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Chapter 13

The Development of Hermann Ganswindt's Spaceflight Ideas*

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Abstract

Hermann Ganswindt (1856–1934) was one of the first persons at the end of the 19th century to propose publicly a flight into space and to the planets on the basis of the reaction principle. Therefore, a crater on the far side of the Moon was named after him. However, it is still not widely known what he suggested exactly, because the prevailing accounts are based on secondary sources. The development of Hermann Ganswindt's ideas from a "Space Vehicle" to "resting places" in Earth orbit as a steppingstone to the planets will be traced, partly using hitherto unknown archival material.

I. Introduction

It is not intended here to give a detailed overview of the state of spaceflight theory at the end of the 19th century. The prominent means of reaching space and other celestial bodies was the gun, originally introduced by Isaac Newton as a thought experiment and later used as a means of traveling to the Moon by Jules

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Verne in his famous novel *From the Earth to the Moon.* However, it was clear to physicists and engineers that the extreme acceleration would crush the travelers at once. It was highly probable that the spaceship could not even leave the gun due to the immense air resistance. Other proposals like shielding gravitation or using a slingshot were also unrealistic.

Figure 13–1: Hermann Ganswindt (1899).

A scientific society "Urania" was founded in Berlin, Germany, in 1888 to disseminate scientific ideas to the general public in a popular manner. One very successful theater show had the title "From the Earth to the Moon" describing an "imaginary trip" to the Moon, which was performed more than 150 times in those years. The author (and cofounder of "Urania") Dr. Max Wilhelm Mayer (1853–1910) stated in an accompanying booklet in 1891 that "unfortunately there is no means and *there will never be one* [emphasis by the author] to detach our ponderous body from the clod of Earth which is pulling us always down" [1] thus summarizing the then current view on the problem.

It was up to the inventor Hermann Ganswindt (Figure 13–1) to present publicly an opposite standpoint.

II. Ganswindt's Spaceflight Concept of 1899

The main source for Ganswindt's spaceflight ideas is his book *Das Jüngste Gericht* (*The Last Judgment*), 2nd edition, published by the author in 1899 [2] (Figure 13–2). Only a few copies are known to exist today.

It consists of two articles, a plate section, followed by explanations of his inventions one by one, with excerpts of patents, newspaper reports, quotes from letters, statements by experts, and other material in 124 pages.

The first article is the text of a lecture with the title "Ueber die wichtigsten Probleme der Menschheit" ("On the most important problems of mankind"). As the title indicates, it covers a wide range of topics, beginning with the problem of aviation and ending with speculative ideas of the structure of the universe, the relation of space and time and a physical theory of resurrection. The part of the "solution of the social problem" is omitted in this version as it is dealt with in a separate article. Ganswindt not only discusses these problems, but also presents his proposals of solving them.

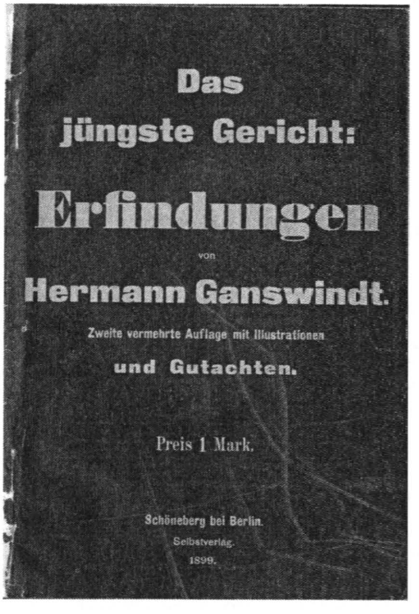


Figure 13–2: Title page of *Das Jüngste Gericht* (1899).

II.1. Ganswindt's Theory of Spaceflight

Ganswindt begins his considerations on spaceflight (pages 6–10) by expressing his wish that he would "love to make an expedition to other celestial bodies in reality to study the real world from a different point of view and to draw my conclusions from it. Therefore I asked myself the scientific question: Does the possibility exist to get beyond the range of the Earth and its atmosphere and to visit, for example, the nearest planets Venus and Mars?" Some sentences before he emphasizes that "mathematics and physics are the only reliable means" for getting a not distorted view of reality. This is a new, namely scientific approach to the problem of spaceflight: Ganswindt does not want to write a novel.

He answers his own question with the bold words: "Yes, it is indeed possible," thereby challenging the general view of the time, and he continues: "I have already paved the way to the solution of the problem of an expedition to other celestial bodies. Namely it is the Law of Inertia or the inertia of masses, which can be exploited as a base in the air as well as in airless space." This statement refers to Newton's physics and the principle "action = reaction." It should be noted that Ganswindt says that the law of inertia also works "in airless space." Several physicists and engineers raised the objection still in the 1920s that rockets will not function in outer space as there is no air for the combustion gases to push against. At first Ganswindt applies the law of inertia to bird flight: The wings are continually seizing air masses and pushing them down thus keeping the bird flying. "It is the same principle which is used when one is jumping off a freely floating boat; the jumping body is pushing back the boat. The faster one is jumping off the boat, the faster the boat will also take the backward movement." This description is still used today to explain the reaction principle. At this point Ganswindt mentions a formula in verbal terms: The "living force" (kinetic energy) of a moving body "is being calculated from mass and velocity squared of the body, that means it is increasing disproportionately to the velocity." Such a moving body would create a pressure when it suddenly hits an obstacle. Ganswindt remembers to have seen automatic scales in Berlin which can measure the force of a punch (a dynamometer). He could hit a punch of 80 kg with his fist which together with his forearm weighs perhaps a pound at most. "That means the living force of a punching fist suddenly neutralized by the upholstery of the scales presses 80 kg." Conversely, if the fist at rest is being pushed by the upholstery with the same velocity it would create the same pressure. The conclusion of this argumentation: "If I constantly hurl a new body of the weight of a fist to the bottom, I'll be lifted up to the top at an accelerated speed." A footnote is added that only a small fraction of the weight of a fist is needed for getting the same effect when using dynamite.

There are no air masses in outer space which can be pushed down by wings. "So how one has to do it here ... to overcome gravity nevertheless?" That is the question; and Ganswindt's answer is: "one designs a flying device on the basis of the laws of reaction of exploding substances." This "flying device" is called "Weltenfahrzeug" (Space Vehicle) by Ganswindt.

