A REVIEW OF AERONAUTICAL PROGRESS*

By JOHN J. LONG

In these days of startling progress in the aeronautical world, we are prone to think that the development of aeronautics is of entirely recent date. The problem of human flight, however, has occupied the mind of man for centuries, and many and divers have been the solutions offered even before the dawn of the nineteenth century.

That famous artist and engineer, Leonardo da Vinci (1452-1519), was the first to give a technical suggestion for artificial flight. His design consisted essentially of wings, which were to be attached to the body of a man and operated by his arms and legs. This scheme never passed beyond the paper stage, but Fauste Veranzio in 1617 made a descent from a tower in Venice in a crude form of parachute, made of canvas, and he was probably the first actual experimenter. Many other schemes, some utterly impractical, followed Veranzio's attempt, notable among which was that of the Marquis de Bacqueville, who, in 1742, made a somewhat successful glide from the window of his Paris mansion across the gardens of the Tuileries, finally landing in the Seine.

The Montgolfier brothers, Joseph and Jacques, invented the hot-air balloon in 1783, and in the fall of that year Pilatre de Rozier, in a balloon of this type, made the first human ascent in a free balloon (November 21, 1783). It is interesting to note that this pioneer aeronaut was also the first to give up his life in the effort to conquer the air. Hydrogen gas had been discovered in 1776, and the celebrated physicist, Chasles, suggested its use in a balloon. DeRozier immediately constructed a balloon in which he attempted to combine the advantages of the hydrogen and the fire balloons, joining together two separate envelopes, the upper filled with hydrogen and the lower filled with heated air—an extremely dangerous combination. After sailing for half an hour, the balloon suddenly burst into flames and the aeronaut was dashed 3,000 feet to his death.

These balloons were, of course, incapable of accurate direction, and efforts were made to design a balloon which would be dirigible. General Meusnier, in 1784, anticipated in his design many of the excellent features of our modern dirigible. Among these may be mentioned the elongated form, the girth fastening, the triangular suspension, the air balloonet, the screw propeller, even indicating the place where the propeller should be installed. The death of Meusnier at the siege of Mayence, a few years later, undoubtedly prevented the practical development of this design.

The great difficulty in the way of the practical dirigible was a suitable power plant, which should combine light weight with efficiency. Giffard, well known as the inventor of the steam boiler injector, engaged himself in an attempt to solve this difficulty, and obtained a working steam engine weighing 100 pounds and capable of five horsepower. In 1852 he built a dirigible in which was installed a three-horsepower engine of this type, with a three-bladed propeller making 110 revolutions per minute. The airship was spindle shaped, 144 feet long, 40 feet in diameter at midsection, and of 90,000 cubic feet capacity. This dirigible, on at least one occasion, attained an independent velocity of about five miles per hour.

Passing over intervening attempts, many of which brought forth improvements of the Giffard design, we come to the work of Captains Renard and Krebs of the French army. They constructed a dirigible in 1884, in shape something like a fish, with the master-section at a distance from the nose of about a quarter length. The airship was driven by a nine-horsepower electric motor, actuated by current from a specially designed battery of chromium chloride cells. This motor drove a large wooden propeller, set forward, at a rate of 50 r.p.m. The rudder, fixed aft, was a solid body made of two four-sided pyramids, fixed together at their bases. The car was fixed rigidly to the net of the balloon by a diagonal rope suspension, and was provided with a sliding counterweight capable of movement fore and aft to balance any displacement of the center of gravity. This balloon, the "La France," left its hangar in September, 1885, performed evolutions over Paris, and returned to the starting point—the first flight on record where a balloon started from a definite point and returned under its own power. The maximum velocity was about 15 miles per hour.

The modern types of dirigibles have added little in fundamental principle to the work of Renard and Krebs. The "rigid" type, as exemplified by the Zeppelin, has been developed in Germany with marked success, while in France the "semi-rigid" type has been exclusively exploited, dating from the first Lebaudy dirigible in 1902.

