POLARIZED LIGHT.

SIMPLE INSTRUMENT FOR THE EXAMINATION OF MICROSCOPIC OBJECTS.

BY GEO. M. HOPKINS.

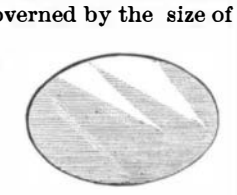
V.

The examination of microscopic crystals by the aid of the polariscope is an exceedingly interesting part of the study of polarized light. The indescribable play of colors, and the variety of exquisite forms of the smaller crystals, render this branch of the subject very fascinating. But to undertake the examination of this class of objects in the usual way, requires a microscope with the addition of a polariscope, which calls for an outlay of at least fifty dollars besides the cost of the objects; and while it is believed that such an outlay would be indirectly if not directly profitable, it is not necessary to expend a fiftieth of that amount to arrive at very satisfactory results.

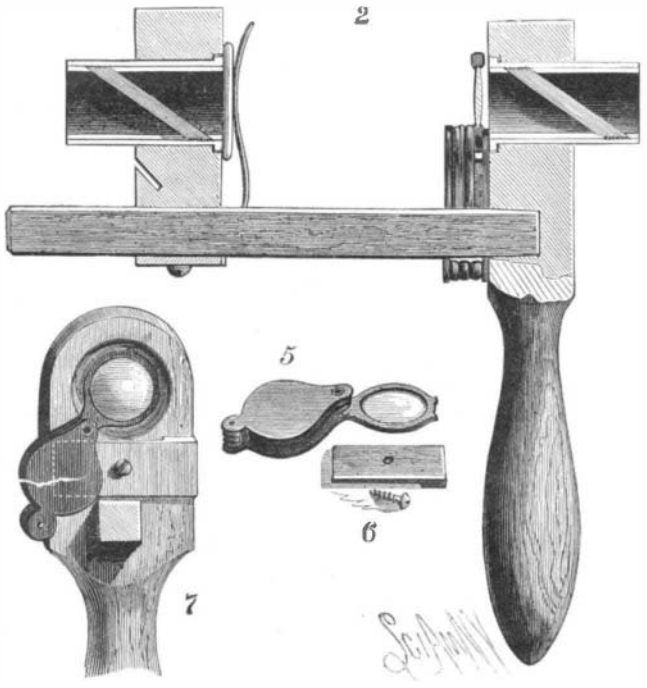
The cost of the compact and efficient little instrument shown in Fig. 1 is as follows: 1 pocket magnifier, having two lenses 1½ in. and 2 in. focus respectively, giving when combined a ¾ in. focus, 50 cents; eighteen elliptical microscope cover glasses for analyzer, 38 cts. The cost of wood for the principal parts, the pasteboard tubes, the glass for the polarizer, and the metal strips for the slide-holding springs can hardly be counted, and the labor must be charged to the account of recreation; so that less than one dollar pays for an instrument that will enable its owner to examine almost the entire range of microscopic polariscope objects with a degree of satisfaction little less than that afforded by the use of the best instruments.

The form, proportions, and material of the body of the instrument are entirely matters of individual taste. In the present case, the hand piece and sliding stage are made of ⅞ in. mahogany, the handle being formed on the hand piece by turning. The stage is 2½ in. square, and has in its lower edge a half inch square transverse groove, which receives the square rod projecting from the hand piece at right angles. The rod is held in the groove by a wooden strip fastened to the lower edge of the stage by two wood screws, so that it bears with a light friction on the under side of the rod.

The hand piece and stage are both pierced above the rod with holes which are axially in line with each other. The diameter of the holes is governed by the size of the cover glasses. Those in the instrument shown are of the exact size and form of the annexed diagram.



