The Men Behind the Space Rockets

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I

Ganswindt and the birth of a theory

I

THE 24th of February, 1949, a date almost exactly in the middle of the twentieth century, will be noted by historians as the D-Day of space travel, the day on which an unmanned rocket reached the height of 250 miles. Measured horizontally 250 miles is no great distance; it can be covered in a few hours in a car and in barely one hour in an aeroplane. Yet even in the middle of the twentieth century it represented a tremendous distance in vertical flight, as the whole of the earth's atmosphere, with the exception of literally a few molecules, lay below this pioneer rocket. There is thus every justification for claiming that it reached cosmic space.

This event opened the era in which infinitely greater discoveries than those once made by Columbus and Galileo await the first man to step on to another planet and see the earth as a star among other stars. Now, perhaps on the eve of this event, is the moment to recall the men who will have made it possible. Although the names of the first men to study the spaces beyond the earth are unknown to us, we do however know the exact moment when the first rough, but fundamentally correct, design of a space ship was demonstrated by its inventor to an amused audience. This almost forgotten event occurred in Berlin and the inventor who braved the accusation of insanity was Hermann Ganswindt, the man who, with more accuracy and less fantasy than the imaginative writers who preceded him, foresaw the advent of the space ship. Not only did he predict it in theory, but by producing the first design for one which was basically sound in principle, he thereby entered the select group of the pioneers of space flight. Ganswindt himself called his machine an "Inter-planetary Vehicle" and it was the tragedy of his life that circumstances made him abandon this most daring idea at an early stage; he was forced to play down the whole project, as the German War Ministry made his scheme for space travel the excuse for refusing to treat seriously Ganswindt's other inventions in the sphere of aeronautics. As early as 1883 he had taken out a patent for a dirigible airship 450 feet long, driven by a 100 h.p. steam engine, which he submitted to the War Ministry; his answer to their curt rejection of the idea was to publish at his own expense a book of a few hundred pages entitled *The Dirigibility of Aerostatic Airships*, and to circulate it among the eminent people of his day in an attempt to arouse interest in his invention while canvassing the War Ministry. It is easy to imagine the reaction of Ministry officials to the hare-brained ideas of a 28-year-old failed law student. At their refusal to adopt them he redoubled his efforts to achieve publicity, but although his brochures even reached the hands of the Crown Prince, the War Ministry diplomatically but firmly expressed the official view by announcing that "airships 450 feet long were in excess of military requirements".

Thus began Ganswindt's career as an inventor. Though pleased when he was compared, half jokingly, to Edison, his long life was filled with disappointments and rebuffs. Years later he was described by Willy Ley, the writer whose special interest is the history of rocket development, in these words: "a highly intelligent and well-educated Teuton who became slightly unbalanced by misfortune—not entirely undeserved—and who, after forty years of quarrelling with everyone on every possible score, reached a stage where even as a character in a novel he would have seemed incredible."

II

Hermann Ganswindt was born at Voigtshof near Seeburg, East Prussia, on June 12th, 1856. His family had never produced any very distinguished figures, but had always been worthy, prosperous citizens. His father owned the oil and grain mills and the saw mills in Voigtshof, his grandfather was a grain merchant and a town councillor of Bischofstein and his mother was the daughter of a rich landowner. Without considering their son's talents or his wishes, his ambitious parents were determined from the first that he should study law and obtain the coveted doctor's degree.

Even while at school his mind was often occupied with daring plans for balloons and airships, while somewhere hidden away in a locked drawer there already lay his first clumsy sketches of a flying machine driven by rockets. In general, however, while occasionally kicking over the traces and shocking the teachers with his bold ideas, he was a healthy, gifted schoolboy who enjoyed life and did well in his examinations. In 1897 he left school to start his university career in Berlin; his happy years at school were to be a sharp contrast to the lifetime of struggle which followed.

