portions of the solution. The solution of pure selenic acid thus obtained was treated with indium hydroxide. Indium selenate crystallized out in white, easily soluble, hygroscopic crystals. Analysis gave the following results:

	Theory for $In_2(SeO_4)_3.10H_2O$. Per cent.	Found. Per cent.
Indium oxide	33.08	32.9 – 33.0
Selenium	28.30	28.3 – 28.2

Indium Caesium Selenate, $CsIn(SeO_4)_2.12H_2O$.—Caesium-indium-selenate, the alum, was made by crystallizing a solution of caesium selenate (prepared from caesium hydroxide and selenic acid) and indium selenate. The alum crystallizes in beautiful colorless octahedra, belonging to the tetragonal system, which are soluble in water, efflorescent in the air and are of the following composition:

	Theory for $CsIn(SeO_4)_2.12H_2O$. Per cent.	Found. Per cent.
Selenium	21.18	21.04
Indium	15.3	15.5
Caesium	17.7	17.8

In the above analyses the selenium was determined by repeated precipitation with sulphur dioxide gas from a hot dilute solution of the salt. The precipitate was collected on a Gooch filter, and the filtrate was boiled down and again treated with sulphur dioxide. It was found necessary to repeat this operation several times in order to remove all of the selenium from the solution. The Gooch filter was dried at 102–5° and the selenium was weighed.

The indium was precipitated by ammonium hydroxide as the hydroxide from the hydrochloric acid solution of the salt, collected on an ashless filter, heated in a porcelain crucible and weighed as In_2O_3.

For the determination of the caesium, the selenium was first removed and the caesium was then precipitated from the chloride solution by chlorplatinic acid and weighed as caesium chlorplatinate.

CORNELL UNIVERSITY,
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A NEW FORM OF COLORIMETER.

BY GEORGE STEIGER.

Received November 6, 1907.

The many uses to which colorimeters can be put are too well known to need mention here.

Instruments using the principle upon which this one is based—the ratio of the thickness of the liquid through, and not the actual dilution to equal concentrations—are not applicable to all colorimetric determinations. It will be found, in comparing such a solution as is used in the colorimetric determination of manganese and some other substances, that there is a change not only of the intensity of the color, but also of the color itself, making it impossible to find a point at which two solutions of different concentrations will have the same depth of tint. In some other cases, as for instance the yellow color of the higher titanium salts, this principle gives perfect satisfaction.

The instrument to be described consists of two wooden boxes, the interior portions of which are finished in dead black. In Fig. 1, AA is a piece of finely ground glass, and this should be illuminated with the full light of the sky. B is a mirror mounted to swing so that light may be thrown perpendicularly through the hole C.

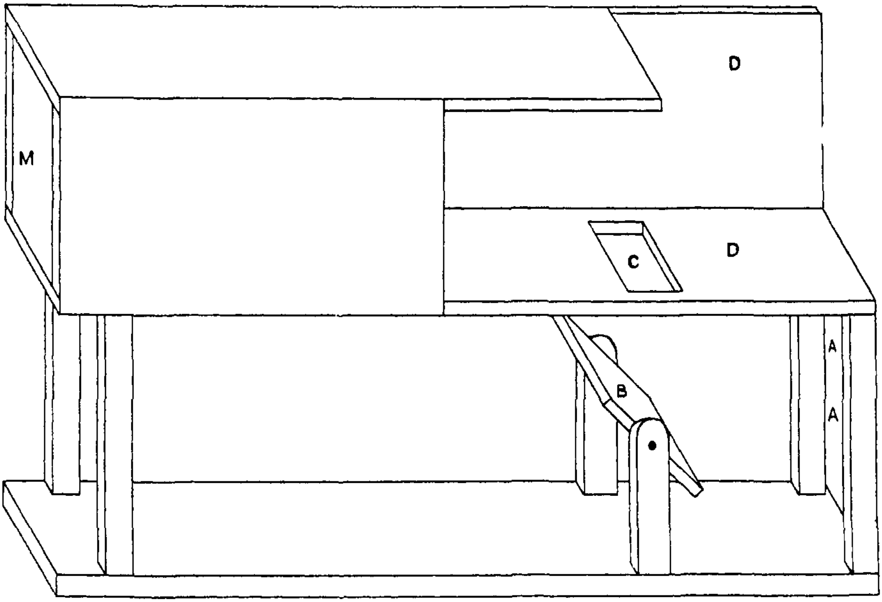

Fig. 1.

