

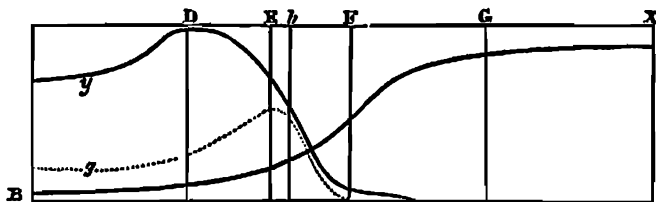
ART. XLIV.—*On the Green tint produced by mixing blue and yellow powders*; by O. N. ROOD, Prof. of Physics in Columbia College.

It is known to every one, that the mechanical mixture of yellow and blue powders, ("water or oil colors,") produces a more or less lively green. This fact, with others similar in nature, was formerly used by some physicists in support of the view that there are only three primary colors—red, yellow and blue,—and that the other tints of the spectrum are formed by a mixture of these three in certain proportions. Helmholtz has, however, shown that the mixture of the blue and yellow of the *spectrum* produces not green, but *white light*. Similarly it is

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now known that if a circular disc be painted with alternate blue and yellow sectors, and then be caused to rotate rapidly, the resultant tint will be gray, or reddish gray, but not green. Helmholtz has accounted for the production of a green color when blue and yellow pigments are mixed, in a manner like the following: Light reflected from a painted surface is of a two-fold kind: 1st, That which comes directly from the surfaces of the little atoms of colored powder; this will, in ordinary daylight, be white, and small in amount. 2nd, That light which penetrates through two or more atoms of the pigment, and is then reflected; this is always colored, and colored merely because in its passage through the atoms, certain rays have been absorbed. For example, the white light which penetrates through an atom of ultramarine, in this operation becomes deprived mainly of the red, orange, and yellow rays; the green, blue and violet rays being left comparatively unweakened. The particles of chrome-yellow, on the other hand, in the same process absorb the blue and violet rays, reflecting back the red, orange and green rays. Hence it will be seen that by the joint action of the ultramarine and chrome-yellow, all the rays of the spectrum are absorbed except the green; therefore green light alone is reflected back to the eye.

This theory I have lately tested with the aid of the spectroscope. Three strips of white paper, each $\frac{1}{16}$ th of an inch in breadth, were painted respectively with chrome-yellow, artificial-ultramarine, and a mixture of these two pigments in such proportion as to produce a green. The strips were placed together before the slit of a spectroscope, illuminated by light from a white cloud, and their spectra compared with a normal spectrum from a strip of white paper. It was found that if the intensity of the tints of the normal spectrum be represented by the rect-



angle BX, the spectra from the yellow, green, and blue papers, will be approximately represented by the areas contained in the curves *y*, *g* and *B*. Mere inspection shows that the spectrum from the green paper is made up of those rays which are common to both of the other spectra, its maximum being between the fixed lines *E* and *b*. Inspection also of the curves given by the chrome-yellow and ultramarine, show that both are rather

deficient in the green element, and therefore comparatively unfit to produce a bright green by mixture.

A disc was now painted with alternate blue and yellow sectors, the same materials being used; when it was caused to revolve rapidly the resultant tint presented to the naked eye was slightly reddish grey. Next the same disc was made to rotate before the slit of the spectroscope: prismatic analysis showed that its spectrum was totally different from the spectrum furnished by the green paper: it approximated to the normal spectrum, being in fact the sum of the spectra *y* and *B* in the diagram; there was, however, a rather dark space between the fixed lines *b* and *F*. This may account for the fact that the revolving disc viewed by the naked eye appeared slightly reddish, instead of pure grey.

It will be seen, then, that the results of spectral analysis account for this singular phenomenon in all its details.

It would be equally easy to account for the fact, that much more brilliant greens are produced by mechanically mixing those yellow and blue pigments, which are, one or both, originally slightly greenish in tint.

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