into sheet and wire when heated at low temperature. 30 per cent. and 40 per cent. with great difficulty only at a temperature little less than melting point, being brittle when cold, but with a grain of great beauty and fineness.

50 per cent. I have as yet failed to work up into forms other than castings beyond what I can effect by pressure when in a semi-fused condition.

The general results of my work on this alloy would lead me, therefore, to make the following recommendations.

For the manufacture of standard rules to use an alloy of not less than 85 per cent. platinum and 15 per cent. iridium, adopting the tubular form.

For the standard weights to use an alloy of not less than 80 per per cent. platinum and 20 per cent. iridium, adopting the form now generally made.

Finally, following the expression of the great French chemist, M. Dumas, I hope by these labours "d'avoir enriché l'outillage scientifique d'un alliage doué des propriétés précieuse."

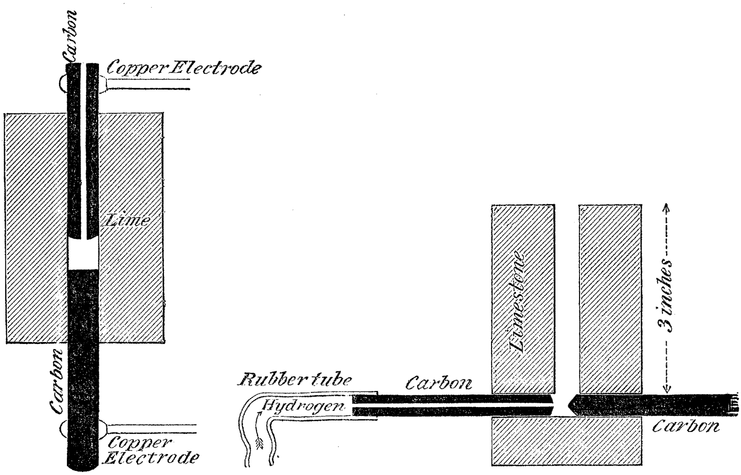
III. "On the Reversal of the Lines of Metallic Vapours." No. VI. By G. D. Liveing, M.A., Professor of Chemistry, and J. Dewar, M.A., F.R.S., Jacksonian Professor, University of Cambridge. Received March 27, 1879.

The experiments described in the following communication were made with the electric arc, and in lime crucibles,* or in crucibles of a highly calcareous sandstone, kindly supplied to us by Messrs. Johnson, Matthey, and Co., as described in our fourth communication on this subject; but for some of them we used, instead of a galvanic battery, a magneto-electric machine producing a much more powerful current and a much longer arc. The experiments with this machine were made, through the kindness of Dr. Tyndall, at the Royal Institution, and we are indebted to Messrs. Siemens both for the working of the machine and for sparing to us the services of a skilled engineer, in

* In our first paper on this subject, communicated in February, 1878, when referring to the experiments of Lockyer and Roberts ("Proc. Roy. Soc.," xxiii), we mentioned that they employed the combined action of a charcoal furnace and an oxyhydrogen blowpipe, but omitted to mention that they used a lime chamber after the model of Stas. Referring to fig. 1 in our communication of February 12, 1879, where the use of an oxyhydrogen blowpipe in a lime block is represented, we disclaim any novelty in the use of lime; the difference between our experiments and theirs consisting in this, that we use the continuous spectrum from the hot walls of our crucible, instead of an external independent source of light, as a background against which the absorbent action of the vapours is seen, in the same way as we had previously used iron tubes, and now use the electric arc.

the person of Mr. Oscar Doermer, whose assistance was most valuable. We wish to express our thanks to all these gentlemen for the facilities they so readily granted to us.

The results obtained with the powerful current from the magneto-electric machine did not differ at all in kind from those obtained with the battery, and much less in degree than we had expected. We had really but one day's work with this machine, which we can only regard as a preliminary trial of it, and, in the meantime, until we have the opportunity of a longer series of experiments with it, we communicate the results obtained to the Royal Society.



