Belgian Stratosphere Balloon Experiment

THE most difficult part of the planning of a large stratospheric balloon is how to control the rate of descent in the upper atmosphere. If a balloon is large enough to reach about 19 miles (1/100 atmosphere) the hydrogen must contract during the descent, and the bag will be only 10 per cent filled at 10 miles: it is then difficult to avoid a dangerous flapping of the bag, except by controlling the speed by a continuous dropping of ballast; incidentally, the weight of that extra ballast would have reduced the maximum altitude reached.

If air is allowed to flow into the bag through the appendix, the flapping danger disappears; but, during the daytime, the sun heating the air in the bag causes sufficient expansion to stop the descent, even if all the hydrogen is removed. A better solution seems to be to admit air, but to remove it automatically as soon as it is warmed. That method was tested by Max Cosyns during his 1934 ascent, by replacing the valve of his balloon by a collapsible fabric tube, about six feet in diameter, distended by wooden rings, and stretching down the axis of the balloon (Fig. 1*a*). If the opening of that tube is set near the limit between the hydrogen and the air, the air flows continuously upwards as soon as it is warmed. The method worked perfectly well on the *F.N.R.S.*, the diameter of which was 100 ft.

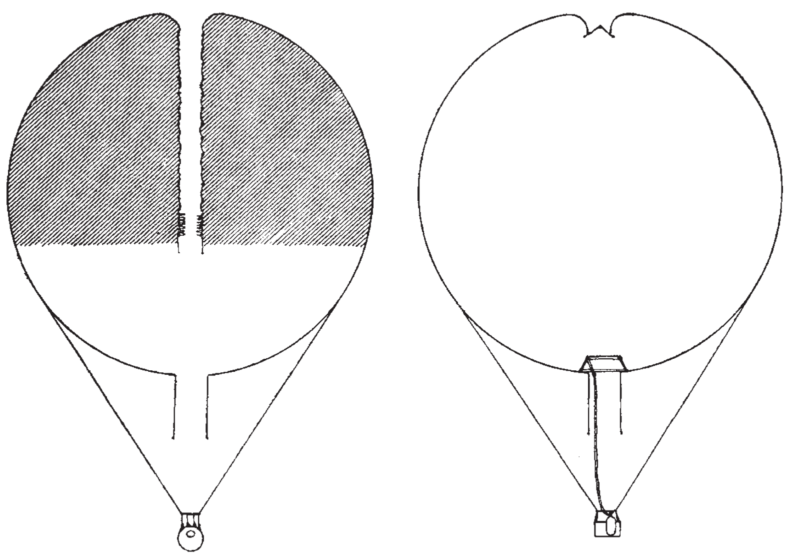

Fig. 1.

For a 200-ft. balloon, the use of the same principle would require a tube 17 ft. in diameter, twice as long as before, and about twenty times as heavy, which weight is prohibitive. To calculate the minimum diameter admissible, it is necessary to know exactly the amount of heating inside the bag due to the sun. As it depends on the thermal air eddies inside and outside the bag, it is useless to try to determine that quantity by extrapolation from experiments made on models a few feet in diameter. In order to measure the heat transfer on a model as large as possible, an experimental ascent was planned by A. Piccard and M. Cosyns with the old *F.N.R.S.* filled with hot air. At an altitude of about 5 miles, the heating power of the sun is not very far from its maximum value, and the temperature is about the same as at 20 miles. Knowing the total weight of the balloon, and the amount of supplementary heat necessary to balance it, the temperature rise due to the sun could be deduced with a precision of a few tenths of a degree.

The supplementary calories were to be furnished by a burner placed inside the bag (Fig. 1*b*) using pure propane, 150 lb. of which was carried in the liquid state in an aluminium bottle weighing 60 lb. The burner was able to burn 2 lb. of propane each minute, with good efficiency, and twice as much in emergency (the lifting power given by a pound of propane is about 160 lb.). It was composed by 42 batwing-burners placed on a ring 7 ft. in diameter, to ensure a good mixture of hot and cold air, and to prevent a flow of gases at too high a temperature from reaching the top of the balloon. The flow of propane was measured by a diaphragm 'dèprimomètre,' and by weighing at intervals the aluminium bottle.

Unfortunately, just before starting on May 25, the twisting of some ropes obliged the land crew to release some of the slings, and an unforeseen squall shook violently the bottom of the balloon, upturning the burner before it was possible to shut off the flame; the bag of the balloon was destroyed by fire in about a minute. The material loss was not important, as the *F.N.R.S.* was getting old and was about to be dismantled.

M. COSYNS.