work, as, for instance, with soft celloidin, fresh, or alcohol-hardened preparations. The second knife "B" is the most generally useful knife. It is not ground to such a fine angle, and is used with the majority of paraffin preparations and also with hard celloidin.

The microtome will cut sections measuring up to 150 × 120 mm. (6″ × 4¾″) in either paraffin or celloidin. The thickness of the sections can be varied from 0 to 0·06 mm., each division on the scale being equal to 0·002 mm. The total distance through which the microtome will automatically feed the object-holder is 21 mm.

Pl. XV. fig. 2 shows the instrument with the knife in position for cutting celloidin section. In fig. 3 the knife is seen in position for cutting paraffin.

An Eighteenth Century Microtome.*—Description of an instrument for cutting transverse slices of wood for microscopical objects.

A A, in No. 1 (fig. 115 †), represents a cylinder of ivory, 3½-in. long and 2-in. in diameter, to the one end of which is fitted B B, a plate of bell-metal, the section of which with the manner of fitting it to the ivory, may be seen in 2, in which the several parts are marked with the same letters as in 1.

C is a plate of brass, fitted to the other end of the cylinder, through which and the ivory there pass two long screws, which take into the thick part of the bell-metal B B, so as to fix both plates strongly to the ivory, into which they are also indented, so as to prevent such shaking as might otherwise happen after swelling or shrinking.

D D. The cutter, whose edge is a spiral, and the difference of whose longest and shortest radii is equal to the thickness of the largest piece of wood that the instrument would take in. The lowest side of this cutter must be ground extremely flat and true, in order that all the parts of its edge may be exactly in the same plane, and that the middle part of it may be applied closely to the flat circular plane left at the centre of the plate B B, to preserve it in the proper direction when carried round by the handle.

All that part of the bell-metal which the edge of the cutter traverses is turned so low as not to touch it (see the section), the middle of the cutter is about ⅕-in. thick and has in it a square hole that fits on the end of a steel axis P P, one end of which turns on a pivot in the plate C, the other end in the plate B B. This end has a conical shoulder which fits into a hole of the same shape in the under side of the plate, as represented in the section.

e e. A piece of brass somewhat in the form of an index, which is also put on the axis P P; this piece has a round hole in its centre, so large as to admit of its being turned into any position with regard to the cutter; and in order to keep it concentric thereto there is left on it a circular projection, which fits into a cavity made in the lower side of the handle where it fits on the axis (see the section).

* The Construction of Timber from its early Growth; explained by the Microscope and proved from Experiments, in a great variety of kinds. By John Hill, M.D., Member of the Imperial Academy. London, 1774, 2nd ed., 64 pp. folio (44 pls.).

† The block for this illustration was kindly presented by Mr. C. Lees Curties.