In some cases we have introduced a current of hydrogen, or of coal-gas, into the crucibles by means of a small lateral opening, or by a perforation through one of the carbon electrodes; sometimes the perforated carbon was placed vertically, and we examined the light through the perforation (see diagrams). When no such current of gas is introduced, there is frequently a flame of carbonic oxide burning at the mouth of the tube, but the current of hydrogen produces very marked effects. As a rule, it increases the brilliance of the continuous spectrum, and diminishes relatively the apparent intensity of the bright lines, or makes them altogether disappear with the exception of the carbon lines. When this last is the case, the reversed lines are seen simply as black lines on a continuous background. The calcium line with wave-length 4226 is always seen under these circumstances as a more or less broad black band on a continuous background, and when the temperature of the crucible has risen sufficiently, the lines with wave-lengths 4434 and 4454, and next that with wave-length 4425, appear as simple black lines. So too do the blue and red lines of lithium, and the barium line of wave-length 5535,

appear steadily as sharp black lines, when no trace of the other lines of these metals, either dark or bright, can be detected. Dark bands also frequently appear, with ill-defined edges, in the positions of the well-known bright green and orange bands of lime.

In the case of sodium, using the chloride, we have repeatedly reversed the pair of lines (5687, 5681) next more refrangible than the D group. In every case the less refrangible of the two was the first to be seen reversed, and was the more strongly reversed, as has also been observed by Mr. Lockyer. But our observations on this pair of lines differ from his in so far as he says that "the double green line of sodium shows scarcely any trace of absorption when the lines are visible," while we have repeatedly seen the reversal as dark lines appearing on the expanded bright lines; a second pair of faint bright lines, like ghosts of the first, usually coming out at the same time on the more refrangible side.

Using potassium carbonate, besides the violet and red lines which had been reversed before, we saw the group, wave-lengths 5831, 5802, and 5782, all reversed, the middle line of the three being the first to show reversal. Also the lines wave-lengths 6913, 6946, well reversed, the less refrangible remaining reversed the longer. Also the group, wave-lengths 5353, 5338, 5319 reversed, the most refrangible not being reversed until after the others. Also the line wave-length 5112 reversed, while two other lines of this group, wave-lengths 5095 and 5081, were not seen reversed.

Using lithium chloride, not only were the red and blue lines, as usual, easily reversed, and the orange line well reversed for a long time, but also the green line was distinctly reversed; the violet line still unreversed, though broad and expanded. Had this green line belonged to cæsium, the two blue lines of that metal which are so easily reversed could not have failed to appear; but there was no trace of them.

In the case of rubidium, we have seen the less refrangible of the red lines well reversed as a black line on a continuous background, but it is not easy to get, even from the arc in one of our crucibles, sufficient light in the low red to show the reversal of the extreme ray of this metal.

With charred barium tartrate, and also with baryta and aluminium together, we have obtained the reversal of the line with wave-length 6496, besides the reversals previously described. The less refrangible line, wave-length 6677, was not reversed.

With charred strontium tartrate, the lines with wave-lengths 4812, 4831, and 4873, were reversed, and by the addition of aluminium, the line wave-length 4962 was reversed for a long time, and lines wave-lengths 4895, 4868, about, were also reversed.

On putting calcium chloride into the crucible, the line wave-length

4302 was reversed, this being the only one of the well-marked group to which it belongs which appeared reversed. On another occasion, when charred strontium tartrate was used, the line wave-length 4877 was seen reversed, as well as the strontium line near it. Also the lines wave-lengths 6161, 6121, have again been seen momentarily reversed.

With magnesium, no new reversals of the lines of the metal have been observed by us; but when a stream of hydrogen or of coal-gas was led into the crucible, the line wave-length 5210, previously seen by us in iron tubes, and ascribed by us to a combination of magnesium with hydrogen, was regularly seen, usually as a dark line, sometimes with a tail of fine dark lines on the more refrangible side similar to the tail of bright lines seen in the sparks taken in hydrogen between magnesium points. Sometimes, however, this line (5210) was seen bright. It always disappeared when the gas was discontinued, and appeared again sharply on re-admitting the hydrogen. These effects were, however, only well-defined in crucibles having a height of at least 3 inches above the arc.

