

results hitherto attained. The machine (cigar shaped) was 90 feet long with a diameter of 29, it carried a rudder of unvarnished silk, a propeller 9 feet long, and an electric motor—the whole fabric, with stores, motor, and aeronauts, weighing 2650 lbs. It managed to make seven miles against a head wind and did not manage to make any further appearance, as (so it was thought at the time) the flight had revealed some structural defects of radical character.

Proceeding on the lines followed by his predecessors Giffard, Dupuy de Lome, and Tissandier, Captain Renard, of the French army, chief of the balloon department of the service, reached high water mark of that day with his celebrated "dirigible" balloon *La France*. In his ascent he was accompanied by his assistant Captain Krebs of the same service. His machine was more like a cigar than any of its forerunners (see figure 3), it carried its propeller in front and its motor was electric, of greater power than Tissandier's. The ascent was made in June 1885. Here is the account published of the same by the *Times*. "The balloon was of elliptical form and carried an electric motor, a screw and a rudder, the motive power being derived from electrical accumulators which could supply during four hours a power of ten horses. These worked the screw which served as a propeller to the apparatus. The balloon was made of light strong silk, and was covered as usual with a netting to which the car was suspended. All the propelling mechanism was contained within the car, the rudder alone projecting outside like that of a boat. The car was mounted by Captain Renard, Director of the Balloon Works, and by his assistant, Captain Krebs, both engineer officers. On being released from the earth the balloon at once rose to a height of about 180 feet and, urged by the swift rotary movement of the screw, made a straight course for the Hermitage of Villebon, about seven miles distant as the crow flies. A wind was moving against it at a speed of 18 feet per second. Captain Renard worked the propeller, Captain Krebs steered. Villebon had been fixed upon as the goal of the journey, and when this place was reached Captain Krebs waved a flag as a signal that he was going to turn. The spectators were then amazed and delighted to see the balloon gracefully describe a curve of 300 metres radius and sail back to Meudon. On approaching the lawn from which the ascent had been made, the balloon descended in an oblique direction and with a steady motion, showing the engine was completely under control. Within twenty feet of the ground the machine was eased and a rope being thrown out from the car, the balloon was hauled down and touched the earth without the slightest shock. The whole journey had occupied about forty minutes.

From this account it is clear that the balloon *La France* had attained a speed of 21 miles an hour half of the course against a wind of 12½ miles. The feat caused great enthusiasm throughout the world. The United States government at once commissioned Thayer, the well known aeronaut, to build a "dirigible" double the size, carrying double the power. The theory was simple enough. It was in fact thought to be a mere question of proportion a question of lifting power. Double the lifting power, and you doubled the power carriage. The orders to Thayer therefore were to build a balloon of a diameter of 60 feet with an ascending force of 70 tons, driven by compressed air. A speed of 40 miles an hour was confidently expected as the result. The machine was designed according to instructions, but never built. The trouble was that Captain Renard ascertained by further experiments with *La France* that the machine was absolutely unmanageable in a heavy wind and nearly so in a moderately brisk breeze. The French War Office built another and larger machine nearly double the size. It had a motor of gasoline of 50 h.p., was said to be exceptionally manageable and altogether great things were mysteriously predicted of it on its first appearance, which would not be till the outbreak of war. Then the Germans, all the critics declared, would understand the meaning of *La Revanche*. But this redoubtable machine was never taken out into the light of day and has not been heard of for years.

Since the last appearance of Captain Renard's navigable airship there have been many, and in the hands of enthusiastic devotees. But they have never, in spite of the encouragement of prize offerings enough to stimulate the dreams of avarice, advanced beyond the efficiency achieved by *La France*. Her best factor of control and stability was the front propeller, and that has been followed in all the copies. Renard himself, now a colonel, disgusted by the demonstrations of weakness in the balloon principle of construction, has long been one of the most stringent supporters of the system of aviation. His contemporaries remained, however, staunch to the principle of arial navigation on behalf of which he had led the way with such high hopes.



ZEPPELIN'S BALLOON

By the end of the last century a host of aeronauts was competing for the lead. Invention succeeded invention and trial succeeded trial. The scientific journals gave great space to the chronicle of their doings, prizes were offered to stimulate their enterprise, every war office was busy and the number of aero-clubs multiplied.

In the first year of the present century Count Zeppelin, of the German army, made his great effort. He had headed the famous cavalry raid which opened the campaign of 1870/71. He was determined to wrest from the same enemy the empire of the air won by the efforts of Renard and the mysterious invention that was alleged to have followed them. The Kaiser looked on with approval, saying in his magnificent way that the Count had revolutionised the art of ballooning. The Count's airship was built in a floating house on Lake Constance. It was 420 feet long with a diameter of 28 feet, it was covered with a network of aluminum, its material was water-tight pergamoid above, and light silk below. Fashioned in cigar shape, it was divided into seventeen compartments, each carrying its own separate gas supply. Suspended was a gangway nearly the length of the fabric, carrying two aluminum cars, each furnished with benzene motor of 10 h.p. with oil tanks and water ballast. There were two aero propellers at the sides of the machine about the centre a rudder and a running weight for keeping the balance. On the day the ship was brought out of its house it had cost the inventor £7000, and the ascent that followed cost him £600 more. On that day, in the presence of a large crowd of spectators, the majestic fabric rose into the air and was very soon in difficulties. The steering apparatus fouled one of the propellers the breakdown of a winch paralysed the running weight, and the power was found to be not nearly enough. Nevertheless, after sailing some four miles, on a fairly straight course, the ship came safely to land, and as she was taken back to the floating house there were many congratulations and as many prophecies