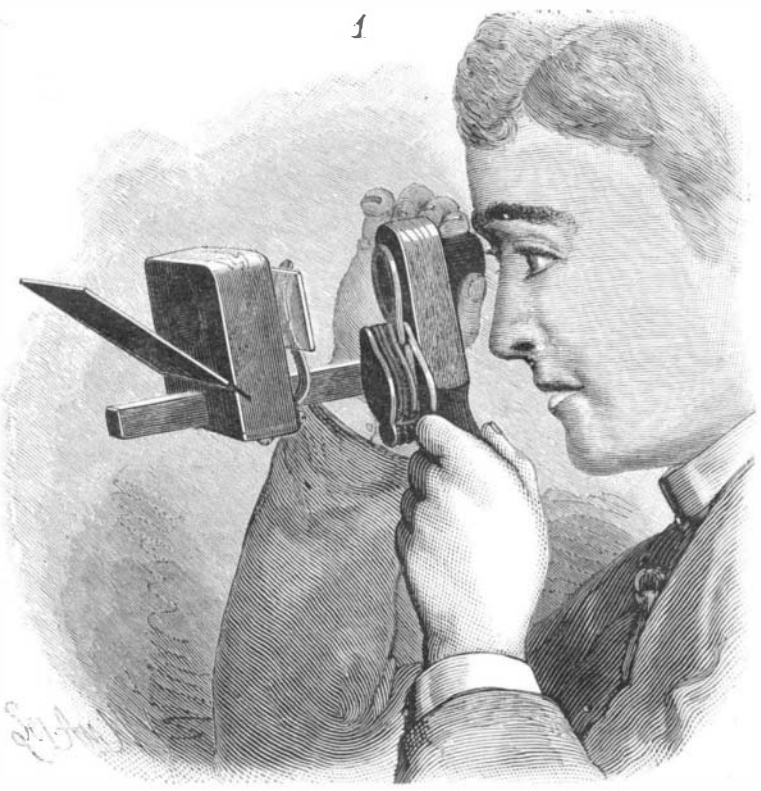
These cover glasses are procurable from any dealer in supplies for microscopists. Eighteen of them, at least, are required. The paper tube inclosing these glasses is a little more than 1⅛ in. internal diameter; its outside diameter is ⅞ in. and its length is 1¾ in. A narrow paper collar is glued around one



LONGITUDINAL SECTION OF POLARISCOPE AND DETAILS. HALF SIZE.

end of the tube, and both the hand piece and the stage are counterbored to receive the collar, as shown in the sectional view, Fig. 2. To the tube thus described is fitted an internal paper tube, which is about ⅛ in. shorter than the outer tube. The inner tube is divided diagonally at an angle of 35° 25′, which is the complement of the polarizing angle for glass (54° 35′). The oblique surfaces thus formed, when placed in the tube in opposition to each other, support between them the glass plates at the polarizing angle. The simplest way to arrange the angles of the tubes and other parts of the polariscope is by the employment of a triangle of cardboard like that illustrated in Fig. 8. In fact, a copy of the triangle here shown may be used.

It is sometimes a matter of considerable difficulty to clean the thin cover glasses without the risk of breaking a large percentage of them. An effective device for holding the glasses while they are being cleaned is



POLARISCOPE FOR MICROSCOPIC OBJECTS.

shown in Fig. 4. It consists of a piece of thin Bristol-board, having an elliptical aperture loosely fitting the edges of the glass to be cleaned, and a plain card glued to the back of the apertured card, and forming the bottom of the shallow recess into which the glasses are dropped for cleaning. The holder may be pressed down upon the table by the fingers of one hand, while the glass is rubbed with a soft linen handkerchief, after being breathed on. Glasses that cannot be easily and thoroughly cleaned in this way are worthless for this purpose.

Before the glass plates are put together, they are dusted with a camel's hair brush to remove any adhering lint and dust. The paper tubes are made dead black inside and outside.

The front of the stage is provided with a pair of thin brass springs, which serve to clamp the object slide with a light pressure to the stage. In the back of the stage, below the central aperture, is formed a groove for receiving the black glass polarizing plate. The groove supports the black glass at an angle of 54° 35′ with the plane of the stage, or at an angle of 35° 25′ with the holes in the stage and hand piece. The polarizing plate may consist of a plate of polished black glass, but it is generally more convenient to employ an ordinary piece of glass blackened on one side. A thin pine wedge cemented to the back of the plate causes it to bind in the groove of the stage.

To the inner face of the hand piece is clamped an ordinary pocket magnifier, shown in Fig. 5, by means of the wooden clip shown in Fig. 6. Fig. 7 shows the arrangement of the magnifier relative to the analyzer. Any magnifier of suitable focus may be pressed into the service. The face of the stage and other parts of the instrument visible through the analyzer are blackened.

