barbicane's speech is soon followed by a convincingly quantitative discourse on celestial navigation. In *Die Rakete*, the mathematics begins even before the introduction, in a list of formulae such as:

$$y = \frac{v \cdot \frac{d\gamma}{dv} + 2\gamma}{v \cdot \frac{d\gamma}{dv} + \gamma}: \qquad z = \frac{v \cdot \frac{d^2\gamma}{dv^2} + 2 \cdot \frac{d\gamma}{dv}}{v \cdot \frac{d\gamma}{dv} + \gamma}$$

And on page ten, only two pages after Oberth's restrained manifesto:

$$\frac{\partial(\frac{Q}{v})}{\partial v} + \frac{\partial c}{\partial v} \cdot \frac{dm}{ds} + c \cdot \frac{\partial(\frac{dm}{ds})}{\partial v} = 0$$

And on page twelve:[37]

$$dm = \frac{F \cdot \beta}{g} \cdot \bar{v}^L \cdot \left(\bar{v} \frac{d\gamma}{dv} + \gamma \right) \cdot \left[\frac{d\beta}{\beta} - \frac{dg}{g} + \frac{2d\bar{v}}{v} + \frac{\bar{v} \cdot \frac{d^2\gamma}{d\bar{v}^2} + 2\frac{d\gamma}{d\bar{v}}}{\bar{v} \cdot \frac{d\gamma}{d\bar{v}} + \gamma} \cdot dv \right]$$

For the nonprofessional reader, the math undoubtedly made a strong and forbidding initial impression. But those who kept reading were rewarded with a wealth of ideas that would have set their minds ablaze. Multistage rockets, liquid fuels, telescope tracking, launch from water, space stations, the likely physiological and even psychological effects of weightlessness, orbiting telescopes and weapons, astronauts in modified diving suits floating freely in space, and more.

Thanks to Oberth's intellectual perseverance, ingenuity, and penetration, astronautics arrived in Europe in one fell swoop. But it was also thanks to his experience of being rejected without grounds by scholars who should have known better. As he wrote to Max Valier in 1924, "I feared the skepticism of certain scholars and . . . I wanted to reduce these gentlemen to silence right from the beginning by the fullness of the calculations. At the same time I wanted to write the book in such a way that in it each of the more serious objections to the cause, which I could conceive, is refuted or at least dealt with."[38]

Figure 1 Hermann Oberth (1894-1989).

At the same time that Oberth was making *Die Rakete* as complete as possible, he was also attempting to bring a major philosophical work to a satisfactory state of completion. He writes that in 1922, "I knew a lot of what I was going to write about this subject, but there seemed to be so much still to do, so I postponed publication."[39] He eventually published one chapter of his proposed book in 1931, under the title *Forschung und Jenseits* [Research and the Beyond].

A central fact of Oberth's experience is that he was interested in many things at once, and that, over time, he integrated them into a coherent world view. It is therefore a fact of "space history" that the accomplishment of space flight did not begin with a man thinking strictly about astronautics, but with a man whose thoughts about astronautics rubbed shoulders (as I will show below) with thoughts about philosophy, religion, mysticism, and occultism.

To him, religious, mystic, and occult phenomena undeniably existed, but little or nothing was really known about them. Known, that is, by his standards of proof and evidence.

For example, around 1930, when Oberth was in Berlin, he went to a séance. The medium went into a trance and told him his dead brother wanted to speak to him. His brother's message included details that the medium herself could not possibly have known.[40]

Oberth seems never to have been haunted by the unknown. In his view, what one didn't know, one could reasonably aspire to discover through research and creative thought. He seems to have found religious and psychic phenomena as accessible to his style of inquiry as physical and mathematical ones. Even the one thing no one could ever know, namely the exact nature of God, was unknowable for a knowable and beneficial reason. Oberth believed that God does not want us to know exactly what He is and what He wants because, if we did, our good deeds would tend to be calculated investments in the hereafter.[41]

Oberth once tried to prove mathematically the existence of God. The house was filled with scratch paper and Oberth was enjoying himself. But when he came to the conclusion that the existence of God could not be proven with mathematics, he abandoned the effort without regret.[42]

Not only did these subjects occupy his mind along with astronautics, but they put astronautics into a larger context. In 1924, Oberth was planning a new book which would be one of a pair, the other written in a more popular style by Max Valier. He sent Valier a plan for the chapters, which included these two:

> (5) The kingdom of heaven. Galilei, Giordano Bruno, pantheism, how the belief in gaseous gods must have come into being. Is there a "soul." The "enigma of the universe." Consciousness, mechanical effects of the phenomenon of consciousness. Telepathy, reasons for the failure of most telepathic experiments. Why do all religions locate the seat of the good angels up above? The fiasco of the religions of revelation. Parapsychologic experiments beyond the atmosphere of the earth. . . .
>
> (7) Conclusion. The broad lines of the evolution of nature. From the inorganic to the organic, from chaos to organization, from the meaningless to the meaningful. From barbarism to civilization, from conflict amongst everyone to co-operation and to the mastery of nature by co-operation.[43]

Valier warned Oberth against alienating supporters of space flight with such material.[44] Their project was never completed, and Oberth ignored Valier's advice in the book often considered his masterpiece, *Wege zur Raumschiffahrt* [Paths to spaceflight], published in 1929. For example, he suggests that it will be possible in space to test the theory that hypnosis and suggestion involve the transmission of forces or substances.[45]

Human expansion into space was part of God's order. All creatures tended to take up as much livable space as they could occupy. Oberth expressed this memorably in the final words of *Menschen im Weltraum* [Man into space] "This is the goal: To make available for life every place where life is possible. To make inhabitable all worlds as yet uninhabitable, and all life purposeful."[46]

What's more, as it became evident that overpopulation and depletion of energy resources threatened human civilization, space travel was clearly a very necessary tool for the human race to develop. From *Wege* in 1929 to the end of his life, Oberth promoted the gathering of solar energy from orbiting reflectors.

The professionals Oberth hoped to win over were not won over.

> I was amazed upon seeing the lack of general education, the disinterest in new ideas, and the vanity and self-complacency . . . Why, for example did Lorenz invent one objection after the other to space travel, one more senseless than the other . . . I think he did this because he had once said that space flight was impossible, and he did not want to retract his statement . . . [Once] he integrated in wrong intervals. If a student of his had done so in an examination, he probably would have failed him.[47]

The controversy with Privy Councilor Lorenz was but one of many such battles with men who substituted their preconceptions, reputations, or both for serious consideration of what Oberth was saying:

> In 1924 I moved [from Romania] to Würzburg in Germany at the invitation of a banker who wanted to finance my rocket project. However, it turned out that he was awaiting an opinion on the value of this project from a professor at the Berlin Technical University. Finally, after six months, the opinion arrived, by which time the money I had saved for experiments had been used for my support.
>
> The professor wrote that my calculations were certainly correct, but, obviously, I had departed from sound fundamental premises. He advised the banker to abandon the project, but did not reveal how my fundamental premises were actually wrong. Nor did he so when I told him about my situation and called his attention in a courteous manner to his irresponsible procedure, since I was financially ruined by his action.[48]

Just how much these skirmishes meant to Oberth can be judged by the emphasis given decades later in two autobiographical essays to these unworthy objections and his rebuttals. In 1983, he is still telling stories of great inventions held back by the disapproval of short-sighted "experts." His account of Napoleon rejecting an early steamship on the advice of a scholar exactly parallels his own experience with the German War Department in 1917 and with the banker in 1924.[49]

While *Die Rakete* flopped with its intended audience, it made an historic impact on an unexpected audience. Many could not begin to follow the math. Some were still in high school. But they responded to the possibility of space travel. They responded to the density of stimulating and original ideas. In 1926, rocket societies began to appear.

And here is where the book's mathematical and scientific rigor played an unexpected and historic role. Oberth taught a number of readers that the road to space was open to dreamers, but that it could not be traveled by dreams. It must be traveled by intellectual rigor.

