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The Challenge of the Sky

The 75th anniversary of the Wright brothers' historic flight comes later this year. These days we tend to take our ability to fly for granted. Here is a review of how this astonishing faculty was developed, and of what it means to the human spirit today...

□ The date was November 21, 1783; the place, the Bois de Boulogne in Paris. An excited crowd looked on as two French aristocrats, Jean-François Pilâtre de Rozier and the Marquis d'Arlandes, climbed into a tub-like circular "gallery" suspended below a huge linen bag inflated with hot air from a fire of straw. A natural historian by profession, Pilâtre de Rozier was the hero of the hour. Word had spread through the throng of his response when King Louis XVI offered to supply two condemned prisoners to risk the perils of being hoisted aloft by the Montgolfier brothers' amazing new invention. According to the gossip that buzzed about, the historian had exclaimed: "Shall vile criminals have the honour of first rising in the sky? I myself shall go!"

At approximately 2 p.m. the mooring lines holding the balloon to the ground were cast off and it began to ascend very slowly. The spectators held their breath as the two men fed the fire in a brazier in the gallery with handfuls of damp straw and the surface of the balloon was set alight in several places by the sparks. But they had come prepared; they rushed around the gallery with wet sponges, snuffing out the fires on the linen. This danger past, the balloon rose smoothly, soaring above the Invalides and the École Militaire.

The two "aeronauts" came safely to earth more than 20 minutes later beyond the Boulevards, several miles from their starting-point. With that long leap over the roof tops of Paris, one of the oldest and boldest dreams of mankind was realized. Since the infancy of civilization, human beings had gazed at the sky and wished for what seemed to be impossible — to break the invisible bonds that held them to the earth and so transform themselves into aerial creatures. And now the impossible had been done.

From that day on, people would never cease to attempt to fly higher, farther, faster and in greater numbers. Within a fortnight, another Frenchman, the physicist J.A.C. Charles, rose to a height of two miles in a balloon filled with hydrogen gas produced by pouring sulphuric acid on iron filings. Charles experienced violent pains in the ears and jaw from depressurization, and was so shaken by the experience that he publicly vowed never to fly again.

But nothing could stop the impetus to take to the air. In January, 1785, the English Channel was successfully crossed by balloon from Dover to a woods near Calais — though not before the two aeronauts aboard had saved themselves from coming down in the water by throwing out all the unnecessary weight in the carrying car, including most of the clothing they wore.

In June of that year the gallant Pilâtre de Rozier became history's first fatal casualty of the quest for improved ways to fly when his experimental combination hot air and hydrogen balloon burst into flames at 3,000 feet in an attempt to cross the Channel from France to England. Two other familiar types in aviation also made their appearance:

the first aerial hijacker, who jumped with sword drawn into the car beside a well-known French balloonist and demanded to be taken along (he was overpowered by the ground crew), and the first stunt flyer, who flew sitting astride a horse.

As in later times, progressive minds pondered the possibilities of flight. The statesman and writer Horace Walpole speculated that the balloon would replace the sailing ships, turning Britain's seaports into deserted villages. Come what may, Walpole was enthusiastic. "How posterity will laugh at us, one way or the other!" he wrote to his friend Sir Horace Mann in 1785. "If half a dozen break their necks, and Balloonism is exploded, we shall be called fools for having imagined it could be brought to use: if it should be turned to account, we shall be ridiculed for having doubted."

In 1863, a two-storey airliner with all the modern conveniences

Among the first to tap the practical potential of balloons were military men. The French Army was quick to press them into service for reconnaissance purposes. The battle of Fleurus in 1794 was said to have been won by virtue of information on enemy movements gained by balloon. As early as 1849 the Austrians used small unmanned balloons to bomb Venice. Balloons were employed extensively for artillery observation by the Union Army in the American Civil War.

In 1863 the idea of an airliner, with all modern conveniences, was broached by a Paris photographer named Nadar. He launched a giant balloon carrying a two-storey cabin which contained a refreshment room, lavatory, etc. On its second flight his craft took 17 hours to carry nine passengers on a 400-mile trip to Hanover. It was a rough passage. The wind so jostled the airship that none of the passengers escaped being bruised and several were seriously hurt.

