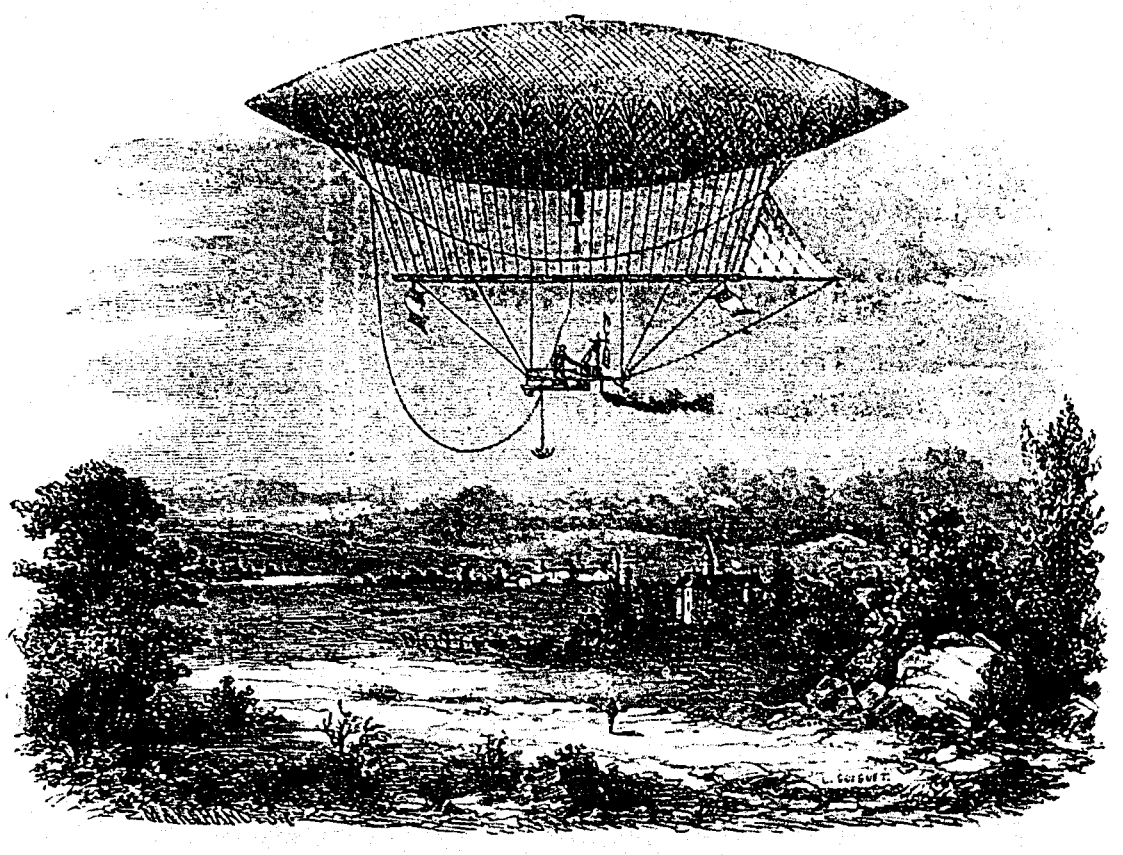
NAVIGABLE BALLOONS

For many years past the question of the possibility of constructing balloons which should be capable of being guided in their mid-air course has formed a subject of intense interest for aëronauts, and one which excited a good deal of attention in the general world of science. Several so-called navigable balloons have been constructed, but few, if any of these, were worthy of the name, the majority turning out miserable failures.

The first real success in aërial navigation was achieved in 1852 by Henry Giffard, who made his trial ascent in Paris on the 24th of September in that year. His balloon was of an elongated form, terminating at each end in a point, and measuring 144 ft. in length and 31 feet in diameter This was covered with a net, by which it was confined to a large cross-beam, from which hung the car. At one end of the cross-beam was a moveable triangular sail which performed the part of a rudder, the beam itself acting in the same manner as a ship's keel. The great novelty in Mr. Giffard's balloon was the mode of propulsion, which was steam. The place of the usual car was taken by an engine and tender —the former of 30 man power, and the whole weighing only 330 lbs. By means of this engine a fan, or screw, resembling in shape the usual steamship screw, was put in motion. The object of this screw was to furnish sufficient resistance to the force of the wind to allow of the balloon remaining motionless long enough for it to answer easily to its "helm." Mr. Giffard's first ascension was made under unfavourable circumstances, the wind being very high, but he met with sufficient success to put beyond a doubt the correctness of his principle of aërial navigation.



GIFFARD'S BALLOON, 1852.

Since 1852 this question of aërial navigation was very much lost sight of until it was last year once more brought into prominence by the exigencies of warfare. During the siege of Paris balloons were once more brought into requisition, though strange to say the principle of navigation was utterly overlooked by the Government. The results were what might have been expected. Out of sixty balloons dispatched fifteen fell into the sea or into the hands of the enemy. All this loss might have been easily avoided had Giffard's simple principle of navigation been put into use. As it was only one man bestowed a thought upon it. M. Dupuy de Lôme, the celebrated engineer, offered to construct a balloon which should have steering powers of its own, but he encountered so many delays from the supineness of the Government, and the difficulty of procuring requisite material that his machine was only finished four days before the capitulation. Then came the disorganisation caused by the second siege of Paris. At last M. de Lôme obtained permission to use some buildings at the Fort of Vincennes, and thence, on the 2nd of February, he started on his trial trip. *Engineering* gives the following full account of this interesting voyage :

The construction of this aërial machine, starts with the principle, that to obtain a navigable balloon, the two following conditions must be complied with.

1st. The permanence of the form of the balloon, without any sensible undulation of its surface.

