

## Wave-lengths of other Lines in Spectrum. No. 2.

2869.5	2910	2947	2991	3031
2872.5	2913	2951	2994	3039
2876	2917.5	2955	2999	3042
2880	2922.5	2959	3002	3046
2883	2925.5	2966	3005	3051
2887.5	2929	2967.5	3010	3057.5
2892	2932.5	2970.5	3013	3246
2895	2935.5	2975.5	3017	3271
2897	2940	2981	3019.5	3429.5
2904	2943	2989	3029	3473
2907.5				

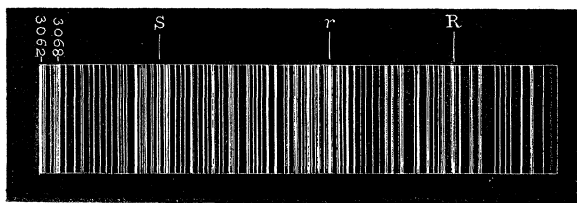
## Wave-lengths of other Lines in Spectrum. No. 3.

3872	3890	4310
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XV. "On the Spectrum of Water." By G. D. LIVEING, M.A., F.R.S., Professor of Chemistry, and J. DEWAR, M.A., F.R.S., Jacksonian Professor, University of Cambridge. Received June 17, 1880.

In our last communication to the Society, "On the Spectrum of the Compounds of Carbon with Hydrogen and Nitrogen, No. II," we noticed that a remarkable series of lines, extending over the region between the lines S and R of the solar spectrum, were developed in the flame of coal-gas burning in oxygen. The arrangement of lines and bands, of which this spectrum consists, is shown in the accompanying diagram,\* fig. 1. It begins at the more refrangible end with two

FIG. 1.

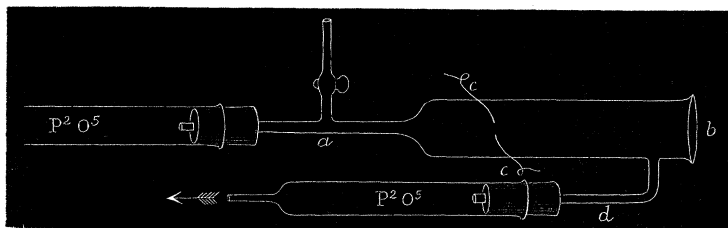


strong bands, with wave-lengths about 3062, 3068, and extends up to about the wave-length 3210. It is well developed in the flame of hydro-

\* This diagram gives tolerably well the general character of the spectrum, but the artist has not in all cases correctly rendered the relative strength of the lines. Those of the less refrangible half are almost too strongly rendered.

gen as well as of hydrocarbons, burning in oxygen, and less strongly in the flames of non-hydrogenous gases, such as carbonic oxide and cyanogen, if burnt in moist oxygen. Special pains were taken to purify the gases from sulphur. The same spectrum is given by the electric spark taken, without condenser, in moist hydrogen, oxygen, nitrogen, and carbonic acid gas, but it disappears if the gas and apparatus be thoroughly dried. We are led to the conclusion that the spectrum is that of water. The accompanying diagram, fig. 2, shows

FIG. 2.



the apparatus used for comparing the spectra of the spark in the gases, dry and moist. The tube in which the sparks were passed was closed at the end *b* by a quartz lens cemented to the glass; *cc* were platinum wires sealed into the glass. The gas was introduced through the narrow tube *a*, provided with a branch closed by a glass stopcock. The gas was passed from the gas-holder through two long drying-tubes, of which the first was filled with calcium chloride, and the second with phosphoric anhydride. The joints were all made with dry corks, in order to avoid the hydrocarbons which contaminate gases passed through rubber tubes. The exit-tube *d* was armed with a tube of phosphoric anhydride, to prevent moisture entering that way. It was necessary to pass a current of dry gas for fully an hour through the warmed apparatus before the moisture was sufficiently expelled. When this was done, photographs of the spark showed either no trace, or only the faintest traces, of the spectrum above described. On now introducing a drop of water through stopcock in the branch at *a*, and letting it spread over a plug of asbestos placed in the tube at *a*, the current of gas of course passed into the sparking tube moist instead of dry; and on now passing the spark, the spectrum above described at once imprinted itself on the photographic plate. The effect was the same, whether the gas used were hydrogen, oxygen, nitrogen, or carbonic acid. In the case of nitrogen, some of the channelled bands due to that gas overlap the water spectrum, and partly obscure it, but not so much but that it can be still very distinctly recognised. When a condenser is used, the water spectrum disappears. The same spectrum

seems to appear in the De Meritens arc, but is much less fully developed. The spectrum we have figured does not by any means exhaust the ultra-violet spectra of the flames we have observed, but it is as much as we have been able at present to observe closely and to trace to water as its cause. In writing of this and other spectra which we have traced to be due to compounds, we abstain from speculating upon the particular molecular condition or stage of combination or decomposition, which may give rise to such spectra. The interest of finding an ultra-violet spectrum of water in a flame at all seemed to justify our laying before the Society so much as we have already determined. It opens up questions as to the emissive power for radiation of short wave-length of gaseous substances at the comparatively low temperatures of flames, with regard to which we are accumulating facts, which we propose to discuss in a future communication. It is obvious, however, that this opens up a very large and extensive field of inquiry which will necessitate great precautions in the conduct of the experiments; for instance, we are not prepared to guarantee that oxides of nitrogen from traces of air may not have something to do with some parts of the spectrum here described. Such facts as we have placed before the Society will completely modify the inferences which have been drawn as to the assumed continuity of flame spectra even under compression, and as to the character of the specific absorption of the vapour of water.

The Society adjourned over the Long Vacation to Thursday, November 18th.

*Presents, June 10, 1880.*

Transactions.

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FIG. 2.

