THE CHEMICAL EFFECT OF THE SPECTRUM

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TRANSLATOR'S PREFACE.

THE original of this small book is in German, but it subsequently appeared in French, and from a copy of the latter, annotated by the Author, it was translated for the pages of the *Photographic Journal*. The author, Dr. Eder, who is so well known for his practical and scientific acquaintance with photography, has in this work shown the depth of his knowledge of the photographic literature of every country; for the size of the compilation can by no means be taken as a measure of the labour it involved. Its value as a book of reference can scarcely be overrated, and it is for this reason that it has been deemed advisable to reprint it from the *Photographic Journal*. From some of the conclusions which the Author draws, the Translator and Editor has ventured to differ, but as to the facts there is no difference of opinion between them.

W. DE W. A.

November, 1883.

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CHAPTER I.

INTRODUCTORY.

For nearly half a century detailed experiments have been made on the chemical action of luminous rays. These experiments are very delicate, and the reactions which produce them extremely difficult to render useful; for not only the quality of the chemical agents used, but also the quality of light which acts upon them and causes the reaction has to be taken into account.

It is interesting to see in so many years how much has produced conclusive results. It is altogether impossible to deny that modern photo-chemists are those who, by aid of spectrum analysis, have explained the chemical reactions produced by light.

Of all the chemical compounds the salts of silver have been most studied in regard to their behaviour in light. It is upon these salts the observation was first made, that all rays of the spectrum have not the same chemical action. For this reason we shall first occupy ourselves with the action of the solar spectrum on the different silver-compounds, as they are, above others, those which occupy the chief position in photography.

Nearly all the salts of silver take a deep colour when exposed

to the action of white light, and for nearly all the blue and violet rays have a more intense reducing action than the red rays. In 1777 SCHEELE had already written, in his work "Von der Luft und der Erde," that of all the rays of the spectrum the violet most blacken silver chloride.

SENNEBIER, repeating Scheele's experiments, found that chloride of silver was darkened by violet light in 15 seconds in the same manner as if exposed to the yellow rays for 5½ minutes, or during 20 minutes to the red rays.

BERARD (Gilbert, "Annales de Physique," 1813, vol. vi) and SEEBECK (Goethe, "De la Science des Couleurs," 1820, vol. ii, fig. 716) confirmed these experiments at the commencement of this century, and remarked that the extreme limit of the violet has the most intense chemical action. They impregnated paper with silver chloride, exposed it to the solar spectrum, and saw that the violet region strongly blackened it, the blue less, the yellow very little, or not at all, and the red very feebly.

Berard made another very interesting experiment. He collected by means of a lens the rays of the spectrum between the violet and the green, to form a beam of white light, and he proceeded in the same way to produce a brilliant white point by collecting the rays between the yellow and the red:* despite the heat of this beam, it had no action on silver chloride, although the exposure was prolonged for two hours. The other beam, although less intense, blackened silver chloride in ten minutes.

On the 22nd February, 1801, RITTER ("Des Rayons Lumineux Chimiques," Gilbert, "Ann. de Phys.," vol. vii, p. 525, vol. xii, p. 409) found that silver chloride was quickly darkened also by the rays which lay beyond the violet of the solar spectrum. He deduced from this that there were two kinds of invisible rays in the solar spectrum, the one below the red (where is found, as is known, the invisible-heat rays†),

[* There seems to be some mistake regarding the colour of brilliant dots produced. Yellow and red will never make white, neither will violet, blue, and green.—*Editor.*]

[† This term is that which is usually adopted; but it must be remembered that rays are neither "heat rays" nor "chemical rays." The same rays may have a heating effect or a chemical effect, according to the kind of matter on which they fall.—*Editor.*]

the others beyond the violet possessing above all chemical properties. WOLLASTON ("De certains Effets Chimiques de la Lumière," Gilbert, "Ann. de Phys.," vol. xxxix, p. 291) confirms Ritter's deductions. It is recognised that solar light contains numberless rays completely invisible, which nevertheless well show their action on a photographic plate.

It is better to submit the substances to be experimented upon to the action of each region separately. Experiments made with pure spectrum colours—that is to say, colours produced through the decomposition of white light by means of a prism—are more exact than those made by means of variously coloured glasses. Light coloured by its passage through differently coloured glasses, like the spectrum colours, shows a totally different chemical action according to the colour of the glass through which it has passed; and this Seebeck had already indicated. He found that silver chloride darkened under the action of light, after having passed through violet, blue, and green-blue glasses, whilst it preserved its colour after passing through yellow, green, and red glasses. Other yellow substances take away the blackening property of sun-light: thus silver-chloride paper remains unaltered by light when it passes through chromate of potash,* sulphide of ammonium, the chlorides of iron, gold, and platinum (Draper, "Phil. Mag.," vol. xvi, p. 81). BECQUEREL, in his interesting Memoir ("Ann. de Chim. et de Phys.," 1843, vol. ix), made very curious observations upon the use of coloured glasses. He examined the rays which these glasses transmitted, and remarked that the light so obtained was not homogeneous when examined by the spectroscope; and that for this reason it was useful to try coloured glasses in the spectroscope before adopting them for photographic experiments.

As the blue and violet light of the extremity of the spectrum

* In 1855 Hunt recommended a mixture of bichromate of potash and gum or glue for tinting the windows of the dark-room in which sensitive plates have to be prepared (Hunt's "Photography"). I cannot recommend this preparation, because mixtures of this kind become brown or green under the action of light, and are then not so safe. For the action of other colouring matters, and particularly organic matters, *see* Burdy, "Bulletin de la Société Française," 1879, p. 98; Abney, Tóth, and Eder, "Photographic Journal," 1879.