Photography of Minima in Magneto-Optic Apparatus

Recently there has been developed in this laboratory a photographic method for the study of the minima of light intensity in the magneto-optic method of analysis observed visually by Allison and others. In view of the criticism this method has withstood and the failure of some investigators to operate the apparatus successfully, a letter communicating some positive objective tests of this nature seems to be in order at this time.

The magneto-optic apparatus is identical with that Allison[1] uses for visual work except that a Wollaston prism has been substituted for the analyzing nicol prism. The Wollaston prism is so placed that its two beams lie in a horizontal plane. The polarizing nicol is rotated until the two beams from the Wollaston are of approximately equal intensity. The two images of a narrow vertical slit placed just ahead of the Wollaston are brought to a sharp focus on a photographic plate by a single lens. Each picture is composed of two sharp lines, one being due to light polarized in a vertical plane and the other to light polarized in a horizontal plane. Any rotation in the plane of polarization of the light as it passes through the liquids in the apparatus will cause a brightening of one of the beams and an equivalent dimming in the other. The lines of each picture were examined with a conventional type microphotometer by using a vacuum thermocouple and a short period galvanometer. The line densities were read directly from the galvanometer deflection. The photographic plate, an Eastman Hyperpress plate, was racked by steps along a horizontal track so that 14 to 20 pictures could be made on a strip. The average plate contained several such strips. A synchronous motor operating an electrical switch made the time of exposure and the time between exposures uniform for all the pictures.

The pictures were made with the trolley alternately on the position of the minimum and off this position a centimeter or two. The positions of minima used were those found from repeated visual work. Clamps on the trolley wheel made these two positions constant for any series of pictures. Pure water blanks were first used for each compound studied and the pictures taken with the trolley on and off the position of a minimum characteristic of the compound to be introduced. To overcome any possibility of any mechanical characteristic of the apparatus or electrical circuit duplicate exposures were made for each picture with the current in the coils reversed to its original direction.

Table I represents the averaged results of 225 pictures of water run as blanks for 338 pictures of compounds. These pictures were made on a number of different photographic plates taken over a period of two months. The camera and its optical system were completely dismantled after each plate. The compounds examined included two inorganic acids and three salts all at a concentration of one part in 10^5 parts of water.

TABLE I.

Fields	Current	Compounds	No. of pictures	Algebraic ave. for water	Arithmetical ave. for water	No. of pictures
Assisting	Regular	+10.8	137	+0.45	1.9	89
Assisting	Reversed	−9.95	103	−1.44	1.44	54
Opposing	Regular	−8.0	30	−0.82	2.5	46
Opposing	Reversed	+9.1	68	−0.11	2.7	36

The values given in the above table are the percentages by which the difference in density of the two lines photographed when the trolley was on the minimum position differs from the corresponding difference in density when the trolley was at an off position. This is not the absolute intensity change seen when the trolley moves through a minimum.

It was found that for compounds in every case whether the fields were opposing or assisting a change in the direction of the current gave a corresponding change in the sign of the percentage. The water however varied with no regularity in sign. Both the algebraic and arithmetic averages are given for the water to show the random distribution of sign. The above table does not include the results of 200 pictures taken before an automatic timing device was used. They are, however, perfectly in accord with those listed.

These perfectly objective tests demonstrate the reality and the reproducibility of the minima. The minima are sharp since the on and off positions of the trolley differed by only a centimeter or two. They are characteristic of the compound since pure water blanks give much lower values than the same water and tube give after a trace of the compound has been added.

The work is being continued with a view of presenting a more extended paper.

GORDON HUGHES
ROY GOSLIN

Department of Physics,
Alabama Polytechnic Institute,
January 19, 1935.

[1] Allison and Murphy, J. Am. Chem. Soc. **52**, 3796 (1930).

Hyperfine Structure of the Cadmium Resonance Line

I have recently been experimenting with a liquid-air cooled Schüler tube, the cathode of which is a thin glass projection coated internally with cadmium. As a fairly rigorous test of the cooling, I have photographed by means of a Lummer plate the hyperfine structure of the resonance line at λ2288 $^1S_0-{}^1P_1$, which was observed by Professor R. W. Wood[1] to have a doublet structure of 0.38 cm^{-1}. With currents of 35 m.a. in my tube the line shows as a reversal with a separation of about 0.2 cm^{-1}, but with a current of 15 m.a., the separation is only about 0.08 cm^{-1}. Whether this is still due to a reversal or not, it is impossible to say. In any case, it gives an upper limit to the splitting of the $^1P_1$ term. The spark resonance line at λ2265 $^2S_{\frac{1}{2}}-{}^2P_{1\frac{1}{2}}$ appears to have a close hazy satellite on the short wavelength side.

A. G. SHENSTONE

Princeton University,
January 22, 1935.

[1] Wood, Phil. Mag. **2**, 611 (1926).