

Otto Lilienthal and Sailing Flight

....., Ladies and gentlemen,

first of all I want to sincerely thank you, the organizers of “Soaring100”, for your kind invitation to be part in this event. I visited Kitty Hawk more than 10 years ago while touring historic sites in the United States. At every turn, I was very impressed by the American preservation of historical sites, maintaining national parks, creating national memorials, and preserving historic artifacts. We Germans realize that ours is an old cultural nation – in the “Old world,” but we have much to learn from America in supporting memorials, museums and national monuments. Again, thank you for the opportunity to be here.

As a representative of the Lilienthal Museum in Anklam, Otto Lilienthal’s birthplace, I am honored to be able to participate in this event in North Carolina. We appreciate that the Wright Brothers concluded that Lilienthal’s aerodynamic studies and numerous glider flights in the years between 1891 and 1896 were the first scientific approaches to flight. The Wright flights from Kill Devil Hill followed Lilienthal’s method of practical research of flight from a round hill for maximum success, regardless of wind direction. Lilienthal also glided from the top of several different hills thousands of times.

--1-- This is one of the only 4 known portrait photographs of Lilienthal. This is not surprising. Photography was still a novelty in the late 19th century. And the fact that we have a lot of photographs taken of Lilienthal's flights that are highly valued today is very sensational. We think, we know all the photographers namely and they are well known names in the history of photography today.

--2-- The possibility to take action photographs of moving objects with his focal plane fast shutter was discovered particular at this time. The photographer Ottomar Anschütz took pictures of flying storks in 1884. five of these photos are preserved in the Otto Lilienthal Photograph Collection which owns our museum. Otto Lilienthal declared that the stork was his most important teacher.

--3-(s. 84)- This is a picture from his book published in 1889, titled: “The Flight of Birds as the Basis of Aviation”. In the frontispiece of the book is a watercolor of circling storks, drawn by Lilienthal.

--4-(xx) And this is the drawing on the last page of the book: As you see: The stork gave birth to two famous discoveries – action photography and human flight.

--5-(xx)- Ottomar Anschütz, the stork photographer, became the most important photographer of Lilienthal's flights in 1893 and 1894. This is a photo taken at his “flight station”, a structure high on the top of a hill near his home in the suburb of the growing city of Berlin. It was the first artificial flight station, a starting ramp.

--6-- This photo, taken in 1893 by Alex Krajewski at another flight location about 70 miles from Berlin. It is the site of Lilienthal’s fatal crash three years later in 1896. Lilienthal described these impressive photographs very modestly in a lecture in 1894: **“I want to ask you not to take my achievements for more than they are. Through the photographic pictures, where you can see me flying high above in**

the sky, one can get the impression that the problem is already solved. That is not at all the case. I have to admit that it will still take quite a lot of work to turn this simple gliding into a long-term human flight. The achievements so far are for human flight nothing more than the first insecure steps of a child meaning to imitate the walk of men.

The greatest distance Lilienthal was able to fly (including first maneuvers) was about 800 feet from a height of about 180 feet. His flight against the wind lasted about a minute, therefore. This corresponds to a glide ratio of about 5 : 1 at best.

--7-- A similar result was achieved with a replica of the same Lilienthal glider on the test car of the German Hang Glider Association.

Lilienthal's flights were essentially gliding, no soaring flights. Nevertheless Lilienthal described flights, when he was taken to heights by the wind to a higher level than his starting point.

--8-(0828)- This is a picture from an article in 1895. Its original title was: "Aviation Sport and Flying Practice". It was published in "Aeronautical Annual" in 1896 under the title of "Practical experiments for the development of human flight". This drawing demonstrates two points:

The first is Lilienthal's experiences gathered in his flights near the village Stölln, you saw in the last photo. He has described this experiences in the article as follows: "This gave the most interesting results of all my practical flying experiments hitherto. Six or seven meters velocity of wind sufficed to enable the sailing surface of 18 square meters to carry me almost horizontally against the wind from the top of my hill without any starting jump. If the wind is stronger, I allow myself to be simply lifted from the point of the hill and to sail slowly towards the wind. The direction of the flight has, with strong wind, a strong upward tendency. I often reach positions in the air which are much higher than my starting point. At the climax of such a line of flight I sometimes come to a standstill for some time, so that I am enabled while floating to speak with the gentlemen who wish to photograph me, regarding the best position for the photographing."