2nd. Obtaining a horizontal axis of least resistance in a direction parallel to the propelling force.

The permanence of form is assured by a fan carried in the car, and put in communication by a tube with a small balloon placed within the large one at its lowest part. The volume of this small balloon is one-tenth of that of the larger one. It is furnished with a valve opening both within and without, and regulated by springs. The large balloon is provided with two hanging tubes open to the air, and falling for a distance of 25 ft. from the lower part of the balloon. The inflation of the little balloon causes the hydrogen to fall more or less in the hanging tubes, but never sufficiently to force it out of their open ends.

To obtain a horizontal plane of least resistance, the form given to the balloon was that developed by the arc of a circle turning around its chord, and in which the versed sine was nearly one-fifth of the length of the chord.

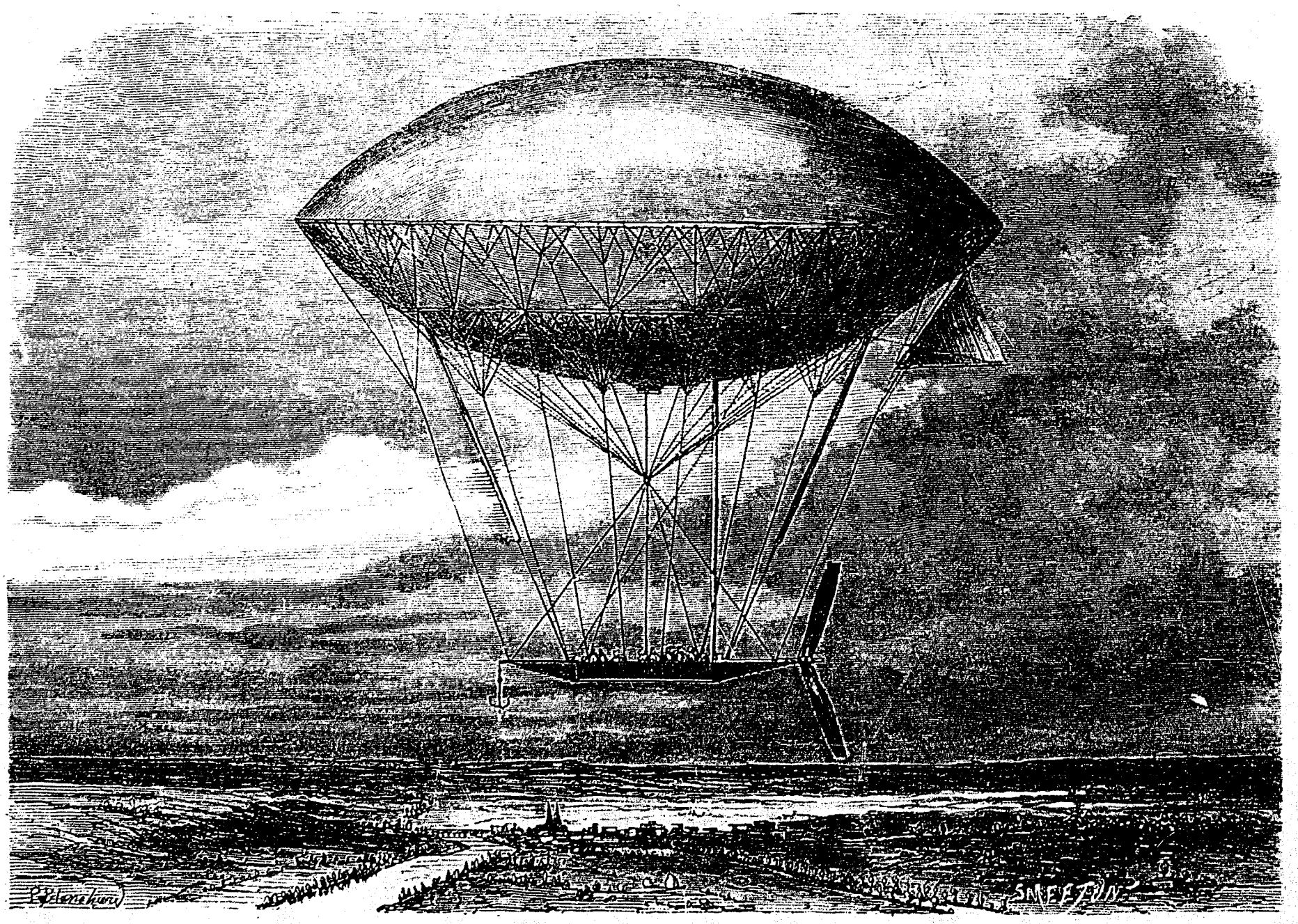
The following are the principal dimensions of the balloon :

	ft.	in.
Total length from out to out ..	118	6
Greatest diameter	48	9
Cubic contents ..	122,000	0
Total height from the top of balloon to the bottom of the car .	95	6
Length of the car	41	3
Greatest width of the car	10	8
Diameter of screw	29	6
Pitch of screw	26	2

Ascensional force : tons.

With small balloon not inflated	3.799
" " inflated	3.419
Number of revolutions of screw per minute to obtain a speed of 5 miles per hour	21
Time required to fill the small balloon by aid of the fan	15 minutes.

The upper portion of the balloon is covered with an envelope of fabric, which supports the car by a zone placed around the centre of the body. This envelope is then continued below the upper half until it covers about three-fourths of the body. Below the envelope, and attached in a similar manner, is a second zone within the first one, having the form of a cone tangential to the sides of the balloon. The summit of this cone serves to attach the cordage by which the car is sustained. The rudder consists of a triangular sail placed be-



DUPUY DE LOME'S BALLOON, 1872.