

controversy with Mrs. Ayrton. It will suffice to say that she is writing of things of which her knowledge is, naturally, second-hand, besides being clearly very inadequate. This is apparent in at least eight separate points in her letter, of which I will only refer to her mention of the successful use of the fans in what must obviously have been a *very* exceptional type of "mustard-gas" bombardment. I assure Mrs. Ayrton that she is mistaken if she imagines that she has in this matter any considerable body of support amongst those who knew the facts, from whatever point of view. I hope, in conclusion, that nothing I wrote has led Mrs. Ayrton to suppose that I regard her advocacy of her fans to be influenced by questions of "payment or reward." Nothing was further from my mind.

A. J. ALLMAND.

King's College, W.C.2, June 30.

PROF. ALLMAND, having read neither the specific charges I have made against the War Office nor the evidence, principally from official documents, with which I have sustained them, attempts to counter them with statements unsupported by evidence of any kind. He finds me ignorant, for instance, on eight points, of which the only one he names is obviously no matter either of my knowledge or ignorance, since it refers simply to a quotation from the letter of a very able and gallant "fighting soldier." Had he read the article he criticises he would have seen the whole quotation.

I am ready to sustain those charges, and to produce the evidence before any proper tribunal. I repeat them.

I accuse the War Office of having caused great loss of life and much avoidable suffering by:

(1) Having refused for a whole year to make use of anti-gas fans, which they were yet compelled finally to adopt owing to their proved efficacy.

(2) Never having set up an efficient organisation for training officers and men in their use, although I had warned them that this was indispensable.

(3) Having thus deprived the troops of the knowledge requisite for understanding what could be done with the fans, and having thereby induced the idea that they were useless.

(4) Having trusted entirely to fires for clearing dug-outs of gas, regardless of the fact that in many places dry wood and paper were often unobtainable.

(5) Ranking sandbags and ground-sheets as of equal efficacy with fans for clearing gas.

(6) Sending out an inadequate supply.

The scientific men implicated in these grave charges have not even made the plain statement with regard to them that the Editor of NATURE considered so desirable, much less produced any evidence in refutation of them.

HERTHA AYRTON.

July 11.

THE continuance of this correspondence in our columns would not, we think, serve any useful purpose. In a note in NATURE of May 13 it was pointed out that Mrs. Ayrton's indictment of the War Office was "not against the military element, but rather against the experts who were associated with the Gas Service." It is easy to understand the reluctance of these officers to express their views upon anti-gas fans, even if they were free to do so; and though Mrs. Ayrton is anxious to have all the facts judged by a tribunal appointed for that purpose, we must confess that the likelihood of a scientific body constituting such a tribunal is very remote. The inquiry is one that the Conjoint Board of Scientific Societies could take up appropriately, but no satisfactory conclusion could be reached without examining a number of witnesses, and the resources and powers of the

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Board are scarcely sufficient for such action. The only practicable course, therefore, would seem to be for the War Office to appoint a Committee to investigate Mrs. Ayrton's charges, and in the interests of scientific truth and efficiency we hope this will be done.—ED. NATURE.

#### The Stretching of Rubber in Free Balloons.

IN NATURE of June 10, p. 454, in connection with the attainment of high levels of the atmosphere by sounding- or pilot-balloons, Mr. W. H. Dines considers that such balloons would burst before reaching great heights, as the rubber of which these balloons are made would be stretched eightfold linearly, and he remarks that he does not think that any rubber will stand this treatment.

Properly vulcanised soft rubber will, however, stretch to more than ten times its original length if in the form of a ring-shaped test-piece. Moreover, the load increases more rapidly than the elongation at the later stages. The remarkable tensile properties of soft rubber are not always sufficiently recognised. The breaking strain of a properly vulcanised sample should be not less than 1500 grams per sq. mm. cross-sectional area of the original test-piece. Allowing for the stretching, which would reduce the cross-sectional area to one-tenth, the breaking strain would be 15,000 grams per sq. mm. cross-sectional area of the sample when fully elongated, or nearly 10 tons per sq. in. It would not, however, be safe to rely on these figures, as the rubber of the balloon would tear at the neck where it is tied together before the bursting pressure was reached. Mr. Dines has also failed to take into consideration the fact that part of the hydrogen would be lost by diffusion during the ascent of the balloon, which would reduce the pressure of the contained gas.

HENRY P. STEVENS.

15 Borough High Street, London

Bridge, S.E.1, June 29.

WITH reference to Mr. Stevens's interesting statements about the stretching of rubber, I think he has overlooked the fact that in a balloon the rubber is stretched simultaneously in both directions, whereas he refers apparently to one direction only.

I have cut a strip half an inch wide from a balloon used at Benson; it stretched sevenfold before breaking, but when extended sixfold its width was reduced from 0.50 in. to 0.22 in., instead of being extended to 3.00 in., as would be the case in actual use. Its unstretched thickness was 0.013 in., its thickness at breaking greater than 0.004 in., but when extended sixfold each way its thickness would only be 0.00036 in.

The loss of hydrogen by diffusion or leakage is equivalent to not giving the balloon so large a free lift at starting, and would alone increase the height, but in practice it sometimes leads to the bursting height not being reached at all because the free lift has vanished before that point is reached. It has been found that within fairly wide limits the maximum height is only slightly dependent on the free lift at starting. But diffusion of the hydrogen outwards is accompanied by diffusion of air inwards, and this increases the specific gravity of the gas and lessens the height.

I did not mention the effect of the tension of the rubber on the pressure, and therefore on the specific gravity, of the enclosed gas. Taking Mr. Stevens's figure of a breaking strain of 15,000 grams per sq. mm. of unstretched section, this will raise the internal pressure by quite an appreciable amount, and thereby reduce the height at which the balloon bursts.

Benson.

W. H. DINES.