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OR,

MONTHLY RECORD OF OBSERVATIONS ON ANIMAL AND VEGETABLE ANATOMY AND PHYSIOLOGY,

Chiefly made by the Aid of the Microscope.

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Assisted by many Eminent Observers.

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some time in drying, and, even when it has become hard, is liable to soften in a warm room, or when exposed to a rather high temperature, the weight of the fluid and preparation within, or any pressure from without, will often separate the joints, and the contents therefore escape, and perhaps be injured. The above process will always prevent this; but, if the marine glue be the cementing material, this process is unnecessary. Another ingenious contrivance has also been suggested by the same indefatigable anatomist:—It is often necessary, for the perfect examination of a contained preparation, that every part of it should be brought within the reach of the focus of the object-glass, and the under plate of the boxes would, in the majority of cases, prevent our examining its sides; yet the projection of this under plate is necessary for packing it in a box, in order to make it portable. The contrivance consists simply in making the under plate of the box flush with its sides, and to project at the ends from $\frac{1}{10}$th to $\frac{1}{4}$th of an inch, according to the size of the box required; these projecting ends to be bevelled off (Fig. 5), so as to fit similar bevelled surfaces, but cemented by their plane surfaces, in an inverse or opposite direction, to a much larger plate of glass, so that the box shall glide in, and in this way be adapted for packing in a microscopic preparation case. As it is often difficult to clean glass used for mounting objects, and unless the surfaces of the glass be clean, air-bubbles are sure to be enclosed in the simple cells, it may not be out of place here to describe the process by which glass may be readily and effectually cleaned from all adhering matters, greasy or otherwise.

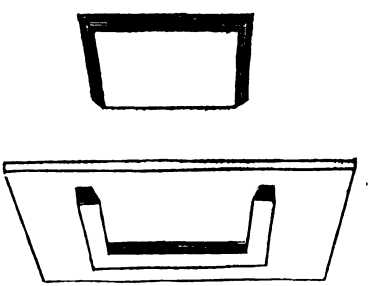


Fig. 5.

The best process (and it is certain to effect it) which Mr. Goadby has found for this indispensable object is to first apply, by means of a pointed stick, some *oil of vitriol*, with which the surfaces should be well rubbed; and immediately after the vitriol has been well applied, then use, in a similar way, caustic potash, and afterwards well rinse the glass in water, and wipe it dry by means of a fine cloth, taking care to prevent the contact of the fingers with any portion of its surfaces. To prevent this, the rinsing should always be effected by holding the glass with a forceps.

ROSS'S IMPROVED ACHROMATIC COMPOUND AND SIMPLE MICROSCOPE.

Previous to the improvements which have recently been made, the Compound Microscope was but a comparatively feeble and inefficient instrument, and was considered useless for the purposes of investigation. This was owing to the distance the light had to traverse after refraction, through the uncorrected object-glasses, and the consequent increased dispersion producing only confused vision. This error was

diminished to the utmost possible extent by limiting the aperture of the object-glasses, and thus restricting the angle of the pencil of light from each point of the object, while the enlargement of the aperture is the real improvement in the optical part of the instrument. Even after the improvement of the simple microscope, by the use of doublets and triplets, the long course of the rays, and the large angular pencil required in the compound instrument, deterred the most sanguine from anticipating the period, when they should be conducted through such a path as to be free from both chromatic and spherical error; and the general opinion was, that the compound would never rival the simple microscope. Nor is this opinion to be wondered at, when we consider the increase of difficulty attending every enlargement of the pencil, and that these difficulties had to be contended with and removed by operations on portions of glass, so small that they are themselves almost microscopic objects.

Fortunately for science, and especially for the departments of animal and vegetable physiology, these opinions have been shown to be unfounded, and the compound microscope is now one of the most important instruments ever bestowed by art upon the investigator of Nature; it reveals to us the beauties of form and colour in the minute works of Creation, which leads to such instructive pursuits, that the microscope must become an educational instrument. To these claims on our attention, it appears from some observations in the introductory paper of this Journal that others of high importance are added, namely, the classification of genera, and the examination of human organic matter, affording evidence regarding the nature and seat of disease.

I have thus noticed the claims of the achromatic microscope in its improved state, previous to entering on a description of the mechanical and optical parts of the instrument.

The mechanical construction represented in Plate 4, is derived from a practical acquaintance with the various improvements made in the microscope for the last twelve years. The general arrangement, which is properly the province of the mechanic, has been contrived to obtain the utmost freedom from tremor, and to afford the greatest facility in using the various movements, while the extent, direction, and number of these have been collected from the experience of the most indefatigable observers in all the various branches of microscopic inquiry. Nearly one hundred instruments have been made on the plan here represented, and as no alteration or addition has been found necessary for the accomplishment of all the modes of microscopic investigation at present employed, the mechanical structure of the microscope stand may be considered thus far established.