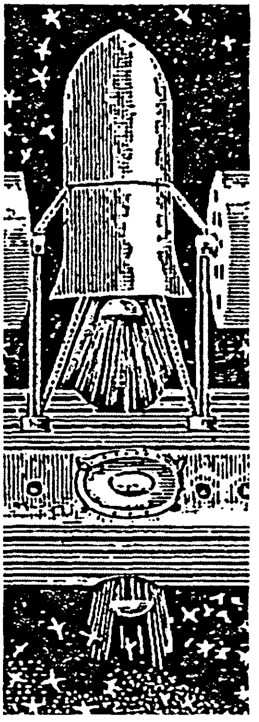


Figure 13–3: Exploding dynamite cartridge (Ganswindt's drawing of his Space Vehicle in [2]).

That is all about the propulsion and its underlying principles we can find in the lecture text. When preparing it for print Ganswindt obviously felt the need to add some more explanations, which are appended at the end of his book (p. 113). A small bullet will be hurled away from a greater steel cylinder by a specially designed dynamite cartridge. "If the small bullet reaches an initial velocity of 1000 m in one second, then the steel block over it will only achieve a velocity of about 50 m per second according to its greater mass." This ambiguous statement is made clearer by a detail of the drawing of the Space Vehicle (Figure 13–3). The dynamite cartridge will fell into two pieces by its explosion; one piece is leaving the cylinder, the other part is hitting it transferring its momentum to it, after which it is falling back. In other words: Ganswindt applies Newton's Momentum Conservation Principle. It seems that the numerical values are only meant to illustrate the principle, as is it improbable that Ganswindt believes the mass of the steel cylinder being only 20 times the mass of a dynamite cartridge.

Figure 13–4: H. and Botho von Römer. The reaction principle according to Ganswindt and Tsiolkovsky.

His propulsion is based on the physical process of elastic collision in which part of the kinetic energy of the exploding dynamite cartridge is transferred to the Space Vehicle. A drawing of the brothers Hans and Botho von Römer, who are famous for their superb technical drawings, not only of spaceflight, compares Ganswindt's use of the reaction principle with that of Tsiolkovsky (Figure 13–4) [3].

When Ganswindt heard of powder and liquid-fuel rockets in the 1920s he argued that they are not efficient enough. In addition he believed that the "huge hydraulic pressure built up by the explosions in the nozzles will cause the fuel tanks to burst," if they do not have strong walls, as Ganswindt is cited in a newspaper article in 1928 [4].

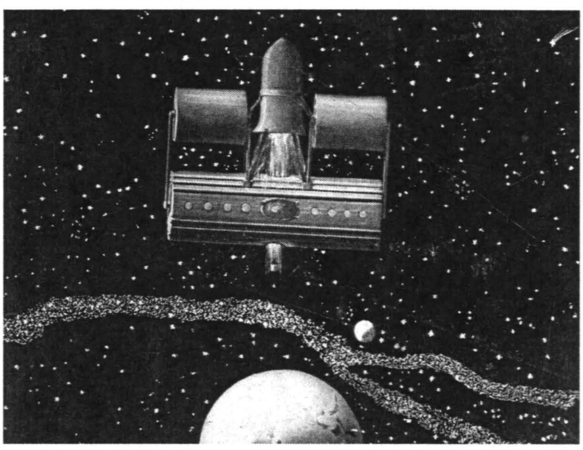


Figure 13–5: Ganswindt's "Weltenfahrzeug" (Space Vehicle) [2].

The lecture text of 1899 contains a general description of the Space Vehicle, mentioning only a few design features (Figure 13–5). The main component consists of a "steel cylinder with a diameter as small as possible but in such a way that it can take in just two travelers and the necessary supply." Compressed air is contained in slim cylinders attached to the main cylinder. Heat is regulated with the help of the heat created by the explosions. The Space Vehicle will be controlled by inclining the upper steel block. An important, but often overseen feature described in the already mentioned appendix are the "very elastic links" connecting the steel block with the cylindrical steel gondola "by which it will be set in steady acceleration without pushes with a final velocity of perhaps 20 m [per second], until the living force of the block which—so to speak here—takes over the role of a flywheel, has been used up, whereupon a new explosion will take place, which will double the speed achieved by the first explosion." According to these remarks the explosion of the dynamite cartridge will accelerate the upper steel cylinder to 5g stretching the "very elastic connecting links" which will then accelerate the whole Space Vehicle to 2g in the following slackening of the links thus transforming the very short pushes happening in time intervals to a steady acceleration.

We may now attempt to reconstruct Ganswindt's spaceflight theory. He states in the appendix: "as many explosions have taken place, as many times greater the velocity of the vehicle is": $v \approx N$, v velocity, N number of explosions. This formula can be derived from the well-known Newton formula: $v = a \cdot t$, a acceleration, t time, under the assumption that the acceleration is constant (namely 2g) as well as the time between explosions. It is not astonishing that one can find a similar formula for the distance covered: $d \approx N^2$, d distance. In a circular of 1902 he rejected the allegation of the "Berliner Tageblatt," a Berlin newspaper, that he had claimed that 100 distance units are covered after 100 explosion recoils and 1000 distance units after 1000 explosion recoils. "According to my design the distances covered are as the explosion recoils squared." [5] Here the underlying Newton formula is $d = ½\, a \cdot t^2$. We may therefore conclude that Ganswindt applied Newtonian physics (law of inertia, the momentum conservation principle, the theory of elastic collision, and the laws of motion) at a level which is taught in school.

II.2. The Concept of a Mars Expedition in 1899

Ganswindt returns to his original question whether it is possible to visit our neighboring planets. The Space Vehicle is more efficient the faster it is. Therefore it would be unsuitable on Earth because of the air resistance. However, nothing would stand in the way of reaching the velocity of a meteor or comet in outer space. “It is just such a velocity which we need for an expedition through space.” After leaving the atmosphere the velocity can be increased in such a way “that one could reach Mars or Venus in about 22 hours.” That is an astonishing short time! How does Ganswindt arrive at this conclusion?

