

THE MONTGOLFIER BROTHERS

History of the hot air balloon

The oldest successful human-carrying flight technology is nothing more than a bag of hot air lifting a gondola. The first manned flight ever took place in 1783 and unmanned balloons were already popular in 220 AD for military signalling in China! They were the first mechanisms used in air warfare and with the record set at 21,027 meters they can fly at extremely high altitudes. In 1991 a 74 thousand cubic meters hot air balloon flew over a distance of 7671 kilometres and the ground speed record is set at 110 meters per second! Imagine it all started for real when an inventor was doing the laundry...

TEXT JAN SCHNEIDERS, STUDENT AEROSPACE ENGINEERING, EDITOR LEONARDO TIMES

HISTORY

The Chinese already found a use for unmanned hot air balloons in the Three Kingdoms era (220-280 AD) where they used so called Kongming lanterns for military signalling. More than a thousand years later the first documented flight in Europe was performed in 1709 by the priest Bartolomeu de Gusmão. He created a small balloon made of paper containing hot air and managed to lift it about four meters high. After a few more tests the 'flying priest' attempted to lift himself from the St. George's Castle in Lisbon, but sadly, this only resulted in a one kilometre controlled fall.

The first real and successful manned ascent was performed by the brothers Joseph-Michel and Jacques-Etienne Montgolfier in 1783. They were born into a family of very successful paper manufacturers with sixteen children. Joseph possessed a typical inventor's temperament; he was a dreamer and a maverick. One day he observed laundry drying over a fire, forming pockets that billowed upwards. Fulfilled with excitement Joseph imagined that this could be the ultimate solution to one of the great military issues of the day: an assault on the fortress of Gibraltar, which was impregnable by both sea and land. An air assault could possibly

be realized with the phenomena he had observed!

Having never heard of the experiments of the flying priest more than seventy years earlier he thought the lifting force was generated by a special gas, which he called 'Montgolfier gas'. With the property of levity he believed that it was this fictitious gas lifting burning embers from a fire and that this gas could possibly lift a balloon! Joseph became very enthusiast and planned to build a box-like chamber out of very thin wood covered with lightweight taffeta cloth. He recruited his brother by writing him the prophetic

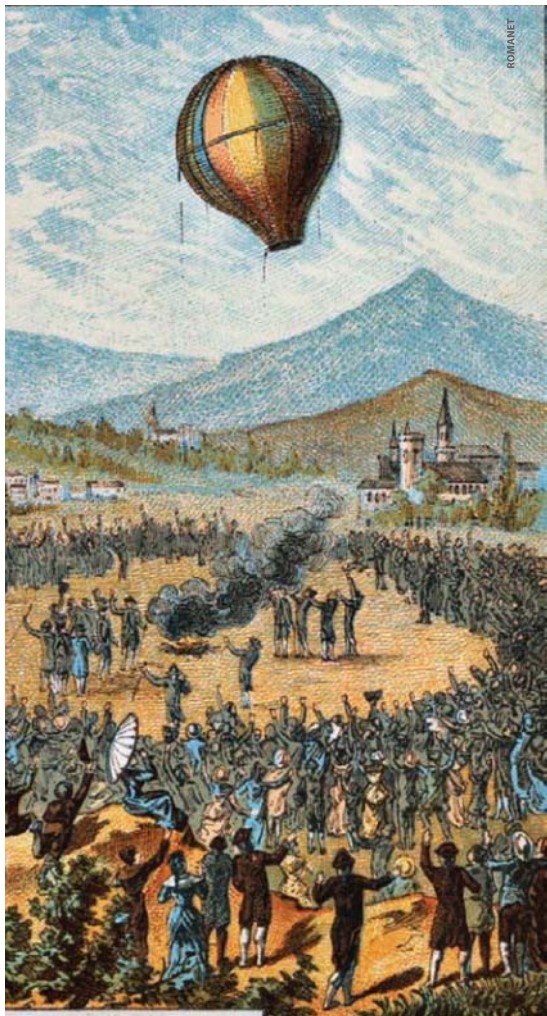


Figure 1. First public test flight with an hot air balloon.

words: 'Get in a supply of taffeta and of cordage, quickly, and you will see one of the most astonishing sights in the world.' Together they build a 27 cubic meters contraption. On the very first flight test they lost control of the craft because the lifting force it generated exceeded all their expectations. But even though the balloon did not go exactly where they wanted it to go, it did fly! The box floated nearly two kilometres and after it stranded the balloon was destroyed by the indiscretion of a bystander, who believed the balloon to be a monster attacking him from the sky.

