

some vastly different from their predecessors, some only subtly so. There probably would have been a great many more bi-wing gliders except for his death in 1896. Many of the designs seemed whimsical—wings shaped like those of a bat, a triangular tail like some birds, wings that folded back out of the way for storage but with an infrastructure that looked like individual feathers. But they worked, even the ones with the flappable wings. (He didn't launch by flapping those wings; rather, he took his usual leap off Fliegeberg, began to glide, and supplemented that with the occa-

sional flap, just like a bird.)

Aeronautical Homework

In a way, Lilienthal's experiments and his scientific writings about them, were the "homework" the Wright Brothers didn't have to do. They didn't have to design their early gliders from scratch because they had Lilienthal's experiments to turn to. Conducted over only five years, Lilienthal's flights numbered in excess of 2,000, and he was meticulous about documenting what did and didn't work and learning from his mistakes. It is believed that from his first glider flight in 1891, he flew every day for the next five years, many of his flights longer than 800 feet.

From those experimental flights, Lilienthal imparted to the Wrights the concepts of wing camber, a stabilizing vertical rudder in addition to a horizontal stabilizer, and a dedicated airfield from which to practice and experiment. Because of Lilienthal's pioneering work, the Wright Brothers could cut to the chase, prove their concept through glider work, then concentrate on combining their design with Charles Taylor's engine. The Wrights also learned the lesson of photography from Lilienthal. Whereas they weren't to become the media darlings that Lilienthal became (not by his design), they recognized the need for their ultimate triumph to be captured on film. That famous photograph, a freeze-frame of history in the making, was indisputable.

Powered Flight—Almost

Lilienthal had experimented with attaching, as he called it, a "dynamo" to an ornithopter design as early as 1893. The carbonic acid, gas motor produced all of two horsepower and was supposed to power the flapping of only the wingtips. Lilienthal decided after assembling it that it wouldn't fly and, indeed, never attempted to test fly it. In 1895 he tried again, this time with a more powerful motor which was supposed to move almost the entire wing. He did try to test fly this

configuration without success, and some scientists then and now believe he didn't succeed because he hadn't yet divorced himself from his fascination with bird flight, hence the focus on flapping wings. His experiments with powered airplanes didn't include and his theoretical writings about powered flight didn't involve propellers. Yet, with our perfect 20/20 hindsight many now believe he would have eventually abandoned his reliance on bird flight and come to the inevitable conclusion about propeller-generated thrust. Rather, because he was the engineer he was, he was dedicated to the time-honored trial and error method.

Prussian Hero

Nevertheless, his persistence even in the face of his failures at powered flight made Lilienthal a hero to his people and to aviation enthusiasts, such as they were, around the world, perhaps even to the Wrights themselves. "The Flying Man," "The Winged Prussian," was certainly an inspiration to them and indispensable in their ultimate accomplishment. (However, one German engineer still didn't believe that flight was possible, even given Lilienthal's extensive photographic documentation, and referred to Lilienthal as "The Flying Squirrel.")

Sunday, August 9, 1896, started off as usual at Fliegeberg. The winds were favorable and promised the 48-year old Otto Lilienthal hours of unimpeded gliding. So favorable did the winds appear to be that he opted that day for a mono-wing glider with a new approach to steering—opening and closing slits of cloth on the wings instead of shifting his body weight. (Some birds will "flare" their wingtip feathers to dissipate lift and make those "on a dime" turns. Lilienthal was attempting to duplicate this with a type of wing warping.) The launch was uneventful, but at an altitude of 50 feet, without warning a gust of wind pitched the glider upward. It stalled, and the force up the sudden pitch-up was apparently strong enough to break a section of the wing.

"So perfectly was the machine fitted together that it was impossible to find a single loose cord or brace, and the cloth was everywhere under such tension that the whole machine rang like a drum when rapped with the knuckles. As it lay on the grass in the bright sunshine, with its 24 square yards of snow white cloth spread before you, you felt as if the flying age was really commencing. Here was a flying machine, not constructed by a crank, to be seen at a county fair at 10 cents a head or to furnish material for encyclopedia articles on aerial navigation, but by an engineer of ability...a machine not made to look at, but to fly with."

Robert W. Wood, Boston Transcript Reporter, describing his first sight of a Lilienthal glider on August 2, 1896