On putting a fragment of metallic gallium into a crucible, the less refrangible line, wave-length 4170, came out bright, and soon a dark line appeared in the middle of it. The other line, wave-length 4031, showed the same effect, but less strongly.

In the cases of cadmium and copper, though we have made no thorough examination of them, we can corroborate the results arrived at by Cornu. We noticed particularly the disappearance in the arc of the cadmium lines, with wave-lengths 5377 and 5336.

On the addition of aluminium to either copper or silver in our lime crucibles, we noticed that the copper or silver lines which had been previously predominant, almost faded away, while the calcium lines came out instead with marked brilliancy. In no case could we detect the red lines of aluminium in the arc.

With a view to re-introduce into the arc the magnesium line wave-length 4481, we tried the action of an induction spark in a lime crucible simultaneously with the arc, but without success; for the conducting power of the hot walls of the crucible, and the highly expanded gases within it, caused the resistance to be so much diminished, that the spark passed as in a highly rarefied medium. In order to succeed with this experiment, it seems plain that it must be made in an apparatus which will allow of its being performed under a pressure of several atmospheres.

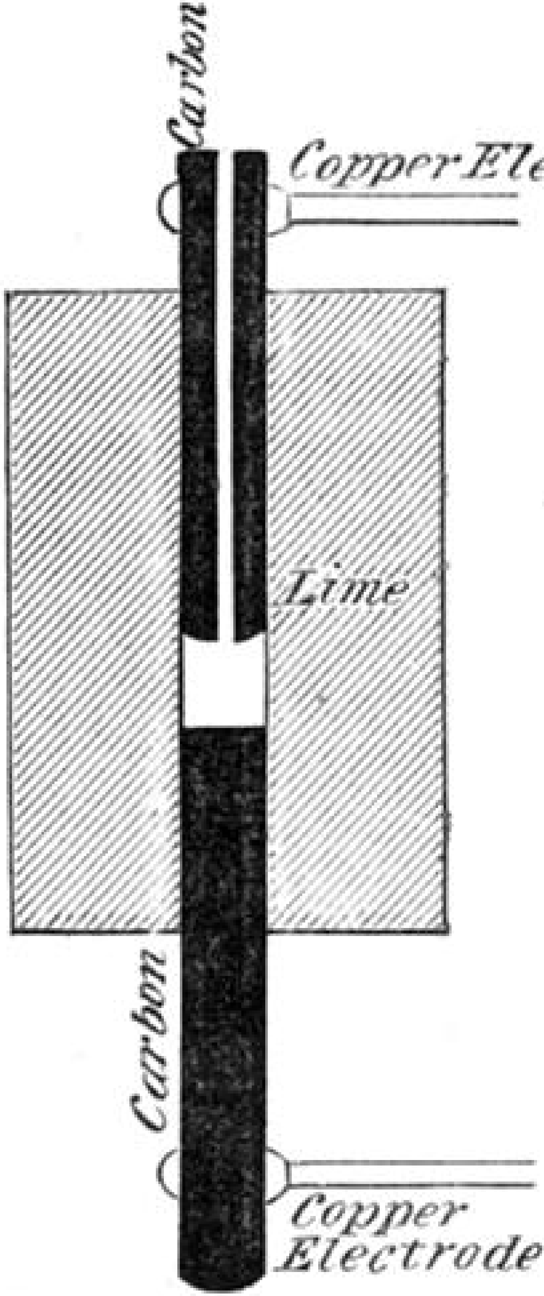
Reviewing the series of reversals which we have observed, we may remark that in many cases the least refrangible of two lines near together is the most easily reversed, as has been previously remarked by Cornu. Thus, in the case of barium (though there is no very distinct grouping of the lines of that metal) taking the rays in order, we have