Ganswindt began to study law, but after a short period spent at home, he went, not to Berlin, but to Zurich. There he spent his first term, went on to Leipzig for his second and only then did he matriculate at the University of Berlin. So far all had proceeded according to his parents' plan; the Recorder of Leipzig University certified that Hermann Ganswindt of Voigtshof went down in May 1881, having attended the necessary lectures and added that "as to his moral conduct, nothing unfavourable has been noted against him here."

But from now on the young student began to rebel against the career envisaged by his parents. It may be that the interruption of his studies by his compulsory military service contributed to this. Ganswindt served his period of one year with the Second Regiment of Foot Guards, where he again enjoyed a time relatively free from care.

On returning to Berlin, instead of finishing his studies he now wrote a pamphlet with the equivocal title *The Last Judgment*. In this he sought to justify his desertion of the law, saying that he wished to have no more to do with the "dispensation of injustice", as he called the legal profession. His parents in East Prussia were much alarmed; his father wrote imploring letters and reluctantly the dutiful son re-registered at Berlin University—the beginning of a bitter struggle between his sense of duty and his inclinations. Although still nominally a student of law, Ganswindt was never seen in the lecture rooms and in 1884 he was sent down for "non-attendance at lectures". A year later, again under parental pressure, he once more submitted his name, but again he preferred to sit in his rooms drawing sketches and plans. One such plan was for a helicopter, the first in the world, designed almost twenty years before the first successful powered flight by the Wright brothers. After another twelve months, his name was struck from the University register for the last time. Inclination had won and his youthful impetuosity had ruined the programme which his parents had so carefully drawn up. Hermann Ganswindt forgot about statutes and the principles of law, which he was later to need so much, and turned to technical matters.

III

He could now give his whole attention to the idea of a dirigible airship. The first step was to find out the cause of the failure of previous attempts. It seemed to Ganswindt that Giffard and Dupuy de Lôme, with their small airships which became unmanageable in the first strong gust of wind, were making a fundamental error. By simple deduction Ganswindt arrived at the solution of the problem of the dirigible: for it to be steered at all, he reasoned, the airship must have a speed of at least 30 m.p.h., the attainment of which would require a propulsive force of about 100 h.p. If it were to carry a steam engine of such power (there were then no internal combustion engines), it would have to be bigger than any airship ever designed or built before.

Having patented his plans, based on this theory, in 1883, Ganswindt began his new career as an inventor with an enthusiasm which refused to be damped by official rejection of his scheme. Realizing the need for its practical execution, he founded a " Society for the Encouragement of Airship Travel " in order to raise subscriptions to build an airship ; but the meagre funds which trickled in were too small even for such an optimist as Ganswindt. When finally it became obvious that even an inventor must earn money, he set up in business and opened a small factory in Schöneberg, then only a suburb of Berlin. He worked with immense zeal, and with his inventions, as well as by means of posters, exhibitions and publicity photographs, he achieved considerable local fame, which led to his being called the " Edison of Schöneberg "; meant ironically at first, this nickname later acquired an undertone of respect and Ganswindt enjoyed hearing it. He was at all times his own draughtsman, engineer, fitter and mechanic, styling himself " The Original Inventor of Airships, Aeroplanes, Motor Cars, Internal Combustion Engines, Free-wheeling Systems, etc., etc.," thereby making it clear that whilst it might be generally held that others had invented these things, it was in fact he who had supplied the ideas and designs in the first place. His hair had by now grown thin, so that his forehead appeared higher. Between the deep-set eyes a heavy line had formed which made his penetrating gaze appear even more sombre. A sparse and slightly crinkled beard covered the powerful upper lip and ran to a point at his chin. Whoever met Hermann Ganswindt felt that he was dealing with a man of importance who had only one weak point—an inability to rid himself of a preconceived opinion.

