HEAVIER-THAN-AIR FLIGHT

Legend has it, as we have seen, that people were flying centuries before the Birth of Christ. On the other hand, we think of the Wright Brothers as having been truly the first men to fly in an airplane, but we seldom read the "fine print" and stop to realize that they were the first to build and fly a *powered* passenger-carrying airplane.

While balloons and dirigibles were in the air and carrying passengers, the heavier-than-air enthusiasts were to continue their experiments for 120 years before the Wright Brothers finally put together knowledge gained by earlier experimenters, plus their own, and made the dream of powered flight come true. Most of the pioneering aviationists could not divorce themselves from the idea of flying in the same manner as the birds. Since birds flap their wings to fly and do a good job of it, the early experimenters reasoned that man should do the same. The ornithopter, they thought, had to be the answer.

By 1800, most experimenters had realized that the man-powered ornithopter couldn't work, but they still thought the flapping wing might work if it could be powered mechanically. Toward this goal much effort was wasted.

In England, one of the world's great inventive minds was working on a new concept for heavier-than-air flight—a fixed wing. In 1804, Sir George Cayley constructed a whirling-arm device to test the resistance and lift of a miniature "wing" as it traveled through air. No doubt it was the knowledge Cayley gained from this experiment that led to his construction in the same year of the world's first *model* glider.

Cayley's glider consisted of an ordinary kite fixed to a pole (fuselage), and a tail plane and fin (horizontal and vertical stabilizers). Oddly enough, the kite, which uses fixed-wing aerodynamics, had been flown in China for many centuries, and in Europe since the 15th Century. But Cayley was the first to recognize and use its aerodynamic principles for free glider flight. On his 1804 model, he *inclined* the kite portion at an angle of incidence of about six degrees. The angle, in effect, produced an angle of attack that provided greater lift by allowing the wind to pass up and over the "wing." (You will learn more about lift in the textbook AIRCRAFT IN FLIGHT.)

The tail unit of Cayley's glider was attached to the pole by a universal joint. The joint allowed adjustment to any angle so that Cayley could control the glider's flight by preadjusting the tail unit's angle.

FIGURE 9 Cayley's glider; 1853

Cayley's 1804 "whirling arm" experiments and the model glider were of tremendous historic importance—the true beginning of fixed wing aircraft research.

From 1804 until 1853, he continued to develop improved gliders. In 1849, he built a triplane glider and sent it skimming down a hill with a boy as a passenger. In 1852, he designed another man-carrying glider and persuaded his reluctant coachmen to glide across a small valley. In 1853, at 80 years of age, he designed his most advanced glider. Along with these experiments, he designed dirigibles and helicopters far beyond his time.

Cayley wrote and published significant papers describing his aerodynamic experiments and theories. Among his findings was that wings should have *camber* (curved surfaces) to smooth and curve the air flow over them, and that wings with *dihedral* (a "v" angle) give an aircraft lateral stability and that tail surfaces are necessary for longitudinal stability. In short, it was Cayley whose genius laid the foundation for future developments in heavier-than-air flight.

His work was directly responsible for the next significant step in fixed-wing aircraft development—on the "model" level—taken by two of his contemporaries, also Englishmen—W. S. Henson and John Stringfellow. In 1842, Henson, who carefully studied Cayley's theories and experiments, designed the first steam-powered, propeller-driven, passenger-carrying aircraft. This design, with a 150-foot wingspan, never got off the drawing board, but it was another important "first."

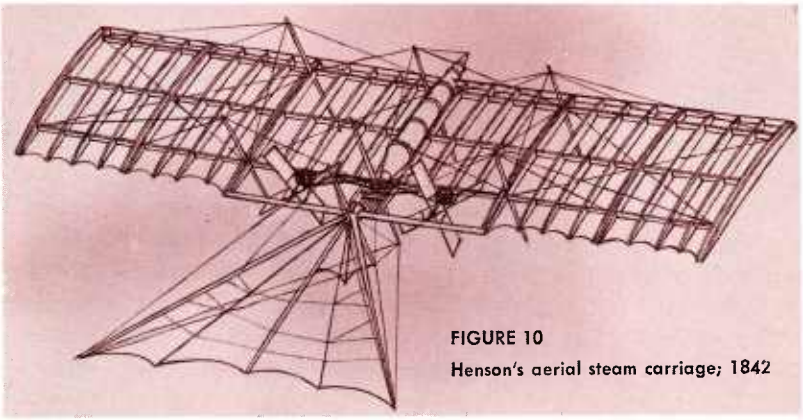

FIGURE 10
Henson's aerial steam carriage; 1842

FIGURE 11 Lilienthal's glider; 1895

Henson and Stringfellow built a model of the ambitious design with a 20-foot wingspan. In 1847, the model was tested but achieved merely a "descending glide." One reason it did not fly was that the steam engine was too heavy.

Henson gave up, but Stringfellow continued experiments based on Henson's designs. He built a model with a 10-foot wingspan and a small steam engine to power it. When he tested it in 1848, it achieved a part-powered, half-glide. Even though the test was made with a model, it was at that time considered to be the first time an airplane actually flew under power.

Ornithopter proponents did not give up because of Cayley's, Henson's, and Stringfellow's demonstrations. So it was with Frenchman Hurean DeVilleneuve. DeVilleneuve reasoned that he could achieve flapping-wing flight if he could devise a way to avoid lifting excessive weight.

To power his craft, which had a wingspan of almost 50 feet, he used a steam engine, but, ingeniously, he left the heavy boiler on the ground. Running from the boiler was a long flexible tube to the steam engine in the body of his ornithopter. Sometime in 1865, DeVilleneuve boarded his machine and turned on the steam. Abruptly the craft rose, vigorously flapping its wings. The pilot was probably