The second portion of the apparatus consists of a box, as shown in Fig. 2, made with two parallel grooves in the bottom, in which the two glass cells, CC, can be moved back and forth, and the hole E, which admits light reflected by the mirror B of Fig. 1. These cells are about 15 cm. long, 2.5 cm. wide, and 5 cm. deep. On the bottom of each cell and near the outside edge is engraved a scale, a convenient unit for which is the millimeter. FF are glass tubes with mirrors, GG, attached to the lower ends at an angle of 45°. These tubes may be lifted up when it is desired to remove the cells, they may also be removed entirely from the clips RR for cleaning purposes, but they should be pushed down when in use so that the lower edges of the mirrors touch the bottoms of the cells. When ready for use this box is placed in the space marked DD, Fig. 1.

Care should be taken to place the mirrors at an exact angle of 45°.

Under these conditions, in each cell, all light coming through the bottom of the cell and reflected through the end K, will go through the same thickness of liquid, and if the mirror were a reflecting surface coming in direct contact with the liquid this distance would be represented by the line O P, Fig. 3. There is a small error here, due to the converging of the rays to the eye; this is so slight, however, as not to cause any perceptible uneven illumination.

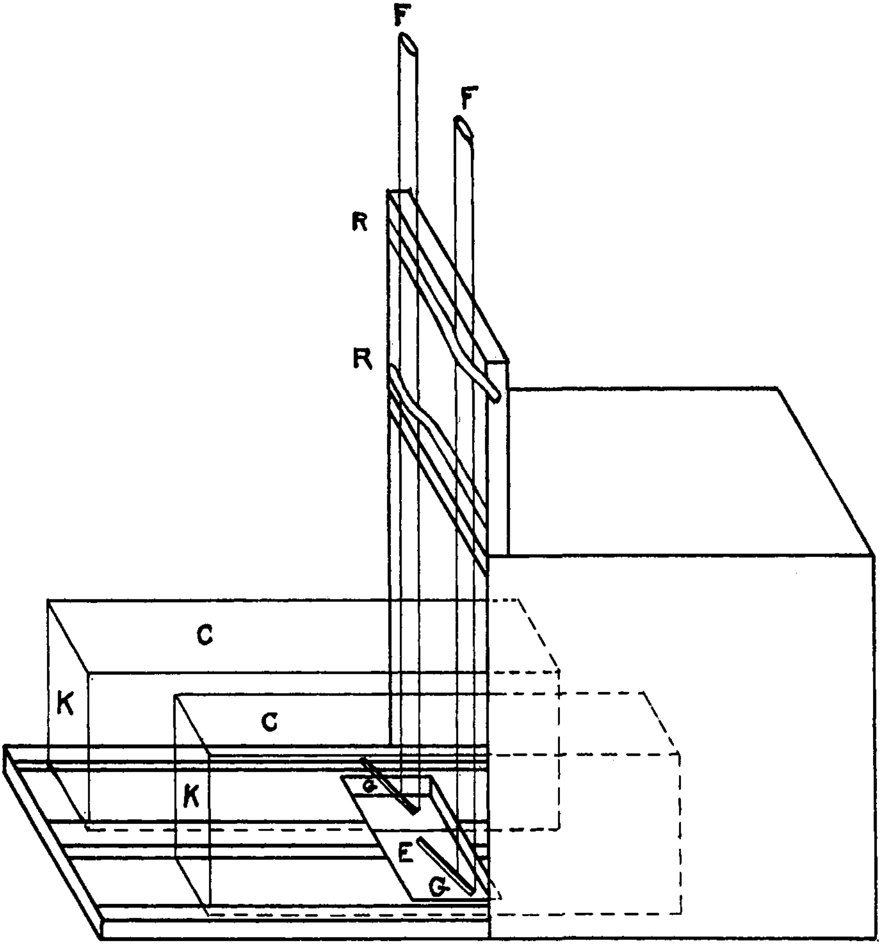

Fig. 2.

The mirrors being made of ordinary looking glass, the reflecting surface will be the upper side G H G, Fig. 3, and the light must go through the glass of the mirror before striking the reflecting surface, and the same on leaving. The distance which the light travels through the glass of the mirror will be represented by twice the length of the hypotenuse of an isosceles-right-angle-triangle, the equal sides of which are each equal to the thickness of the glass, and must be deducted from the length O P.