The object to be viewed is placed on the stage and focused, when the instrument is held so that the black glass polarizing plate reflects the light through the object and through the analyzer. The analyzer is then turned, and the object observed. To heighten the color effects, a plate of selenite or mica may be placed immediately behind the object, or between the stage and black glass plate. Mica plates of suitable thickness are selected by trial in the instrument, and preserved for future use.

It is sometimes desirable to rotate the polarizer. When the black glass plate is used, this is impracticable, but by removing this plate, and inserting in the stage a polarizer consisting of a tube containing plates like the analyzer, the effects of rotating the polarizer may be observed. To render the rotation of the paper tubes smooth and uniform, their bearings in the hand piece and stage are rubbed over with the point of a soft lead pencil, imparting to them a thin coating of plumbago, which diminishes friction and prevents sticking. The objects which may be examined by the aid of this instrument are very numerous. Many of them are easily prepared, and some need no preparation at all. The chemical salts mentioned below may be prepared for observation by allowing their solutions to evaporate on a slip of glass: Alum, bichromate of potash, bichloride of mercury, boracic acid, carbonate of potash, carbonate of soda, citric acid, chlorate of potash, hyposulphite of soda, iodide of potassium, nitrate of ammonia, nitrate of copper, nitrate of soda, oxalic acid, prussiate of potash (red), prussiate of potash (yellow), sugar, sulphate of copper, sulphate of iron, sulphate of nickel, sulphate of potash, sulphate of soda, sulphate of zinc, tartaric acid.

Slips of glass, 1 × 3 inches, are convenient for this purpose. A circle about ¾ inch diameter is formed on each slip with a piece of paraffin or wax, and while the slips are supported in a level position, a few drops of a rather strong solution are placed in each circle, and the slips are allowed to remain quietly until the crystals form.

For methods of covering and preserving these crystals, as well as for hints on the preparation of the more difficult crystals, the reader is referred to the works on microscopy, as these matters are without the province of this article.

The following vegetable and animal substances may be shown by polarized light:

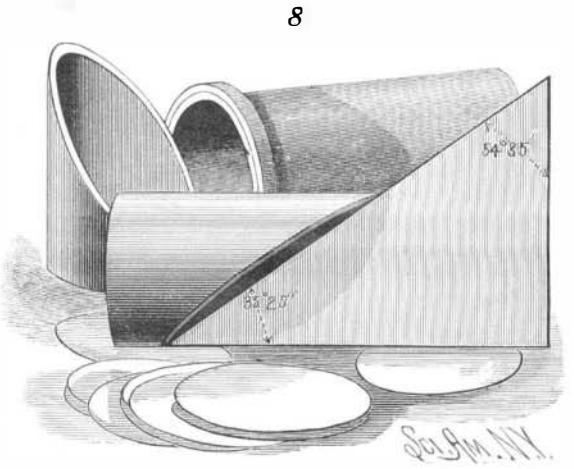
Cuticles, hairs, scales from leaves, fibers of cotton and flax, starch grains, thin longitudinal sections of wood, oiled; spicules of sponges and gorgoneæ, cuttlefish bone, hairs, quills, horn, finger nail, and skin. These objects should be thin and translucent or transparent. It is necessary in some cases to increase their transparency by soaking them in oil or some other suitable liquid.

Many rock sections and sections of minerals may be studied advantageously by the aid of polarized light, but since the objects are quite difficult to prepare, no list of them is given.

It is perhaps well to suggest that the polarizer and analyzer shown in Fig. 2 may be readily adapted to a microscope, placing the polarizer below the stage and the analyzer in the draw tubes.

DEAFNESS appears to be exceptionally prevalent in Kennebec County, Maine, and in Martha's Vineyard.

HOLDER FOR GLASS.



TRIANGLE AND PAPER TUBE. FULL SIZE.

A recent scientific investigation of the matter shows that in both districts there is abundant evidence of heredity, and especially of atavism. In the families affected there were also found blindness, insanity, idiocy, and deformity, and in some cases a long history of consanguineal marriages. In Martha's Vineyard the distribution of deafness coincides with that of certain soils, and its eastern boundary is also the typhoid fever line.