

## Dinner Speech on the occasion of the 16<sup>th</sup> AIAA/DLR/DGLR International Space Planes and Hypersonic Systems and Technologies Conference, Bremen 2009

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Dear guests of Honor, dear Ladies and Gentlemen. Just two weeks ago I was asked to come here and give a dinner speech. When I googled "Dinner speech" – the definition I found was - "like a girl's dress": Long enough to cover everything important, but short enough to stay interesting. So, do not worry, I will not cover the complete hypersonic history.

The early days of pioneering spaceflight have been really adventurous. Had you been a plane pioneer, you could have just crashed from some 20 or 30 meters high. As a rocket pioneer you never needed to leave the ground. These motors could just explode in your hands.

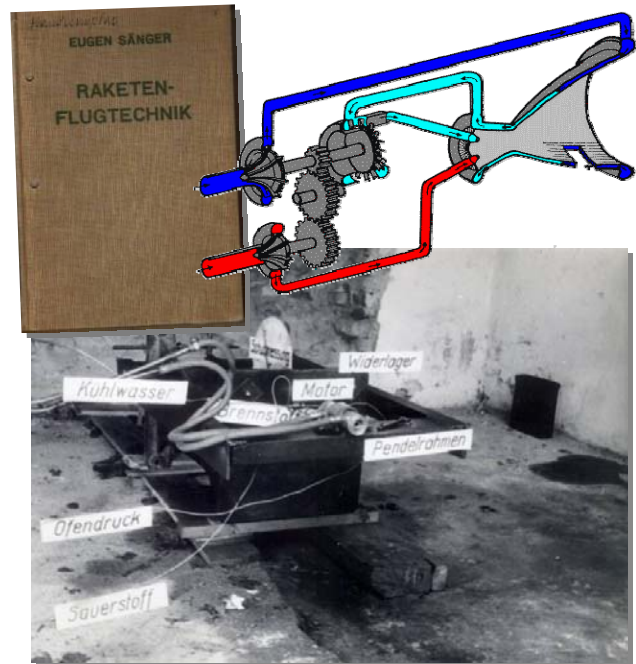


Eugen A. Sänger

One of the early space pioneers was a young Austrian engineer, **Eugen Sänger**. In 1929 he was ready to present a thesis about a space plane that could reach an orbital space station and continue the journey with an electric propelled spaceship using the time dilatation **Albert Einstein** described in his **Special relativity theory**. He was too far ahead of his time!

He was advised to graduate with a much more conventional topic. He did, but continued to pursue his ideas.

The most important part of each vehicle is the engine. After publishing his theories in a book called "Rocket Flight Engineering", he started to construct the rocket engine.



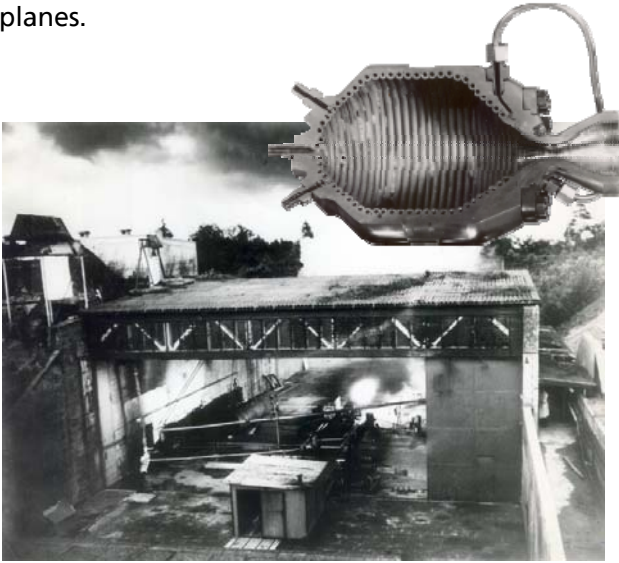
First book, patent drawing and test bank Eugen Sänger realized 1933 in Vienna.

After systematic trials, like it is done today, he experienced the design of this motor. It looked like most modern expander cycle engines and it is not too long ago that even **Vulcain** used his patent drawing for advertising.

But this was the end for a poor student without rich parents. He asked the Austrian government for support and finally got an answer. "Rocket engines will not work, first they will explode" That meant he had to continue working on common static calculations to earn his living. In his diary he wrote that he wanted to earn money with rocket engineering in Russia and buy a house at the shore of the Lake of Constance.

In the meantime his ideas went around the world, and other hypersonic pioneers, like for example **Tsien Hsue-shen (Qián Xuésén)**, started to correspond with **Sänger**.

At last, Germany, at this time eagerly looking for new technologies, invited him to build a rocket test centre for rocket engines and rocket planes.