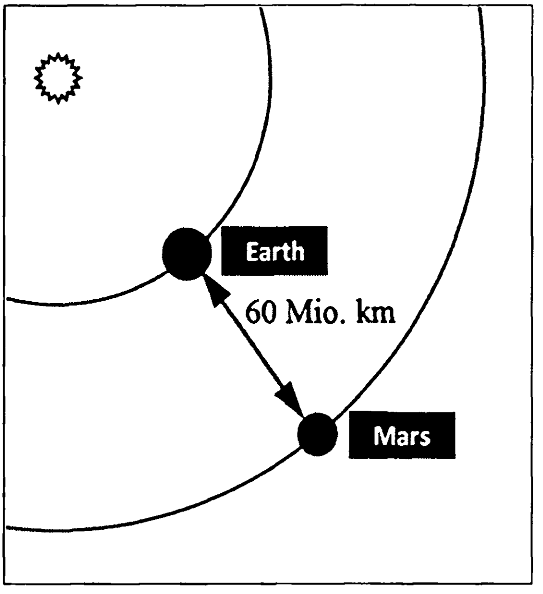


Figure 13–6: Possible concept of Ganswindt’s Mars expedition.

The distance between Earth and Mars is given as 8 million (German) miles (that is about 60 million km), when both are nearest to each other. One would leave “with an acceleration twice as large as that of falling bodies [that is 2g] and decelerate in a similar manner from the middle of the way.” Using these information given by Ganswindt the following formula can be derived [6]:

$$t = \sqrt{\frac{4d}{a}}$$

t time [sec]
d distance [m]: 60 million km
a acceleration [m / sec^2]: 20 m / sec^2
Then $t \approx 30$ hours.

We do not know how Ganswindt really calculated, but surely he must have used a similar approach, namely of traveling to Mars on a straight direct course. It seems that Ganswindt saw a problem here as he added a footnote to his lecture: “To travel without waste of energy one will have to move the vehicle practically in a trajectory of a celestial body, for example, in one of a comet." However, there is no indication that Ganswindt knew how much time it takes to fly to the planets in this way.

II.3. Rapid Traffic between Continents

Some remarks in the appendix are devoted to another application field:

"If one is steering the vehicle beyond the atmosphere into an orbit of a meteor which is circling the Earth then it will move without further explosions and without any loss of work with the velocity it has now reached in a circular or elliptical orbit and will reach another continent in a few hours where it will be turned for landing to stop the vehicle by explosions which have the opposite effect."

Ganswindt's mentioning of "a few hours" needed for traveling from one continent to another indicates that he had not yet made any calculation of the flight times of ballistic trajectories.

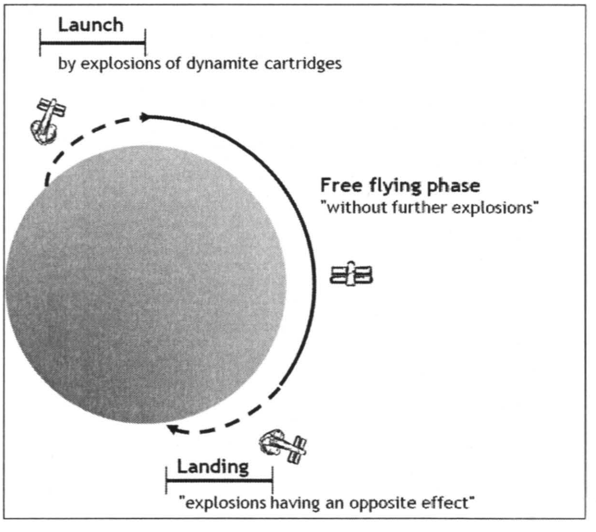


Figure 13–7: Intercontinal traffic by rockets according to Ganswindt.

III. The Date of Ganswindt's Lecture

There is a lot of confusion concerning the date of Ganswindt's lecture. Max Valier wrote in *Raketenfahrt,* a popular book about spaceflight in 1930, that the lecture was held in the Berlin Philharmonie in 1881 [7]. The science writer and space historian Willy Ley made a strong statement, practically an eyewitness account:

"I have seen, in Ganswindt's own collection, a printed program of one of his lectures, delivered on May 27, 1891, at the Philharmonie—as the name

> indicates, a concert hall—in Berlin. The lecture was mainly devoted to aviation, but newspaper reviews proved that Ganswindt had expounded his theory of space travel, too ... the date of May 27, 1891, is the earliest that can be *proved*" [8].

As he was—and still is—an authority in space history, this date is widely accepted and repeated in many articles, books, and websites. However, as will be shown, it is wrong. A lesser-known German space historian Alfred Fritz held the opinion that 27 May 1893 was the date of the lecture in the Berlin Philharmonie relying on Ganswindt's daughter Freya [9]. Still other dates can be found in less reliable sources like newspaper or magazine reports. Ilse Essers, who wrote a Ganswindt biography some 40 years ago, discussed these conflicting statements—and accepted them all as valid! "Ganswindt had already talked publicly earlier—for the first time in 1881—about his project of a Space Vehicle ... In May 1893, a poster on all advertisements pillars of Berlin invited to Ganswindt's experimental lecture on aviation ... it was the same lecture which he had held in 1891 before he left Berlin" [10]. Even the title of her biography was: *Hermann Ganswindt. Pioneer of spaceflight with his Space Vehicle since 1881.*

Author	**Year**	**Date**	**Place**
Valier	1881	—	Berlin Philharmonie
Ley	1891	May 27	Berlin Philharmonie
Fritz	1893	May 27	Berlin Philharmonie
Essers	1881	—	—
	1891	—	Berlin
	1893	May 27	Berlin Philharmonie

Table 13–1: Different dates given for Ganswindt's lecture on spaceflight.

But it seems highly improbable that Ganswindt held the same lecture at the same place on the same date, but in different years (Table 13–1).

When looking for primary sources one can find in Ganswindt's book *The Last Judgment* the following statement: Press comments "after the lecture in Berlin on May 27, 1893 printed at the beginning of this book" citing a newspaper report (p. 116). Another evidence is given by an advertisement in the Berlin local press (Figure 13–8).

The date 27 May 1893 can be seen as proved. But what about the other dates?

Philharmonie.

