

SCIENCE

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ON COLOR BLINDNESS.

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On the Application of the Flicker Photometer to the Quantitative Study of Color Blindness.

IN the previous number of this JOURNAL, I gave a short account of one of the forms of certain flicker photometers devised by myself, and now will still further illustrate its use by detailing some experiments that were made with it on persons more or less color blind to red. The mode of proceeding was as follows: Plates of deep red and violet-blue glass were placed on opposite sides of the prism and one of the lamps allowed to remain stationary; the blue glass was next to it. On the side of the movable lamp the red glass was placed. In case, then, the patient was more or less blind to red light it would be necessary for him to move up the lamp which furnished the red light nearer to the prism, in order to cause the flicker to disappear, than would be the case in normal vision. This experiment having then been repeated by a person with normal vision, the joint result furnishes the means of measuring the amount of red color blindness, it being, of course, assumed in this procedure that the eyes of the two experimenters are normal for blue light. This determination being finished, I replaced the red glass by green, the blue glass remaining in its old position next to the stationary lamp, and new measurements were made as before by both persons in order to test for green color blindness.

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In this manner Mr. T, known to be somewhat color blind to red, was examined, and I found that putting the amount of red light perceived by myself as 100 he perceived only 63.04 per cent. It was also ascertained that his vision was not only defective for red light, but to a less extent for green, he perceiving only 85.5 per cent. of it. A set of control experiments were then made on Mr. T. The blue glass was replaced by the green glass and the red glass was put next to the movable lamp, and for the moment it was assumed that the vision of Mr. T for green light was the same as my own—in other words, green instead of blue light was made the standard, and it was temporarily assumed that both of us were equally affected by green light. The amounts of red perceived by him in two experiments were 71.3 and 70 per cent., as compared with 100 by myself. But as he really perceived only 85.5 per cent. of the green light, to obtain the correct value of his perception of red in these two experiments we must take $\frac{85.5}{100}$ of 70.6 = 60.4, which differs from the value for the red directly obtained by 2.6 per cent. It may be remarked, in passing, that this case of color blindness was not suspected till revealed by some flicker experiments with colored discs made by myself in Mr. T's presence.

A second case which I examined was of a more pronounced character, and had previously been known to exist. Out of 100 rays of red light perceived by myself, Mr. A. was affected only by 19.44 per cent., violet-blue, as before, being the standard. With the same standard only 86.9 per cent. of the green light was perceived. Taking green as the standard, 22.9 and 23.3 per cent. of red was perceived, and as before, $\frac{86.9}{100}$ of 23.1 = 20, instead of 19.44, obtained in the direct determination.

The third case of Mr. B. was quite similar to the last, a well-known and pronounced instance of red color-blindness. Violet-blue being taken as the standard, 20.4 per cent. of red was perceived, and 83.8 of green light. Green being made the standard, 25.5 per cent. of red light was perceived, and as before $\frac{83.8}{100}$ of 25.5 = 21.36, instead of 20.4, as directly obtained when using violet-blue light as the standard.

In these determinations, as in all others of a similar kind which I have superintended, the persons experimented on moved the lamp themselves, without assistance from me, and, owing to the presence of screens, were in complete ignorance of the results they were obtaining. I have been quite surprised to find how quickly persons wholly unused to physical experiments of any kind were able to obtain reliable results with the flicker photometer as now arranged. They needed a little more time, and their probable error was somewhat larger than is the case with an experienced person. Each result given above is obtained from the mean of from ten to fifteen readings registered on the file of paper connected with the moving lamp. Finally, it is to be remembered that in all of these determinations I have for the time being assumed my own color-vision to be strictly normal, which, now that we have this accurate photometric method, is hardly quite a safe proceeding for any man, or even woman, as some of my unpublished results show.

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THE OPENING OF THE NEW LABORATORY FOR PHYSICAL CHEMISTRY IN LEIPSIK.

A SHORT time ago an abstract of the address delivered by Nernst at the opening of the new laboratory for physical chemistry at the University of Göttingen was given in SCIENCE. The University in Leipsic has