THE MAGNETO-OPTIC METHOD OF ANALYSIS

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ABSTRACT

The magneto-optic method of analysis which has been devised by Professor Fred Allison depends upon the fact that when a water solution of an inorganic salt is subjected to a magnetic field it rotates the plane of polarized light (Faraday effect). When the magnetic field is applied there is a brief time interval before the Faraday effect can be detected. The length of this lag depends on the nature of the material in solution. If it is possible to measure the extremely short spaces of time which represent the differences in the lag, then it ought to be possible to use these differences as a means of chemical analysis.

The apparatus includes a light source such as a metal spark. This light is polarized by a Nicol prism and passes through two tubes which are surrounded by oppositely wound coils of wire. Behind the second coil is placed another Nicol prism, the two prisms being "crossed" so that a minimum of light emerges at the zero position. The two tubes are filled with different liquids, and the second coil is moved a short distance away so that the light is compelled to travel a slightly longer path and hence delay for a fraction of a second the effect of the magnetic field. By careful adjustment the delay caused by the increased light path may be made to coincide with the Faraday lag and at this point a minimum of light emerges. By noting the position of these minima, it is found that each inorganic salt has a minimum for each of the isotopes of the metal. This apparatus is therefore a device for measuring the time required for light to travel a distance of a few millimeters.

The method is extremely sensitive since the minima persist even when the solution contains only a slight trace of solute. Roughly, it should be possible to detect a single drop of brine in 100,000 barrels of pure water.

It is to be expected that any method which is so extremely sensitive might easily mislead an observer. Accordingly results on the magneto-optic apparatus have been carefully checked against standard methods such as the arc spectra, the absorption spectra and X-ray spectra with satisfactory checks in every case. We believe that in the hands of a careful, well trained observer the method can be depended upon to give accurate results.

Its advantages are: (a) extremely small quantities can be detected; (b) complex mixtures can be analyzed without separating the constituent materials; (c) the analysis is possible with a minute sample; (d) there is almost no loss of material; (e) the apparatus is moderate in cost; (f) the method may be adapted within limits to both qualitative and quantitative work.

The great weakness in the method under present conditions is the uncertainty on the part of various observers in detecting the minima. If a photoelectric cell could be brought into use or a photographic record made the large personal equation would be eliminated and the method would find many useful applications.