*A first test bank for rocket motors up to 1000 kN thrust was built in the Heathland of Lüneburg and first trials with 10kN motors were performed.*

Nothing is ever easy. When looking for an area to build a test centre, one time he suffered a motorcycle accident and broke some ribs. Another time, when he was with his friend **Count Helmut Zborowski** exploring the area, they learned to late that they were entering a bombing test range. They already heard the engines of the bombers and had to decide what to do. The goal for the bombers was a small tin hut. Both engineers, they calculated and decided that it was most likely that these bombers would not hit the tin hut – and they survived in it.

The test center was founded in the Heathland of Lüneburg and completed within two years.

The rocket engines became bigger, the aerodynamic calculation for hypersonic speeds more advanced and **Sänger** started to evaluate a patent of the French engineer **René Lorin**. The omnipresent problem of space flight is the amount of payload. These ramjet engines should help. A ramjet uses the oxygen of the atmosphere to burn the propellant and therefore saves the weight of the oxygen and the oxygen tanks - I know you know.

And again, nothing is ever easy. A first tube was mounted on a truck and started to scare the residents. Not enough. To increase the speed the team looked for a contemporary plane with a special empennage be able to mount a ramjet.

First a **DO 17Z** and later a **DO 217 E2** became a convenient flying test bed.

They chose a quite Sunday for a first trial - and just came to a stop a few meters from the nearest trees. They shifted the centre of gravity towards the cockpit and tried again. **Eugen Sänger** himself, always working as “payload specialist”, collected the data and the pilot, Captain **Paul Spremberg**, learned to launch the monster. One time, when **Sänger** started his Ramjet in the air, one of the nearby residents was just sitting on a toilet. Terribly scared, he jumped off the toilet forgetting his pants and was the laughing stock of the neighborhood. Later on, when he heard about, **Sänger** could just stumble: “poor guy”. Quite often the residents reported a burning plane and eventually, the fire brigade got used to those trials.

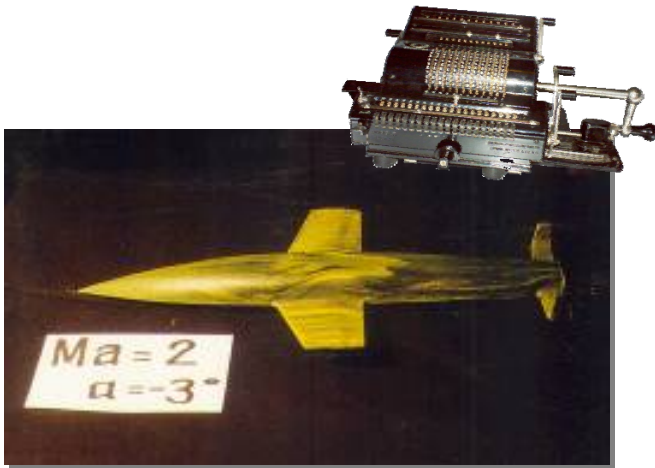


*Ramjet trials, first on an Opel truck, later on Dornier planes as flying test beds.*

But one day it almost got serious: A propellant line broke and the kerosene spread all over the cockpit. They could hardly open a window and land the assembly. Another time, they learned, after having landed, that parts of the plane’s tail had melted away.

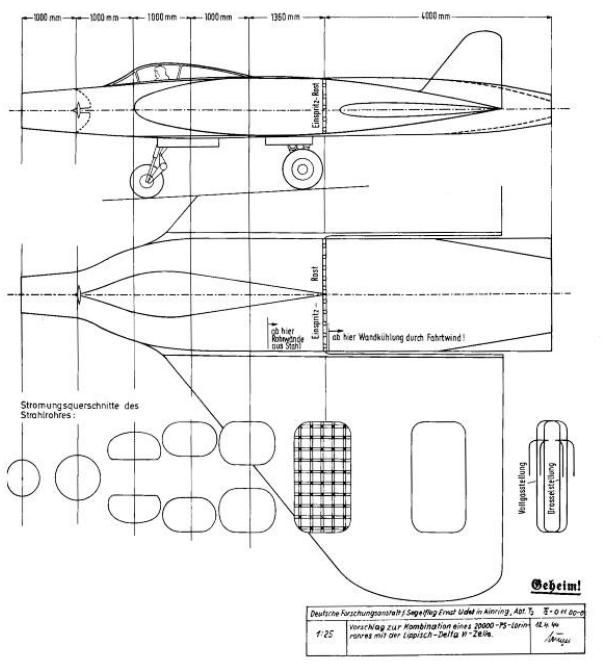
In the meantime a first wind tunnel model was designed with the help of a pinwheel calculator. It had the same flat bottom as most of today’s designs and the disrespectful workshop just called it “flat iron”.

