*On the Fracture of Polished Glass Surfaces.** By F. H. WENHAM.From the *London Mechanics' Magazine*, October, 1865.

The short communication which I submit to your notice scarcely merits consideration as a discovery; but as the microscope has in this case immediately detected the cause of a well known phenomenon, I bring it forward as an example of the use of the instrument in practical investigations. It is a fact known to the philosophical instrument makers, that if a metal wire be drawn through a glass tube, a few hours afterwards the tube will burst into fragments. The annealed glass tubes used for the water gauges of steam boilers are sometimes destroyed in this way, after the act of forcing a piece of cotton waste through them with a wire for the purpose of cleaning the bore. This will not happen if a piece of soft wood is employed. The late Andrew Ross informed me that on one occasion, late in the evening, he lightly pushed a piece of cotton wool through a number of barometer tubes with a piece of cane, for the purpose of clearing out any particles of dust. The next morning he found most of the tubes broken up into small fragments, the hard siliceous coating of the cane proving as destructive as he had previously known a wire to be.

After having drawn the point of a steel burnisher over the surface of a slip of polished glass, the following appearances will be observed under the microscope, using the polarizing apparatus and selenite plate with a two-thirds object glass. A colored stripe is visible in the passage of the burnisher, showing that the surface of the glass has been placed in a state of tension in the direction of the line. The glass, too, seems not altogether devoid of plasticity, for the waves of color show that it has been carried forward in ripples, resembling the mark left on a leather bound book after the passage of a blunt point. It may be inferred from this that the mere burnishing of the surface of the glass with a substance inferior in hardness will, without any scratching, cause an irregular strain in the bore of tubes sufficient to split them, and the concussion attendant upon the fracture often reduces the tube to small fragments. If the burnished lines upon the glass slip be examined a few days afterwards, the colors will have become much less visible, showing that the strained portion of the glass partly recovers its equilibrium.

On attempting to polish out a minute scratch on the surface of a piece of glass, it sometimes appears to widen during the process, and at length resolves itself into two irregular parallel rows. Also, a clean cut made with a diamond on a piece of plate glass, if left for a time, the surface in the vicinity of the cut will break up, forming a coarse irregular line. If the diamond be raised and struck lightly on the surface of the glass, the form of the edges of the short stroke thus made may be plainly seen, using the binocular polariscope. A conical ridge of glass appears to be left with its apex under the line of the cut, and the glass is frequently wedged up on both sides of the ridge, explaining the cause of the double line of fracture which sometimes makes its appearance in polishing out a scratch. This effect may also

* Read before the Microscopical Society.

be exemplified by observing the marks left on a polished glass surface from the light blows of a steel centre punch. The point of the punch drives in an atom of the glass, and the fracture extends some distance into the interior, expanding downwards in the form of a truncated cone. The polariscope shows that the conical centre is in a state of compression, and that the surrounding exterior portion of the glass is also under strain. The smooth, round edge of a glazier's diamond, when drawn over a polished glass surface, burnishes down and compresses the glass beneath the cut, and in the case of thin sheets the wedge-like force of the compressed line splits the glass nearly through, but when the glass is thick and rigid, as plate glass, unless the sheet is bent back and broken through immediately after the cut, greater difficulty will be experienced if allowed to remain for a time, for the compressed line of glass will speedily tear up the portion on both sides, leaving a wide ragged groove in place of the original clean and scarcely visible line.

For the Journal of the Franklin Institute.

The Giffard Injector. By CHARLES E. EMERY, Asst. Eng. U.S.N.

The writer, by permission, recently tried some brief experiments with a view of ascertaining the cost of forcing water with a Giffard injector, an account of which may not be uninteresting, inasmuch as there is a wide difference of opinion in regard to the economy of using this device for feeding boilers. The injector employed was one of moderate size attached to the auxiliary boiler of the U. S. Steam Expansion Experiments. The water was supplied from a tank, with a head of from three to four feet, and was delivered by the injector into a pipe with two branches, one connected to the boiler, and the other to a water chamber, having attached to it a steam gauge and safety valve. Each branch of the pipe was provided with a stop valve, so that the water could at pleasure be forced into the boiler or out of the safety valve on the water chamber at the desired pressure shown by the gauge. Before starting an experiment, the boiler was supplied with sufficient water to last an hour without feeding, the boiler and water chamber gauges being compared by opening valves on both branches of lower pipe when the injector was in operation. The water connexion with boiler was then carefully closed. During the experiments the water was measured before being supplied to the injector; the safety valve on the water chamber was loaded to the desired pressure, and the injected water passed through it, and was again carefully measured, the increase in quantity showing the amount of steam drawn from the boiler. The "overflow" water was collected in a separate vessel and returned to the first tank. The following table shows the best results of the experiments under the conditions expressed. The pressures and temperatures are the means of records taken every fifteen minutes.