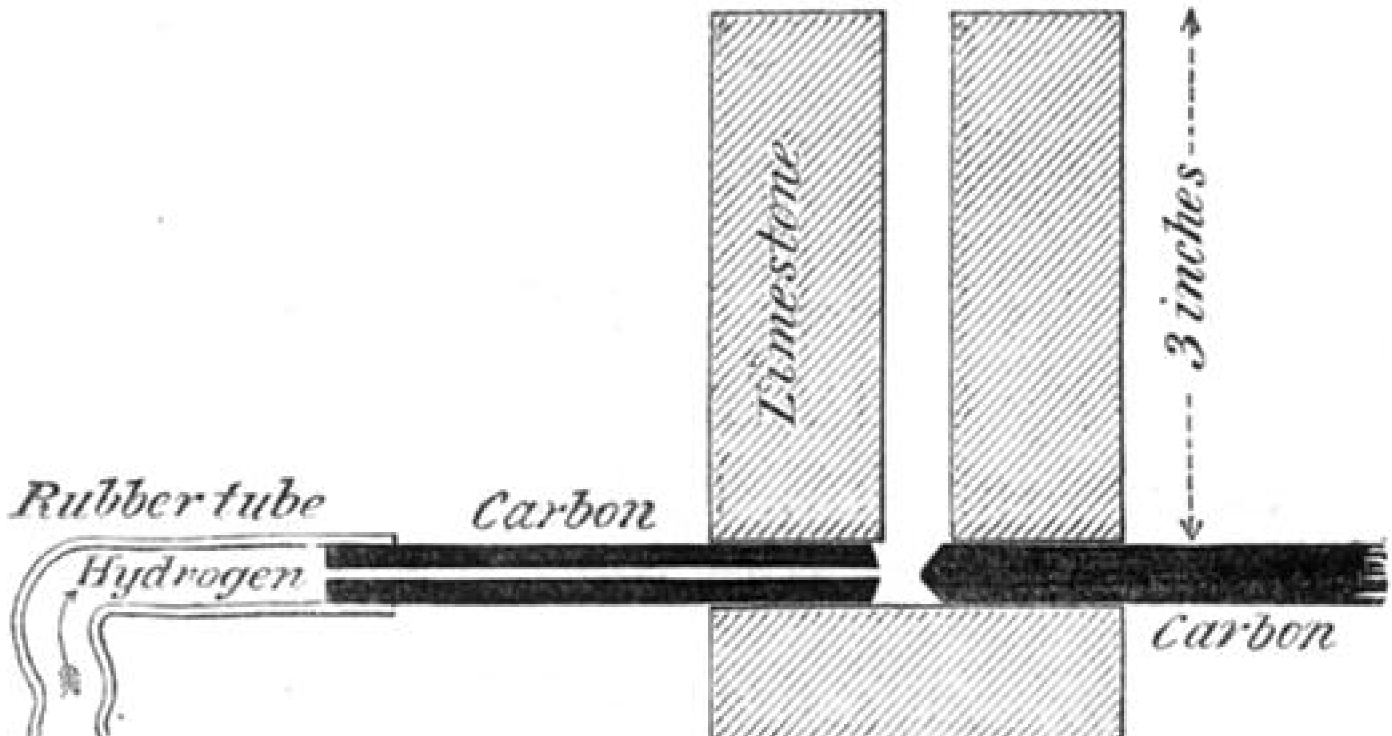
the line wave-length 5535 readily reversed, while that with wave-length 5518 is less easily reversed; the line wave-length 4933 is comparatively easily reversed, whereas that with wave-length 4899 has not been reversed by us. On the other hand, the line wave-length 4553 has been reversed, but not the 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


Carbon
Copper Electrode
Lime
Carbon
Copper
Electrode


Limestone
3 inches
Rubber tube
Carbon
Hydrogen
Carbon