Berlin, Sonnabend, den 27. Mai 1893, Abends 8 Uhr. Experimental-Vortrag über Luftschifffahrt von

Hermann Ganswindt

aus Voigtshof bei Seeburg (Ostpr.) Eintrittskarten zu 5, 4, 3, 2 u. 1 ℳ sind in sämmtl. Cigarren-Niederl. der Firma Carl Martienzen, im Bureau der Philharm. u. a. d. Abendk. zu haben. Der Ganswindtsche Flugapparat wurde s. Z. in einem Gebäude d. Eisenbahnbrigade untergebracht u. vom Herrn Generalstabschef, Excell. Gr. Schlieffen u. von and. Autoritäten gutachtl. befürwortet. Bei Capitalbetheilig. am Unterneh. noch für je 10 ℳ 1000 ℳ, für je 100 ℳ 10000 ℳ sichere Gewinnaussicht. Mehrere hundert Theilhaber schon vorhanden. (16214-16)1

Figure 13–8: Advertisement for Ganswindt's lecture in Berlin on 27 May 1893 [11].

1. Berlin am 7. Oktober 1888 im Reichskanzleramt auf seine Eingabe an den Fürsten Bismarck.
2. Berlin am 16. Februar 1884 vor dem Vorsitzenden des „Deutschen Vereins zur Förderung der Luftschiffahrt", Freiherrn vom Hagen, vor der Vereinssitzung an demselben Abend im Unionshotel, Jägerstrasse 18, auf Empfehlung des Herrn Geheimen Regierungsrat Dr. v. Rottenburg mit Unterbreitung der Zeichnungen des Luftschiffes.
3. Berlin am 14. Mai 1887 vor dem Plenum des „Deutschen Vereins zur Förderung der Luftschiffahrt" mit Unterbreitung der Zeichnung des Luftschiffes im Restaurant Speil, Unter den Linden, auf Empfehlung des grossen Generalstabes der Armee.

3a. Frankfurt a. d. Oder am 10. Juni 1887 gelegentlich einer militärischen Uebung beim Leibregiment auf Aufforderung des Herrn Hauptmann v. Colani vor Offizieren, Unteroffizieren und Einjährig-Freiwilligen.

4. Berlin am 15. Februar 1888 in der konstituierenden Versammlung des von Ganswindt gegründeten „Patriotischen Vereins für Luftschiffahrt", welche das Ganswindtsche Luftschiffprojekt für die Verwirklichung aus Vereinsmitteln wählte, welche letzteren aber schliesslich nur zur Verwirklichung des von Excellenz Graf v. Schlieffen gutachtlich anerkannten Versuchs-Flugapparates ausreichten.
5. Berlin am 18. November 1889 vor dem Plenum des „Deutschen Vereins zur Förderung der Luftschiffahrt" in der Diskussion über Flugapparate im Anschluss an einen Vortrag des Herrn Baumeister Hansen in der Kriegsakademie in der Dorotheenstrasse.
6. Berlin am 7. Februar 1890 vor dem Chef des Generalstabes der Armee Excellenz Graf v. Schlieffen mit einer Suite sachverständiger Offiziere an seinem aus Stahl erbauten Flugapparat-Versuchs-Modell, Perleberger Strasse 13 im Saal. Darauf erfolgte Einräumung eines Gebäudes zur Unterbringung des Apparates in der Eisenbahnbrigade und die Erteilung eines eigenhändig geschriebenen anerkennenden Gutachtens von Excellenz Graf v. Schlieffen.

Figure 13–9: First part of the list of Ganswindt's lectures.

Recently, a document was discovered written by a certain Adolf Jacobsen, chairman of Ganswindt's Protective Committee on 30 July 1908. It is a petition to the city of Spandau [12]. At that time there was a national campaign for collecting money to support the construction of airships of Count Zeppelin. As Ganswindt had patented a dirigible already in 1883 the petition asked for supporting him financially, too. As a proof that he was among the first to have spoken about dirigibles the petition contains a list of *all* Ganswindt's lectures.

Dann unternahm Ganswindt Vortragsreisen mit Vorträgen in folgenden Städten:

7. Heimatstadt Seeburg i. Ostpr. am 23. Dezember 1891.
8. Allenstein am 8. Januar 1892.
9. Guttstadt am 23. Januar 1892.
10. Heilsberg, am 28. Februar 1892.
11. Bischofstein am 8. März 1892.
12. Osterode i. Ostpr. am 8. März 1892.
13. Bartenstein am 24. April 1892.
14. Marienburg am 29. April 1892.
15. Marienwerder am 1. Mai 1892.
16. Graudenz am 2. Mai 1892.
17. Thorn am 3. Mai 1892.
18. Culm i. Westpr. am 5. Mai 1892.
19. Pr. Stargard am 7. Mai 1892.
20. Dirschau am 9. Mai 1892.
21. Graudenz am 11. Mai 1892.
22. Thorn am 12. Mai 1892.
23. Bromberg im Mai 1892.
24. In seiner Gymnasialstadt Lyck, wo Ganswindt das Abiturientenexamen gemacht hat, vor seinen früheren Lehrern, insbesondere seinem Lehrer in der Mathematik und Physik, Professor Bock, dessen bester Schüler er immer gewesen war, und vor gutbesetztem Saal im Kaiserhof am 11. Januar 1893
25. Johannisburg am 30. Januar 1893.
26. Marggrabowa am 1. Februar 1893.
27. Goldap am 4. Februar 1893.
28. Angerburg am 6. Februar 1893.
29. Loetzen am 8. Februar 1893.
30. Berlin in der Philharmonie am 27. Mai 1893, vor ca. 1000 Zuhörern.

Ferner hat Ganswindt Tausende Vorträge gehalten in: Schöneberg bei Berlin in seinem Etablissement vom 3. Oktober 1894 ab fast täglich einen oder mehrere Vorträge über sein Luftschiff ca. 14 Jahre lang.

Figure 13–10: Second part of the list of Ganswindt's lectures.

The list begins with a Ganswindt lecture on 7 October 1883. According to the descriptions this first lecture and the following ones were about the dirigible or Ganswindt's flying machine. There was no lecture whatsoever in 1881! Ganswindt began a lecture tour in his hometown on 23 December 1891; he held lectures in several East and West Prussian cities and then at last in the Berlin Philharmonie on 23 May 1893.

The earliest known contemporary evidence for Ganswindt's spaceflight ideas is an article from his lecture in Thorn (now Toruń, Poland) on 5 May 1892, which mentions the "expedition to other celestial bodies" based on the "law of inertia" (Figure 13–11) [13]. Willy Ley must have mixed up the date of the first lecture at the end of 1891 with the date of the last lecture of the tour in 1893.