But **Sänger’s** work did not really satisfy the **Reichsluftfahrtministerium**. It was 1942 and Germans air force did not need a space plane until about 20 years later in time. When **Sänger** did not want to change his schedule, he was immediately retired from his test centre.



A first hypersonic plane was designed with the help of a pinwheel calculator.

Nevertheless **Eugen Sänger** and his closest co-workers were important scientist at this time. They were transferred to the **German Research Institute for Gliding** near the Austrian border. There they continued with a lot of paperwork. Some drafts for more war relevant projects were produced as for example, in cooperation with **Alexander Lippisch**, a sketch showing a plane with an integrated ramjet. It was a very first modern hypersonic plane design. But wartimes came to an end.



Together with Alexander Lippisch, Sänger outlined a first plane with an integrated jet propulsion.

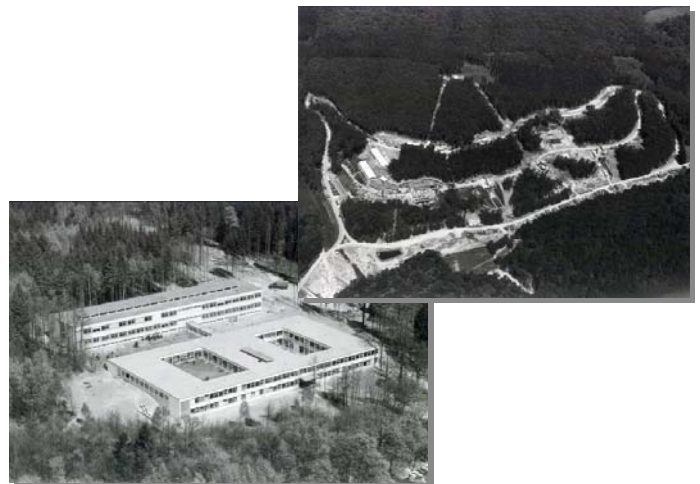
Again, **Sänger** and his close co-workers were moved - this time to Paris. Such a short time after WWII Paris did not have the time nor the money to care for space flight developments. Nevertheless Sänger was asked, for example, to help with the pre-configuration of a first plane with a combined turbo-ramjet propulsion, the

GRIFTON, and last not least was allowed to found, together with **Alexandre Ananoff**, the International Astronautical Federation. They were still speaking about space flight within the annual astronautical congresses.



First meeting of the International Astronautical Federation in Lodon 1951 with I. Sänger-Bredt, H. Oberth, E. Sänger, A.C. Clarke, V.A. Cleaver.

Such congresses take a long time, and at one time, **Theodor von Karman** and **Eugen Sänger**, by now married to his former co-worker Irene Bredt, decided to take a short trip in the surrounding area. Driving a four seat cabriolet, Eugen Sänger came to a stop in the middle of a cow herd. Suddenly a cow licked von Karman's face, who was sleeping in the backseat. Von Karman woke up and whispered "Oh Madame".



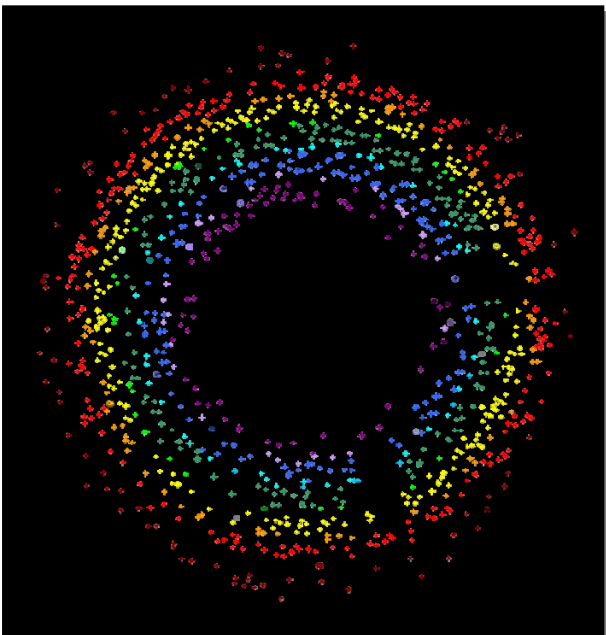
A very first spaceflight research institute and a rocket test ground were build near Stuttgart in the late nineteen fifties.

No rocket had yet reached an orbit, when Germany decided in 1953 to found a first European institute for space flight and selected **Eugen Sänger** to build and to head this institute. An administration building, laboratories and test facilities arose and the

new institute organized a first meeting between US- and Russian space scientists.