Nadar was well aware of the weakness of the balloon as a medium of mass transportation. Although it could be navigated to some extent, it would be at the mercy of the winds as long as there was no force to drive it along. His efforts to finance the development of powered balloons failed. Many methods of propelling balloons had previously been suggested, including rowing them through the air like boats and towing them with harnessed flocks of birds. One French government experiment in 1872 employing eight labourers to power a propeller actually succeeded in driving a balloon against a strong wind.

Experiments with steam, clockwork, electric and gasoline motors, as well as with cigar-shaped body designs, led to the successful development of the rigid-bodied dirigible by Count Ferdinand von Zeppelin of the German Army in 1897. In 1910 Zeppelin balloons were used to inaugurate the first regularly-scheduled passenger air service; it carried almost 40,000 people before it was suspended at the outbreak of World War I. The Germans then used the Zeppelin to introduce a new horror of war: the bombing of civilians in cities. In the 1920s the 775-foot *Graf Zeppelin* was the vehicle for the first transatlantic air service, flying passengers between Germany and North and South America. Another world war was looming when the age of dirigible travel came to a sudden finish. On May 6, 1937, the huge, luxurious German airship Hindenburg collapsed in flames at the end of its 37th transatlantic crossing at Lakehurst, New Jersey, with the loss of 36 lives.

An artificial bird brings the inspiration for the propeller

Ballooning thus played a long and significant part in the achievement of human flight — a part often belittled by historians. Some writers, indeed, have suggested that it impeded the development of heavier-than-air aviation in that it discouraged the search for alternative ways to fly. On the other hand, it can be said that ballooning actually stimulated interest in working towards a more efficient form of aerial transportation. Certainly it established the intellectual framework necessary to progress in aviation simply by demonstrating the fundamental fact that it was possible for man to fly.

It is difficult for a modern person to appreciate the extent of this psychological break-through. For many centuries people had been staking their lives on the belief that, given the right conditions, they could fly like birds on artificial wings. By compar-

ing the physiques of birds and humans in the latter part of the 17th century, G.A. Borelli of Italy showed scientifically that man could not fly under his own power.

In 1670 Borelli constructed an artificial bird which for the next 200 years would be a subject of study and modification. Out of this research it was discovered that the propulsion for a bird's flight comes from the outer section of the wing, which twists in the air. From this came the concept of the twisted aerial screw, or propeller. In 1796 Sir George Cayley constructed a miniature model flying machine which rose in the air by means of two counter-rotating propellers. He estimated that if the area of the propellers could be increased to 200 square feet, the device could lift a man.

The airplane gets a lift from models powered by rubber bands

Cayley is a case in point of the stimulus the development of heavier-than-air aviation received from ballooning. He was only ten years old when the first balloon flights piqued his imagination as to the different ways in which man might fly. He grew into a country gentleman with a wide range of scientific interests. He studied the flying properties of kites and birds, concentrating on the resistance encountered by a body moving through the air. This, he recognised, would have to be overcome by a combination of wings and engines in any non-balloon flying machine.

Through experiments with model wings, Cayley also came to realize that stability and control would be crucial to the success of aviation. In 1804 he built a model glider which has been called the world's first true airplane. In 1849 he launched a full-sized glider which carried a ten-year-old boy off the ground for several yards in the first documented heavier-than-air human flight.

Cayley's aerodynamic theories were improved upon by Alphonse Pénaud of France, who in 1871 constructed a two-propeller vertical flying model powered by a twisted rubber band which he called a *hélicoptère*. Soon to become a popular toy, it worked on the same principle as the big machines that bear its name today. Pénaud next built a horizontal model with wings called "aeroplanes" which resembled the modern aircraft in almost every detail. Having made great strides in aerodynamics with these models, he was ready to go on to building a full-sized manned flying boat.

His proposal for this machine included several of the key technical features that would enable aircraft to fly in the next century, including a forward propeller, a tail plane, central controls, and retractable landing gear. He set out to raise financial backing for what might well have become the world's first practical airplane, but could find no one willing to take the risk. Heart-broken, he committed suicide in 1880. He was 30 years old.

In the meantime other, more affluent inventors were working on the problems of powered aviation. A disciple of Cayley's, William S. Henson, designed a prototype of an "aerial steam carriage" to carry "letters, goods and passengers from place to place", but it never flew. As long as steam engines were employed for power, no aircraft could lift itself with a man in it. The last of several attempts to fly a man with steam power ended in the Potomac River near Washington, D.C., when S.P. Langley's promising "aerodrome" broke into pieces as it was being launched on December 8, 1903.