After this small success the brothers decided to demonstrate a new balloon in public to establish their claim to the invention. They constructed a balloon which could contain 790 cubic meters of air and weighed about 225 kilograms. On 4 June 1783 this first public demonstration of their brand new aerostat took place at Annonay in France (see also figure 1). The flight reached an estimated altitude of 2000 meters and lasted about ten minutes. The word of their success quickly reached Paris and the brothers started to work on a new balloon immediately. The next step was to get a living being up in the air. There was some concern about the effects of flight into the upper atmo-

sphere on living creatures, hence the king kindly proposed to launch two criminals with the next flight for testing purposes.

The brothers however decided to send three animals up in the air: a sheep because it was believed to have a reasonable approximation of human physiology, a duck, which was expected to be unharmed by any altitude the aircraft could reach and a rooster were also put in the basket below the balloon to observe the possibly harmful effects from within the aircraft itself. It rose up in the air from the royal palace in Versailles through heavy rainfall and was carried away to a nearby village by a heavy storm. At this time the brothers still believed it was the 'Montgolfier Gas' within smoke which caused the balloon to rise, hence there was a smoky mess in and around the aircraft. In spite of that and while the weather conditions weren't perfect, the balloon landed safely; the first flight with living creatures was a success!

Following the success in Versailles a 1700 square meters large hot air balloon was created for the first flights with human passengers. After a few tethered flights the first free flight with humans was finally made on 21 November 1783. Taking off from the western outskirts of Paris the aircraft flew at about 3000 feet over a distance of nine kilometres.

Further developments did not always go without problems. The first aircraft disaster occurred in 1785 when a hot air balloon crashed in the town of Tullamore (Ireland), resulting in a fire that burned down about one hundred houses. Almost parallel to the hot air balloon, hydrogen balloons were developed. This proved to be a better technology and further development led to airships such as for example the Zeppelin.

FLIGHT TECHNIQUE

Hot air balloons do not rely on the fictitious Montgolfier gas, but solely on the buoyancy of hot air in the balloon. The hot air inside the balloon is lighter than the surrounding air, making the total weight of the aircraft lighter than the weight of the displaced air. The temperature of the air in the balloon and thereby the rate of climb or descent can be controlled by burners and sometimes by vents in the balloon. This is the only way to have any influence on the direction where the balloon is going!

A balloon moves with the wind, which means that its passengers will feel no wind during cruise flight! If the balloonist wants to change direction he can only change altitude to try to get someplace where the wind is blowing in a different

direction. Due to the Coriolis effect the wind direction turns - in the ideal case and in the northern hemisphere - right with an increasing altitude. This allows the pilot to, up to a certain degree, actually go to a predetermined direction. It also means that the pilot can expect a turn to the left when descending. This can make landing difficult and history shows that of all accidents with hot air balloons many involve the balloon ending up in power lines.

MODERN BALLOONING

Steerable balloons like Zeppelins became very popular during the 1930s. Only a few years later though, the end of the short airship era was marked by the Hindenburg disaster in 1937. The Hindenburg LZ 129 caught fire and demonstrated how dangerous airships could be; it was completely destroyed in less than a minute while attempting to dock with its mooring mast (see figure 2).

In science, hydrogen balloons were extensively used for upper-atmosphere research in the mid-20th century. These flights set a series of altitude records before space flight eclipsed ballooning as an endeavor. But even though they are becoming obsolete for scientific purposes on earth, balloons could be useful for exploring other planets. The lack of directional control is then not a big concern, since there is no need to go in a specific direction. If there is an atmosphere thick enough to provide buoyancy, a balloon could examine large areas with far more detail than an orbiting satellite can. The Soviet Union already sent balloons to Venus in 1985, but due to the blazing temperatures at the surface of the planet these missions did not last very long. Scientists are working on a new mission though and perhaps in the near future balloons can provide us with new insights into the astonishing climate of Venus... ✈



Figure 2. The Hindenburg on fire in 1937

References

- C.C. Gillispie, The Montgolfier brothers and the invention of aviation 1783-1784
- J. Dicht, John P. Jackson, The Science and Art of Hot Air Ballooning