It was in during the 1956 IAF congress in Rome that **Sänger** delivered a lecture on the accessibility of stars. There, he described a spaceship fitted with a unique photon-propulsion system, making it possible to accelerate and reach a velocity close to the speed of light. This unique propulsion system would allow crew members to travel to distant solar systems, perform their mission, and return to the starting point... within their own lifetimes.

Einstein's special relativity theory served as a basis for some computations. Among other things, the theory says that when an object or vehicle travels at relativistic velocities, this object or vehicle can be associated to a given, velocity-dependent space-time coordinate system. Based on this assumption, a simple model could be derived: a spaceship starting its journey from the Earth, accelerated to near speed-of-light velocities and finally slowed down again, could reach a 100-light-year distant star after a 10-year journey only calculated in the vehicle's frame... or 100 year long for an earth-based observer. To achieve such a remarkable performance, the propulsion system had to be able to transform the fuel carried along with it, and expel it as radiation. The "ray-drive" could be as fast as light itself. A first design was thus completed.



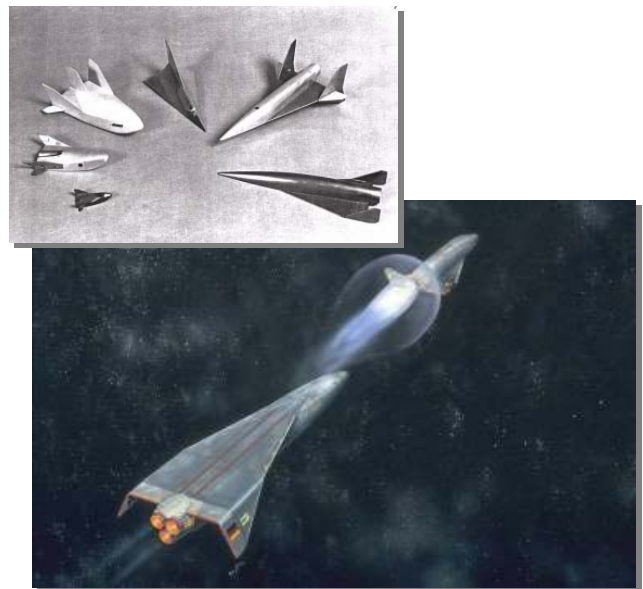
*Thus, the dilated universe would look like as seen by an observer moving at velocities close to the speed of light.*

Incidentally, **Eugen Sänger** also computed what the dilated universe would look like, as seen by an observer moving at velocities close to the speed of light. The "seventicoloured star-bow" describes a toroidal star bow in the colours of the rainbow.

**Pope PIUS-XII** (the twelfth) read this paper, and heralded it as a reason to announce astronautics as a mission from God.

A short time later the first satellite flew and the German Government established a first German Space budget. **Sänger's** Institute was the only one to handle such topics and therefore the community of the German aeronautic institutes decided to integrate **Sänger's** facilities. **Sänger** did not accept and was retired once more from his institute. He still headed the section for space transportation at **Eurospace**, today's **ESA**, got a first European space flight chair in Berlin and wrote a report for the German industry how to develop a space plane.

Even after **Eugen Sänger** passed away, the topic "reusable space transportation" got viable. The **Junkers Flugzeug und Motorenwerke** continued **Sänger's** proposals and, together with the **German Research Foundation** presented a concept for a two stage to orbit space plane. But the responsible German minister decided to have "courage for a gap" as he described it and the results went into the US Shuttle development.



*Within the German ART team, a first reusable two stage to orbit space plane has been planned.*

Once more in the nineteen eighties, German engineers and scientists continued the topic. The knowledge was still present and within a few years a quite attractive model of a two stage to orbit space plane travelled around the air and space shows and near Munich, a Mach 7 ramjet produced an awful noise. One said that sometimes the CEO of the German Aerospace dropped his pencil when he was in his office at the same time. In the early nineties, the **Hermes** proposal failed and "**Sänger**" was delayed once more.



*Content of the german national hypersonic research program was once more a two stage to orbit space plane, this time with a combined turbo-ram jet propulsion.*

I cannot explain to you anything about today's situation you don't know yourself. We are all waiting for the US decisions about the future of manned space flight and even the German community wants to know what to expect from their new government. Obviously, it is not the time today to start a 500 billion space flight project after failing with even simpler concepts. In a transparency from an IAF speech of the nineteen fifties **Sänger** expected economical and safe space transportation to be installed until nineteen eighty. There seems to be some delay and obviously it might be good to realize more progress. Is it the right stuff always to advance the frontiers and never to build something? What do you think about that?

Dear Ladies and Gentlemen. Thank you very much for your attention.