The second point presented in the picture is Lilienthal's wish to make this soaring experiences possible at his man-made flying site "Aviator Hill" near his home. The upper part of the drawing shows the existing hill, he used after 1894 with a small hangar on the top. But this hill was only 15 meters high, limiting flight distances to about 80 meters. Lilienthal tried to find sponsors to increase the height of this hill to 30 meters. That would have allowed him to fly every day, every evening as successfully as in his weekend flying location about 100 km from "Aviator Hill" near his home near Berlin.

--9(0137a)- Lilienthal was not able to realize this. But the "Aviator Hill" with the height of 15 m still exists and was redesigned as a monument in 1932. This is a historic view of the area. Since 1920, the so called "Grater Berlin Act" the suburb Lichterfelde where Lilienthal lived and where the hill is located is part of southern Berlin.

--10 -(1339)- This is a view looking back from Lilienthal's starting point to the ground.

From 1894 on, Lilienthal used only these two flight sites: “Aviator hill” served as the company grounds of the aircraft production division of his factory. Here, he flew in the evenings and tested his new glider designs. Photographers often accompanied him. On weekends he drove to Stölln to set new flying records.

--11-(xx). Ninety photographs were taken on “Aviator Hill”. All photographs from 1894 to 1896 were taken there, because obviously it was easier to take a photographer along to this place than for a journey of 100 km. The only exceptions are the few photos taken by the American physicist Robert William Wood on August 2, 1896, one week before Lilienthal’s fatal crash at this location.

Lilienthal used other flight areas before 1894. He built and flew more than ten different glider designs in the six years. His most important designs are shown in the display over there. Lilienthal performed different systems of control and attempts of propulsion of his gliders but he achieved his impressive results in 1893 already and was not able to surpass those results in the last 3 years of his flying experience.

Obviously, this was not his primary interest. He spent many evenings on his “Aviator Hill”, many weekends in Stölln, and he enjoyed being airborne for about one minute more than anything else. But flying was only one of Lilienthal's numerous technical and cultural interests. He had several patents for steam engines that he manufactured in his factory; a project for a Berlin peoples theatre where he was director, author, and actor; and other social projects that he pursued jointly with his brother Gustav. Moreover Gustav was his most important coworker in the beginning of the flight experiments.

Now I would like to add some non-technical comments about Lilienthal’s concept of flying:

--12 -(panel)- Lilienthal’ approach

Urge for knowledge – to discover the physical principles of the wing

Visionary approach – to realize an old dream of mankind

Flying as a sport

Flying as a business – Mass production and export of the “Normal Soaring Apparatus” [One of these is in the Smithsonian National Air and Space Museum in Washington. Bildxxx]

Military use?

Sensational flights - Lilienthal as a headliner

First item: Lilienthal’s scientific approach

Otto Lilienthal was a very well educated talented young engineer, a graduate of the „Gewerbeakademie” (Industrial Academy), today’s Berlin technical University. But his first interest in flying was not a scientific one. Lilienthal just wanted to fly. As an educated engineer, he realized that the scientific knowledge in this field was insufficient to start. He stated this in his book “Bird flight as the basis of aviation”, published in 1889, two years before his first flights. The German foreword was omitted in the English translation of the book, published in 1911. Lilienthal started his book with these words: “Our knowledge of the mechanical processes during bird flight obviously is not on a level, comparable with those of other branches of science. It seems that research in the field of active flight has been channeled by unfavorable circumstances into a wrong and unsuccessful direction. Our knowledge about the forces of the air is completely inadequate and a mathematical description of the problem of flight is without any basis.” In this way Lilienthal described the aim of his

book. Interestingly the Wright brothers stated nearly the same position about 10 years later about the necessity of new experiments (e.g. wind tunnel for air foils and propellers) before regular successful flights.