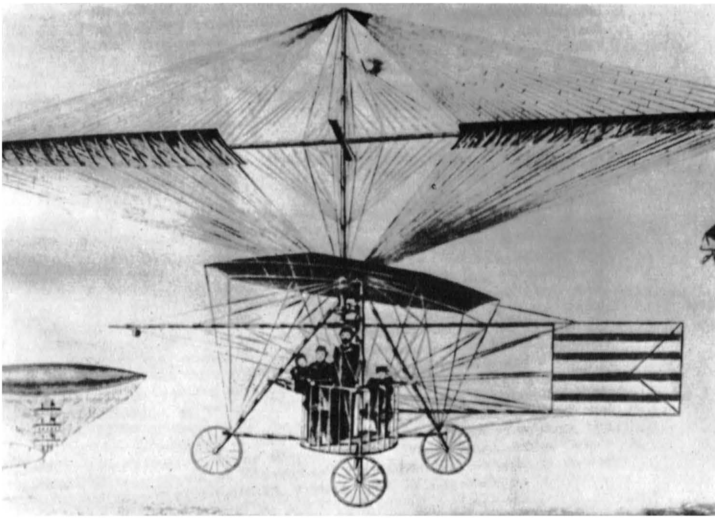
As a well-known manufacturer he was now able to satisfy his natural desire to arouse attention; two of his most successful inventions, a pedal-driven boat and a pedal-car carrying two passengers, caused a sensation when publicly demonstrated. At the same time he continued his efforts to achieve a practical means of flying. To confound the many sceptics who denied the possibility of human flight, he turned all his energies to convincing them that his theories were sound by organizing public lectures in the Berlin Philharmonic Hall, where he harangued his audiences on what he called " The most Urgent Problems of Mankind ".

" No less a man than Napoleon," he declared, " maintained that Fulton, the inventor of the steamship, was insane because he wanted to invade England with a fleet ‘ driven by boiling water ’, in Napoleon’s sarcastic phrase. Even when steamships had been in service for years, the learned Dr. Lardrer produced ‘ scientific evidence ’ that no steamer could ever reach America; . . . did he really think that his proofs could make men abandon the attempt to cross the Atlantic and throw their steamships on the scrap heap?” Here, Ganswindt’s sarcastic emphasis on the words “ learned ” and “ scientific evidence ” produced applause which showed that the audience well appreciated the absurdity of denying accomplished scientific facts. Spurred on, he continued: “ I am convinced that in a few years’ time, when my flying machine has been perfected, no normal household will be without one.” Again the audience laughed, but no longer at the enemies of progress: they now laughed at the lecturer himself. Impetuous as ever, Ganswindt had over-reached himself in trying to combine his brilliant ideas with wild prophecies far beyond the comprehension of his listeners. For although he spoke these words in 1891, the year in which Lilienthal made his first experiments in gliding, there were still no dirigible airships, no powered aircraft or even motor cars. Unabashed, Ganswindt went on to outline his project for a flying machine:

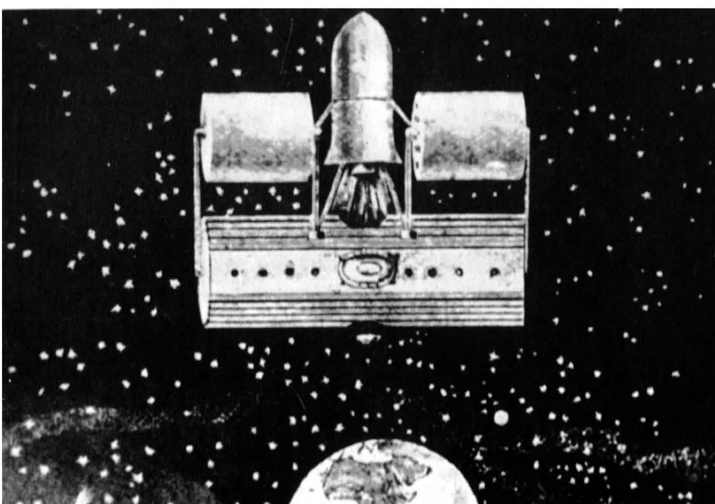
“ In my flying apparatus a small company of travellers will be carried in a cabin surrounded by as many windows as possible. Then, when the light but powerful internal combustion engine has been set in motion by means of a simple device, the whole conveyance will mount rapidly and safely into the air. Answering to the helm, it will proceed in the direction chosen by the navigator after a glance at the map. The speed of travel may be regulated as desired and can be increased to a hundred miles an hour or more.”