One person who learned this lesson from *Die Rakete* was Wernher von Braun. He saw the book advertised in a nature magazine in 1925, when he was only twelve or thirteen, and promptly sent away for it. "When the precious volume arrived, I carried it to my room. Opening it I was aghast. Its pages were a hash of mathematical formulas. It was gibberish. I rushed to my math teacher. 'How can I understand what this man is saying?' I demanded. He told me to study mathematics and physics, my two worst courses." Von Braun became determined to conquer these subjects, for the sake of space flight. He became the school's star math student and went on to earn a doctorate in physics for his early research in rocketry.[50]

Krafft Ehricke had a similar experience at one remove. His dedication to space was inspired by the 1929 movie, *Frau im Mond* [The Woman in the Moon]. But that movie was part of the public response to *Die Rakete*. Oberth was a technical consultant for the movie. Ehricke was captivated by the special terminology he heard in the movie—"velocity, thrust, trajectory, orbital paths"—and spent the next few years studying the subjects he would need to master in order to understand *Die Rakete*.[51] German-born Richard Gompertz, who worked in the American space program, was also inspired by *Frau im Mond*, and he went on to read the works of Oberth, Tsiolkovsky, and Goddard.[52]

The Austrian rocket pioneer, Max Valier, was already a student of physics and astronomy and an experienced pilot when he read *Die Rakete* in 1924, but it was that book which inspired him to devote his career to rocketry.[53]

Another Austrian rocketeer, Eugen Sänger, was first inspired by *Auf Zwei Planeten*, but reading *Die Rakete* in 1924 made him think so seriously about space travel that he went on to a degree in aeronautical engineering.[54]

According to Dannenberg, many members of the Peenemünde team became "space people" because of Oberth's books.

Oberth held out to his readers not only a body of information and ideas, but an intellectual standard, without which the necessary work could not be done. This standard was his own intellectual standard and had been since boyhood.

Die Rakete's fame eventually brought Oberth into contact with some of the amateur rocket societies his book had sparked into existence. In person, as in writing, he set an example of intellectual rigor. He may have seemed like a personification of his book, but that was because the book was a reification of the man.

Dannenberg recalls that at Peenemünde, Oberth was known for the thoroughness with which he would try to answer technical questions. "Although he may not have an answer right now when you talk to him, he would go back to his study, he would think about it, and eventually he would come up with a real good answer." Stuhlinger made the same observation a quarter-century later in Huntsville: "He was a quiet, taciturn scientist; if a colleague asked him for some advice, however, he took great pains in providing as much information and help as possible."[55]

Rolf Engel was eighteen when he worked for a while with Oberth, who remembered him as "fascinated by my work. I had to say: You must have imagination, but you must always realize what can be done with the means at hand. Don't get lost in fantasy. It was so intoxicating for those young boys."[56]

Engel recalls one evening, after an important and successful test, when he, von Braun, Klaus Riedel, and Oberth

> were sitting together in a small restaurant in Berlin, and naturally we had a lot of questions—technical questions—and we asked Oberth about them. And he was able, with a slide rule and formulas, to give more or less precise answers. This maybe had a very deep influence on our little circle. It was Wernher von Braun who, in the evening when we went home, said, 'You have to have vision. And you have to have the technical and physical knowledge to prove them.'[57]

It wasn't always a treat to deal with such a man. According to Willy Ley, "whenever Oberth opened his mouth you got the feeling that you were in a classroom and there was no way of leaving . . . until the lesson was over."[58]

But it could be fun to watch someone else get the treatment. In 1928, Ley witnessed a public debate between Privy Councilor Professor Dr. Lorenz and Oberth. Lorenz, all of whose titles commanded deference in Germany, maintained that Oberth's spaceship, in order to achieve escape velocity, would have to hold 33 times its own weight in fuel, and that this was impossible.

> Lorenz spoke at length; Oberth answered with a very short speech. He pointed out that he had followed the Privy Councilor's arguments and that one could arrive at the ratio of 34:1. Personally, by knowing that one factor was more advantageous than the Privy Councilor had assumed, he had arrived at the ratio of 20:1, as the Privy Councilor would have seen if he had finished reading Oberth's book. But in any case Oberth could not help it if the Privy Councilor refused to believe that it is possible to build an aluminum pot into which one could pour enough water so that the full pot would weigh twenty times as much as the empty pot.[59]

The *Frau im Mond* project brought Oberth into contact with people he had never intended to work with: amateurs who had been inspired by his book (or by Valier's rocket-cars, of which Oberth was scornful) and who had formed rocket societies.

But Oberth was a loner. He rarely chose anyone to work with him, and when he did, he generally regretted it. I asked him how he judged the young people who came to him, people such as von Braun and Engel. "They just came," he said. "I simply took the young people as they were, but always worked alone when some problem needed thought." In fact, he sometimes worked alone even when others were around, as Gartmann described earlier.

It is notable that Oberth, in two autobiographical essays, makes only this one bland reference to any of the people he ever worked with: "I was helped [in 1930] by students of the Technical University of Berlin. Among them was Wernher von Braun, who has since made space travel a reality."[60] Yet von Braun was a vivid personality who left a strong impression on nearly everyone he met. In this case, the silence may indicate resentment that von Braun didn't include Oberth in his history-making "rocket team." But when I interviewed Oberth, the only person about whom he would say more than a trivial amount was the man who caused him the most aggravation, Rudolf Nebel.

Oberth had his wife, Mathilde, and later, his daughter, Erna, to make visitors comfortable in a way he couldn't do, and also to protect him from as much of their intrusion as possible. These women would greet visitors to Oberth's home, make small talk, and remind them not to take up too much of the Professor's time. Oberth could then emerge from his study and speak only as long as he cared to, without wasting time on preliminaries and farewells. He didn't al-

ways familiarize himself with who was coming; he might simply ask, "What do you want?"[61]

In fact, it was the need to entertain guests which led to the founding of the Hermann Oberth Museum. Oberth had spoken only briefly with some foreign visitors, after which Mathilde tried to entertain them. Lacking a common language, she showed them photos. Dr. A. F. Staats, president of the Hermann Oberth Society, was there and suggested they make a display room where people could wait for Oberth without needing to be entertained. This display room grew into the museum.[62]

Instead of having a third edition of *Die Rakete* reprinted, Oberth rewrote and expanded it into *Wege zur Raumschiffahrt* (1929). *Wege* brought in even more disciples. Helmut Zoike, who worked at Peenemünde, had been generally interested in space when a family friend recommended *Wege*. That "got me into it," he recalls. When he read it at age fifteen, it was "way over my head, but it was an inspiration."[63]

For Oberth, the battle went on. Dannenberg calls *Wege* "in large extent a reply to the many, many questions and even criticisms he had received. That was . . . typical for Oberth. He did not let anything like that sit." Oberth devoted a significant amount of *Wege* to rebuttals, even bothering to correct the inaccuracies of contemporary German science fiction. Ley chides him for flawing his masterpiece with "the completely unnecessary refutation of absolutely unimportant newspaper articles."[64] Valier had earlier offered the same advice: "What a pity for each line which, let's say, Zeppelin wrote against his assailants [since he succeeded anyway]. One converts no one with writing, only with actions!!"[65] But *Wege*, like *Die Rakete*, is a reflection of its author.

Oberth also spent time in *Wege* scolding his new allies in the space movement. And this brings us to a second aspect of what Oberth's new role was like for him.

He had become the guru of a movement, but the movement was not composed of his scientific peers, as he had hoped. A prime example was Max Valier. One of the most enthusiastic of the early rocketeers, and probably the movement's greatest generator of publicity and new recruits, Valier was not intellectually rigorous—"I am opposed to formulae and partial to curves"—and was something of a loose cannon.[66]

In *Wege*, Oberth vents his frustration with Valier, dripping condescension and letting us know how much Valier depended on him to do the real brain work:

> It is not exactly a recommendation for Valier's technical abilities that he still has not grasped these things after occupying himself with them for three years, after studying the writings of Goddard, Hohmann, and myself,

and after a correspondence with me about them that could well comprise 120 typed pages.

. . . I am leaving the whole responsibility of propagating this idea [of the rocket airplane] to him. As a writer, it is naturally much less harmful to him if one of his ideas does not prove feasible. On the other hand, as a physicist, I must keep from making rash claims and strive to make only suggestions whose feasibility is established.