--13-(xx)- Let me show you three drawings from more than 80 in Lilienthal's book: In this plate one once again: In this plate (I show you again) he outlined the important properties of the wing: the curvature, the sharp tailing edge and the smooth leading edge.

--14-(Abb. 48-52)-This is the summary of cross sections he studied further. But only the curvature of the wing has been the topic of Lilienthal's detailed measurements. The other properties were beyond the accuracy of his measuring devices, as he admitted.

--15-(Tafel)- The polar curve for display of lift and drag of his wings is the final lesson of his aerodynamics. It was Wilbur Wright, who characterized this book in the following way: (I quote) "For nearly twenty years his tables and charts were the best to be found in print. His work in this line alone would have been sufficient to place Lilienthal in the front rank, yet there still remains to be mentioned his greatest contribution to the cause. Lilienthal was the real founder of out-of-door experimenting. [...] His efforts constituted the greatest contribution to final success that had been made by any of the nineteenth century group of workers."

Lilienthal's desire to fly was a lifelong desire. We know about his flying ideas, experiments, and flying attempts in all phases of his life - as a youngster, as a poor student in Berlin, as a young inventor in different engineering works and as an entrepreneur. In 1871 he returned home from the Franco-Prussian War and met his brother Gustav with the words: "Now we will succeed" and no one doubts that his meaning was: Now we will fly!

Wilbur Wright described Lilienthal: "As a missionary he was wonderful. He presented the cause of human flight to his readers so earnestly, so attractively, and so convincingly that it was difficult for anyone to resist the temptation to make an attempt at it himself, [...] he was without question the greatest of the precursors, and the world owes to him a great debt." We do not know why, but being able to fly was one of the fundamental goals of Lilienthal's life.

Third item: Flying as a sport

A unique concept of Lilienthal that distinguishes him from many others is the desire to realize human flight as a sport. One newspaper reported: "We today know sports of riding, driving, hunting, sailing, rowing, running and swimming. There is a new one: Flying!" In different articles Lilienthal discussed flight as a branch of gymnastics. That is why a common place like his "Aviator Hill" near the city of Berlin was important for his view of flying. "Such a place", he wrote, "in which young men can practice sailing flights and can at times make motor experiments with the wings would prove to be of great interest, both to those participating and to the public in general. And when, from time to time, competitive flights were arranged, we should soon have a national pastime in this as in other existing sports. One can see even now the pleasure and interest of the public in such races, when gymnasts skilled in flight, shooting through the air, would be greater and more intense than, for instance, in horse or boat racing. The air is the freest element; it admits of the most unfettered movement, and the motion through it affords the greatest delight not only to the person flying, but also to those looking on. It is with astonishment and admiration that we follow the air gymnast swinging himself from trapeze to trapeze; but what are these tiny springs as compared to the powerful bound

which the sailer in the air is able to take from the top of the hill, and which carries him over the ground for hundreds of yards? [...] Can any sport be more exciting than flying? Strength and adroitness, courage and decision, can nowhere gain such triumphs as in these gigantic bounds into the air, when the gymnast safely steers his soaring machine house-high over the heads of the spectators.”

His few hours of flight, a minute at time, opened the door to Soaring100.

That the danger here is easily avoided when one practices in a reasonable way, I have sufficiently proved, as I myself have made thousands of experiments within the last five years, and have had no accidents whatever, a few scratches excepted. [...] If we can succeed in enticing to the hill the young men who today make use of the bicycle and the boat to strengthen their nerves and muscle, so that, borne by their wings, they may glide through the air, we shall then have directed the development of human flight into a course which leads towards perfection.”

Fourth item: Lilienthal's idea of the aviation business

When Lilienthal designed his collapsible “Normal Soaring Apparatus” in 1893 he regarded it to be a well engineered device to sell for flight experiments of others. One of the first known purchasers was the Frenchman Charles Count de Lambert. And the Count became one of the first three pilots in the Wright flight training school in France 14 years later.