of her future greatness. But she never left that house again. The trip had revealed structural defects of radical character. Attempts were made to raise funds, as the inventor's means were exhausted, but without avail, the business of investing in airships having come to be regarded as risky. The Zeppelin airship was never heard of more, and the only subsequent news that concerned her in any way was the announcement of her patriotic proprietor's bankruptcy.

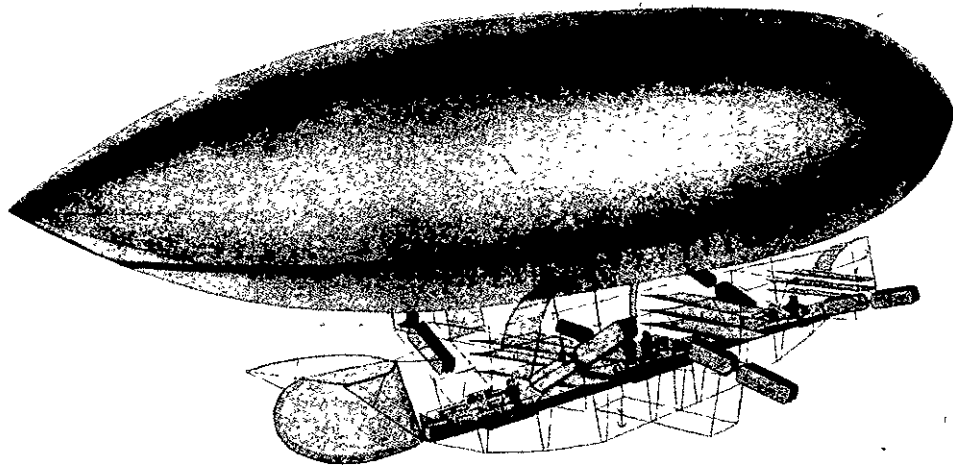
A host of rivals was in the field, the patent offices of Europe and America were busy, and men began to seriously consider whether after all they were not destined to fly, in machines of cunning construction.

Conspicuous among the crowd of aeronauts was Santos Dumont, the young and enterprising Brazilian. He appeared first in the front in the same year that witnessed the failure of Zeppelin with a cigar-shaped balloon supporting a spar on which he rode after the manner of a cyclist. Machine after machine did he construct until he astonished the world by flying round the Eiffel Tower and winning the Deutsch prize of £4000. He had a gasoline motor developing great power with very light weight a thing which seemed to realise the mechanical aspiration of "a horse-power in a watch case" and he did the distance—3½ miles and back—in half an hour. The world applauded him wildly, but he fell short of the record of Renard by two miles an hour, and he only flew half the French soldier's distance, and in subsequent efforts he had many dangerous accidents. Encouraged by the plaudits of the public of many countries he went on building on the same lines, until he was announced as a competitor for the prize offered by the authorities of the St. Louis Exhibition for the best airship. He was to compete in a vessel 165 feet long by 27 feet of diameter, with a motive power of 60 horses.

This inventor was the theme of much comment at this time. People seemed to think him capable of any feat, no matter how extraordinary. He had said one authority, a very handy machine, just the thing for paying visits in 50 feet by 18 of 3 h.p. and a speed of 10 miles an hour rain or shine; he was building his great omnibus airship 157 feet by 28. He would carry a load of passengers with regularity and despatch and he would charge them by weight. These and other stories went round about the young man, while he steadily plugged away at his calling.

In the crowd of his rivals the brothers Lebaudy took a high place with a balloon dirigible of the inevitable cigar-shape, 185 feet by 32, driven by a 40-h.p. gasoline motor which, having beaten the Santos Dumont record was taken up by the French war office, ever on the look-out for novelties of promising character.

The names of the rest were legion, and all were sailing airships of the old pattern which Renard had brought to a condition not seriously surpassed by any of his successors. The new types were better framed they had very much better motors, and had attained nearer to permanency of rigidity—the quality for lack of which balloons become flabby and refuse to steer—but they were totally unmanageable in anything like a "breeze." The papers were full of the doings and intentions of the Marquis de Dion, of Messrs Pilet, Robert, Girardet, Boisset, Bourgoin, Francois and a host of others. Nor was England behind. The honour of the flag was supported by Spencer with a machine 93 by 24 with a power of 24 horses, by Beedle with one of the same dimensions and half the power, and by the veteran experimenter of twenty-five years Dr.



DR. BARTON'S AIR-SHIP.