At that time this was a prodigious speed; the railway, then the fastest means of transport, was slow in comparison. Ganswindt clearly under-estimated the technical obstacles to his plan, which were to take years to overcome; but it was part of his temperament to make promises which he could never fulfil, despite his own great faith in them. With

Hermann Ganswindt published his first design for a spaceship in 1891



Ganswindt's " flying machine " with its helicopter-like propulsion



The Ganswindt " cosmic vehicle " was to be driven by the thrust of exploding dynamite cartridges a disparaging reference to the slowness, danger and discomfort of railway travel, he continued:

" Collisions will be avoided by arranging that machines moving towards each other shall fly at different heights. Any possibility of a crash is totally excluded, since if by accident the engine should cease to function, the great expanse of wings would act as a parachute and thus prevent a sudden descent. Should even these fail through mischance, a parachute would open and permit a slow, controlled drop on to the nearest suitable landing place."

Ganswindt really did build his flying machine, but it was not completed until the summer of 1901, emerging as a type of helicopter with room for two passengers. When it was ready, the only thing lacking was the engine. The inventor experienced the same difficulty as every other amateur aircraft constructor in the nineteenth century who built, mostly by hand, the strangest flying machines which never flew, through lack of a light but efficient motor. Nevertheless, internal combustion motors were now to be found, since Nikolaus Otto had evolved the four-stroke engine, but their makers tended to exaggerate their capacity—a fact which Ganswindt was to learn to his cost when, having bought for his helicopter an engine for which the maker claimed an output of 60 h.p., he found that it would yield a bare 40 h.p. This was embarrassing, as he had already publicly announced the first flight of his aircraft, but even now his ingenuity did not fail him. He replaced the central axis, on which the rotors turned, by a tube, through which he passed a wire cable fastened at one end to the ground and at the other to the roof of the factory. He then wound a second cable round the guide tube enabling the helicopter to be hauled upwards. The lifting mechanism consisted of a heavy counter-weight which would sink into a deep hole hastily dug for the purpose.

Luck was with him, for the helicopter really flew, although only for a few seconds. It would, of course, have flown better with a proper engine, but then Ganswindt would only have encountered, decades in advance of later helicopter constructors, the basic problem of its inability to remain stable for more than a few seconds without tipping over. Even so, his good luck did not last long. Enemies claimed that the machine had been pulled up by the cable which ostensibly had served only as a guide. Any blacksmith, they maintained, could have built the machine for 500 marks; the whole device was nothing but a fraud to extract money from the credulous.

Ganswindt took up the challenge. Friends spontaneously offered to pay 35,000 marks to any smith who could copy the helicopter. Nobody tried it. His detractors then dug up yellowing copies of his first pamphlet, in which he had criticized the legal system, whereupon the inventor countered with a letter from Count Schlieffen praising his helicopter. This had little effect and he was arrested and charged with fraud on the grounds that his claim to be able to build flying machines was a manifest impossibility. The court adjourned to Ganswindt's workshop, where the judges soon realized that he was no swindler and acquitted him. To the public, though, he was now a marked man; the newspapers refused his advertisements and his posters were removed from the hoardings. The episode left him a deeply embittered man.

IV

Although Ganswindt did not publicly mention space travel until he was thirty-five, the thought had long occupied him and there existed a considerable literature on the subject with which to feed his imagination. He was just nine years old when several novels about space flight appeared, decked out with plausible scientific trappings. One anonymous author suggested an anti-gravity device; another, Achille Eyrand, thought of a rocket motor, but believed it possible to trap the exhaust gases and re-use them, while a third was well aware that very high speeds would be required for a flight to the moon; the fastest thing he knew of was a cannon-ball, so it was in one of these that he fired his passengers off into space. This novel became a classic: its author was Jules Verne.

