

The position of the median score for each group shows a general agreement between test scores and teachers' ratings for scholarship. The overlapping of the scores of the various scholarship groups may be due to many causes. In the first place, it is not assumed that the tests measure all those qualities which should be considered in making marks. It is conceivable that students who usually do well might do poorly on a single test. Adding the scores of the two tests should give a more accurate measure of the ability of individual students. The agreement between test scores and teachers' rating must be far from exact for the inaccuracies of teachers' estimates are well known. It seems quite likely, however, that these tests give a more accurate measure of the ability of individual students than any other single thing that could be used.

The results from our first experience with measuring the product from instruction in chemistry are most gratifying. On the basis of these results the tests are now being revised. The revised tests will be circulated near the close of the school year (1920-21) in what is hoped will be a final form.

The author of this study is very grateful, indeed, to those chemistry teachers who cooperated so generously by giving these tests and scoring the results. He sincerely hopes that when the revised tests are circulated the teachers will again lend their cooperation and thus make possible the formulation of a useful scale for measuring the results which accrue from giving instruction in chemistry to high school students.

AN ELEMENTARY DIFFRACTION METHOD FOR MEASUREMENT OF WAVE LENGTH

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When plane waves of monochromatic light fall on a small circular aperture and the emergent light is observed in an eye-piece placed at any position along a normal to the plane of the aperture, the diffraction pattern in general consists of alternately bright and dark circular rings with a bright or dark centre. If the eye-piece be moved from a considerable distance towards the aperture, it passes through fairly well-defined positions in which the central portion of the diffraction pattern is of maximum or of minimum intensity. Successive positions are somewhat as indicated in Fig. 1.

Now, by the method of half-period zones, it is easily proved that at positions of maximum intensity, $r^2 = n b_n \lambda$ ($n = 1, 3, 5$, etc.) while at positions of minimum intensity, $r^2 = n b_n \lambda$



FIGURE 1.

($n = 2, 4, 6$, etc.), where

r = radius of aperture,

b_n = distance from eye-piece to aperture,

λ = wave-length.

It follows, therefore, that a value of the wave-length may readily be obtained from measurements of b_n and r .

While only rough determinations of the wave-length are possible, the method gives results with, if anything, less variation than is often found in those obtained from a "Newton's Rings" apparatus. Moreover, it enables the student to calculate the wave-length of light *from two extremely simple linear measurements*, and, at the same time, by providing an elementary quantitative experiment on diffraction, is of value in clearing the frequently hazy ideas of the average student on this subject.



FIGURE 2.

In the actual experiment a pin-hole P, illuminated by a strong source of light, was placed at some distance from the circular aperture A, beyond which the emergent light could be observed in an eye-piece E, movable along a good optical bench. The source of light was either an arc lamp, before which pieces of ruby and of cobalt blue glasses were placed so that only a narrow portion of the red end of the spectrum was transmitted; or a mercury vapor lamp with the yellow lines filtered so that for visual observation the green line was the chief constituent of the transmitted light. As a rule values of b_n were obtained only for positions of minimum intensity, it being a trifle easier to observe positions at which the centre of the pattern was a sharp black dot than those of maximum intensity. A few of the latter, however, were also observed.

A summary of some typical measurements is given below. In all cases, the value of b_n given is the average of at least eight readings obtained by approaching the positions from both sides. It will be noted that two values of the wave-length are given. Those in the columns headed λ are calculated on the assumption that plane waves fall on the aperture. Obviously, unless the source is at a considerable distance from the aperture, this assumption is not justifiable, and, as a rule, it is necessary to take into account the distance R from the source to the aperture. Values obtained which in this way from the relation

$$r^2 = \frac{n}{\bar{b}_n} \frac{\lambda}{\bar{R}}$$

are given in the last column of the table.

Case I.

Source—Arc light filtered with red and blue glass.

$R = 341$ cm. $r = 0.79$ mm.

n	b_n	λ	λ'
4	23.6 cm.	.000066	.000070
6	15.5	.000067	.000070
8	11.6	.000067	.000070
10	9.42	.000066	.000068

Case II.

Source—Mercury vapor lamp with yellow lines filtered.

$R = 205$ cm. $r = 0.79$ mm.

n	b_n	λ	λ'
4	32.2	.000048	.000056
6	20.4	.000051	.000056
8	15.2	.000051	.000055
10	12.1	.000052	.000055
5	25.2	.000049	.000056
7	17.2	.000052	.000056
9	13.2	.000052	.000056

AN EXPERIMENT TO ILLUSTRATE THE CAUSE OF THE TIDES

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In my experience as a teacher I have found that the cause of the phenomena of tides is grasped with difficulty by the average student of astronomy. To help the students form a clear and accurate mental picture of the nature of tides, as well as of their cause, it occurred to me to use a toy rubber balloon filled with water.