Lilienthal received four patents for his flying machine, one in the United States. In 1895 Lilienthal ran an advertisement in the “Pocket book of Aeronautics”: The offer is a “soaring apparatus for the training of individual flight”. We know about ten gliders were sold. Three of them are kept in Museums today.

--16-(xx)- One is on display in the National Air and Space Museum today. At the same time, Lilienthal tried to sell the patent in the United States with the help of Octave Chanute and James Means. In 1896, he received an invitation from James Means, to travel to America for two or three month at Means's expense. Means wrote: “The object of your visit is to introduce to the people of the United States the use of the air-sailing machine as a SPORT.” But it was not possible for Lilienthal to leave his factory for more than a few days. He was the inventor-businessman, but without an appropriate representative. In Berlin, there was held a “trade show” (similar to a world fair) in 1896, in which he was an exhibitor. It was before the end of the trade show that Lilienthal died from a flight crash on August 9, 1896. Shifting the pilot's weight had limited effect for control, especially during strong air currents. The Wright Brothers overcame this problem with their warped wing and later Curtiss improved control with the aileron.

Thoughts about a military use of the aircraft

Lilienthal discussed a very different use of his airplane but not for military use.

There are two visions that Lilienthal combined with “his” aircraft in some articles and lessons. The first was the idea of global, world-spanning air traffic and the second was that of eternal peace. There is a letter preserved, written in 1895 to Moritz Egidy, a former Prussian officer:

“Dear Lieutenant Colonel”, he wrote,

“I have often listened to you with enthusiasm, when you refer to the borders not as separating the countries but rather as connecting them. I, too, have made it a lifelong task of mine to add a cultural element to my work that should result in uniting countries and reconciling their people. Our experience of today's civilization suffers from the fact that it only happens on the

surface of the earth. We have invented barricades between our countries, custom regulations and constraints, and complicated traffic laws. These are only possible because we are not in control of the 'kingdom of the air', and not as 'free as a bird'.

Numerous technicians in every nation are doing their utmost to achieve the dream of free, unlimited flight and it is precisely here where changes can be made that would have a radical effect on our whole way of life. The borders between countries would lose their significance because they could not be closed off from each other. Linguistic differences would disappear, as human mobility increased. National defense would cease to devour the best resources of nations as it would become impossible in itself. And the necessity of resolving disagreements among nations in some other way than by bloody battles would, in its turn, lead us to eternal peace.

We are getting closer to this goal. When we will reach it, I do not know. The little bit that I have contributed to this is enclosed with this letter. [...]

Yours Sincerely

Otto Lilienthal”

The last item: Lilienthal as a headliner

I mentioned the interesting coincidence of timing of the first flights of Lilienthal and the beginning of action - or snapshot photography.

--17-(xx)- Ottomar Anschütz kept his high speed shutter as a secret for many years. In 1890, a Berlin optical factory was allowed to manufacture camaras with the Anschütz shutter and were the exclusive manufacturer for more than 30 years. This was the first really portable camera, a small box with high shutter speed.

--18-(xx) Here is another photo taken by Ottomar Anschütz. On every photograph by Anschütz there were printed the words “nach dem Leben aufgenommen” – “taken from life”.

--19-() This is a postcard from 1907, ten years after Lilienthal’s death. Even than Anschütz used his Lilienthal photos to advertise his studio.

But the large number of photos is not the only reason for the worldwide knowledge of Lilienthal’s flights. The second reason was the message: “man can fly” was newsworthy, an interesting headline for the new illustrated magazines.

--20-(j0625) Here are two historic examples. This is the cover of the Italian “La Tribuna” of October 14, 1894. The drawing was made from a photo by Anschütz.

--21-(1526)- And this is a public concept for a prospective air traffic with Lilienthal’s wings out of a German satirical magazine in those times.

Ladies and Gentlemen, in my work in the Lilienthal Museum, I have been a student of all facets of Otto Lilienthal's life and accomplishments for 20 years. Without doubt, Lilienthal represents the best traditions of German history, humanitarianism, philanthropy, engineering and science. It has been a great pleasure for me to share some of his life and times with you.

Thank you.