latter pitched the occupants would be in danger. Some misgivings having affected the authorities, they thought it better to have some further advice before permitting any passenger to ascend.

At that time the balloon was fully inflated ready for an ascent, and the proprietor was clamorous for permission to invite the public. The fireworks were let off about 500 yards away, though rockets were forbidden.

Under apprehension of some disaster, Mr. Fred Brearey was sent for, when the following questions in writing were submitted to him, and he was requested to stay and witness the behaviour of the balloon when ascending and descending.

The site of the ground was, as the locality (Edge Hill) suggested, the most exposed neighbourhood of Liverpool, and during six days there was no possibility of an ascent, owing to strong winds.

It was said by Dr. Wölfert that the waste of gas was 1,000ft. for the twenty-four hours.

As Mr. Brearey could not prolong his stay more than a week, and the force of the wind showed no signs of abatement, he left the following report for Mr. Leslie, one of the Honorary Secretaries,—

LIVERPOOL INTERNATIONAL EXHIBITION.

Copy Report of Mr. F. W. Brearey on the Balloon.

To Frank J. Leslie, Esq.

Dear Sir, *CAPTIVE BALLOON.*

I now reply to the following Questions upon which you ask my opinion, at the same time making such comments as the subject demands.

1st.—Question.

Is the balloon, in regard to design, workmanship, and finish, perfectly satisfactory to you, and in your opinion good and sufficient?

Answer.

For purpose of captive ascents, no English aëronaut would construct a balloon otherwise than of a spherical form, or as near to it as other requirements would allow. It is not only the best shape for the economical storage of gas, but it presents the simplest, most efficient, and safest method of controlling ascent and descent, viz., by one attached cord, which permits it to rise vertically without displacement of gas. Unless the balloon in its present elongated shape is under perfect control by its six attached ropes, so that the strain may be equally adjusted, a greater strain may be thrown upon one cord than it has been tested for, and this strain is liable to great increase by varying wind pressure. The variation of horizontal position which would be caused by an unequal restraint of rope would create a displacement of gas, that is, its flow to the highest position, and therefore the danger would be aggravated, especially as the car being a fixture, and not pendant, would assume the same inclination as the balloon.

2nd.—Question.

Has every precaution been taken which you could reasonably suggest in order to ensure the safety of persons ascending and descending with the balloon, both with regard to tackle and machinery for hoisting and lowering, the appliances for keeping the balloon as a "captive," and also as regards the enclosure to and from which the balloon proceeds

Answer.

Bearing in mind the objections urged against the form of the balloon for captive purposes, I have also to remark that, with respect to its dimensions, the substance of the envelope is not in my opinion commensurate, and that the enclosure falls far short of the space required for hauling down the balloon with safety to the structure when swayed about by a wind. I believe that, with these exceptions, every precaution has been taken, as also to haul down this form of balloon with safety, so far as the netting and rope attachments are concerned. The additional care taken to sustain the car, viz., by twenty-eight ropes passing through the balloon and attached to twenty-eight air cushions, which are thereby pressed downwards upon the envelope, attest the desire of the aëronaut to secure safety. These ropes are in addition to twenty-eight ropes from the car to the netting. I have no experience of ropes depending from air cushions and passing through the balloon, nor have I any knowledge that for captive purposes this form of balloon has ever before been used.

The tackle and machinery for hauling down is entirely an engineer's question.

3rd.—Questions.

Do you consider that any special danger to the Exhibition Building arises from the presence of the balloon filled with gas? What would be the probable result if, by any means, the covering of the balloon were ignited, so as to allow the escape of the gas? Would the chief danger be from explosion or from fire?

Answers.

There is always danger from the approximation of any material in a state of ignition to a gas receptacle formed of combustible materials. The nature of the catastrophe would

depend upon whether the gas was pure, or mixed with atmospheric air. In the present case, as the balloon has been some time inflated, there must be a mixture of atmospheric air, which would render it explosive, but the materials which confine it being so little resistant, the effects would, I think, be expended principally in the upper atmosphere; though, doubtless, it would wreck the hoarding, and fragments of the ignited material might be distributed by the wind. If the gas was pure, it would be ignited only at the spot where it meets with the atmospheric air; but as that spot would rapidly enlarge, the volume of gas would form a blazing cone, dissipating itself in the upper atmosphere, but still leaving ignited fragments, which, under careless management and favouring circumstances, might be as dangerous to the building as in the preceding case. In either case, however, with the precautions exercised as hitherto, this danger may reasonably be considered as eliminated.

4th.—Question.

Having considered the matters raised in the foregoing questions, is it in your opinion safe and proper for the Council to permit the public to ascend in the balloon?

Answer.

Certainly not, without having it tested by repeated ascents, loaded to the extent of the number of passengers which the car is intended to hold; and each ascent should be carefully recorded.

(Signed)

FRED. W. BREAREY,
Hon. Sec. to the Aëronautical Society of Great Britain.

11*th Sept.*, 1886.

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MEMORANDUM.—When this balloon was tested as recommended above, it was, whilst being hauled down, blown over the hoarding against a telephone-post, and it then rebounded on to the Concert Hall of the Exhibition Building, with the result that a great rent was made in the balloon. The aëronaut saved himself by a hazardous leap. Mr. Leslie communicated the accident to Mr. Brearey in writing as follows:—"You will of course have heard all about the collapse of the balloon soon after your return to town. The whole thing is now, I think, finally at an end, and the result shows the wisdom of the precautions you advised."