The optical part also has arrived at such perfection, that points or lines, whose distance is such that their separation is bordering on interfering with the physical constitution of light, can be distinctly separated; thus ensuring a reality in the appearance of objects, where the minuteness of their detail approaches the natural limit of microscopic vision.

Description of the Instrument, (Plates 4 and 5.)

A A are two uprights, strengthened by internal buttresses, mounted on a strong tripod (B), at the upper part, and between the uprights is an axis

(C), upon which the whole of the upper part of the instrument turns, so as to enable it to take a horizontal or vertical position, or any intermediate inclination, such, for instance, as that shown in the plate. This moveable part is fixed to the axis near its centre of gravity, and consists of the stage (D D), the triangular bar and its socket (E and F), the arm (G), which carries the microscope tube (H), and the mirror (I). The stage (D D) has rectangular movements, one inch in extent, on the racked cylinders (*a a*), and are moved by pinions connected with the milled heads (*b b'*); it also has the usual appendages of forceps to hold minute objects, and lens to condense the light upon them. The triangular bar, together with the arm and microscope tube, is moved by the milled heads (*e e*), and a more delicate adjustment of this optical part is affected by the milled head (*f*). The other milled head (*g*) fixes the arm (G) to the triangular bar.

The outline of the structure, as before observed, has been arranged to obtain, first, the utmost freedom from tremor; and, secondly, to afford the greatest facility in using the various movements.

In experimenting to obtain the first of these conditions, I suspended the moveable part of the instrument near the centre of gravity, and employed the inverted pendulum (an instrument contrived to indicate otherwise insensible vibrations) to arrange the form and quantity of material, so as to produce, as nearly as possible, an equality of vibration throughout the whole instrument; hence the object upon the stage and the optical part vibrating equally, no visible vibration is caused. The arrangement for accomplishing the second condition is, first, that the whole movements should be as near the base of the instrument as is consistent with the greatest proximity among themselves; then the milled heads (*e* and *f*) for moving the triangular bar, and the fine adjustment for the optical part, should be moved by the left hand, while the heads (*b b'*) for the movement of the stage, should be worked by the right hand. The other milled head (*e*) is convenient when the right hand may be unemployed with the stage movements. The positions of the milled heads (*b b'*) are extremely convenient, as the middle finger may be placed under *b*, and the fore-finger under *b'*, and the thumb passed from the one to the other in the most natural and easy manner. The left hand is also readily shifted from the milled head (*e*) to employ the fore or middle finger to move the screw head *f*. This head is connected with a screw and lever, which makes one revolution of it move the optical part $\frac{1}{300}$th of an inch. This arrangement affords an elastic movement to the end of the tube, as a guard against injuring the glasses or the object under examination.

The accompanying apparatus to the microscope is represented in Plate 5, where 1, 2, and 3, are the eye-glasses; 4, a micrometer eye-glass for measuring the linear dimensions of objects; 5, a Wollaston's camera-lucida for drawing objects which are placed in the microscope, with lenses for making the pencil equally visible with the object seen in the prism; 6, a concave silver reflector for illuminating opaque objects, (this I arranged as a general illuminator, and may be used with the whole range of object-glasses). 7, The achromatic Wollaston condenser, first achromatized by Dujardin for illuminating transparent objects, in which the light is brought to focal points in a plane coincident with the object; hence no inflexion or diffraction occurs, and the

outline or detail of the object is represented nearly divested of penumbra; 8, represents a plate and tube holding a polarizing prism to be applied under the object, while an analyzing prism is placed behind the object-glass or above the eye-glass. Structures are ascertained when viewed in this apparatus, which cannot otherwise be detected; 9, forceps for holding objects; 10, a lens for condensing light, in conjunction with the large lens represented in Plate 5; 11 and 12, Varley's animalcula cages; 13, an adjustable compressor, designed by Mr. Lister; 14, a plate for fixing a frog, fish, &c. upon, for viewing the circulation of the blood; 15, an arm for holding single lenses, to be applied to the microscope when the arm (G) carrying the optical tube is removed.

The optical part of the microscope has been in a state of progressive improvement since the year 1820, during which time Selligne, Frauenhofer, Amici, and Chevalier on the continent, and the late Mr. Tully of London, succeeded to a certain extent in their attempts to construct achromatic object-glasses for the microscope; and about the year 1829, Mr. J. J. Lister discovered certain properties in achromatic combinations, which proved of such value to the practical optician, that the progress of improvement was in consequence greatly facilitated, and a gradual increase in the aperture of object-glasses (which, as before observed, is the chief improvement) took place; and I have recently succeeded in transmitting into the pupil of the eye a pencil of light from the object of 90° in angular extent.