All the same, I am supporting Valier in his work. Since he is not a specialist, I worked out the theory of the rocket airplane at his request and, among other things, calculated a model for him.[67]

Another Austrian rocketeer, Franz von Hoefft, received this kiss-off in *Wege*:

. . . Hoefft immediately forced himself upon me as an executing practitioner. In all the newspapers with which he is associated (and that is quite a number, for he is a technical reporter) it can be seen that he has "improved" my sketches pretty well in every point. In so doing he lacks one thing: 20 years of thorough penetration (supported by the necessary gift of combining) of this material, today spread over all the disciplines of technology. In the fundamentals, he has still kept slavishly to the information I gave him.

I hope that what I have said here, together with what I still have to report about Valier and Hoefft, will suffice to show that I am not entirely dispensable even yet.[68]

Oberth was capable of taking criticism seriously. In the fall of 1929, he began his ill-fated attempt to build a rocket to be launched as a publicity stunt for the opening of *Frau im Mond*. One critic had said that fuel and liquid oxygen brought together would never burn for the required duration, but would explode. This objection was not backed up with a title, but with manufacturing experience. Oberth was frankly scared, by his own account, and the first task he set himself was to investigate such combustion.[69]

In addition to all this contact with people, Oberth's success brought two emotionally intense encounters with hardware. In 1929, director Fritz Lang invited Oberth to Berlin to serve as technical advisor to his new movie, *Frau im Mond*. It was decided that Oberth would build and launch a rocket as publicity for the movie. This was an enormous opportunity for Oberth and those who joined him on the project. Lang was world-famous. If the rocket worked, it, too, would be world-famous, and that should bring financial support for more rocket development.

While it is true that the project Oberth had in mind was simply too ambitious for anyone in Germany to have carried out at that time, it is also true that he made a difficult situation worse by his own mismanagement. He had no experience in conducting an engineering effort. He was hopeless in conducting business with the studio. And when he hired two assistants, he made the worst choices imaginable. He was injured in an explosion and finally left town, later claiming he had suffered a breakdown.

Managing an engineering project played to several of Oberth's weaknesses, so he could certainly have been under enough stress for a breakdown. What's more, as Willy Ley describes the situation, Oberth was dangerously out of his element.

> He had grown up in the small towns of Transylvania and he had studied in the leisurely atmosphere of Heidelberg and of Munich. Now he was suddenly plunged into the strange atmosphere of fast-moving, efficient, flippant, and sophisticated Berlin. . . . People spoke to him in a dialect which was strange and, to him, ultrarapid. . . He ate his lunch in a canteen where Russian and English and French (none of which he knew how to use himself) were as common as German.[70]

Such circumstances call for flexibility, and Oberth had little of that, as an incident later in his life illustrates. In 1958, Oberth came to the United States and Dannenberg had occasion to be his host. Dannenberg, having lived in the United States for some fifteen years, was used to speaking English. Oberth knew some English, but always replied testily, "Can't you answer me in German?"

There was a success amidst the frustrations and failure, in which one of Oberth's strengths shines through. While testing the combustion of liquid fuel and liquid oxygen (as mentioned above):

> Oberth was quick to see that something took place which had never been observed but which was very advantageous: the burning droplets tore themselves apart and were consumed much faster than had been assumed. This discovery meant that much larger amounts of fuel could be burned in a given space and during a given interval of time than had been believed possible. For one thing, it made the still theoretical rocket motors much smaller and lighter.[71]

As in the swimming pool years before, Oberth was quick to understand a physical phenomenon and quick to see what it meant for the accomplishment of space travel.

Oberth returned to Romania in a huff after the movie project, but he was back in Berlin by the spring of 1930. He had thought up a new engine design,

the *Kegeldüse* [cone-engine]. A test of the *Kegeldüse*, to be administered by a state agency, had been arranged. On July 23, 1930, the *Kegeldüse* performed perfectly and Oberth received a certification of its performance. It must have been a sweet victory, his first taste of the official recognition he had tried so hard to gain. While the certification didn't result in any new funds, as had been hoped, four decades later Oberth was still proud of the little engine's success, claiming: "With that the door to space travel was pushed open."[72]

Oberth is Left Behind

In 1929, Col. Karl Emil Becker, chief of the German Army Ordnance's Department of Ballistics and Munitions, initiated an investigation into liquid rocket technology for military purposes. In December 1930, Becker ordered the development of such a weapon. Near the end of 1932, Capt. Walter Dornberger hired 18-year-old Wernher von Braun as his technical assistant at the Army proving ground in Kummersdorf. Private groups such as the Verein für Raumschiffahrt [Society for Space Travel], of which von Braun was a member, were entirely unable to carry out the huge research and testing program needed for space travel. The Army was the best and only game in town.

Von Braun's decision was the end of Oberth's key role in space history, because it began the necessary large-scale engineering effort to which Oberth could contribute little. Oberth lacked the training to be an engineer, but more importantly, he lacked the inclination. As Zoike said, "he was not engineering-minded." Men who worked with him on actual rocket construction report that he was all scientist. He didn't like the messy physical details of engineering, and it was hard to make him understand or even acknowledge such problems. Perhaps this impatience with physical details was the flip side of his gift for seeing through such details to the underlying principles.

Mathilde Oberth, by contrast, was quite handy. According to Erna Roth-Oberth, many things were made by hand during her childhood in Romania. It was her mother who "made a lot of things . . . She made all the clothes for us . . . and baked bread." I wonder if Oberth was ever struck by his wife's possession of some of the abilities he suffered so much for lacking.

We can see this disinclination for engineering quite a ways back. Oberth's youthful experiments, such as observing water in a bottle during the instant of free fall while jumping from a diving board, are astonishing, because he could extract so much information *without* using special apparatus. He says that, having discovered rocket propulsion was the key to space travel, "I was not able to carry out any experimental work for a long time. It might well have been possible for me to produce and launch some rockets containing gunpowder. But such

attempts appeared to me silly tricks compared to what I wanted to achieve."[73] He is perhaps right, but these are not the words of an inventor. Von Braun, by contrast, got into trouble as a youth for building his own skyrocket-powered wagon, which went out of control, and for launching firecrackers into other people's property. These episodes contributed nothing to the development of rocket technology, but they are the mark of someone who likes to solve engineering problems.

I asked Oberth if, in the early days when rockets were small enough to hold, he had liked the feel of these embodiments of his ambition. He said he never thought about that. Nor had he found the noise, glare, and explosion of a launch exciting.

As the father of rocketry, Oberth was indeed a typical father of a certain type. He did not bear and give birth to the devices he had engendered. Once they were born, he was not comfortable around the ill-behaved creatures, although he would later take pride in their successes.

Oberth acknowledged his disinclination for engineering and what it had cost him. At the first successful test of a V-2, in which the rocket rose 60 miles to the border of outer space, Oberth is reported to have shaken Dornberger's hand and said, "That is something only the Germans could achieve. I would never have been able to do it."[74] And in 1962 he wrote: "In 1930 I was given the chance to build a rocket in Berlin, but I was unable to deal with all the practical problems of construction and the rocket was unsuccessful. Afterward, I learned the trades of the locksmith and mechanic. Had I known them earlier, my work in Berlin might have been a success."[75] In fact, these actions were too little, too late, and not really to the point anyway.

Building rockets turned out to be a bigger job than anyone imagined in the twenties and early thirties. Teamwork and management became as important as engineering, and Oberth was hopeless as a manager or team player. He was never a "people person." For example, he listed his recreations as "smoking, wandering, gardening, music, bicycling, rowing, or reading about philosophy and occultism."[76] Not one of these requires a companion. He liked to play the piano, learning melodies by ear and inventing variations on them, but not playing with other people.[77]

It is telling that, despite the enormous impact Oberth had on the lives of many younger men who met him or read his books, he is generally mentioned with respect but not with any demonstrable fondness. Dannenberg remembers that people at Peenemünde who tried to engage the master in conversation at dinner often did not succeed.

Willy Ley gives a revealing glimpse of how tight-lipped Oberth could be. During the *Frau im Mond* project, Oberth hired an assistant named Rudolf Ne-

bel. They worked together for several months, trying to build a rocket, yet Oberth never mentioned to Nebel the existence of the Verein für Raumschiffahrt, of which he was president![78]

However, Erna remembers being six or seven and asking her father about the papers she saw on his desk and on the table. He told her about rockets and satellites, and also talked about these things at the dinner table. He also entertained his high school students with these ideas.

