

SCIENCE

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ON A FLICKER PHOTOMETER.

IN the September number of the *American Journal of Science* for 1893 I described a photometric method founded on flickers which I had proved to be independent of color, and stated that there did not seem to be any reason why it should not be applied to ordinary photometric work. In January, 1896, Professor F. P. Whitman published, in the *Physical Review*, an account of a photometer with a revolving disc of cardboard, in which this flicker method was utilized with more or less success. Afterwards I constructed and experimented with five different forms of flicker photometers, and in November, 1896, read a paper on the subject before the National Academy of Sciences.

I propose here to give a short account of one of these forms, and to mention a few experiments that were made with it by myself and others.

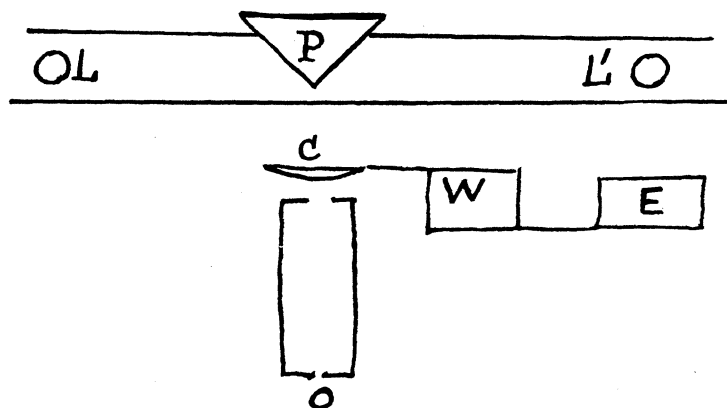
The two sides of the white, upright, 90° prism, P, are illuminated with the lights to be compared, coming from the incandescent lamps L and L', and the flicker is brought about by the rapid motion of the cylindrical lens, or biprism of small angle, C. This is caused to oscillate horizontally by a train of toothed wheels, W, which can either be turned by hand, or better by a small electromotor, E, the speed of which is regulated by a friction break. When the apparatus is in action the two illuminated sides

of the prism, P, are presented rapidly in succession to the eye placed at the aperture, O. The incandescent lamps, L, L', move over graduated bars or 'ways,' the total length of which is 3.3 meters. A long light wooden rod with a square cross-section is employed to move one of the lamps, and to carry the file of paper on which the readings are registered, obviating the necessity of removing the eye from O.

lamps was determined by Dr. Tufts and myself on the same day, the results in each case being the mean of 15 readings.

Dr. Tufts	O. N. R.
90.79	90.94
91.49	
91.14	

The difference between Dr. Tuft's mean and my result being $\frac{2}{10}$ of a per cent.



It is important that the edge of the prism where its faces meet should be *sharp*, and a satisfactory prism of this kind I have made from plaster of Paris cast in a peculiar mould, but unglazed paper stretched over a well-made wooden prism answers tolerably well, when prepared with a preliminary vertical cut extending not quite half way through the paper. In all the determinations given below, this arrangement was used, although it is certain that a prism with an *invisible* edge would have furnished still better results. The electromotor was usually employed; always when persons other than myself used the apparatus.

In order to show the action of the photometer with white light some experiments by myself in company with other persons are given below. The relative illuminating power of two 16-candle power incandescent

Three weeks later I made experiments, still using white light, with ladies, who saw the photometer for the first time. The figures obtained were:

Miss L.	Miss H.	O. N. R.
92.47	91.31	91.33

To test the action of the photometer with saturated colored light, the amount of light transmitted by a plate of red glass was directly determined, the result being that out of 100 rays of white light it transmitted 14.6. In this case the flicker was, of course, between almost spectral red and white light. A similar determination was made with a plate of green glass; it transmitted 8.4 rays. Here the flicker was between almost spectral green light and white.

These two plates of glass were then placed on opposite sides of the prism and the ratio of the amounts of light transmitted by them determined. In this case the flicker

was between spectral red and green. In the calculation of the results the amount of red light transmitted was taken as 14.6, and the amounts of green light calculated from the ratios obtained ; these were as follows :

8.7 The mean of all the results was
8.9 8.78, instead of 8.4 per cent, as di-
8.7 rectly determined.

8.9 These measurements were made
9.4 by myself, but I thought it would be
8.6 interesting to see how nearly the
8.3 same result would be obtained by a
8.78 person wholly unused to the photometer, and in general to photometric work. Miss L., after the nature of a flicker had been explained to her, at once obtained 9.07, which differs by $\frac{3}{10}$ of a per cent. from the mean of my more elaborate work.

Results of equal or greater accuracy were obtained by myself and others using blue and red light, or green and blue light, all of them being intense or saturated. No trouble was found in causing the disappearance of the flicker when the speed of the motor was properly regulated, nor were the eyes more fatigued than in making ordinary optical observations ; of course, if the illumination is feeble the flicker becomes feeble ; consequently the lamps and their distances from the prism should be so chosen as to afford the best illumination possible under the given conditions.

OGDEN N. ROOD.

COLUMBIA UNIVERSITY.

THE NEW YORK ZOOLOGICAL PARK.

MUCH progress has been made during the past year by the Zoological Society of New York, and the establishment of the Park in the near future now depends solely upon the cooperation of the city government. Under the present city administration, and especially with the policy of economy which has been generally adopted, it appears possible that the project may be somewhat de-

layed, although the Park Commissioners are in hearty sympathy with the project of the Society.

In the recently issued report of the Executive Committee, the following are enumerated as the chief results of the year's work : A contract with the City of New York, unanimously adopted by the Commissioners of the Sinking Fund, March 24, 1897 ; completion of the General Plan of the Park, and its unanimous approval by the Park Commissioners, November 22, 1897 ; subscription of the first \$100,000 toward the gift of \$250,000 from the Society to the city, completed February 15, 1898 ; preliminary plans of nine of the principal buildings, prepared and submitted for criticism to several American and European zoological garden specialists ; increase of the membership of the Society from 118 to 600 active members.

According to the agreement with the city, \$125,000 is to be expended by the city in the preparation of walks, sewers, public comfort buildings, boundary fences, etc., and a large part at least of this preliminary work is absolutely essential before the Society can judiciously expend any portion of its Park Improvement Fund of \$250,000. During the next few weeks the matter will probably be decided, and in the meantime detailed plans for every division of work are being prepared with the greatest care.

The preliminary plan of the Park presented by Director Hornaday in 1896 was used as a basis for criticism and suggestion by various leading zoological experts of the country, especially by Dr. C. Hart Merriam, Mr. George B. Grinnell and Mr. D. G. Elliott, who made a careful inspection of the Park and offered a number of valuable suggestions. The preliminary plan was then approved by the Executive Committee and a close topographical survey of the Park ordered. The next step was the combination of the zoological or scientific with the