

ART. IX.—*On a new Petrographical Microscope of American Manufacture*; by GEORGE H. WILLIAMS.

THE importance of the microscope in geological investigations—particularly in the domain of the crystalline rocks—is now universally recognized, even by those geologists who do not themselves employ it. The light already shed upon some of the darkest and most intricate problems by recent petrographical methods, uncertain though it sometimes be, is full of promise for the future. Geology is reaping almost as great

benefits from the application of the microscope as her sister sciences, biology and medicine; and there seems to be no good reason why this instrument should not be made of as much educational value in her field as in theirs.

Not all who study the natural sciences are able or care to become original investigators. The scientific training, however, possesses for every one certain peculiar advantages, and the organic sciences have not been slow to appreciate how valuable a factor in such a training the microscope may be made. Five years of practical experience have convinced the writer that the microscope in geology may, with as great success, be employed for purely educational purposes.

If then the microscope be of such use in geology, both as a means of research and as an educational discipline, the production of instruments especially designed for rock-study becomes a matter of importance. Such a demand has for some time past been met, with varying success, by several Continental manufacturers; but, owing to the limited interest in microgeology on this side of the Atlantic, the attempts of American makers to supply petrographical microscopes have hitherto been wholly inadequate.

The advantages to the constantly increasing number of petrographical students in America, of a suitable instrument of home manufacture, are too apparent to need enumeration. Indeed, the actual demand for such an instrument has been so often and so urgently forced upon the writer's attention, that, at his request, the well-known Bausch and Lomb Optical Company of Rochester, N. Y., undertook the construction of a purely petrographical stand which should satisfy all the demands for mineral and rock study and at the same time come within the means of geological students. Each essential point was designated by the writer and has been elaborated by the manufacturer in the simplest and most inexpensive manner consistent with satisfactory results. The instrument in its present shape, though it may be subject to further improvements, offers at a reasonable price (\$135.00) a complete petrographical and mineralogical microscope of excellent workmanship, possessing all essential features, and several advantages (such as a sliding analyzer and mechanical stage) to be secured only on the more expensive European stands.

It has been thought that a figure and description of this microscope would prove of interest to all whose attention is devoted to geology, whether as teachers or as investigators.

The accompanying cut shows the instrument constructed upon what is known as the Bausch and Lomb "*Model Stand.*" (See Bausch and Lomb Illustrated Catalogue for 1887, pp. 15.) This has a frame of japanned iron, with brass tube, stage and

mirror-bar. It was selected in order to reduce the total expense as much as possible, but all the petrographical appliances may be adapted to any of the brass stands of this firm, if desired; with a proportionate increase in expense.



(One-third natural size.)

The screw supporting the arm between the pillars allows the instrument to be inclined at any angle. The main tube is provided with a cloth lining into which the draw-tube carrying the ocular, is fitted. There is a coarse adjustment by rack and pinion and a fine adjustment by a micrometer screw. The mirror is both flat and concave and the mirror-bar adjustable.

Coming now to the peculiarly petrographical features, we have the lower nicol-prism or polarizer enclosed in a cylindrical metal box, both ends of which are protected by glass. This box is capable of a complete revolution and is provided

with a graduated silvered circle and index. It is held by a cylindrical frame in which it may be raised or depressed at will by a rack and pinion movement. This frame is attached to the under side of the stage by a swinging arm, so that the whole polarizing apparatus may be thrown to one side if desired. A strong compound lens may be screwed upon the upper end of the polarizer whenever strong illumination or converged polarized light are needed.

The circular stage (9.5 cm. in diameter) is provided with a beveled silvered edge, graduated to degrees. Upon this is mounted for smooth and concentric revolution the admirable mechanical stage, known in the manufacturer's catalogue as No. 1052. This carries an index for reading the graduated circle, and is also provided with silvered graduations for its two rectangular movements, whereby any point in a section can be readily located. The upper sliding bar which carries the object has been shortened so as to be only flush with the revolving stage when pushed to its extreme limit on either side. With this, square or short rectangular glasses must be used for mounting which will avoid any interference with the revolution of the stage.

Into the nose-piece, just above the objective, is an opening intended to receive the four following accessories, each mounted in a separate brass frame: (1) a Bertrand lens for magnifying the interference figures; (2) a quarter-undulation mica-plate; (3) a quartz wedge; (4) a Klein quartz-plate or a gypsum plate with red of the first order.

The centering of the various objectives is secured by two screws having motions at right angles to each other.

The upper Nicol-prism or analyzer is inserted in the tube in order to avoid the diminishing of the size of the field which is unavoidable when the prism is placed over the ocular as a cap. To accomplish this, and at the same time to keep the tube dust-tight, the nicol is enclosed in one side of a double chambered box. The other side is left vacant and the box may be slid to and fro according as ordinary or polarized light is desired. A metal sheath protects this box from above.

The microscope as here described in a case with a single eye-piece, but without objectives, may be obtained for \$108.00. With two eye-pieces (one with cross-hairs and the other with micrometer) and two objectives ($\frac{2}{3}$ and $\frac{1}{4}$ inch) its cost is \$135.00. The cost of a solid brass stand is about \$25.00 more.

The instrument as here figured is less expensive than the importation of the lower grades of European petrographical stands; and considerable practical experience with it has shown that it renders decidedly better service.