And while interviewers have often found him tight-lipped, given to the briefest possible answers, he could open up unexpectedly. B. John Zavrel first met Oberth at his home in Feucht in 1984: "The fifteen minute meeting I requested became two hours of a wonderful visit."[79] Historian Frank Winter conducted a rather frustrating oral history interview with Oberth, left the house, then had to return. He found himself alone with Oberth (previously, Erna had been there translating), whereupon Oberth suddenly warmed up and told Winter an interesting anecdote in English, which he spoke only with great difficulty.[80]

Walter Hecker, a longtime friend of the Oberths, disagreed that Oberth was normally withdrawn; "only when it was overwhelming, people running over him."[81]

At least one person saw the invisible curtain coming down on Oberth's historical role. In 1931, Rolf Engel contrasted Oberth's theoretical genius with the impracticality and inability to cooperate with people, which made him unsuitable for an engineering team. "I dare to predict that Oberth will never reappear in the future practical development of rocket technology."[82]

It was during World War II that Oberth would have begun to experience the end of his role in history. He knew that the real work was going on at Peenemünde and wanted very much to be part of it. Several factors got in the way. First, Oberth was Romanian, not German. He considered himself a loyal German. But, of course, citizenship mattered to the military. According to von Braun, another obstacle was interservice rivalry. Since the Army had Peenemünde, the Luftwaffe got hold of Oberth and put him to work in Vienna.[83] Such rivalry was real, but at that juncture the Army and Luftwaffe were allies in rocketry.[84]

After a while in Vienna, Oberth felt that he had been "put on ice," to make sure he wasn't recruited by another country. That may or may not have been true in Vienna, but it was certainly true of his next assignment to Dresden, where he was expected to develop a fuel pump for a large rocket. In time, he learned that the V-2's fuel pump system had already been completed, so it was clear he was on ice. This time, he was told plainly that he had better become a German citizen. Oberth agreed, but the red tape took time.[85]

When he finally got to Peenemünde in 1941, most of the development work had been done. He witnessed the V-2's first successful test flight, on October 3, 1942. This was a great day for von Braun's rocket team, as the conquest of space had now clearly begun, and Oberth was warmly congratulated for the success of his ideas. All the same, it had been done without him, even done behind his back. He was frustrated there. The work went too slowly, and now there wasn't anything important for him to do. In 1943, when it was decided to stop all advanced work and put every effort into production of V-2s for the war, Oberth left. He told me in 1989 that he felt "betrayed" by the Peenemünde team, some of whom were former protégés.

But as we have seen, it is unlikely he could have been much use at Peenemünde. Von Braun and his team were struggling with very practical and messy problems—the working details of guidance, stability, fuel flow, temperature control, and so on. Oberth disapproved when they transplanted already-developed submarine and aviation technology, a time-saving expedient they couldn't afford not to take.[86] This is not surprising from a man whose problem-solving creativity made him "just like a vending machine, you could go there and pull out a new idea."[87]

As with any "secret miracle weapon" project, there was intense time pressure. The engineers worked as a team and developed an intense camaraderie (which has lasted to this day). Oberth was not the man to thrive in such an enterprise, and his theoretical work, however brilliant, was simply beside the point for the time being. Stuhlinger thinks that Oberth felt isolated, frustrated, and disappointed by the gap between his solitary intellectual activity and the busy, productive activity of the others, but he realized that "his talent was not the one which was needed on an everyday basis."[88]

All the same, he was impatient at Peenemünde when they had to waste time mass-producing weapons instead of advancing the rocket technology. And Dannenberg says that after the first successful V-2 launch, Oberth told Stuhlinger that, while he was glad it had worked, the important business was not to launch vehicles but to explore space.

Oberth had pointed these men the way from the wilderness to the city, but now they were finding their way amongst the one-way streets and back alleys which he knew little about.

Like most Germans, Oberth suffered a battery of grievous losses during the 1940s. His mother died in 1941, and his father died the year after the war ended. His eldest child, Julius, never returned from the Russian front. And his daughter, Ilse, was killed in 1944 in an accident at a factory which produced liquid oxygen for the V-2s.

In 1938, Oberth had finally finished a full draft of the philosophical work which had still seemed to be missing too many pieces back in 1922. But a bomb attack destroyed not only the text but most of the supporting materials. The rest were destroyed during the war.[89]

Also during the war, Oberth had reportedly hidden a collection of astronautical papers. Gartmann says it was a 1,300-page magnum opus, which was hidden in a dugout and destroyed near the end of the war.[90] Erna Roth-Oberth remembers hearing that it was a suitcase containing much of his early correspondence, and perhaps also a manuscript. This was left amongst some people who may have used the pages for fuel during the winter.

Whether for lack of time or lack of heart, Oberth never recreated either manuscript.

Oberth also lost his chance to fulfill his dream. From the time he read Verne, he wanted to go to the stars, not just to the Moon.[91] He told Valier, "I have no other ambition than to take part in inter-planetary travel."[92] In *Wege*, he says, after criticizing a colleague, "I myself, likewise, am grateful to anyone who draws my attention to any mistake in my work. In no way do I have the ambition to remain the winner in every debate and later to break my neck with the first manned rocket. I would rather take a slap here and there and later fly in a correctly-constructed space-ship."[93] In 1931, he told a reporter, "I hope one day, not before fifteen years at the earliest, to be able to fly in a rocket, if not to the Moon, to the planet Mars or Jupiter.[94] And he once wrote this poem in a guest book:

> Warum an der Erde kleben?
> Sieh der Mond steht gleich daneben.
> [Why stick to the Earth?
> See the Moon right nearby.][95]

When Oberth worked in Huntsville for a few years in the fifties, he let it be known that he would like to be an astronaut when the time came. "I always thought they should send old men as explorers," he explained. "We're expendable."[96] He certainly knew he wouldn't be chosen, but he clearly still wanted to go.

While he did not become an astronaut, neither did he become a successful consulting engineer in astronautics, a wish he had expressed in *Wege*. He was, in fact, employed quite a few times as one, but never had any significant financial or scientific success to show for it. He said he never earned one cent from his patent rights.[97] Both in Peenemünde and in Huntsville, he did advanced work which doesn't seem ever to have been used. The work he did in Peenemünde on multistaging was out-of-date by the time anyone was ready to

try using the technique. This is one of several cases in which Oberth was ahead of his time as a theorist but, because he didn't keep up with technology, ended up too far behind the times to contribute when it became possible to carry out such ideas.

Oberth's first two books are his indisputable contributions to the achievement of space travel. Yet, on September 22, 1970, he wrote to NASA historian Eugene M. Emme:

> I have, of course, no objection, that "Wege zur Raumschiffahrt" shall be translated in English and if you cannot offer me any royalties, well, then I am content also with 6 copies.
>
> But freely spoken: Prof. Ivao Nakamory in Tokyo paid me for the permission to translate it into Japanese DM 820 and until now I thought that Americans are even richer than Japanese.[98]

Oberth Expands His Range

Oberth had hoped for a busy place in the astronautics industry he foresaw in the opening of *Die Rakete*. But throughout the thirties and forties, he was repeatedly shown that this would never be.

Many Germans were in desperate straits after the war, with little or no work and barely enough (or sometimes not enough) food to survive. For three years after the war, in which the V-2 had proven Oberth's vision of space travel to be possible, he could find no job at all. He and his family worked in their garden and raised a few animals to feed themselves. In 1952 he told a reporter, "All my attempts to find a job as teacher in university, high school, or even public school were futile. I guess I can do nothing better than grow cabbages and turnips in my vegetable garden."[99]

Eventually, he worked on two unworthy rocketry projects, relocating to Switzerland in 1948, and then to Italy in 1950. Compared with many other Germans, Oberth was lucky to have a job and lucky to be out of Germany for a while. He could send his family not only money but food from Switzerland. But the father of space travel had had to sneak into Switzerland to take a job in a fireworks factory, offered by an admirer.

In Italy, he worked on an ammonium nitrate-fueled rocket, an idea he came up with towards the end of the war, when it became increasingly difficult to get hold of all sorts of materials, including rocket fuels. Of course, this was hardly advancing the field of rocketry.