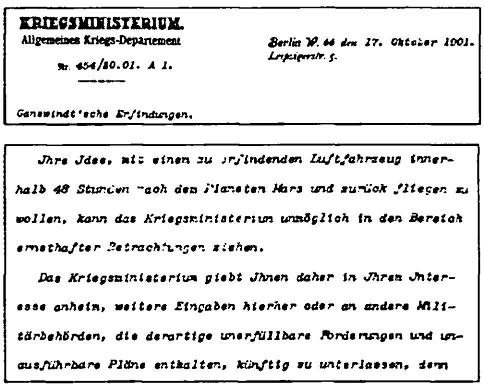
Der Redner erörterte nun das Problem einer Expedition nach anderen Weltkörpern, für welche er als Stützpunkt im luftleeren Raume das Trägheitsgesetz oder Beharrungsvermögen gefunden haben will. Ferner schilderte er, was der Mensch im Weltenraume schauen werde, und brachte damit die Probleme der vierten Dimension und der Auferstehung in Verbindung.

Figure 13–11: Report about a Ganswindt lecture in 1892 mentioning his spaceflight ideas.

IV. The Correspondence with the Ministry of War

Hermann Ganswindt explained in 1899 that he did not take out a patent for his invention of a Space Vehicle "as there will probably be no commercial exploitation in the short time of 15 years; then the patent would have been expired" (p. 113).

But already two years later the situation seemed to have changed. Ganswindt tried to sell his invention of a flying machine to the German Ministry of War. In a petition to the German Kaiser (on 12 September 1901) he asked for 20 million Reichsmark. Half of the money would be given to his financial supporters, the rest will be used for continuing the tests with a steerable balloon and "the Space Vehicle invented by me with which I want to make it possible to carry out an expedition to the planet Mars and back in 48 hours." This petition was leaked to the press in April 1902 [14].


KRIEGSMINISTERIUM.
Allgemeines Kriegs-Departement

Nr. 454/10.01. A 1.

Berlin W. 66 den 17. Oktober 1901.
Leipzigerstr. 5.

Ganswindt'sche Erfindungen.

Jhre Jdee, mit einem zu erfindenden Luftfahrzeug innerhalb 48 Stunden nach dem Planeten Mars und zurück fliegen zu wollen, kann das Kriegsministerium unmöglich in den Bereich ernsthafter Betrachtungen ziehen.

Das Kriegsministerium giebt Jhnen daher in Jhrem Jnteresse anheim, weitere Eingaben hierher oder an andere Militärbehörden, die derartige unerfüllbare Forderungen und unausführbare Pläne enthalten, künftig zu unterlassen, denn

Figure 13–12: Letter of the German Ministry of War to Hermann Ganswindt on 17 October 1901.

The answer prepared by the Ministry of War was not to be long in coming. A letter was sent to Ganswindt on 17 October 1901 harshly rejecting his offer. "The Ministry of War cannot examine seriously your idea to travel to the planet Mars and back in 48 hours with a still to be invented airship" [15]. This letter is the first official document concerning spaceflight; one can also say: the first official rejection of a spaceflight proposal.

The letter also advised Ganswindt to refrain in the future from sending petitions to the military authorities which contain "such unrealizable demands and impossible plans."

V. Baron Gostkowski's Criticism in 1900

One copy of Ganswindt's *The Last Judgment* found its way to Lemberg (now Lviv, Ukraine) where it was read by Professor Roman Baron Gostkowski (1837–1912), a Polish railway engineer (Figure 13–13).

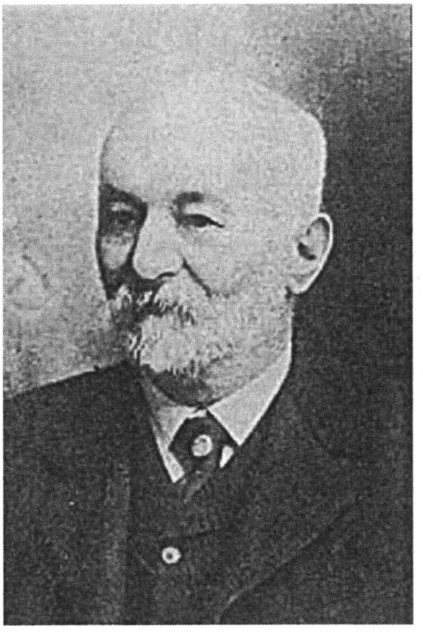
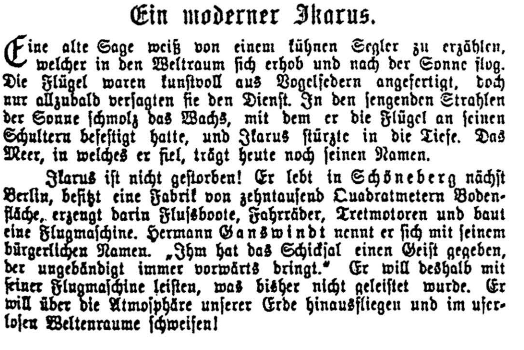


Figure 13–13: Roman Baron Gostkowski (1837–1912) [16].

He reviewed it under the title "a modern Icarus" in the Viennese journal *Die Zeit* (Figure 13–14) [17].



Ein moderner Ikarus.

Eine alte Sage weiß von einem kühnen Segler zu erzählen, welcher in den Weltraum sich erhob und nach der Sonne flog. Die Flügel waren kunstvoll aus Vogelfedern angefertigt, doch nur allzubald versagten sie den Dienst. In den sengenden Strahlen der Sonne schmolz das Wachs, mit dem er die Flügel an seinen Schultern befestigt hatte, und Ikarus stürzte in die Tiefe. Das Meer, in welches er fiel, trägt heute noch seinen Namen.

Ikarus ist nicht gestorben! Er lebt in Schöneberg nächst Berlin, besitzt eine Fabrik von zehntausend Quadratmetern Bodenfläche, erzeugt darin Flussboote, Fahrräder, Tretmotoren und baut eine Flugmaschine. Hermann Ganswindt nennt er sich mit seinem bürgerlichen Namen. „Ihm hat das Schicksal einen Geist gegeben, der ungebändigt immer vorwärts bringt." Er will deshalb mit seiner Flugmaschine leisten, was bisher nicht geleistet wurde. Er will über die Atmosphäre unserer Erde hinausfliegen und im uferlosen Weltenraume schweifen!