But in all these books there was no mention of the most important factor of all: Sir Isaac Newton's Third Law of Motion, which he had formulated with brilliant clarity as long ago as 1687:

"*Actioni contrariam semper et aequalam esse reactionem*" (Action and reaction are always equal and opposite)—in other words, a force acting between two bodies will move both and this movement will take place in contrary directions. Newton did not hesitate to add: "This is the principle which will enable mankind in later centuries to undertake flight to the stars." The solution, after two centuries, was thus waiting for the first alert enquirer to grasp it; it is not surprising that this should have occurred at the end of the nineteenth century, the "century of inventions" and the culminating age of years of speculation on the possibility of flight through space.

In the past, however, men had not always thought of cosmic space as something through which travel was possible. For a long time the stars were merely regarded as lights in the sky and not as heavenly bodies comparable with the earth; in all probability the great meteoric storm in the year 465 B.C. led certain enlightened minds to think otherwise. Stones had fallen from the heavens; consequently matter resembling that found on earth must be present in the skies. The Greek thinker Anaxagoras, then teaching in Athens, came to the extremely daring conclusion that the moon might conceivably be a body like the earth and as such might even be greater in size than the whole of the Peloponnesus.

Five hundred years later the historian and philosopher Plutarch adopted this theory. In his book, *De Facie in Orbe Lunae* ("The Face in the Moon"), he discussed the possibility that the moon might contain landscapes, mountains and valleys, suggesting that there might be other features in the moon very much like those on earth. In A.D. 160, Lucian of Samosata, a witty satirist who mocked the failings and pretensions of his time, wrote the first, and for a long time the only, tales of travel to the moon: *A True Story* and *The Flight to the Moon of Ikaromenippus*, which were mixtures of utopian fantasy, science and contemporary satire. In *A True Story*, a ship was cast up on the moon by heavy storms; this was held to be possible on the assumption that the atmosphere reached from the earth to the moon. To the joy of the shipwrecked crew, the inhabitants of the moon spoke Greek. Their king, Endymion, was about to embark on an attack against the inhabitants of the sun. Both sides had mobilized huge armies: there were 60 million foot soldiers, 80,000 men mounted on three-headed hawks, 20,000 riding crows, 30,000 on the backs of fleas, artillery in the form of garlic-throwers and finally an army of giant spiders, the smallest of which was " as large as the greatest island of the Cyclades ".

The concept of the world expounded by Aristotle, which was to dominate western science for centuries to come, did not admit of the notion of space travel. There was a sharp division between earth and heaven which, until well into the seventeenth century, ruled out any idea of flight into space. Only after 1600 did translations and reprints of Lucian's stories begin to appear. The astronomer, Kepler, who discovered the laws of planetary motion, wrote a story entitled *A Dream of the Moon*, in which he described the lunar craters as being the walled cities of the moon-dwellers; they, in turn, were pictured as intelligent beings, but shaped like serpents.

A few years later an Englishman, Bishop Wilkins, enumerated four different ways of flying to the moon: firstly, through spirits or angels; secondly, with the aid of birds ; thirdly, with artificial wings and lastly, in a flying chariot. Although he did not use the very word, this was the first mention of anything in the nature of a " space ship "; but from Bishop Wilkins' " flying chariot " to Ganswindt's " Interplanetary Vehicle " was as great a leap as that which lay between Ganswindt's project and the space ship of the second half of the twentieth century. Bishop Wilkins' book started a series of imaginative, pseudo-scientific works on space travel; the French writer Cyrano de Bergerac equipped the hero of one of his romances with flasks filled with morning dew, " since this, as is known, attracts the sun ". He also proposed the idea of spheres containing the smoke of sacrificial fires, because this " had the property of ascending heavenwards ". His characters were drawn up to the moon in a flying carriage of iron, holding aloft a ball made of " the concentrated essence of the force of magnetism ".

