

CHAPTER SEVENTH.

Geometrical Details.--Calculation of the Capacity of the Balloon.--The Double Receptacle.--The Covering.--The Car.--The Mysterious Apparatus.--The Provisions and Stores.--The Final Summing up.

Dr. Ferguson had long been engaged upon the details of his expedition. It is easy to comprehend that the balloon --that marvellous vehicle which was to convey him through the air--was the constant object of his solicitude.

At the outset, in order not to give the balloon too ponderous dimensions, he had decided to fill it with hydrogen gas, which is fourteen and a half times lighter than common air. The production of this gas is easy, and it has given the greatest satisfaction hitherto in aerostatic experiments.

The doctor, according to very accurate calculations, found that, including the articles indispensable to his journey and his apparatus, he should have to carry a weight of 4,000 pounds; therefore he had to find out what would be the ascensional force of a balloon capable of raising such a weight, and, consequently, what would be its capacity.

A weight of four thousand pounds is represented by a displacement of the air amounting to forty-four thousand

eight hundred and forty-seven cubic feet; or, in other words, forty-four thousand eight hundred and forty-seven cubic feet of air weigh about four thousand pounds.

By giving the balloon these cubic dimensions, and filling it with hydrogen gas, instead of common air--the former being fourteen and a half times lighter and weighing therefore only two hundred and seventy-six pounds--a difference of three thousand seven hundred and twenty-four pounds in equilibrium is produced; and it is this difference between the weight of the gas contained in the balloon and the weight of the surrounding atmosphere that constitutes the ascensional force of the former.

However, were the forty-four thousand eight hundred and forty-seven cubic feet of gas of which we speak, all introduced into the balloon, it would be entirely filled; but that would not do, because, as the balloon continued to mount into the more rarefied layers of the atmosphere, the gas within would dilate, and soon burst the cover containing it. Balloons, then, are usually only two-thirds filled.

But the doctor, in carrying out a project known only to himself, resolved to fill his balloon only one-half; and, since he had to carry forty-four thousand eight hundred and forty-seven cubic feet of gas, to give his balloon

nearly double capacity he arranged it in that elongated, oval shape which has come to be preferred. The horizontal diameter was fifty feet, and the vertical diameter seventy-five feet. He thus obtained a spheroid, the capacity of which amounted, in round numbers, to ninety thousand cubic feet.

Could Dr. Ferguson have used two balloons, his chances of success would have been increased; for, should one burst in the air, he could, by throwing out ballast, keep himself up with the other. But the management of two balloons would, necessarily, be very difficult, in view of the problem how to keep them both at an equal ascensional force.

After having pondered the matter carefully, Dr. Ferguson, by an ingenious arrangement, combined the advantages of two balloons, without incurring their inconveniences. He constructed two of different sizes, and inclosed the smaller in the larger one. His external balloon, which had the dimensions given above, contained a less one of the same shape, which was only forty-five feet in horizontal, and sixty-eight feet in vertical diameter. The capacity of this interior balloon was only sixty-seven thousand cubic feet: it was to float in the fluid surrounding it. A valve opened from one balloon into the other, and thus enabled the aeronaut to communicate with both.

This arrangement offered the advantage, that if gas had to be let off, so as to descend, that which was in the outer balloon would go first; and, were it completely emptied, the smaller one would still remain intact. The outer envelope might then be cast off as a useless encumbrance; and the second balloon, left free to itself, would not offer the same hold to the currents of air as a half-inflated one must needs present.

Moreover, in case of an accident happening to the outside balloon, such as getting torn, for instance, the other would remain intact.

The balloons were made of a strong but light Lyons silk, coated with gutta percha. This gummy, resinous substance is absolutely water-proof, and also resists acids and gas perfectly. The silk was doubled, at the upper extremity of the oval, where most of the strain would come.

Such an envelope as this could retain the inflating fluid for any length of time. It weighed half a pound per nine square feet. Hence the surface of the outside balloon being about eleven thousand six hundred square feet, its envelope weighed six hundred and fifty pounds. The envelope of the second or inner balloon, having nine thousand two hundred square feet of surface, weighed only about five hundred and ten pounds, or say eleven hundred and sixty

pounds for both.

The network that supported the car was made of very strong hempen cord, and the two valves were the object of the most minute and careful attention, as the rudder of a ship would be.

The car, which was of a circular form and fifteen feet in diameter, was made of wicker-work, strengthened with a slight covering of iron, and protected below by a system of elastic springs, to deaden the shock of collision. Its weight, along with that of the network, did not exceed two hundred and fifty pounds.

In addition to the above, the doctor caused to be constructed two sheet-iron chests two lines in thickness. These were connected by means of pipes furnished with stopcocks. He joined to these a spiral, two inches in diameter, which terminated in two branch pieces of unequal length, the longer of which, however, was twenty-five feet in height and the shorter only fifteen feet.

These sheet-iron chests were embedded in the car in such a way as to take up the least possible amount of space. The spiral, which was not to be adjusted until some future moment, was packed up, separately, along with a very strong Buntzen electric battery. This apparatus

had been so ingeniously combined that it did not weigh more than seven hundred pounds, even including twenty-five gallons of water in another receptacle.

The instruments provided for the journey consisted of two barometers, two thermometers, two compasses, a sextant, two chronometers, an artificial horizon, and an altazimuth, to throw out the height of distant and inaccessible objects.

The Greenwich Observatory had placed itself at the doctor's disposal. The latter, however, did not intend to make experiments in physics; he merely wanted to be able to know in what direction he was passing, and to determine the position of the principal rivers, mountains, and towns.

He also provided himself with three thoroughly tested iron anchors, and a light but strong silk ladder fifty feet in length.

He at the same time carefully weighed his stores of provision, which consisted of tea, coffee, biscuit, salted meat, and pemmican, a preparation which comprises many nutritive elements in a small space. Besides a sufficient stock of pure brandy, he arranged two water-tanks, each of which contained twenty-two gallons.

The consumption of these articles would necessarily, little by little, diminish the weight to be sustained, for it must be remembered that the equilibrium of a balloon floating in the atmosphere is extremely sensitive. The loss of an almost insignificant weight suffices to produce a very noticeable displacement.

Nor did the doctor forget an awning to shelter the car, nor the coverings and blankets that were to be the bedding of the journey, nor some fowling pieces and rifles, with their requisite supply of powder and ball.

Here is the summing up of his various items, and their weight, as he computed it:

| | |
|---|-------------|
| Ferguson..... | 135 pounds. |
| Kennedy..... | 153 " |
| Joe..... | 120 " |
| Weight of the outside balloon..... | 650 " |
| Weight of the second balloon..... | 510 " |
| Car and network..... | 280 " |
| Anchors, instruments, awnings, and sundry utensils, guns, coverings, etc..... | 190 " |
| Meat, pemmican, biscuits, tea, coffee, brandy..... | 386 " |
| Water..... | 400 " |

Apparatus..... 700 "
Weight of the hydrogen..... 276 "
Ballast..... 200 "

4,000 pounds.

Such were the items of the four thousand pounds that Dr. Ferguson proposed to carry up with him. He took only two hundred pounds of ballast for "unforeseen emergencies," as he remarked, since otherwise he did not expect to use any, thanks to the peculiarity of his apparatus.