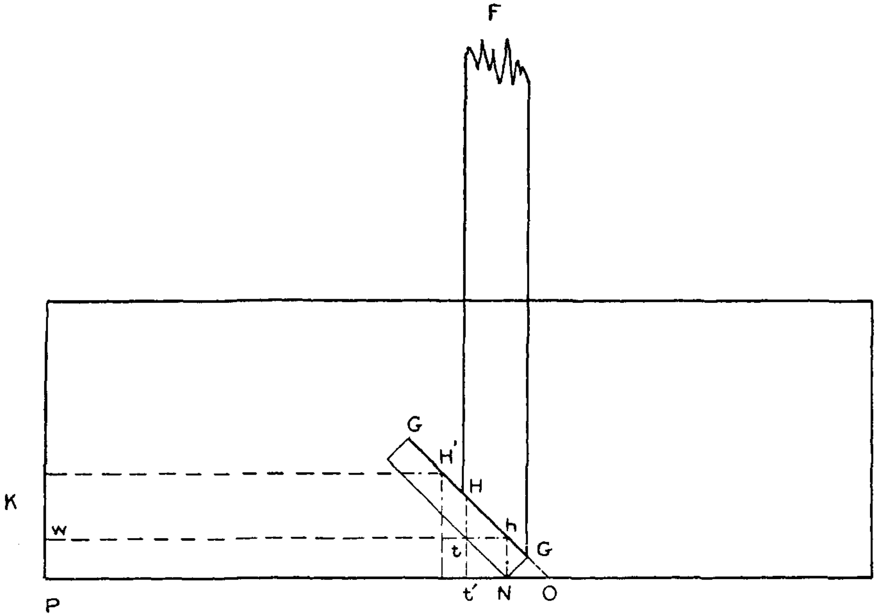

Fig. 3.

A ray of light entering the glass at the point marked N will travel to *h* and then be reflected to *t*. From *t* to *w* it will go through the colorimetric solution, and this distance is therefore the length to be measured. A point, H, is marked on the mirror near the outer edge, so that it may be seen in the same line of vision as the scale on the bottom of the cell, and perpendicularly above *t*. In looking through the end K, this mark will be recorded at the point *t'* directly below it on the scale, and *t'*P being the same at *t w*, the distance desired can be read off. The position of the point H is determined by measuring off, on the back of the mirror, a distance from the lower edge equivalent to three times the thickness of the glass. It may be convenient, if thin looking glass has been used, to have this point farther up on the mirror (H'), in order that it may be seen more plainly, but if so moved an addition must be made to the observed reading, equivalent to one of the sides adjacent to the right angle of an isosceles-right-angle-triangle, the hypotenuse of which is equal to the distance this point has been removed from H. It is convenient in making the graduation on the cell to allow for this correction. The reading can then be made directly.

Glass cells to answer the purpose may be had of any of the large supply houses, but not graduated, the graduation must be done in the laboratory. The supports F F can be made of rather heavy walled glass tubing, about 1 cm. outside diameter.

The mirrors are made of a good grade of looking glass, the lower and top edges blackened, and cemented to the ground ends of the glass tubes with Canada balsam, after which the backs are coated with paraffin. Paraffin answers well as a coating for a large number of colorimetric solutions. In case a liquid is to be used which attacks paraffin, a substitute must be employed which is unaffected by the liquid in question. It will be found necessary to replace the mirrors from time to time, as it is not possible to so protect the silvered surfaces as to prevent the gradual eating in from the edges by the various solutions used.

The comparison is made by pouring a solution of known strength into one of the cells. The unknown solution made up to a definite volume, is put into the other. The left-hand cell is then placed at a convenient point, which should be determined by the depth of color of the solution it contains. The right-hand cell is then moved back and forth till, on looking in the end M of the apparatus, Fig. 1, the two mirrors appear to be of the same shade.

The strengths of the two colorimetric solutions being inversely proportional to the thickness of the liquids looked through, by substituting in the following equation the amount of the material to be determined may be found.

Let R equal the reading of the cell containing the known solution with a concentration C, and r the reading of the cell containing the unknown solution, which has a concentration c, then

$$c = \frac{RC}{r}.$$

Chemical Laboratory,
U. S. Geological Survey,
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THE ESTIMATION OF SMALL AMOUNTS OF FLUORINE.

By George Steiger.

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The estimation of fluorine in such substances as rock mixtures, which require a carbonate fusion to bring the fluorine into a soluble form, is not only a long and difficult operation, but also the final results are far from being satisfactory.

When as much as one tenth of one per cent. is present, a negative result will often be obtained by the Berzelius method, the one usually employed.

The method to be described is based on the well known fact, that the presence of fluorine has a powerful bleaching effect on the yellow color,