the line wave-length 5535 readily reversed, while that with wave-length 5518 is less easily reversed; the line wave-length 4933 is comparatively easily reversed, whereas that with wave-length 4899 has not been reversed by us. On the other hand, the line wave-length 4553 has been reversed, but not the line wave-length 4524. In the case of strontium, the lines wave-length 4831 and 4812 have been reversed, but not the line wave-length 4784, and the two lines wave-length 4741 and 4721 remain both unreversed. In the group of five lines of calcium, wave-length 4318 to 4282, it is only the middle line wave-length 4302 which has been reversed. Of the potassium groups of lines wave-length 5831 and 5782, 5802, 5782 are reversed, the line wave-length 5811 has not been reversed, and of the others the line wave-length 5802 is the first to appear reversed. It is worthy of remark that the first of these lines is faint and the last is the brightest of the group. The group wave-length 5355, 5336, 5319 have been all reversed, but the last of the three (5319) was the most difficult to reverse: it is also the feeblest of the group. In the more refrangible group, wave-length 5112, 5095, 5081, the least refrangible is the only one reversed.

Making a general summation of our results respecting the alkaline earth metals, potassium, and sodium, and having regard only to the most characteristic rays, which for barium we reckon as 21, for strontium 34, for calcium 37, for potassium 31, and for sodium 12, the reversals in our experiments number respectively 6, 10, 11, 13, and 4. That is in the case of the alkaline earth metals about one-third, and these chiefly in the more refrangible third of the visible spectrum, the characteristic rays remaining unreversed in the more refrangible part of the spectrum being respectively 2, 5, and 4. In the case of potassium we reversed two in the upper third, all the rest in the least refrangible third. These experiments relate to mixtures of salts of these metals combined with the action of reducing agents. In a future communication we will contrast these results with those of the isolated metals, calcium, strontium, and barium.

IV. "Note on the unknown Chromospheric Substance of Young." By G. D. LIVEING, M.A., Professor of Chemistry, and J. DEWAR, M.A., F.R.S., Jacksonian Professor, University of Cambridge. Received March 27, 1879.

In the preliminary catalogue of the bright lines in the spectrum of the chromosphere published by Young in 1861, he calls special attention to the lines numbered 1 and 82 in the catalogue, remarking that "they are very persistently present, though faint, and can be distinctly seen in the spectroscope to belong to the chromosphere, as such, not being due, like most of the other lines, to the exceptional elevation

of matter to heights where it does not properly belong. It would seem very probable that both these lines are due to the same substance which causes the D_3 line."

Again, in a letter to "Nature," June, 1872, Young says, "I confess I am sorry that the spectrum of iron shows a bright line coincident with 1474 (K); for, all things considered, I cannot think that iron vapour has anything to do with this line in the spectrum of the corona, and the coincidence has only served to mislead. But there are in the spectrum many cases of lines belonging to the spectra of different metals coinciding, if not absolutely, yet so closely, that no existing spectroscope can separate them, and I am disposed to believe that the close coincidence is not accidental, but probably points to some physical relationship, some similarity of molecular constitution perhaps, between the metals concerned. . . . So, in the case of the green coronal matter, is it not likely that though not iron it may turn out to bear some important relation to that metal?" In 1876 he proves that the coronal line 1474 is not actually coincident with the line of iron.

In the catalogue of bright lines observed by Young at Sherman in the Rocky Mountains, to which we have directed special attention in one of our previous communications, it appears that the above-mentioned lines 1 and 82, along with D_3, were as persistently present as hydrogen, the only other line approaching them in frequency of occurrence being the green coronal line 1474 of Kirchhoff, which was present on 90 occasions out of 100. It has occurred to us that these four lines may belong to the same substance. An analogy in the ratio of the wave-lengths of certain groups of lines occurring in different metals has been already pointed out by Stoney, Mascart, Salet, Boisbaudran, and Cornu; and without any special reductions, or claims to an exact ratio in whole numbers, the following analogies are worthy of note:—

Hydrogen.	Lithium.	Magnesium.	Chromospheric substance.
Wave-length:—			
(1) 6563·9	(1) 6706	(1) 5183	(1) 7055 *
(2) 4862·1	(2) 6102	(2) 3837·8	(2) 5874·9
(3) 4340	(3) 4970	(3) 3335	(3) 5315·9
(4) 4102·4	(4) 4604		(4) 4471·2
	(5) 4130		
Ratio of wave-length of—			
(1) (2) & (4)	(1) (3) & (5)	(1) (2) (3)	(1) (3) & (4)
$\frac{1}{20}$ $\frac{1}{27}$ $\frac{1}{32}$	$\frac{1}{20}$ $\frac{1}{26\cdot9}$ $\frac{1}{31\cdot6}$	$\frac{1}{20}$ $\frac{1}{27}$ $\frac{1}{31\cdot1}$	$\frac{1}{20}$ $\frac{1}{26\cdot5}$ & $\frac{1}{31\cdot6}$

* This wave-length is not so accurately known as the other rays belonging to the chromosphere.

The ratio of the wave-lengths of F to G of hydrogen ((2) to (3) in the table above) is nearly identical with the ratio of D_3 to the coronal green line ((2) to (3) in table above).

This near coincidence in the ratios of certain lines of hydrogen, lithium, and magnesium, substances belonging to the same type, combined with a similar ratio in the wave-lengths of the nearly equally persistent lines of the chromosphere, greatly strengthens the probability of the assumption that these lines belong to one substance.

The fact that the two less refrangible rays have no representative in the Fraunhofer lines, is by no means opposed to their belonging to one substance, since we know that aluminium behaves in a similar way in the atmosphere of the sun; and in the total eclipse of 1875 the hydrogen line *h* was not visible in the chromosphere, that is, we suppose, was on the limit between brightness and reversal; and during the late eclipse the two most refrangible rays of hydrogen were not detected from the same cause.

Until our knowledge of the order of reversibility of lines belonging to different types of metals has been extended, it would be rash to infer the group of metals to which it belongs, or its probable molecular weight.

V. "Contributions to Molecular Physics in High Vacua." By WILLIAM CROOKES, F.R.S. Received March 27, 1879.

(Abstract.)

This paper is a continuation of one "On the Illumination of Lines of Molecular Pressure, and the Trajectory of Molecules," which was read before the Royal Society on the 5th of December last. The author has further examined the action of the molecular rays electrically projected from the negative pole in very highly exhausted tubes, and finds that the green phosphorescence of the glass (by means of which the presence of the molecular rays is manifested) does not take place close to the negative pole. Within the dark space there is absolutely no phosphorescence; at very high exhaustions the luminous boundary of the dark space disappears, and now the phosphorescence extends all over the sensitive surface. Assuming that the phosphorescence is due either directly or indirectly to the impact of the molecules on the phosphorescent surface, it is reasonable to suppose that a certain velocity is required to produce the effect. The author adduces arguments to show that within the dark space, at a moderate exhaustion, the velocity does not accumulate to a sufficient extent to produce phosphorescence, but at higher exhaustions the mean free path is long enough to allow the molecules to get up sufficient speed