Oberth gives these episodes no more than a perfunctory line or two in his autobiographical writings, and Adolph said he dismissed them as "kid stuff," done purely for survival.

Oberth published *Menschen im Weltraum* [Men in Space] in 1954 and *Das Mondauto* [The Moon Car] in 1959, but these books had none of the impact of *Die Rakete zu den Planetenraümen* and *Wege zur Raumschiffahrt.*

Meanwhile, von Braun's team, having turned themselves over to the American army near the end of the war, were established in the United States. While they, too, seemed to be on ice for a while, their patience was rewarded with facilities at the Redstone Arsenal in Huntsville, Alabama. These facilities became the NASA Marshall Space Flight Center. Oberth had written to von Braun from Switzerland, wishing to be included, but again, there seemed to be no hurry to do so. He was finally invited in 1955. But, just as at Peenemünde, he felt out of place amongst the busy team, doing research which no one used.

In 1958, he reached mandatory retirement age but, having been in the U.S. only a few years, he could earn only a tiny pension. He was eligible for a much better German teacher's pension, but he had to live in Germany to collect it. So he moved back home to Feucht, a suburb of Nuremberg, where he had bought a home during the war. He lived there until his death in December 1989.

After the war, Oberth sought to regain his place in the world as an intellectual. In 1946, he formed a "Scholar's Circle" in Feucht,[100] but this attracted mostly inventors of perpetual motion devices.[101] In 1947, Sänger wrote to him, "I know that in Feucht you are living unknown and withdrawn from public life, while the world is talking of the amazing results of your ideas. This seems to be the way of the world in all really great matters."[102]

In time, Oberth received many official honors, but, by several accounts, he was indifferent to them. He would receive an award, take it home and lose it. To him, this whole business of honoring people was baffling. He said that, at such events (whether it was he or someone else who was being honored), he felt like a tone-deaf man at a concert, unable to perceive what others were so excited about.[103]

In 1969, Wernher Von Braun used the occasion of Oberth's 75th birthday celebration to make an announcement about Apollo 11. As Erna recalls it, Oberth drank his coffee, ate his cake, and said nothing.

Von Braun made sure Oberth had a seat of honor at the launch of Apollo 11. But he was seated beside that painful old thorn in his side, Rudolf Nebel!

Naturally, such events required him to be around groups of people, which was never very comfortable for him, and to waste time he would rather have spent thinking, researching, and writing. And one can easily imagine that Oberth would have little patience with the sort of hackneyed oratory and dull small talk

with strangers that characterizes such festivities. What's more, as he got older, such events were just too tiring and confusing. Rolf Engel recalls that at Oberth's huge and gala ninetieth birthday party, Oberth seemed very uncomfortable and didn't recognize some of the people he had known.[104]

Oberth was invited to the launch, on October 30, 1985, of the German D-1 Spacelab aboard Shuttle Mission 61-A. He did not want to go, but Erna did and prevailed upon him to do so. After the launch, they spent one day on an official visit to the National Air & Space Museum in Washington, DC. Photographs of Oberth next to various exhibits show a man who looks entirely disengaged—even from the exhibit about himself! Erna says that he was angry at her for dragging him there and just wasn't interested in the past.[105]

This visit also showed how unknown Oberth was. Americans have heard of von Braun and Goddard, but not of Oberth. Arthur C. Clarke tells this story:

> I last glimpsed this strange and brilliant man in circumstances that neatly summed up the frustrations of his life. He was one of a crowd of visitors being conducted through the [Goddard Space Center]. None of the young scientists who were acting as guides recognized him; I wondered how many of them even knew his name![106]

Frank Winter, one of Oberth's hosts at the National Air & Space Museum, noticed the same thing. Even when Oberth stood next to the display about himself, no one outside the official party seemed to take notice.[107]

When Oberth visited the Goddard Space Flight Center on November 6, NASA historian Sylvia Fries was present and noted: "Not many have shown an interest in meeting him, and the German government apparently wishes no official association with him; he was not invited by NASA to any of the official events surrounding the Shuttle launch . . . and his request to speak to the Shuttle crew during the hookup was denied."[108] In fact, his visit was not sponsored by the museum or by NASA, but by the L5 Society and the Academy of Model Aeronautics of the National Aeronautic Association. Oberth later said politely that "many Americans know and remember my pioneering rocketry work."[109] But it is unlikely that he failed to notice his official unimportance.

In the mid-fifties, Oberth's career took a turn which he seems to have found very stimulating, but which his peers and admirers generally found embarrassing and best left unmentioned. Responding to the rash of UFO sightings, he announced that he believed UFOs could be real space vehicles, carrying intelligent extraterrestrials. He participated in UFO conferences and thus considerably tarnished his reputation as a scientist.

Oberth spoke up publicly for other causes generally considered pseudo-scientific, such as para-psychology and the research of Jürgen Spanuth, who

claimed to have proven that Atlantis had been located in present-day Germany before being destroyed in a period of world-wide natural catastrophes during the thirteenth century B.C.[110]

It's impossible not to recall that, by advocating space flight in the 1920s, Oberth himself was once in this category. And he made the connection himself in 1967, recalling the wrongheaded resistance he had faced decades before and concluding, "I am not exhuming dead bodies. I am talking about something living! When listening to the objections of today's scientists against new inventions and discoveries, the same thing is found again."[111]

One outcome of the UFO publicity was that Oberth was contacted by Barbara Troll, who claimed to be in psychic contact with extraterrestrials. During her trances, she had written down her conversations with them, and they had instructed her to bring the material to Professor Oberth.[112] Oberth read her writings, which were in an occult jargon familiar to him, and which called the aliens Uranids. The results included two books, *Katechismus der Uraniden* [Catechism of the Uranids], published in 1966, and *Wählerfibel für ein Weltparlament* [Voter's Primer for a World Parliament; an English translation is called *Primer for Those Who Would Govern*], which appeared in 1984. *Katechismus* is a philosophical treatise, subtitled "Does Our Religion Have a Future?" *Wählerfibel* is a compendium of political, economic, and ethical views, offered as the bare minimum anyone exercising or electing political leadership must know. Both quote the Uranids, who have much practical advice for humanity.

Oberth claims he was struck by the "consistent logic" and the "strikingly mathematical objectivity and clarity of thought" of Troll's material, in contrast to her limited education and intelligence. Such work certainly couldn't have come from her, giving credence to her claim that it was from the Uranids.[113]

However, the Uranids' opinions seem always to be Oberth's own. Oberth himself was too rational to imagine that aliens would be just like humans; he discussed that very subject in *Wege*.[114] Yet there is nothing at all alien about the Uranids' perspective, and their society and institutions correspond to Western society and institutions, from monotheism to patent law!

It is not unusual for a person of accomplishment in one field to try to apply the techniques of his or her success to a wider scope of activity later in life. What's more, Oberth had already been shut out of his previous field of astronautics. He knew he was too far out of touch with current technology. And he foresaw that, over the next 50 years, politics—hardly his strong suit—might have more impact on space flight than technology.[115]

Oberth's life had turned out to be a vindication of the policy of publicly defending a position once you had proven it correct and for as long as no one proved it to be incorrect. When he believed he saw plausible ideas being sup-

pressed, rather than honestly disproven, it was natural for him to speak up in their defense. He even felt it was his moral responsibility: "I have always felt responsible to the Lord for the use I made of the abilities He gave me."[116] "In my opinion, research now has the damned duty to track down what this all is."[117]

Oberth's self-appointed role in the UFO controversy was in some ways like his role thirty years earlier in the controversy over whether space flight was possible and, if so, how. Here again was a possibility which captivated him but was not being treated with the necessary intellectual rigor. "I occupy myself with UFO research because it is in the line of space travel and because I believe that objective people must examine the material that has been gathered with so much energy and dedication, even from people who are not always objective themselves."[118]

The UFO controversy resembled the early rocket days in one more way: Oberth had to—and was willing to—make do with such allies and organizations as were available, since it wasn't in him to create a circle or found an organization himself. In the 1920s, he had had more frustration than success working with the VfR and with Ufa (the film company which made *Frau im Mond*), and in his collaboration with Valier. This time he got involved with Deutsche UFO/IFO-Studiengesellschaft [German Society for UFO/IFO Studies (DUIST)], headed by publisher Karl L. Veit. Oberth was criticized for this, because DUIST's strong religious orientation was considered incompatible with scientific research. But there was no other organized forum for UFO studies in Germany at the time.[119]

What's more, he found that organizations were making do with him. In 1967, he was chosen by a Japanese UFO-contactee group, the Cosmic Brotherhood Association, to lead a German branch of its youth group, International Sky Scouts. However, they never bothered to ask him beforehand. He was also elected to positions in DUIST without being told. Nevertheless, he participated in both organizations.[120]

But, in important ways, this was a very different battle. First, his present income and career prospects were not at stake; he was long past having to worry about them. Second, he had no original work to contribute, only his characteristic intellectual discipline and his reputation.