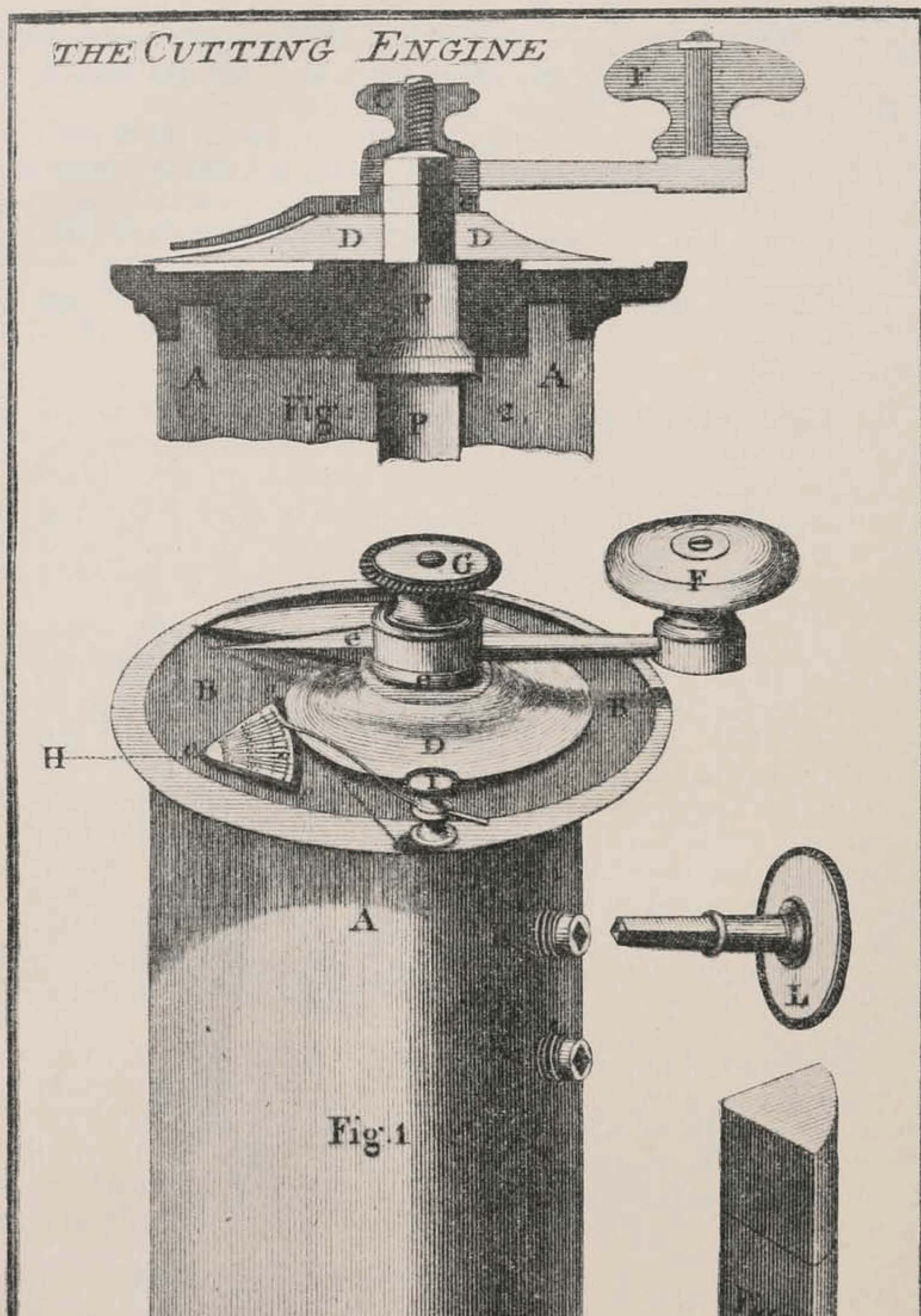

FIG. 115.

F. The handle, which is so fitted on the axis P P that it carries the cutter and the piece *e e* round with it.

G. A nut that screws the handle on its axis and keeps the cutter flat to the bell-metal B B when carried round by the handle.

o o o is a hole, nearly in shape of the sector of circle, pierced through that part of the bell-metal which the edge of the cutter traverses, and continued through the whole length of the cylinder, truly parallel to its axis and of an exact equal width throughout, till it terminates in the plate C.

H represents the end of a piece of wood of which slices are to be cut, and which is put into the cavity *o o o*, into the angular part of which it is gently pressed by means of K K, two brass screws, which pass through the ivory into the cavity *o o o*, and are made to press on the wood *h* by means of L, a key that fits into hollow squares made in the screws K K.

M. A screw that passes through the brass plate C, opposite the middle of the cavity *o o o*, and by means of which the wood *h* is raised to the cutter. This screw has forty threads to an inch, and its head, being divided into twenty-five equal spaces, it is evident that the moving one of these divisions or spaces will make the screw advance, and raise the wood *h* just $\frac{1}{1000}$ of an inch.