Turning now to the development of the "heavier-than-air" machine, Sir George Cayley, in a paper published in *Nicholson's Journal* for 1809-10, enunciated some of the principles and ideas of mechanical flight, and even made a rough calculation of an engine which might be used as motive power, incidentally dropping the hint that a mixture of gas and air, when exploded under a piston, might give very satisfactory results. Cayley analyzed the forces acting on the wings of a bird, and showed experiments which he had performed to illustrate the relations between resistance and velocity in a surface moving through a medium.

In a paper on "Aerial Locomotion," read at the first meeting of the Aeronautical Society of Great Britain, in 1866, F. H. Wenham enunciated the important principle that the supporting force on an inclined surface being driven through the air is limited to a narrow portion near the front edge. This fact, of course, suggested a large "aspect ratio." He also pointed out the desirability of superposing the supporting surfaces to obtain great lifting power.

In 1890 Sir Hiram Maxim carried on a series of experiments on a captive machine of large size. The machine had a total lifting surface of 6,000 square feet and weighed 8,000 pounds. It was driven by two specially designed steam engines, each weighing 310 pounds and capable of developing 180 horsepower. A lifting effect of 3,000 to 4,000 lbs. was obtained, and on one trial the machine broke away from its upper guide rails.

Professor S. P. Langley, celebrated for his researches in solar physics, next took up the problem at the Smithsonian Institute, in Washington. Every detail was scientifically worked out by him, and he even developed a type of engine for his own use. He succeeded in accomplishing many flights with models, and then undertook the construction of a man-carrying machine. After much effort and many trying delays, he evolved a machine which he planned to launch from a house-boat on the Potomac. Defects in the launching apparatus proved disastrous to his "aerodrome," as he called it, and, disheartened by the ridicule of the press and the lack of funds, he was compelled to forego any further experiment.

Contemporaneous with Langley, Otto Lilienthal (1848-1896) had been carrying on exhaustive experiments with man-carrying gliders in Germany. After developing his glider until it was capable of glides of over 300 yards from a height of 30 yards or more, he planned a double-decked aeroplane, equipped with a motor. While testing a new steering arrangement, the machine lost its equilibrium and Lilienthal was killed by a fall of about sixty feet.

Octave Chanute, a bridge engineer, introduced Lilienthal's ideas to this country, and, in conjunction with Herring, developed a biplane glider which was capable of several hundred satisfactory flights. The Wright brothers, Wilbur and Orville, encouraged by what they had learned of Lilienthal's success, made a number of successful gliding experiments, which led to the construction of a motor-driven aeroplane. This resulted in a successful flight of 59 seconds on the 17th of December, 1903—undoubtedly the first man flight in a motor-driven aeroplane.

Santos-Dumont won the Archdeacon prize on October 23, 1906, for a flight of 25 metres, the first flight in Europe, and in January, 1908, Farman covered a triangular course of one kilometer, thereby winning the Archdeacon-Deutsch prize. Farman established yet another record by making the first cross-country flight from Chalons to Rheims, a distance of 17 miles, and Bleriot made the first closed trip across country from Toury to Artenay, a distance of 19 miles. One July 25, 1909, Bleriot crossed the English Channel, and in the same year Glenn Curtiss won the first international contest for America at Rheims.

The modern history of aeronautics is encompassed in a remarkably short span of years. The successful dirigibles of the French army and of Zeppelin in Germany, and the development of the many types

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of aeroplanes in this country by the Wrights and Curtiss, and abroad by Bleriot, Farman and others almost equally well known, are all matters of recent journalistic accounts. When the trans-Atlantic flight, which is now being planned, has become an accomplished fact, mankind will have witnessed the conquest of the last of the three elements—land, water and air—which has so long defied his utmost endeavor, and the possibilities of this conquest are almost beyond description. The rapid development of the past few years has been but the beginning of a greater progress which the future holds for aeronautics.