Figure 13–14: The beginning of Gostkowski's article on Ganswindt's spaceflight ideas.

He was pleased, even excited at first about Ganswindt's ideas: "Icarus has not died. He lives in Schöneberg near Berlin … He is calling himself Hermann Ganswindt with his civil name." But then he asked himself: "Do the expanding gases have enough power to be able to lift apart from the weight of the explosives a gondola heavily laden with people and utensils?" After a rough calculation of the work needed to get into space and comparing it with the energy content of dynamite he concluded: "Even the strongest explosive is too weak to be able to cope with the self-imposed task. A travel to the border of the atmosphere and back—is therefore impossible!" At the end Gostkowski asked in a conciliatory manner: "Whether a way out will be found here—who is able to say it?"

VI. Ganswindt's Spaceflight Concept of 1920

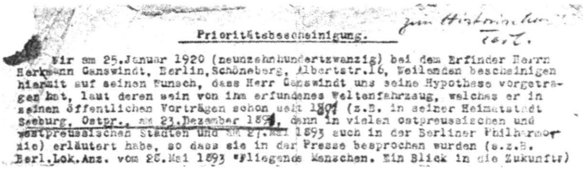
Hermann Ganswindt knew Gostkowski's article, as it was already cited in his petition to the Kaiser in 1901, in which he remarked that this problem (of traveling to Mars) "was beyond great professors who are not able to invent my flying machine" [14]. Though it sounds as if Ganswindt would like to ignore Gostkowski's arguments, it was not the case.

An article of a local newspaper of 1928 [4] summarized Gostkowski's line of reasoning with extensive literal quotes so that it is highly probable that the article was written by Ganswindt himself. "The professor arrives at the conclusion after complicated calculations which have been accepted generally by Ganswindt except miscalculations that the radius of action of such a vehicle does not extend far enough, at least not to our neighboring planets."

Ganswindt and several friends, including his cousin, met on 25 January 1920 and signed a document, a four-page typescript, with the title "Prioritätsbescheinigung" (Priority Statement), which is now in the archive of the Deutsches Museum in Munich (Figures 13–15 and 13–16) [18]. About half of it is devoted to the unfair treatment which Ganswindt had to experience during his lifetime. The rest describes Ganswindt's new concept of spaceflight in winding and long sentences.

The main content is the description of a Venus expedition. The author prepared some schematic drawings to illustrate Ganswindt's concept (Figures 13–17 through 13–20).

The Space Vehicle will be carried by "appropriate aircraft to very thin layers of the atmosphere as high as possible which will allow a faster travel" for saving fuel. Only then it will be propelled by exploding dynamite cartridges beyond the atmosphere into airless space to a first "resting place." Here "circling like a meteor around the Earth" with a speed of 8 km / sec it will create a "large storage place" for food, fuel and building material which will be unloaded by drivers wearing appropriate space suits (Figure 13–17).


Prioritätsbescheinigung.

Wir am 25.Januar 1920 (neunzehnhundertzwanzig) bei dem Erfinder Herrn Hermann Ganswindt, Berlin,Schöneberg, Albertstr.16, Weilenden bescheinigen hiermit auf seinen Wunsch, dass Herr Ganswindt uns seine Hypothese vorgetragen hat, laut deren sein von ihm erfundenes Weltenfahrzeug, welches er in seinen öffentlichen Vorträgen schon seit 1891 (z.B. in seiner Heimatstadt Seeburg, Ostpr., am 23.Dezember 1891, dann in vielen ostpreussischen und westpreussischen Städten und am 27.Mai 1893 auch in der Berliner Philharmonie) erläutert habe, so dass sie in der Presse besprochen wurden (s.z.B. Berl.Lok.Anz. vom 28.Mai 1893 "Fliegende Menschen. Ein Blick in die Zukunft")

Figure 13–15: The first sentences of Ganswindt's "Prioritätsbescheinigung" of 1920.

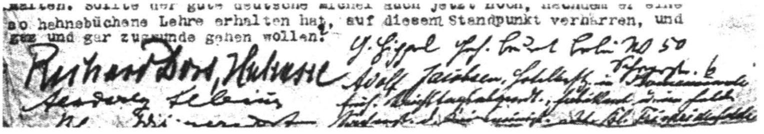


Figure 13–16: Signatures of Ganswindt's friends.

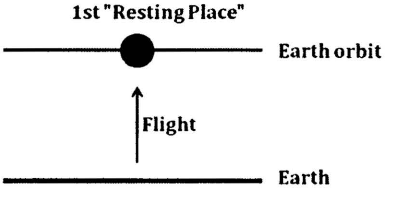


Figure 13–17: Venus expedition: The flight of the Space Vehicle to a "resting place" in Earth orbit.

The empty Space Vehicle will land in gliding for which it will have "very small, but very stable wings." It will then carry more supply, perhaps with a larger number of such vehicles, to the storage place of the first "resting place." It should be no problem astronomically to find it again. If the supplies amply suffice, the expedition will continue to a second "resting place" farther away where Earth's gravity will be much lower (Figure 13–18). The drawing assumes four flights for the next step as Ganswindt does not specify how many flights are necessary for it.

More supply will be transported to this second "resting place" until there is enough material for a travel to another "resting place" even farther away from Earth. At last a "resting place" will be created in such a distance where the gravity is only a small fraction of that on the surface of the Earth. The fuel consisting of dynamite cartridges will now suffice to give the impetus for the Space Vehicle to enter a parabolic trajectory so that it can travel, for example, on the basis of astronomical calculations to the planet Venus (Figure 13–19). How many "resting places" have to be built is not indicated.

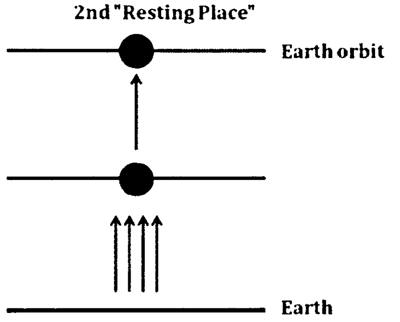


Figure 13–18: Venus expedition: The building of a "resting place" farther away from Earth.