N. An index that points the divisions on the head of the screw M. The breadth of this index, from the one fiducial edge to the other, subtends a division and a half on the head of the screw, by which means half divisions as well as whole ones may be accurately shifted, and the $\frac{1}{2000}$, $\frac{1}{1500}$, $\frac{1}{1000}$, $\frac{1}{750}$, etc., parts of an inch, truly estimated. To render the effect of this screw the more certain, its point is turned round so as to act very near the centre, and a piece of ivory (see 3) is carefully fitted into the cavity *o o o* so as to move freely therein without any lateral shake, and to rest on the end of the screw M. This piece of ivory acting equally on every part of the under surface of the wood, will raise it towards the cutter with much more certainty than if the screw acted immediately on it. Several such pieces of ivory, of different lengths (as represented by 3), ought to be fitted to the instrument, so as readily to suit the length of any given piece of wood. One piece, of the full length of 3, must have one end left rough from the file, that pieces of cork, agaric, the pith of wood, and such other soft substances, may be cemented on it with sealing wax, in which case they can be cut into slices of a determinate thickness, as well as wood.

Now if a piece of wood, whether round or of the shape represented in the instrument at *h*, and of whatever size, be put into the cavity *o o o*, and gently pressed into the angular part thereof by the screws K K, let it be raised towards the cutter by means of the screw M. If the handle be turned to the right, the edge of the cutter will advance on the wood, and cut off such part as lies above the plane in which the edge of the cutter moves, and when the upper surface of the wood is thus rendered flat, slices may be cut of any required thickness, according to the number of divisions that the screw M is made to advance. If the machine be made with due care, it will readily cut a thousand slices in an inch, and if the edge be good and very well set, slices may be cut that are no thicker than the $\frac{1}{1500}$ or even the $\frac{1}{2000}$ part of an inch; but this requires management, much depending on the force with which the screws K K pinch the wood.

It is not an easy matter to procure an edge sufficiently fine for the above purpose, but, with the very best possible, thin slices have a tendency to curl up into rolls, so as to be unfit for the Microscope; to prevent which a very slender spring is made to press gently on that extremity of the slice where the incision begins, so as to keep it flat to the cutter; when this spring is set to its proper position, it is fixed to it by the small finger-screw I. And, lest the action of this spring should destroy the slice after it is wholly cut, and in passing over the extremity of the cutter, the piece *e e* (which turns with the cutter) is fixed by the nut G into such a position that in passing under the spring it raises it, and relieves the slice at the very instant that the cutter has wholly done its office; and thus the slices are made to fall into spirits of wine, in which they are preserved for use.

In some woods the pith shrinks so very fast, that it is extremely difficult to keep it entire in slices that are thinner than 750 to an inch; to remove which imperfection an instrument of the nature above described was made to shift its own screw at every revolution of the handle, so that very little time was left to the pith to shrink, as a hundred slices could easily be cut in a minute, and the pith was as entire as the wood. This instrument had an index which, being set to the numbers 500, 750, 1000, made it cut so many slices to an inch. It performed extremely well, but was judged less fit for general use than that which has already been described, it being more complex and liable to disorder, as well as more difficult to manage.

The cutting engine is an invention of the ingenious Mr. Cummings. The two or three first were perfected under his own hand, and they are now made for general use by Mr. Ramsden.

Numbering Celloidin Sections.*—A. Yurisch gives an account of his experiences with Suzuki's method of numbering serial celloidin sections. This consists, briefly, in numbering the sections in order as they are cut, by marking with Indian ink, so that although mixed during subsequent manipulations, they may be mounted in the correct order. The author finds that such Indian ink marks resist most of the ordinary stains and reagents, and are still legible after sections have been kept for several months. If the numbers are made too large the excess of pigment may be deposited over the surface of the section in small black indelible granules. On the whole, the method is to be commended for its rapidity, simplicity, certainty, and cheapness.

Fischer, Otto—**Uber Ferienkwise für Wissenschaftlche Mikroskopie.**
Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 94–114.

(4) Staining and Injecting.

Detection of Tubercle Bacilli in Milk and Fæces.†—E. H. R. Harries recommends the following method. The smear is first stained

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 63–6.
† British Med. Journ. (1910) ii. p. 1295.