> I have never said that I believe UFOs are spaceships from other worlds. Neither have I said that they are not. I have only observed that for close to 10,000 eyewitnesses, this is the only explanation that they would believe. Naturally, that doesn't mean that they are right. Perhaps UFOs are something completely different and it has not occurred to anyone what they are.[121]

As far as I know, this is the only field in which Oberth became seriously involved without producing a book of his own.

Oberth got himself into more serious trouble with his political opinions. In the early days of the Third Reich, many Germans considered Hitler a hero for pulling their country out of both an economic and psychological depression. But after the war, few Germans would admit publicly that there had ever been anything good to say about Hitler and the Nazis. Oberth was willing to say so, especially because other people were not.

Sometimes he seemed to enjoy getting into hot water, just to prove his independence of mind. He was often contemptuous of the press, and the hostility was often returned.[122] Once, a journalist asked what had been the nicest time of his life. His reply: the period of 1933 to 1945! He was referring to a memorable period of scientific and technological achievement (including the V-2, which had proved space flight possible), but he was also aggravating open wounds.[123] In a section of *Primer* titled "What Hitler Did Wrong," he lists only inadequate foreign propaganda, failure to introduce floating currency, and "boundless impatience."[124] This would naturally be interpreted as praising Hitler with faint damnation.

What was Oberth experiencing when he expressed such opinions and took the resulting heat? I believe that an important part of Oberth's experience of his own life was the loss of his childhood home, Transylvania, followed by the many frustrations he experienced in his intellectual and cultural home, Germany.

Despite his clashes with old-fashioned schoolteachers, Oberth's childhood seems to have been physically and emotionally comfortable and intellectually stimulating. Erna remembers her own childhood in Transylvania as a happy time. Romania (of which Transylvania had become a part) was rich, and, while Oberth himself was not wealthy, his father openly enjoyed his wealth, spoke often of the good things they had, and generously supported both his son and the local medical profession.

But already at that time some things were changing for the worse. It was not as easy to travel into Germany from Romania as it had been from the Austro-Hungarian Empire, and the money was no longer exchangeable, so Oberth's father couldn't send support to him there. Germany itself was in dire straits, so Oberth had a hard time working there. At the time, this seemed to be a terrible obstacle to his goal of developing rocketry.

Oberth had gone to Germany for his university education, but this had ended in the rejection of his doctoral thesis. After the publication of *Die Rakete*, Oberth was deeply disappointed by the narrow-mindedness of the German scientific establishment he had always looked up to.

Oberth felt loyalty to Germany. He wanted his rocket research to benefit Germany, not Romania, and he offered his expertise to Germany during both world wars.[125] But his proposals were rejected during World War I, then carried out without him during World War II.

When it seemed that Germany would win World War II, Oberth had been confident that Hitler would support space travel after the war was over.[126] As it turned out, postwar Germany lacked both money and public support for a space program. During the 1950s, Oberth engaged in a controversy with Dr. Kühn, who popularized science on television, but who insisted that sending a rocket to the Moon would be impossible.[127] What's more, the cream of the German rocketeers were not in Germany but in the United States, where he had been unable to stay.

Germany had never returned Oberth's loyalty, and it became less inclined to do so as his political opinions differed with the post-war mainstream. He felt that the West German governments kowtowed to the former Allies, rather than representing the interests of the German people, for example, by allowing the United States to plan on Germany being the battle-ground for a war with the Soviet Union.[128]

To the very end, Oberth maintained his Transylvanian culture at home: the food, the style of hospitality, sometimes, the dialect and gestures.[129] Dieter von Reeken reports that Oberth reverted, in old age, to a heavy Transylvanian accent, often causing his UFO-related pronouncements to be misunderstood.[130] He visited Cleveland, Ohio, twice in the 1960s, because there was a large Transylvanian population there, including some friends.[131]

Oberth told people that *Primer* was his most important book.[132] If we take him at his word, what could he have meant by it? He seems genuinely to have cared more for meeting his own intellectual standards than for being appreciated by others. Though the latter was important, the former was crucial.

Primer is a collection of opinions about how to run things better than they are run. Its guiding principles are that truth should prevail over falsehood and that people should not be allowed to harm each other.

Oberth had thought about such things all of his life. He had also been a "professor," one way or another, most of his adult life—trying to teach other people the truth. It must have felt right, in his nineties, to organize all his opinions into a workbook for those who would outlive him.

But would anyone listen? I don't think that mattered. His life had taught him that his messages to the world would be heard decades later, if at all. After all, it wasn't until the launch of Sputnik in 1957, that the world at large finally got the message he had first tried to send with his doctoral thesis in 1922. What

was important was that he offer an intellectually rigorous and complete solution to an important problem, and this he felt he had once more done.

Oberth had always been comfortable writing in a discursive and digressive style. I think this reflects two things fundamental to his experience of his own life.

First, he enjoyed the many sides of his mind and felt that they belonged together, not separated from each other. Even in *Wege*, there are digressions that most people would never think of allowing into such a book. For example, the question of life on Mars leads him to a five-page inquiry into the nature of human knowledge. He even says, part way through, "Perhaps later, in a philosophic book, I will write more about these and similar things." He then devotes a paragraph to his belief that science has made man immune to extinction, assuring us that "Some time in the future, on approximately 300 printed pages, I hope to produce convincing proof of my claim." That paragraph also includes a plug for a pre-World War I experiment in social organization called the Freybund, which he considers "the most important thing man has thought up so far."[133] (The Freybund turns up again in *Primer*.)

His refusal to compartmentalize his various interests led to public presentations which others found rambling or even embarrassing. "My Contributions to Astronautics" is a perfect example; it includes "digressions" on why scientists are so narrow-minded and which "pseudosciences" are being unfairly suppressed. In fact, these are not digressions if we consider his subject to be his *experience* of making the contributions he did. Part of that experience was to have learned, the hard way, why scientists become narrow-minded and to have gained, the hard way, sympathy for the victims of that narrow-mindedness.

Second, Oberth had complete confidence in his intellect, which he defined as "the accommodation of [the] organ of thought to the regularities inherent in things," and thus had no fear of expressing his opinions.[134] For example, it didn't bother him that he had never seen a UFO; there was already plenty of data to which he could confidently accommodate his organ of thought.[135]

This confidence in his reasoning mind eliminated any need to stand on titles or seniority, as his opponents had so often done in the 1920s and 1930s. It explains Dieter von Reeken's observation that Oberth, "however eccentric he might be, was never high-and-mighty or afraid of contact with people who thought differently than he."[136]

Specialized history, such as space history, tends to focus on the unique aspects of its subjects lives. But a man like Oberth was still a man; his unique experiences were embedded in common ones, such as growing old.

Oberth lived to be 95 and a half years old. Although subject to illnesses in his youth, he seems to have been quite healthy in middle age. But towards the

end, he was very weak, sometimes needing a wheelchair or walking with the support of another person. According to Hecker, Oberth's mental powers faded in and out during his last several years, though he was in good form when Hecker saw him only a week before his death.