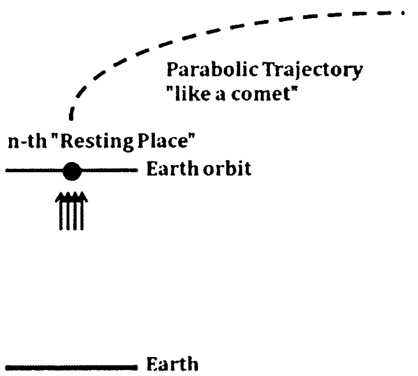


Figure 13–19: Venus expedition: Leaving the gravitational sphere of Earth in a parabolic trajectory.

After arriving at Venus it will enter a circular orbit, uncouple the supplies for the return journey and then land on the planet in gliding.

Perhaps several such expeditions are necessary for taking the technical means and supplies for the return journey to the planet.

In fact it is an astonishing concept! It anticipated that what was later called the "cosmonautical paradox." It was Guido von Pirquet (1880–1966), an Austrian space pioneer, who discovered and published it in the late twenties. His main thesis: "The travel from the space station to the planets is easier to manage than the travel to the space station or its construction!" [19].

Several months later, on 21 April 1920, Ganswindt presented his ideas to the "Allgemeiner humanistischer Kulturbund" (General Humanist Cultural Association), a society about which nothing is known. No newspaper reports have been found yet, only a two-page report by Ganswindt's cousin Richard Dost survived [20]. The part about spaceflight – as described above – was quoted at length in an article of the Berlin newspaper “Der Berliner Westen” on 5 March 1924 [21] and is reproduced here (Figure 13–22).

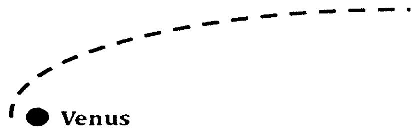


Figure 13–20: Venus expedition: Arrival at Venus.

Die Reise von der Außenstation zu den Planeten ist leichter zu bewältigen, als die Fahrt zur Außenstation respektive deren Bau! Nur um diese handelt es sich also! — Ist diese gesichert, so ist dann alles andere relativ leicht!

Zur Realisierung der Weltraumfahrt genügt bereits die Realisierung der Außenstation!

Figure 13–21: Guido von Pirquet on the “cosmonautical paradox.”

Zunächst weist er darauf hin, daß er nach vier Jahrzehnten einer ungerechten Unterdrückung — sein Luftschiffpatent Nr. 29014 datiert von 1883 — im Begriffe stehe, auf das von ihm erfundene Antriebsmittel eines Weltenfahrzeugs das Patent anzumelden, und zitiert aus einem Bericht über den auf Einladung des „Allgem. human. Kulturbundes“ von ihm am 21. April 1920 gehaltenen Vortrag folgende Stelle:

„Noch sensationeller wirkte Ganswindts Erklärung seines Weltenfahrzeuges nach anderen Planeten, dessen richtiges Prinzip u. a. auch schon der Physikprofessor Roman Baron Gostkowski in der Wiener Zeitschrift „Die Zeit“ vom 28. Juli 1900 auf Grund der veröffentlichten Ganswindtschen Vorträge darüber seit dem Jahre 1891, z. B. in der Berliner Philharmonie am 27. Mai 1893, in einem fünf Spalten langen Aufsatz anerkannt, aber den Aktionsradius eines solchen Fahrzeuges infolge falscher Voraussetzungen viel zu klein berechnet hat, indessen zum Schluß sagt: „Ob hier ein Ausweg gefunden werden wird, wer vermag das zu sagen?“ — Daran anknüpfend, erklärte Ganswindt, daß das Weltenfahrzeug durch eigens dazu konstruierte Flugzeuge möglichst nahe an die Grenze der Atmosphäre getragen werde und sich dann erst mit seinen Explosionsrückschlägen auf seinen Schwungblock in kosmische Fahrgeschwindigkeit versetze außerhalb der Atmosphäre, wie ein Tauchboot die nötige Luft mit sich führend, das Personal in Taucheranzügen, um hier zunächst eine Vorratsstation zu schaffen, indem das Fahrzeug nach Annahme einer Geschwindigkeit von 8-Sek.-Kilometer auch ohne Betriebskraft wie ein kleiner Erdtrabant hier bleibe und nicht mehr herunterfalle. Auch friere man dort nicht, weil die eigene Körperwärme im luftleeren Raum wie in einer Thermosflasche nicht ausstrahlen könne. So hole man nach und nach ungeheure Vorräte an Lebensmitteln, komprimierter Luft, Betriebsstoff und auch Baumaterial an diese Station und gehe dann erst zur Schaffung weiterer Stationen in immer größerer Entfernung von der Erde und dem Bereiche ihrer Anziehungskraft über, bis diese infolge ihrer großen Entfernung so schwach geworden ist, daß man dem Fahrzeug den Anstoß zu einer parabolischen Bahn geben könne, in der es dann automatisch ohne Betriebsstoffverbrauch in die Nähe z. B. der Venus gelangen könne, um hier wieder in die kreisförmige Bahn umgelenkt zu werden und schließlich mit seinen kleinen, stabilen Flügeln den Abstieg in der Atmosphäre dieses Planeten im Gleitflug auszuführen. Nach seiner Hypothese seien die Ringe des Saturn wahrscheinlich solche Vorratsstationen mit ihren durch Jahrtausende angesammelten Abfällen der Weltenfahrzeuge des Saturn. Nach vielen Jahrhunderten Weltenschiffahrt würde die Erde auch solche Saturnringe erhalten, die der Vortragende bildlich veranschaulichte.“

Figure 13–22: Ganswindt about his spaceflight concept of 1920 in a newspaper report.

VII. Ganswindt on Other Topics of Spaceflight

VII.1. Artificial Gravity by Rotation

In his summary of Ganswindt's achievements Max Valier attributed the idea of creating artificial gravity by rotation to him:

> "rotating the whole ship about its longitudinal axis so that the centrifugal force presses the occupants against the surfaces of the cylindrical chamber, which thus become floors, with a force equal to their weight on earth. ... Ganswindt also already thought of the possibility of connecting up two spaceships by a cable of appropriate length and of setting them spinning about their common center of mass in order to produce a centrifugal counter-pressure" [22].