V

Such fanciful schemes of space travel as these had filled Ganswindt's mind from an early age; it was natural, therefore, that while experimenting on the problem of flight in general, he should turn his attention to flight in cosmic space.

In order to interest the public in air travel he delivered an address at the Philharmonic Hall on May 27th, 1891, in which he enthusiastically introduced his " Interplanetary Vehicle " to a public which should, in his opinion, have received the idea with astonished admiration. Instead, they scoffed at it, although there did exist by this time a considerable basis of sound scientific justification for his wild project. The knowledge acquired during the nineteenth century pointed to the assumption that living beings, and even men, might exist on other planets. In 1828, Friedrich Wöhler had demonstrated that living organisms were composed of the same elements as inanimate matter and in 1859 the discovery of spectrum analysis by Kirchhoff and Bunsen enabled it to be proved that the planets and stars are made up of the same elements as the earth. In the same year appeared Charles Darwin's famous work, containing his proposition that all living creatures are related to one another. Then in 1869, Meyer and Mendeleyev established, simultaneously and independently, the existence of the Periodic System of Elements, according to which there were only a limited number of chemical elements, of which about seventy were then known. Taken in conjunction, these theories appeared to indicate the possibility of life on other worlds.

Tangible proof seemed at hand when in 1877 the orbit of Mars brought this planet very close to the earth, allowing it to be clearly observed. Asaph Hall in America discovered the two small martian moons, while from Italy came the sensational news that the astronomer Giovanni Schiaparelli had discovered " canals " on Mars, which to many seemed proof that the planet was inhabited by intelligent beings. Basing his ideas on this accumulated knowledge, Ganswindt constructed his own remarkable hypothesis—which is still occasionally propounded by others even to-day.

" This hypothesis demonstrates," he announced, " that in the endless universe every conceivable species of creature must exist in the dimensions of space and time, and be capable of self-reproduction. The universe contains at this moment an infinite number of worlds which resemble our world in every respect and in which, for example, another Hermann Ganswindt is now delivering this very same lecture—exactly as if an object were placed between two parallel mirrors which would reflect it an infinite number of times. This thought has led me to ask whether it is not possible to leave this earth's atmosphere and reach, for instance, the nearest planets—Venus and Mars? Whatever objections prejudice may make, I declare that it is possible, not only to use wings to provide a fulcrum in air, but also to establish a fulcrum in airless space—which is the solution of the question of travel to other worlds."

These last words were a vital contribution to the theory of space travel, for since Newton, no one had appreciated the significance, in this context, of the Third Law of Motion, which implies the possibility of obtaining a fulcrum, and hence movement, in airless space. His space ship, which Ganswindt now showed to a scornful audience, was based on years of thought devoted to this principle and its practical application.

He had come to the conclusion that an object could be kept in a hovering position by discharging from it other objects in a downward direction, deducing correctly from the flight of birds that: " The bird is able to fly only by constantly grasping static masses of air with its wings and displacing them vertically downwards, in order to grasp in turn further static masses of air." On fair-grounds in Berlin, Ganswindt had seen machines which measured the force of a blow of the fist and these had caused him to reflect. "My fist, which, together with my lower forearm, weighs perhaps a pound, enables me to deliver a blow of 175 lb.—or more than the weight of my body." Hence, he reasoned, his body would be thrown upwards for a moment if he suddenly flung vertically downwards an object weighing as much as his fist, from which it followed that he would rise into the air with increasing speed if he could repeat the movement continuously. This led Ganswindt to the next and most decisive step: the essential factor of speed. "Now if dynamite were used to propel the body forward, obviously a quantity weighing only a fraction of the fist would be sufficient to exercise a far greater propulsive force." When asked how, in that case, he proposed to move in airless space, where there was no air to be grasped and flung downwards, he replied that the equivalent of the "masses of air" would be carried by the flying machine, in the form of the gases latent in the explosive propellent, which were to propel it forward by the force of reaction.