Like other old people, he experienced the deaths of many people he had known, including those a generation younger, such as von Braun. But the most shocking loss in his old age must have been Mathilde's death in 1981. She had always been his constant support, but in the end she became senile, sometimes not even knowing who he was.[137]

Erna, who had been living next door, moved in to care for her father. Of the children, only she had lived with or near her parents most of her life. The boys had gone away to boarding schools. Julius and Ilse were killed during the war, and Adolph made his career in the United States. Erna had already been managing much of Oberth's correspondence and affairs. She also actively sought to secure him more of the fame she felt he deserved, particularly by creating and managing (originally with her husband) the Hermann Oberth Museum. As we have seen, her efforts sometimes involved him in things he didn't want to be bothered with. My own interviews with Oberth in 1989 were entirely Erna's choice. For one thing, I was young and she wanted younger generations to know about Hermann Oberth. My impression was that Oberth himself had no desire to talk with me.

Oberth always knew what he was and how to judge his own performance. He was a scientist, a man who discovered the truth about phenomena and proved that truth so that others could apply it. "It is actually amazing how little the theory of rocketry has progressed," he wrote in *Wege zur Raumschiffahrt*. "The primary reason appears to me to be because it is so difficult. The theory of rocketry is one of the most difficult chapters in the whole theory of mechanics. . . . It took me, for example, over 10 years to work out the theory of rocketry. Not everyone is suited for such a method of work, which is one reason why, until 15 years ago, no theory of rocketry existed.[138]

In 1967, Oberth wrote, "It is well known that manned space travel has required fewer sacrifices than the development of aviation. The main reason for this is that aviation meant a leap into an unknown element, whereas in space travel, most of the problems were solved theoretically before being taken up practically. And, in all humility, I think I contributed to that with my theoretical preparatory work!"[139]

He liked people to know that he had accomplished what Goddard had believed impossible. "Dr. Goddard in 1919, for instance, wrote that it would be impossible to express for a rocket trajectory the interactions of propellant consumption, exhaust velocity, air drag, influence of gravity, etc. in closed numeri-

cal equations. In 1910, I had begun to investigate these mathematical relationships and to derive the equations; these investigations were completed by 1929.[140]

Was Oberth the scientist content, as he said he was, to watch others make his dreams come true? Perhaps he was, because that's one thing he doesn't complain about in his autobiographical essays.

Conclusion

I was walking past a park on my way from the Feucht train station to Oberth's house when I noticed a small gazebo, such as you often see in town parks. There was something oddly familiar about the shape. The roof was conical, with a little device on top . . . it looked like a *Kegeldüse*! I assumed that was only a coincidence. But, indeed, it turned out to be a monument to Hermann Oberth.

Strange . . . the monument was so old-fashioned looking that, even as I was reminded immediately of an invention that had once promised the future to a small band of devotees, I didn't think it could really have anything to do with the "father of space travel."

Yet now, that engine itself had become quaint, no more futuristic-looking than a Model T.

And so it was with Oberth himself. Born in the nineteenth century, brought up in a town that had Gypsies living on the outskirts and didn't have electric lights or water mains until he was eight, he nevertheless became the father of who knows how large and long a future? But that fathering had taken place more than sixty years before. Oberth was now a quaint old man, teetering or needing support as he walked.

What was it like for Hermann Oberth to live his life? A portion of the answer is in this paper. Much of the answer is unknowable. Questions which may be answerable, but which I wasn't able to research in time for this presentation, include:

1. What was it like writing *Die Rakete* and *Wege*?
2. How far back does Oberth's philosophical and occult thinking go? What was it like thinking these thoughts at the same time that he was thinking about space flight?
3. What was experimental rocketry work like for Oberth?
4. What was dealing with other people like for Oberth?
5. What was it like watching the American and Soviet space programs?
6. What were the encounters with Barbara Troll and other psychics like?

7. What was it like writing about the Uranids? Was he serious, kidding, or both?

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Reference Notes

[1]Frank H. Winter, *Rockets into Space*, (Harvard: Cambridge, 1990) says he was twelve. Oberth's "Autobiography, in Arthur C. Clarke, ed., *The Coming of the Space Age* (Meredith: New York, 1967) and my own "Contributions to Astronautics," in Frederick C. Durant and George S. James, eds., *First Steps Toward Space* (Smithsonian Institution Press: Washington, D.C., 1974) [also published as *AAS History Series*, Vol. 6, 1985] says he was eleven. These are the two autobiographical essays referred to several times in the text.

[2]Hermann Oberth, *Primer for Those Who Would Govern* (West-Art: Clarence, New York, 1987), p. 206.

[3]"Autobiography," pp. 116-117.

[4]*Ibid.*, pp. 113-114.

[5]Jules Verne, *Works of Jules Verne*, (Avenel: New York, 1983).

[6]"Autobiography," pp. 114-115.

[7]"Contributions," p. 129.

[8]Interview with Hermann Oberth. Interview dates were September 11, 12, and 16, 1989.

[9]"Contributions," p. 133.

[10]Peter Horwath, quoting Ernst Stuhlinger's memories of Oberth in "Hermann J. Oberth, Father of Space Travel," in Gerhard K. Friesen and Walter Schatzberg, eds., *The German Contribution to the Building of the Americas: Studies in Honor of Karl J. R. Arndt* (Clark Univ. press: Worcester, Massachusetts, 1977), p. 348.

[11]Hans Barth, ed., Hermann Oberth, *Briefwechsel* [Correspondence], Vol. 1 (Kriterion: Bucharest, 1979), p. 156. Letter from Hermann Oberth to Adolph Oberth, Jan. 1, 1949. Translation by Stijn von Even, Marie-Claire Ording, and John Elder.

[12]Heinz Gartmann, *The Men Behind the Space Rockets*, (David McKay, New York, 1956), p. 50.

[13]"Autobiography," pp. 115-116.

[14]"Contributions," p. 132.

[15]"Autobiography," p. 116.

[16]Interview with Hermann Oberth.

[17]Marjorie Dent Candee, *Current Biography Yearbook 1957* (H. W. Wilson: New York, 1957), p. 416.

[18]Gartmann, *Space Rockets*, p. 48.

[19]Interview with Erna Roth-Oberth, Oberth's daughter. All material from Erna Roth-Oberth comes from interviews on July 8 and 28, 1991, except as otherwise noted.

[20]Interview with Ernst Stuhlinger, March 4, 1991.

[21]"Autobiography," p. 116.

[22]Michael J. Neufeld, "Weimar Culture and Futuristic Technology: The Rocketry and Spaceflight Fad in Germany, 1923-1933," *Technology and Culture*, October 1990.

[23]Rom Landau, *God is my Adventure* (Alfred A. knopf: New York, 1936), p. 15.

[24]All references to Konrad Dannenberg are from interviews with him, Nov. 18-19, 1990.

[25]"Contributions," p. 131.

[26]Oberth, *Primer*, p. 273. This book includes a timeline/biography of Oberth in German.

[27]"Contributions," p. 136.

[28]"Autobiography," p. 118.

[29]"Contributions," p. 137.

[30]"Contributions," p. 133.

[31]Hermann Oberth, *Ways to Spaceflight* (NASA: Washington, D.C., 1970), p. 2.

[32]"Autobiography," p. 118.

[33]Interview with Erna Roth-Oberth.

[34]Barth, ed., *Briefwechsel*, Vol. 2, p. 78-79; Letter from Mathilde Oberth to Ernst Stuhlinger, Jan. 17, 1963. Translation by Stijn van Even and John Elder.

[35]Horwath, "Herman Oberth," p. 348.

[36]*Ibid.*, p. 348.

[37]Hermann Oberth, *Die Rakete zu den Planetenräumen* (R. Oldebourg: Munich, 1923), p.5.

[38]Ilse Essers, *Max Valier, A Pioneer of Space Travel, 1895-1930* (NASA: Washington, D.C., 1976), p. 71; Letter from Oberth to Valier, Aug. 4, 1924.

[39]Hermann Oberth, Stoff und Leben: *Betrachtungen zum modernen Weltbild* [Matter and life: Observations on the modern world-view] (Otto Reichl: Remagen, 1959), p. 15. Translation by Marie-Claire Ording and John Elder.

[40]Interview with Erna Roth-Oberth. Walter Hecker (see note 83) remembers this being mentioned.

[41]Interview with Erna Roth-Oberth.

[42]Erna told this story during one of my interviews with her father. He acknowledged it but would not elaborate on it.

[43]Essers, *Max Valier*, pp. 61-62; Letter from Oberth to Valier, June 9, 1924.

