number, the name, the maximum magnitude, the co-ordinates for 1900·0, the precession, and the B.D. number for each star.

The volume is in quarto form, neatly and strongly bound, and altogether promises the addition of a valuable series to current astronomical publications.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Upper-air Temperatures Registered Outside and Inside Balloons

ATTENTION has been directed several times in NATURE to the interest attaching to the knowledge of the rate at which the gas inside rubber balloons takes up the temperature of the air outside. In this connection the results of two registering-balloon ascents from Manchester, made at the suggestion of Mr. Gold, are useful as giving some idea of the magnitudes of various possible errors.

The ascents were made on July 2, 1909, at 6.50 a.m. and 10.17 p.m. respectively. Each balloon carried two instruments, of which one was suspended in the usual manner about 4 metres below the balloon, while the other was fixed inside the balloon. The latter instrument was kept approximately in the centre of the balloon by means of rubber stays. The results are given in the following tables:—

TABLE I.—(6.50 a.m. *Ascent.*)

Height (ks.)	Temperature °C. Instrument outside Balloon.	Instrument inside Balloon. Ascent.	Instrument inside Balloon. Descent.
0	10·8	16	12
1	7·0	16·5	7
2	+ 4·5	15·5	+ 5·5
3	− 0·5	13·5	− 0·5
4	− 6	10	− 4
5	− 12·5	4·5	− 13
6	− 19	+ 1·5	− 18
7	− 24·5	− 1·5	− 23·5
8	− 31·5	− 6·5	− 31·5
9	− 39·5	− 9·5	− 38·5
10	− 44	− 14	− 44
11	− 45	− 15	− 47·5
12	− 44	− 13·5	− 49
13	− 43	− 10	− 48·5
14	− 41·5	− 6	− 47
15	− 39·5	− 2·5	− 42·5

TABLE II.—(10.17 p.m.)

Height (ks.)	Temperature °C. Instrument inside Balloon. Ascent.	Descent.
0	11·5	10
1	+ 2·5	+ 6
2	− 0·5	− 0·5
3	− 6	− 6
4	− 11	− 11
5	− 17	− 17
6	− 23	− 23
7	− 28	− 31
8	− 34	− 38
9	− 40·5	− 44
10	− 48	− 50
11	− 55·5	− 56
12	− 55·5	− 57·5
13	− 56	− 58·5
14	− 57·5	− 57·5

The traces of the two instruments sent up at 6.50 a.m. emphasise the large possible error arising from insolation should the vertical velocity of the balloon fall below the value necessary for efficient ventilation. The temperatures recorded during the ascent diverge as the height increases, the maximum difference—nearly 40° C.—occurring at the maximum height attained, *i.e.* 15 km. That the divergence is not due to a systematic difference between the two instruments is shown by their good agreement during the greater part of the descent. In this connection it is of interest to compare the experimental results with the mathematical computations made by Mr. Gold in NATURE, March 18, 1909, p. 68.

Substituting in his equations the values corresponding to the Dines instrument and the small rubber balloons employed in the ascent, and assuming that half the incident solar radiation is absorbed, we find that $(T-\theta)$, the temperature difference between the gas inside and the air outside, may be 20° C. This is considerably less than the actual value found (30° C.), but the discrepancy is easily explained by the fact that the radiation which penetrates the semi-transparent envelope strikes the almost unventilated instrument inside. That this accounts partly for the difference is evidenced by the fact that the temperature ceases to fall near 11 km., where the pressure is about 150 mm., *i.e.* the pressure below which the natural convection has been found to be ineffective.

The night ascent gives more definite information. The trace of the outside instrument in this case was defective, and it was assumed that the descent readings of the inside instrument gave a close approximation to the readings of the outside one. The doubling of the trace at low altitudes is due to the high initial temperature of the gas inside the balloon—that of the laboratory in which it was filled—and to the effect of daily variation of temperature during the time interval between the beginning of the ascent and the end of the descent. From 2 to 6 km., however, the temperature inside the balloon is the same as that of the outside air. At about 6 km., where there is a considerable increase in the temperature gradient, a lag is developed, which increases to about 8·5 km. where the temperature difference reaches 5° C. Subsequently the lag steadily diminishes, and at 10·5 km. the temperatures are again in agreement to within 1° C. Applying Gold's equation to this case, we find, on substituting the values appropriate to the ascent, that the theoretical lag at 11 km. is about 0·7° C., a rather remarkable agreement in consideration of the fact that the equation is admittedly only approximate. It would appear, therefore, that what might be called the "natural" lag of the balloon temperature in night ascents is small, and that the lag indicated between 6 and 11 km. arose from special circumstances possibly connected with the humidity of the air. The difference between the ascent and descent traces above 11 km. may possibly be attributable to the same cause as the divergence from 15 to 10 km. of the descent traces of the two instruments employed earlier in the day. The results demonstrate conclusively the very large effect of solar radiation compared with that of terrestrial radiation, and indicate that errors in temperature due to air which has already been in contact with the balloon and to radiation from the balloon are, in night ascents, negligible.

In the daytime, however, errors arising from these causes may be considerable. This may, in fact, explain why the differences between the upward and downward traces in ascents by day are more frequent and of greater magnitude than those found for night ascents.

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Avogadro's Hypothesis.

I SHOULD like to direct the attention of Mr. Woolhouse (NATURE, January 20) to the little book "Avogadro and Dalton, the Standing in Chemistry of their Hypotheses" (Edinburgh: W. F. Clay, 1904), in which Dr. Meldrum discusses with great force and discrimination the exact position which should be given to Avogadro's hypothesis. Dr. Meldrum also deals faithfully with those who have made light use of the word "law."

A. SMITHELLS.
The University, Leeds, January 24.