On that same date, some 250 miles to the south, two young men were camped among the windswept sand dunes of the Outer Banks of North Carolina. They were brothers who ran a bicycle repair shop in Dayton, Ohio — Orville and Wilbur Wright. When they were boys their father had given them a 50-cent toy — one of Pénaud's rubber-band-powered helicopter models. They had been "afflicted with the belief that flight is possible to man", as Orville put it, ever since.

Drawing largely on the aerodynamic findings of Otto Lilienthal, the German aviation pioneer who made more than 2,000 glider flights before he crashed to his death in 1896, the Wright brothers began to experiment with gliders in 1900. It was then that they came to a spot on the dunes named Kitty Hawk, which appealed to them because of its soft sand, which minimized the danger from crashes, and the absence of obstacles such as trees.

There they made a number of glider flights to check out the conclusions drawn from experiments with various wing configurations in a wind tunnel they had constructed back in Dayton. As a result of this work they devised a uniquely efficient and stable set of wings which could be flexed at the ends to maintain balance in flight.

They had also built their own light-weight gasoline engine after having failed to interest several automobile engine manufacturers in supplying one for them. It was to drive a propeller of their own design, twisted so as to transform 66 per cent of the engine's 13 horsepower into forward thrust. On the day that Langley's aerodrome failed, they were busy fitting together the pieces of their flying machine which they had pre-shipped from Dayton. Six days later they were ready to try it out.

Wilbur had won the right to drive the machine by the toss of a coin. It charged down the wooden launching rail, rose momentarily, then collapsed in the sand. Wilbur was unhurt, but the plane was damaged. It took another three days to repair it. Then it was Orville's turn.

On December 17, 1903, he laid himself flat on the lower wing of the craft while his brother started the engine. What happened next is perhaps best captured in his own words:

"After running the motor a few minutes to heat it up I released the wire that held the machine to the track and the machine started forward into the wind. Wilbur ran at the side of the machine holding the wing to balance it on the track. Unlike the start on the 14th made in a calm the machine facing a 27-mile wind started very slowly . . . Wilbur was able to stay with it until it lifted from the track after a 40-foot run. One of the life-saving men snapped a camera for us taking a picture just as it reached the end of track and the machine had risen to a height of about two feet . . . The course of the flight up and down was extremely erratic, partly due to irregularities in the air, partly due to inexperience in handling this machine. A sudden dart when a little over 120 feet from the point at which it rose in the air ended the flight . . . This flight lasted only 12 seconds but it was nevertheless the first time in history in which a machine carrying a man had raised itself by its own power into the air in full flight, had sailed forward without a reduction of speed, and had finally landed at a point as high as that from which it had started."

The first passenger aircraft and the world's first airline

A great event in science is like the opening of the flood-gates of a dam. From then on the stream of endeavour moves inestimably faster. Within two years of that flight of less than a minute a few feet off the ground, the Wright brothers had stayed high in the air for more than half an hour and covered 24 miles. By late 1909 Henry Farman had gone nearly 140 miles in four hours, and Louis Blériot had flown across the English Channel in a single wing surface monoplane.

The next few years brought a steady succession of flying exploits and technical advances. Pressed by the terrible imperatives of warfare, aviation took a great leap forward in World War I. In 1919 the first all-metal cantilevered-wing passenger aircraft designed by Germany's Otto Junkers, went into service with the world's first airline, Lufthansa. That same year Alcock and Brown flew the Atlantic Ocean non-stop.

In 1930 a young Royal Air Force officer named Frank Whittle patented the turbo-jet engine. With this, all the basic ingredients became available for trans-oceanic flight as we know it today. Still, it would take the work of thousands of unsung aviation technologists over many years before people could constantly fly in vast numbers at speeds and over distances undreamt-of in the early days of aviation. Who 50 years ago could seriously have predicted that it would one day become a matter of daily routine to fly between London and New York in 3½ hours?

The only word for it is incredible. But then the whole story of man's conquest of the sky may be described by the same word. By showing that people are capable of achieving the seemingly impossible, it raises the question: If man can fly, what can he not do? To the Montgolfiers, the Cayleys, the Wrights and all the rest, we owe the knowledge that no challenge is insurmountable if human ingenuity and will are fully engaged.

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