This marked the birth of the theory which lies behind the present-day space ships; but Ganswindt was too far in advance of his time for it to be understood—a fact which was not surprising in an age which knew neither the airship nor the aeroplane. Even though few could understand him, he went on to describe his projected space ship: "Calculations have shown that such an apparatus, driven by explosives, could only function economically by developing a quite exceptional speed. It would therefore be unsuited to use in the earth's atmosphere, due to the intense air resistance at such high speeds. In a vacuum, on the other hand, there is nothing to prevent the attainment of the speeds of a comet or a meteor; such speeds as these are essential for an expedition into space, owing to the vast distances to be covered."

There then arose the question of how space travellers would survive such distances in a vacuum. Ganswindt answered that survival was quite possible—"Just as we travel safely 125,000,000 miles a year through the airless space round the sun . . . since with the earth we carry the air and everything else we need, so the space ship would carry its own air, heat, food and every other necessity of life." As to the expected duration of such a journey—" Due to the acceleration obtained by a continual discharge of explosives and a total absence of air resistance, the efficiency of the machine would increase the faster it travelled. This would permit such a speed after leaving the atmosphere that Mars or Venus could be reached in about 22 hours, assuming that the initial acceleration was twice that of a falling body and that when the machine had proceeded half-way it would exercise a similar braking power." Exhibiting a somewhat fanciful drawing of his space ship, he continued:

" The main component is a steel cylinder of the smallest diameter compatible with providing space for two passengers and their provisions. This main cylinder is surrounded by thin steel tubes . . . containing the air supply in a highly concentrated state, while above the cylinder is attached the explosion chamber, connected with two lateral cartridge containers. I must emphasize that these are not Jules Verne fantasies, but part of a plan which I still hope to carry out during my lifetime. . . . The time will come when a voyage into space will be a practical proposition." Although Ganswindt could have had no idea of the practical engineering problems involved, such as the initial impetus needed, fuel requirements and details of construction, his theory was entirely correct.

Despite the fierce opposition which it evoked, Ganswindt continued the campaign for some time, repeating his lectures at the Philharmonic Hall. When in July, 1900, Professor Gostkowski, in an article in the Viennese periodical *Die Zeit*, admitted the correctness of Ganswindt's principles, but doubted whether his machine could attain the necessary range, Ganswindt countered by stating that the space ship would be propelled as far as the limit of the earth's atmosphere by means of specially designed aeroplanes—an idea which was to reappear much later and in a somewhat different form, but which is essentially the same as the modern technique of multi-stage rocket propulsion. Even the notion of a platform in space, which half a century later was to become the principal argument for the feasibility of space travel, had already been put forward by Ganswindt; as one who had heard his lectures expressed it: " According to Ganswindt's hypothesis, the rings of Saturn were probably supply depots of this kind, filled with millennium-old debris from the space ships belonging to Saturn. After many centuries of space travel, similar rings would form round the earth, as Ganswindt so graphically described."

His space ship was never built and Ganswindt never realized that he had not solved the problem, but had merely pointed the way to its solution by more practical men. When his stormy life neared its end there already existed rocket testing grounds in and near Berlin and the experimental station at Peenemünde was in the planning stage.

The public, who had almost forgotten the old, embittered but still clamorous Hermann Ganswindt, came to pity him. Many a contemporary felt ashamed at the treatment he had received and newspapers published appreciative articles on his life and work. One commentator wrote: " Ganswindt, in a lifetime of disappointments and setbacks, received far less recognition than was his due. It is true to say that Germany owes him a great debt." But it was too late. He had lost all his money in the post-war inflation and was living in poverty on public assistance, helped by occasional gifts from his twenty-three children. Sometimes he would receive sums of money from people who remained anonymous, but described themselves as " former shareholders " of his companies.

He died on October 25th, 1934, at the age of 78, his great plans unfulfilled. He had met with the fate which, with prophetic insight, he had placed as a text at the head of one of his writings in the year 1899:

> " A death in scorn awaits the one who would
> the confines of this earth o'erleap, whose spirit
> strives to tame eternal space."