The following is a table of my achromatic object-glasses, with their angular apertures, and the magnifying power at which the greatest separating effect is produced:—

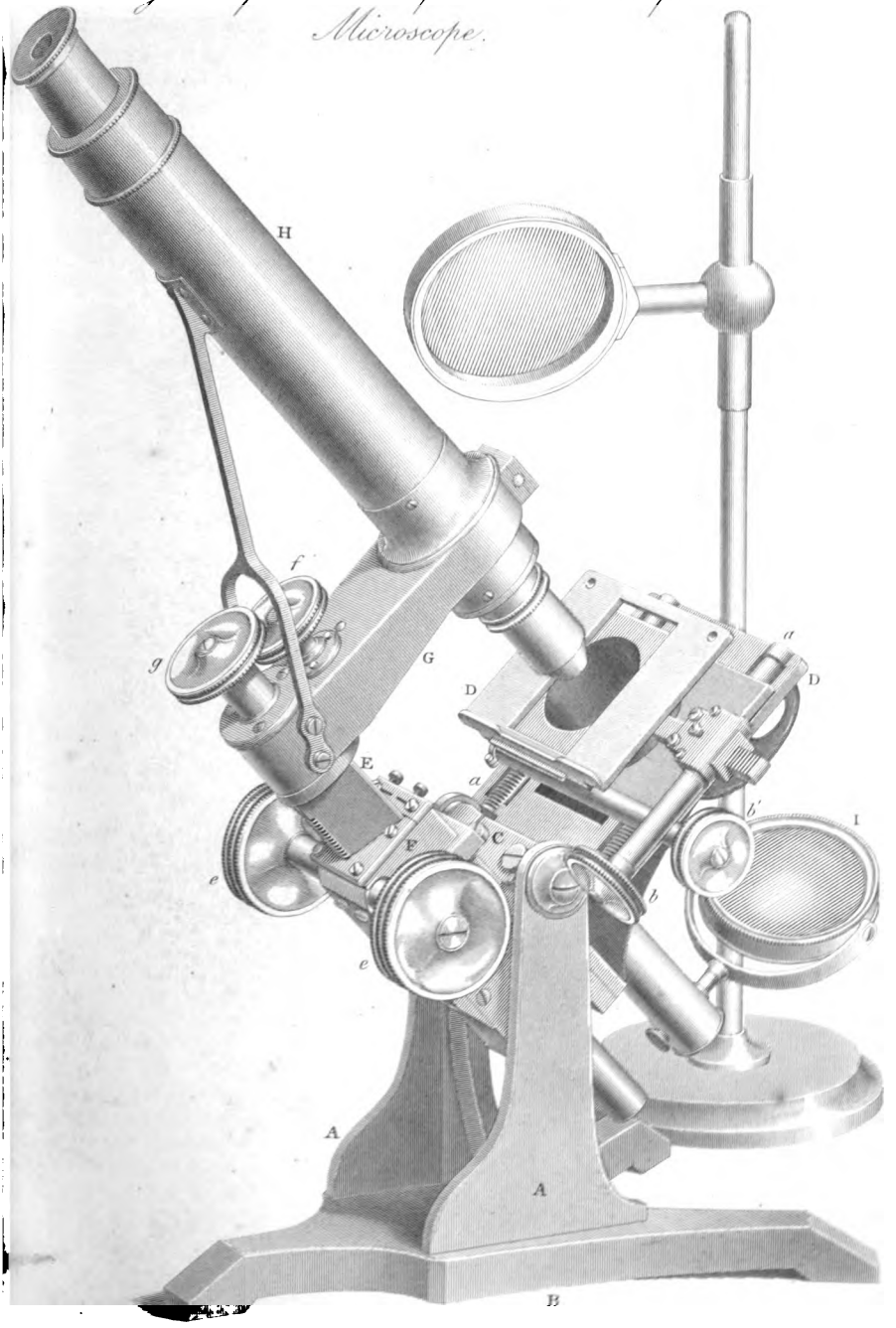
Focal length of object-glass.	*Angular aperture.*	*Greatest separating magnifying power.*
2 inch	10°	80 diameters.
1 „	22°	180 „
½ „	44°	380 „
¼ „	60°	500 „
⅛ „	66°	550 „
⅛ „	70°	570 „
1/12 „	90°	700 „

MR. VARLEY'S DESCRIPTION OF HIS NEW LEVER MOVEMENT,

(For facilitating the Examination of Infusoria and other Animalcula, while under the Microscope, and avoiding the inconveniences attending all former Stage Movements for such examination.)

FINDING that the movement of the stage by *screws*, or of the object by the hand, would not enable me to follow with sufficient government or controul the active motions of many animalcules, and so keeping them within view for a length of time sufficient for observing their habits, structure, and mode of reproduction, I determined on applying levers for the purpose of moving the stage. The first stage which I constructed with this view, was that which was moved by two parallel levers, one at each side, hanging down, and connected at the bottom by a bar parallel with the stage; on moving this bar the two levers were necessarily moved at the same time, and the stage was, therefore, moved

Ross's improved Compound and Simple Microscope.



C. Varley del.