[44]Essers, *Max Valier*, p. 63; Letter from Valier to Oberth, June 19, 1924.

[45]Oberth, *Ways*, p. 460.

[46]Hermann Oberth, *Man Into Space* (Harper's: New York, 1957), p. 167.

[47]"Contributions," pp. 136-137.

[48]"Autobiography," p. 119.

[49]Oberth, *Primer*, p. 41.

[50]Erik Bergaust, *Reaching for the Stars* (Doubleday: Garden City, 1960), p. 42.

[51]Shirley Thomas, *Men of Space*, Vol. 1 (Chilton: Philadelphia, 1960), p. 3.

[52]Lloyd Mallan, *Men, Rockets, and Space Rats* (Julian Messner: New York, 1955), pp. 291-292.

[53]Gartmann, *Space Rockets*, p. 74; Essers, *Max Valier*, pp. 56-67.

[54]Winter, *Rockets*, p. 42.

[55]Horwath, "Hermann Oberth," p. 349.

[56]Interview with Hermann Oberth.

[57]Interview with Rolf Engel, Sept. 13, 1989.

[58]Willy Ley, *Rockets, Missiles, and Men Into Space* (Viking: New York, 1968), p. 107.

[59]*Ibid.*, pp. 109-110.

[60]"Contributions," p. 140.

[61]Letter to the author from B. John Zavrel, May 29, 1991.

[62]Interview with Erna Roth-Oberth.

[63]All references to Helmut Zoike are from an interview on Dec. 4, 1990.

[64]Ley, *Rockets*, p. 114.

[65]Essers, *Max Valier*, p. 68; Letter from Valier to Oberth, July 16, 1924.

[66]Essers, *Max Valier*, p. 66; Letter from Valier to Oberth, July 16, 1924.

[67]Oberth, *Ways*, pp. 376, 379.

[68]*Ibid.*, p. 321.

[69]"Contributions," pp. 139-140; Ley, *Rockets*, pp. 117-118.

[70]Ley, *Rockets*, p. 116.

[71]*Ibid.*, p. 118.

[72]"Contributions," p. 140.

[73]"Autobiography," p. 116.

[74]Frederick I. Ordway, III and Mitchell Sharpe, *The Rocket Team* (Thomas Y. Crowell: New York, 1979), p. 48.

[75]Oberth's introduction to Helen B. Walters, *Hermann Oberth: Father of Space Travel* (Macmillan: New York, 1962), p. xxix. Walter's book, meant for teens, is, as far as I know, the only one on Oberth in English. However, it is heavily fictionalized and largely undocumented.

[76]*Current Biography Yearbook 1957*, p. 418.

[77]Interviews with Erna Roth-Oberth and Adolph Oberth, Oberth's son. All references to Adolph Oberth are from interviews with him, Apr. 26 and 28, July 16, 1991.

[78]Ley, *Rockets*, p. 122.

[79]Letter to the author from John Zavrel, May 29, 1991.

[80]Interview with Frank Winter, July 16, 1991.

[81]All reference to Walter Hecker are from interviews with him July 19, 25, and 27, August 3 and 4, 1991.

[82]Rolf Engel, "The Historical Development of Rocket Technology." An uncredited English translation of an essay "written in the winter of 1931," in the Rolf Engel folders at National Air & Space Museum Library, Washington, D.C.

[83]Ley, *Rockets*, p. 202.

[84]Neufeld, private communication with the author.

[85]Ley, *Rockets*, pp. 202-203.

[86]Interview with Erna Roth-Oberth.

[87]Interview with Walter Hecker.

[88]Interview with Ernst Stuhlinger, Mar. 4, 1991.

[89]Oberth, *Stoff*, p. 15.

[90]Gartmann, *Space Rockets*, p. 72.

[91]Interview with Hermann Oberth.

[92]Essers, *Max Valier*, p. 123; Letter from Oberth to Valier, Jan. 8, 1927. Essers doesn't give the exact date, but the letter is in *Briefwechsel*, Vol. 1, pp. 89-92.

[93]Oberth, *Ways*, p. 221, footnote 1.

[94]"Hopes to Gain Planet 15 Years From Now," *New York Times*, Jan. 30, 1931.

[95]Interview with Erna Roth-Oberth. Translated by Erna Roth-Oberth, Marie-Claire Ording, and John Elder.

[96]Bill Sloat, "Father Predicted Skylab," *Today*, May 15, 1973; "Father of Spaceflight," *Newsweek*, Mar. 25, 1968.

[97]Oberth, *Primer*, p. 167.

[98]Letter from Hermann Oberth to Eugene M. Emme, Sept. 22, 1970. I found this in the Oberth folders at the NASA History Office in Washington, D.C. In fairness to Emme, I must note that I know neither the background nor the outcome, only this one snapshot.

[99]*Current Biography Yearbook 1957*, p. 417.

[100]Barth's chronology in *Primer*, p. 276.

[101]Interview with Erna Roth-Oberth.

[102]Gartmann, *Space Rockets*, p. 48.

[103]Interview with Erna Roth-Oberth.

[104]Interview with Rolf Engel, Sept. 13, 1989.

[105]"Father of Modern Rocketry Visits U.S. to Obtain Exhibits," press release issued by L5 Society, Oct. 28, 1985; *Spaceflight*, Mar. 1986, p. 140; Photographs from Oberth folders at NASM.

[106]Arthur C. Clarke, *The Promise of Space* (Harper & Row: New York, 1968), p. 22.

[107]Interview with Frank Winter, July 16, 1991.

[108]Sylvia Fries, "Memorandum to NASA Historical Documents Collection," Nov. 6, 1985.

[109]Letter from Hermann Oberth to *Aviation Week & Space Technology*, Jan. 6, 1986, p. 96.

[110]"Contributions," p. 138; Jürgen Spanuth, *Atlantis of the North* (Sidgwich & Jackson: London, 1979).

[111]"Contributions," p. 138.

[112]Oberth, *Primer*, pp. 9-10; Interview with Erna Roth-Oberth.

[113]*Ibid.*

[114]Oberth, *Ways*, p. 536 ff.

[115]*Spaceflight*, Mar. 1986, p. 140.

[116]Introduction to Walters, *Oberth*, p. xxix.

[117]Hans Barth, *Hermann Oberth: Titan der Weltraumfahrt* [Hermann Oberth: Titan of Space Travel] (Kriterion: Bucharest, 1974), p. 122. Quoted in Dieter von Reeken, *Hermann Oberth die UFO-Forschung* [Hermann Oberth and UFO Research] (Gesellschaft zur Erforschung des UFO Phänomens e. V.: Lüdenscheid, 1990), p. 14. All passages from von Reeken translated by Marie-Claire Ording and John Elder.

[118]*UFO-Nachrichten* [UFO News], No. 150, 1969, p. 182. Quoted in von Reeken, Oberth, p. 13.

[119]von Reeken, *Oberth*, p. 16.

[120]*Ibid.*, pp. 15-17.

[121]Letter from Oberth to von Reeken, May 26, 1967. Quoted in von Reeken, *Oberth*, p. 12.

[122]Interviews with Erna Roth-Oberth and Adolph Oberth.

[123]Interview with Walter Hecker.

[124]Oberth, *Primer*, pp. 241-242.

[125]Essers, *Max Valier*, p. 103, footnote.

[126]Interview with Hermann Oberth.

[127]Interview with Walter Hecker.

[128]Interview with Adolph Oberth.

[129]Interview with Walter Hecker.

[130]von Reeken, *Oberth*, p. 15.

[131]Interview with Walter Hecker.

[132]Interview with Erna Roth-Oberth; Letter to the author from John Zavrel, May 29, 1991.

[133]Oberth, *Ways*, pp. 537-543.

[134]Oberth, *Primer*, p. 10.

[135]Hermann Oberth, "Wir werden beobachtet" [We Are Being Watched], in *Deutsche Illustrierte*, 1954. Quoted in von Reeken, *Oberth*, p. 12.

[136]von Reeken, *Oberth*, p. 18.

[137]Interview with Erna Roth-Oberth.

[138]Oberth, *Ways*, pp. 189-190.
[139]"Contributions," p. 136.
[140]*Ibid.*, p. 130.