

March 8, 1883.

THE PRESIDENT in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

- I. "Notes on the Absorption of Ultra-Violet Rays by various Substances." 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 March 1, 1883.

The following notes contain some records of ultra-violet absorptions in addition to those which have been examined by Soret, Hartley, M. de Chardonnet, and other investigators. For these observations we have generally used the spark of an induction coil, with Leyden jar, between iron electrodes as the source of light. Occasionally we have used other electrodes, but the lines of iron are so multitudinous, and so closely set in a large part of the ultra-violet region of the spectrum, that they form almost a continuous spectrum, at the same time there are amongst them a sufficient number of breaks and conspicuous lines to serve as points of reference. The spectroscope has a single prism of quartz, and the telescopes have quartz lenses. The image of the spark was projected on to the slit of the spectroscope by a quartz lens, and the absorbent substances were interposed between the slit and the last-mentioned lens. The gases were held in tubes fitted, some with quartz, others with rock salt, plates on the ends; liquids in cells with quartz sides. The spectra were all photographed.

Chlorine in small quantity shows a single absorption band extending from about N (3580) to T (3020). As the quantity of chlorine is increased this band widens, expanding on both sides, but rather more rapidly on the less refrangible side. Different quantities of chlorine produced absorption from about H (3968) to wave-length 2755, from wave-length 4415 to 2665, and from wave-length 4650 to 2630. With the greatest quantity of chlorine tried the absorption did not extend above wave-length 2550.

Bromine vapour in small quantity absorbs light up to about L (3820), and is quite transparent above that. With larger quantity

the absorption increases, gradually extending with increase of bromine vapour from L to P (3360); and at the same time there is a gradually increasing general absorption at the most refrangible end of the spectrum beginning at about wave-length 2500; so that the denser bromine vapour is transparent for a band between wave-length 2500 and 3350.

Liquid bromine in very thin film between two quartz plates is transparent for a band between wave-length about 3650 and 3400, shading away on both sides, so that below M on one side and above P on the other the absorption seems complete. The transparency of the liquid film ends on the more refrangible side just where that of the vapour begins.

Iodine vapour tolerably dense cuts off all within the range of our photographs below wave-length 4300, and its absorption gradually diminishes from that point up to about wave-length 4080, from that point it is transparent.* Denser vapour produces complete absorption up to 4080 and partial absorption above that point.

Iodine dissolved in carbon disulphide is transparent for a band between G and H, cutting off all above and below. It is not possible to tell how much of the light above M (3727) is absorbed by iodine in such a solution, inasmuch as carbon disulphide is opaque for rays more refrangible than M.

Iodine dissolved in carbon tetrachloride when the solution is weak, shows only the absorption due to the solvent, described below. More iodine increases the absorption until it is complete above P (3360), with shading edge as far down as about wave-length 3400.

Sulphurous acid gas produces an absorption band which is very marked between R (3179) and wave-length 2630, and a fainter absorption extending on the less refrangible side to O (3440), and on the other side to the end of the range photographed, wave-length 2300.

Sulphuretted hydrogen produces complete absorption above wave-length 2580. Below that a partial general absorption.

Vapour of carbon disulphide in very small quantity produces an absorption band extending from P to T, shading away at each end; no absorption in the higher region. With more vapour the absorption band widens, extending from about wave-length 3400 to 3000, and a second absorption occurs beginning at about wave-length 2580, and extending to the end of the range photographed.

Carbon tetrachloride liquid produces an absorption band with a maximum about R, extending, but with decreasing intensity, up to

* The principal absorption band of the haloids seems to shift towards the less refrangible side with increase of atomic weight, and so to agree with the general rule which Lecoq de Boisbaudran has noticed in the shifting of corresponding lines in the spectra of groups of similar metals.—March 16.

Q (3285) on one side, and to *s* (3045) on the other. In the higher region there is a second absorption sensible about wave-length 2600, and increasing in intensity up to about wave-length 2580, beyond which point it is complete.

Chlorine peroxide gives a succession of nine shaded bands, at nearly equal intervals, between M and S, with faint indications of others beyond. In the highest region this gas seems quite transparent.

