Account of an Improved Catoptrical Microscope
by Professor AMICI *of Modena*

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Microscopes constructed on catoptrical principles, have been known since the time of Newton; but in consequence of their imperfection, and the great improvements made upon the dioptrical instruments, they have been, of late, almost entirely neglected.

Some years ago, an eminent natural philosopher, Professor Amici of Modena, constructed a very excellent catoptrical microscope, in which he seems to have avoided the imperfections to which the instruments formerly constructed upon the same principle were liable, and to have combined several advantages which are not possessed by the best dioptrical microscopes now in use. The ingenious inventor has lately published a minute description of this improved instrument, in a memoir inserted in the 18th volume of the Transactions of the Italian Society.

The body of this microscope consists of a horizontal brass tube, 12 inches in length, and $1\frac{1}{10}$th in diameter. At one end of the tube is placed a concave speculum of metal, whose axis coincides with that of the tube, and whose superficies is elliptical, and so calculated, that of the two foci, the one falls at the distance of $2\frac{6}{10}$th, and the other at 12 inches from its centre. A small arm within the tube, carries a small plain mirror of metal of an oval form, placed at the distance of $1\frac{6}{10}$ inches from the former, opposite to it in an oblique direction, and supported by an oblique section of a metal cylinder $\frac{5}{10}$th of an inch in diameter. The centre of the polished surface of this mirror coincides with the axis of the concave mirror, which is situated at the distance of $1\frac{5}{10}$ inches from the centre of the other.

This plain mirror is so placed, that, while it receives the image of the object (which is placed on a moveable object-bearer attached to the pillar below it) by means of a small aperture in the under part of the body of the tube, it throws it towards the concave mirror, in which it may be examined by the eye of the observer, applied to the opposite end of the tube, through a greater or smaller number of magnifying eye-glasses, which may be fitted to it.

The internal diameter of the tube, which regulates that of the large mirror, may be $1\frac{1}{10}$ inches, and the thickness of the surrounding metal about $\frac{1}{20}$th. Upon this construction, the object to be examined may always be at the distance of half an inch from the edge of the tube, and consequently be very well lighted on every side, - transparent objects from below, by means of a common illuminating mirror, fitted to the pillar, and moveable, - and opaque bodies from above, either by the natural light falling directly in, or by concentrating an artificial light, by means of a convex glass fitted to the object-bearer, - or still better, by means of a pierced mirror of metal, which is fitted to the tube below, over the object, so as to be brought more or less near to it. The large illuminating mirror below should be concave, having a diameter of three inches, and a focal distance of 2.5 at the utmost.

The effects of the two last-mentioned mirrors may be reciprocally combined, by means of a common corresponding adaptation, - by receiving and reflecting the rays of light, so as to produce

[*] In vol. i. p. 214 we have given a notice respecting this microscope, communicated to us by His Royal Highness the Archduke Maximilian, who, we understand, has recently presented one of the instruments to the Imperial Cabinet of Natural History at Vienna. - ED.

the highest degree of intensity of light, and the most perfect illumination of the object on all sides, both as a whole, and in its different parts, - an advantage, indeed, which may be attained in dioptrical instruments, by similar means.

The inventor considers the proportions above given as best adapted for the convenient use of the instrument, in order to preserve, along with a high degree of effect, and even the highest degree of magnifying power, a moderate distance of the object from the microscope, viz. half an inch, which not only allows the most simple and perfect illumination from above, but also admits of our examining objects of a considerable size entire, without separating the parts, and also small animals alive.

A common dioptrical microscope, whose object-glass has a focal distance of six lines, would correspond with this state of the object, and consequently admit of similar advantages, but with a much diminished magnifying power, of about 1500 or 2000 in the area.

Professor Amici has accordingly compared the best English microscopes of Adams and Dollond with his own, and, upon a comparative examination of the same objects, he maintains that his instrument shews the object more clearly and distinctly, even when magnified in the same degree. The Professor had no opportunity of making experiments with the microscope of De la Barre, and those made at Benedictbeuern by Utzschneider and Fraunhofer; but he thinks himself justified in concluding, that his own admits of a far greater degree of magnifying power than the latter, as he perceives that their largest microscope does not magnify the objects above 22,500 times in the area, while his goes the length of a million. He has also endeavoured to shew, by a mathematical calculation, that such a high degree of magnifying power cannot be attained in a dioptrical instrument.

The following, according to Amici, are the advantages of his microscope.

1. The observer has the convenience of being able to examine the object in a horizontal position, while, in those constructed on the dioptrical principle, the object is examined in a vertical position, that is, from above. The observer, therefore, may be seated, has no occasion to bend his head, and can examine objects more conveniently, or for a longer time, than with a large dioptrical instrument on the common construction.

2. The different degrees of magnifying power can be easily and speedily applied and changed, nothing more being necessary for this purpose than to change the eye-glass, without varying the position or distance of the object, so that it may be examined with great rapidity in all different degrees of magnitude, without the least variation of the point of view; while in the dioptrical instruments, it is necessary not only to change the object-glass, but also the visual distance, which not only occasions loss of time, but very seldom admits of the object being again seen in the same position, and in the same point of view.

3. As in this new instrument the object always remains in the same position, and is kept constantly at the distance of half an inch from the body of the microscope, it consequently admits of our examining objects immersed in fluids, and animal swimming, and that nearly at an equal depth, and in every degree of magnitude. With dioptrical instruments, on the other hand, this is quite impossible, on account of the shortness of the focal distance in the highest degrees of magnifying power, as the object-lens must be brought so near the object as almost to come in contact with the fluid.

4. The light may be brought to bear upon all sides, and in all directions, even by means of a lamp or a taper, as the flame can be brought very near the illuminating mirror, without being troublesome to the observer.

5. As metallic specula do not disperse the light, and consequently produce no colours, the objects appear of their natural colour.

6. The diameter of the concave mirror being so large, compared with its focal distance, we may expect so much more distinctness.

7. As the distinctness of the image produced by reflection is greater than that produced by refraction, the degree of magnifying power may be carried much higher.

We must not omit to mention, that Professor Amici has contrived, by a very ingenious arrangement, to convert his microscope into a species of *camera lucida*, in order to enable the observer conveniently and very exactly to delineate the object, in any degree of magnitude, at pleasure. This circumstance undoubtedly enhances the value of the invention.