Sometimes it is even said that he anticipated Oberth in this matter by "nearly forty years" (assuming 1881 as the date for his first lecture).

It should be clear from the presentation in this article that there is no need for creating artificial gravity by rotation in Ganswindt's spaceflight concept of the early 1890s as there is a constant acceleration or deceleration during all the time of the travel through space. Artificial gravity is not mentioned in the "Priority Statement" of 1920. A first statement on this problem can be found only at the end of 1925 when he is cited in an interview: Weightlessness is not as comfortable as presented by other inventors. "I created the gravity for me myself by bringing that part of the vehicle which is destined for the crew in rapidly rotating movement thus replacing the missing gravity on the side walls left and right by centrifugal force." There is no word in this article about connecting two space vehicles [23]. One can assume that Ganswindt adopted this idea from Oberth who had criticized that rotating small cabins would cause seasickness [24].

VII.2. Interstellar Spaceflight

Max Valier also cited Ganswindt's ideas on traveling to other stars:

> "If sufficient provisions were to be made, Ganswindt even thinks it would be possible to reach other fixed-star systems such as Alpha Centauri, but the acceleration would then have to be ten times the force of Earth's gravity and would have to be maintained for a very long time. For this reason he doubts whether the passengers would be able to endure such a flight" [25].

Though we do not have any original statement by Ganswindt on this matter, he might probably have written about it in a letter to Max Valier. Obviously he returned to his original concept of constant acceleration and deceleration during all the flight. When applying the formula mentioned before with d = 4.3 light-years and a = 100 m / sec^2, then we will get a travel time of $t \approx 1.3$ years. This would explain which parameter Ganswindt chose for the acceleration: 10g for traveling to the stars in a little more than one year, and 2g for traveling to Mars in about one day; saving travel time being the underlying principle. That the maximum velocity would be several times the speed of light would have been no problem for Ganswindt: He rejected Einstein's Theory of Special Relativity.

VII.3. Midcourse Maneuver

German newspaper reported in 1924 that Professor Goddard was planning to send a rocket to the Moon where flash powder should explode which could be observed telescopically. Ganswindt wrote a letter to one of these newspapers first commenting on Goddard's plan: Because of the incalculable air resistance during launch the rocket cannot be aimed at the Moon precisely, and it will fly-by it in some distance at best. According to Newton's law of gravity it will only be deviated in a parabolic trajectory as it will travel with a fast velocity through space. "Therefore one will reach other celestial bodies, including the Moon, only with the help of a Space Vehicle which can be guided during the travel" [21].

VII.4. Space Debris

The "Priority Statement" of 1920 also records a conclusion of his concept of "resting places": After continuing such expeditions in large numbers for several hundred years so many supplies and so much waste would have been deposited at the circular concentric first, second, third etc. "resting places" "that they would form rather closed high but thin rings of materials which, when seen from another planet, must appear shining brightly." Ganswindt claimed to have arrived at another, astronomically interesting conclusion, that we have already such a case in our Solar System, namely the rings of Saturn which are to be seen as millennia-old "resting places" of the inhabitants of that planet [18].

VIII. Ganswindt's Priority

Ganswindt wrote a letter to Hermann Oberth and Max Valier on 25 March 1925 in which he demanded that they would call him as "the first and only inventor of the rocket vehicle" in the future editions of their books [26]. Max Valier answered him some days later:

> "what does 'inventor' mean? After all, one is really the 'discoverer' of an idea and only the 'inventor' of a complete machine. The discovery of the idea is at the moment when the intuitive realization flashes upon the lucky person, an invention is only when the idea has found the form which is technically possible and when it has been brought into effect or when it is

> complete with all the dimensional and material data in the workshop drawings" [27].

Oberth wrote to Ganswindt sometimes later, "that a Mr. Tsiolkovsky tries to prove that rocketlike spaceships are possible. The publication is from 1896 ... Do you know perhaps some details? Personally I would appreciate it naturally if you are granted the priority and not the Russians." Some questions follow: on the kind of fuels, the assumed exhaust velocity, the relation of initial and final mass (mass ratio), the material and dimensions of the Space Vehicle and so on [28]. However, Ganswindt did not answer, as is stated in Oberth's letter to Max Valier on 15 September 1925: "Ganswindt: Have you heard anything from him? He has not answered to my then letter despite repeated requests so that I do not know still today how he actually imagined his rocket. By the way, sometimes no answer is also an answer" [29]. Granting Ganswindt the priority for the idea to use rockets for spaceflight was not only a matter of politeness, but Oberth's personal concern as can be seen in the following passage of a letter to Max Valier on 1 July 1926:

> "I am surprised that Ganswindt has still written to you. May I read his letters? Perhaps I get to know at least a little bit of his plans. I would like to mention him in the third edition of my book so that I have not to award the priority to the Russian Tsiolkovsky or the American Goddard" [30].

As Oberth did not hear anything from Ganswindt for a long time, he had to conclude that Ganswindt cannot present any further details of his Space Vehicle. Therefore he awarded the priority to Tsiolkovsky in a famous letter: "Of course I am the last one who would deny your priority and your merits in the field of rocketry" [31].

However, it was Oberth's opinion that it is still worthwhile to deal with the past masters of space travel Ganswindt and Tsiolkovsky, as he said in a letter to Otto Wiemer in 1933 [32].

IX. Conclusion

Was Ganswindt a genius, far ahead of his time, as one can read here and there? All his inventions are forgotten now. If we remember Ganswindt today it is because of his spaceflight ideas. As it is shown in this article they do not form a single concept, but they develop in two phases. However, one may question whether this last concept really was a way out of the problem which Gostkowski had shown.

Let us summarize Ganswindt's achievements: He based his concepts on Newton's laws of motion, applying intuitively the physical principles to the problem of spaceflight. He refrained from using speculative physics like shielding of gravitation. However, no detailed mathematical calculations survived, and one can assume that there was none. His ideas of spaceflight were rather naive as shown by his concept of a Mars expedition on a straight trajectory. Except some general considerations about the design of the Space Vehicle there were no engineering details worked out.

Ganswindt was perhaps the first person to address the problem of spaceflight as a "scientific question" which should be answered by Newtonian physics. He was the first to bridge the gap between fiction and sound engineering.

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