which changes from 0·48 to 0·59 as κ changes from 0 to 1, with a maximum of 0·67 in between. It is difficult to imagine a model more effective in converting linear into angular velocity, and *vice versâ*, so that 70 per cent. may well be an upper limit of the relative efficiency of transport of rotational and translational energy.

The Specific Heats of Air, Steam and Carbon Dioxide.

By Sir R. T. GLAZEBROOK, F.R.S.

(Received March 6, 1922.)

In a recent number* is a paper by Mr. W. D. Womersley bearing the above title, in which an account is given of a determination of specific heats of the gases named, employing a calorimeter designed by the late Prof. B. Hopkinson.

Mr. Womersley's experiments extended over the range 1000° C. to 2000°, and he states that the lower parts have been filled in from the researches of Swann and Holborn and Henning.

The results are given in a Table on p. 486 for every 100° C. up to 2000°. Swann's experiments were made at temperatures of 20° C. and 100° C., so that the range of values from 200° to 1000° depends on the work of Holborn and Henning, and, unfortunately, some error has been made in connection with their results.

They expressed these as the mean specific heat at constant pressure between 0° C. and the temperature of the observation—in the case of steam between 100° C. and the observation temperature.

Mr. Womersley has transformed their figures into mean volumetric heat per gramme-molecule, but I have been unable to deduce his figures from those given by Holborn and Henning, and, in view of the importance of the matter, it seems desirable to call attention to the discrepancy.

Holborn and Henning, in their paper,† give—Table VIII—their experimental results, and also the results obtained from a formula which expresses the experimental results within, in most cases less than 1 per cent. In the case of steam, two formulæ, which differ but slightly, are given, while in Table IX (p. 842) are stated the results at every 200° C. up to 1400° C.

* 'Roy. Soc. Proc.,' A, vol. 100, p. 483.

† 'Annalen des Physik,' vol. 23, p. 809 (1907).

I have reduced these last to volumetric heats per gramme-molecule in each case by multiplying by 28, 18 and 44 respectively and subtracting 1·985, the difference between the volumetric heats at constant pressure and constant volume.

The results are given in the second, fourth and sixth columns of Table I. In the third, fifth and seventh columns are values taken from Mr. Womersley's Table, which in the range 200° to 1000° are said to " be filled in from the researches of . . . Holborn and Henning." The differences are very considerable, amounting to from 6 to 8 per cent.

The figures at the higher temperatures given in these columns are the results of Mr. Womersley's own experiments. It will be noticed that these are higher than the corresponding figures due to Holborn.

Table I.

Tem- perature.	Nitrogen.		Steam.		Carbon dioxide.	
	Holborn.	Womersley.	Holborn.	Womersley.	Holborn.	Womersley.
° C.						
200	4·70	5·00	6·39	6·61	7·48	7·5
400	4·81	5·177	6·43	6·70	8·04	8·35
600	4·91	5·332	6·52	6·85	8·51	9·03
800	5·02	5·471	6·69	7·02	8·98	9·56
1000	5·13	5·590	6·91	7·29	9·33	9·94
1200	5·23	5·698	7·20	7·75	9·64	10·21
1400	5·34	5·766	7·55	8·35	9·88	10·41

In an appendix to the Report of the B.A. Committee on Gaseous Explosives for 1908, the opinion is expressed that the values given by Holborn and Henning are too low, and this may be the case, but that fact will not explain why the high values given in Mr. Womersley's Table for the range 200° C. to 1000° C. are assigned to these authors.

With regard to Mr. Womersley's own values, it is no doubt difficult to discuss their accuracy from the small-scale diagrams (figs. 4 and 5), in which the slopes of the various lines give the volumetric heats— Mr. Womersley doubtless used large diagrams—but the points are in many cases scattered somewhat too widely to justify the accuracy of 1 to 2 per cent. which is claimed, and in some cases—*e.g.*, fig. 4, the curves for 1800° and 1600°—lines could be drawn of distinctly less slope, which would represent the experimental results more closely.

The values deduced above from Holborn and Henning's results agree

closely with those given by Piers and Bjerram* in various papers in the 'Zeitschrift für Electrochemie' in 1911 and 1912, of which a summary was given by Pye in the 'Automobile Engineer' for February, 1920.

Mr. Womersley states that, at the time the experiments were initiated and carried out, Bjerram's corrections to Pier's results had not arrived; they were to hand before the date of the paper, August, 1921.

A Photographic Spectrum of the Aurora of May 13–15, 1921, and Laboratory Studies in Connection with it.

By Lord Rayleigh, F.R.S.

[Plate 2.]

§ 1. *Aurora of May* 13–15.

On May 13, 1921, and the following days, there was a magnetic storm of almost unprecedented violence, connected without doubt with a large and highly eruptive spot near the centre of the sun's disc.

At the time I was systematically photographing the spectrum of the diffused light of the sky every night for the investigation of the faint aurora line ordinarily present.† The instrument used was the spectrograph No. 1‡ having a Rutherford prism, and a cinematograph lens of 3 inches focus, working at F/1·9. An orthochromatic plate was used. The direction of view was 45° up to the north.

On developing the photograph of May 13 (*i.e.*, begun on the evening of that day) it was found that the nitrogen negative bands had come up strongly, as well as the green aurora line. This was the first intimation I had that anything unusual was in progress, and the day of May 14 was spent in preparing as far as possible for an extended programme if the aurora should continue. Two additional spectrographs were extemporised. The aurora *did* continue on the night of May 14, and presumably throughout the intervening day. Another and somewhat stronger photograph on an orthochromatic plate was got with the Rutherford prism instrument used before.

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* Such small differences as there are appear to be due to the fact that Bjerram used Holborn's experimental results. Table I has been calculated from his smoothed curve.

† 'Roy. Soc. Proc.,' A, vol. 100, p. 367 (1921).

‡ *Loc. cit.*, p. 368.