A slice of chrome-alum a quarter of an inch thick, is transparent between wave-lengths 3270 and 2830, its absorption gradually increases on both sides of those limits, but rather more rapidly on the more refrangible side than on the other, and becomes complete below about wave-length 3360 and above wave-length 2730.

A very thin plate of mica shows absorption beginning about S (3100), rapidly increasing above U (2947), and complete above wave-length 2840.

A thin film of silver precipitated chemically on a plate of quartz transmits well a band of light between wave-length about 3350 and 3070, but is quite opaque beyond those limits on both sides.*

A thin film of gold similarly precipitated merely produces a slight general absorption all along the spectrum.

The difference between the limits of transparency of Iceland spar for the ordinary and extraordinary rays, inferred from theory by Lommel, we find to be very small, and hardly to be detected without using a considerable thickness, three inches or more, of the spar.

We had expected to be able to apply the well-known photometric method by means of polarised light to the comparison of intensities of ultra-violet rays. Ordinary Nicol's prisms are not applicable to ultra-violet rays on account of the opacity of the Canada balsam, with which they are cemented, but through the kindness of the President of the Society, we obtained from him the loan of a pair of Foucault's prisms. Upon taking photographs of the spectrum of the iron spark through this pair of prisms at various inclinations between the planes of polarisation of the two prisms, we found that for the whole range between the position of parallelism and the inclination of 80° there was no sensible difference of effect upon the photographic plate, though the length of exposure was in all cases the same. For inclinations between 80° and 90° there was a sensible and increasing diminution in the photographic effect as the planes of polarisation of the polariser and analyser were more nearly at right

* Cornu has noticed ("Spectre Normal du Soleil," p. 23, note) that such a film of silver is transparent for certain ultra-violet rays, but he places them about wave-length 270, which does not agree with our observations. Chardonnet ("Comp. rend.," February, 1883) says that the transparent band extends from O to S. W. A. Miller ("Phil. Trans.," 1863) noticed that for a certain distance in the ultra-violet a silver reflector did not reflect the incident rays.

angles to one another. It seems to follow from this that the full photographic effect on the dry gelatine plates used by us ensues when the intensity of the light reaches a certain limit, but that for intensities of light beyond that limit there is no sensible increase in the effect until the stage of solarisation is reached.

II. "Note on the Reversal of Hydrogen Lines; and on the Outburst of Hydrogen Lines when Water is dropped into the Arc." 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 March 1, 1883.

The concentration of the radiation of hydrogen in a small number of spectral lines would lead us to expect that the absorption of light of the same refrangibility as those lines would, at the temperature of incandescence, be correspondingly strong, and that therefore the hydrogen lines would be easily reversed. The mass of hydrogen which we can raise to a temperature high enough to show the lines is, however, so small, that notwithstanding the great absorptive power of hydrogen for the rays which it emits, the reversal of the lines has not hitherto been noticed. We find, in fact, that the lines are very readily reversed, and the reversal may be easily observed.

When a short induction spark is taken between electrodes of aluminium or magnesium in hydrogen at atmospheric pressure, a large Leyden jar being connected with the secondary wire of the coil, the hydrogen lines show no reversal; but if the pressure of the hydrogen be increased by half an atmosphere or even less,* the lines expand and a fine dark line may be seen in the middle of the F line. As the pressure is increased this dark line becomes stronger, so that at two atmospheres it is very decided. As the F line expands with increase of pressure the dark line expands too and becomes a band. It is best seen when the pressure is between two and three atmospheres. When the pressure is further increased the dark band becomes diffuse, and at five atmospheres cannot be distinctly traced. No definite reversal of the C line was observed under these circumstances. The dispersion used, however, was only that of one prism.

By using a higher dispersion the reversal of both the C and F lines may be observed at lower pressures. For this purpose we have used a Plücker tube, filled with hydrogen and only exhausted until the spark would pass readily when a large jar was used.

* The pressures here mentioned are only measured by a metallic gauge attached to the Caillietet pump employed, and must therefore be only taken as approximately correct.