SOME PHOTO-ELECTRIC PROPERTIES OF THE
ALKALI METALS.IV. LABORATORY APPLICATIONS.¹

BY F. K. RICHTMYER.

WHILE performing some photo-electric experiments the writer was greatly impressed with the possibilities of putting this phenomenon to various laboratory uses where optical measurements by eye are either extremely difficult or altogether impossible. For example as a photometric device for monochromatic light a sensitive sodium surface excels the eye in several respects :

1. In a properly constructed cell there is absolutely no fatigue.
2. The greatest sensibility is in the blue and violet region, where the eye is least sensitive.
3. The magnitude of the photo-electric current, *i. e.*, the sensibility of the device, can be increased by (*a*) increasing the area of the sodium surface, (*b*) increasing the area of the photometric field, and (*c*) decreasing the distance of the field from the sensitive surface ; whereas the action of the eye depends simply on the intensity of light in the photometric field. In a photometer little gain in sensibility results from increasing the size of field, or, within limits, of moving the field nearer the eye.

A case in point is the measurement of decay of phosphorescence. A sample of Balmain's paint on a visiting card was exposed to sunlight for thirty seconds, and then placed over a window about eight cm. in front of a sodium surface, so that 10 or 12 square centimeters of the card were exposed. At first the rate of deflection of the electrometer² was too rapid for accurate measurement. After about six minutes, however, observations were begun and the rate of

¹ Paper presented at the Princeton meeting of the Physical Society, October 23, 1909.

² For description of apparatus and adjustments see the first paper in this series, *PHYS. REV.*, Vol. XXIX., pp. 71-80.

charge taken by chronograph about every four minutes, continuing for one hour after exposure. The results are shown in data table and graphically in Fig. 1 (*I*), in which the ordinates, while photo-

Fig. 1.

electric currents, are proportional to the intensity of light emitted by the phosphorescing paint.

TABLE I.

Time after Exposure.	Rate of Charge of Electrometer, Proportional to Intensity of Light.	$\frac{1}{\sqrt{I}}$	Time after Exposure.	Rate of Charge of Electrometer, Proportional to Intensity of Light.	$\frac{1}{\sqrt{I}}$
5.53 min.	2.29 mm./sec.	.65	36.65 min.	.236 mm./sec.	2.06
10.68	1.11	.95	40.95	.206	2.20
13.40	.829	1.10	45.18	.176	2.38
16.53	.641	1.25	49.15	.159	2.50
20.60	.489	1.43	52.83	.158	2.51
24.67	.385	1.61	56.88	.131	2.76
28.73	.316	1.78	60.7	.130	2.77
32.75	.259	1.96			

At the end of one hour the substance was just visible. Accurate measurements by the eye would have been practically impossible, whereas the electrometer was being deflected at a fairly

measurable rate — over .1 mm./sec. And this rate of deflection could have been increased many times had the exposed area of paint, and its distance from the cell been sufficiently altered. For example, a card 10 cm. square, placed 6 cm. from the cell would have increased the rate of deflection twenty times or more, *i. e.*, to 2 mm./sec. at the end of one hour, which would make observations possible for several hours.

When the above data are plotted in the usual manner, with $1/\sqrt{I}$ against time the curve shown in Fig. 1 (*II*) results. Except in a general way no great amount of importance should be attached to the compound linear character of this curve, as no special care was taken to eliminate or correct for the leakage currents (previously mentioned¹) through the glass walls of the cell, the object being simply to test the cell as a photometric device and not the study of phosphorescence.

Another possible application results from the fact that the total quantity of electricity discharged from the sensitive surface, and therefore the permanent deflection given to the electrometer, depends on the integral $I \cdot dt$, where I represents the light intensity over an interval of time dt . That is, such a combination of cell and electrometer is to light measurements what the electrolytic cell is to the measurement of quantity of electricity. In this way the study of short decay phosphorescence might be possible. The writer has also made measurements of the relative total quantity of light passing through a photographic shutter set at speeds of .01, .02 and .04 sec. For this purpose the closed shutter, mounted in front of the cell, was illuminated by a beam of parallel light. The "exposure" was then made and the resulting deflection of the electrometer noted. Unfortunately these data were not preserved and it must suffice to say that in the case of .01 sec. the deflection was 20 or 30 mm.

Although possibly a little troublesome to work with, nevertheless it would seem that this phenomenon is capable of more extended laboratory use than has heretofore been made of it.

CORNELL UNIVERSITY,
October, 1909.

¹ PHYS. REV., Vol. XXIX., pp. 71-80.