JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

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FELLOWS OF THE SOCIETY.

FOR THE YEAR

1899.

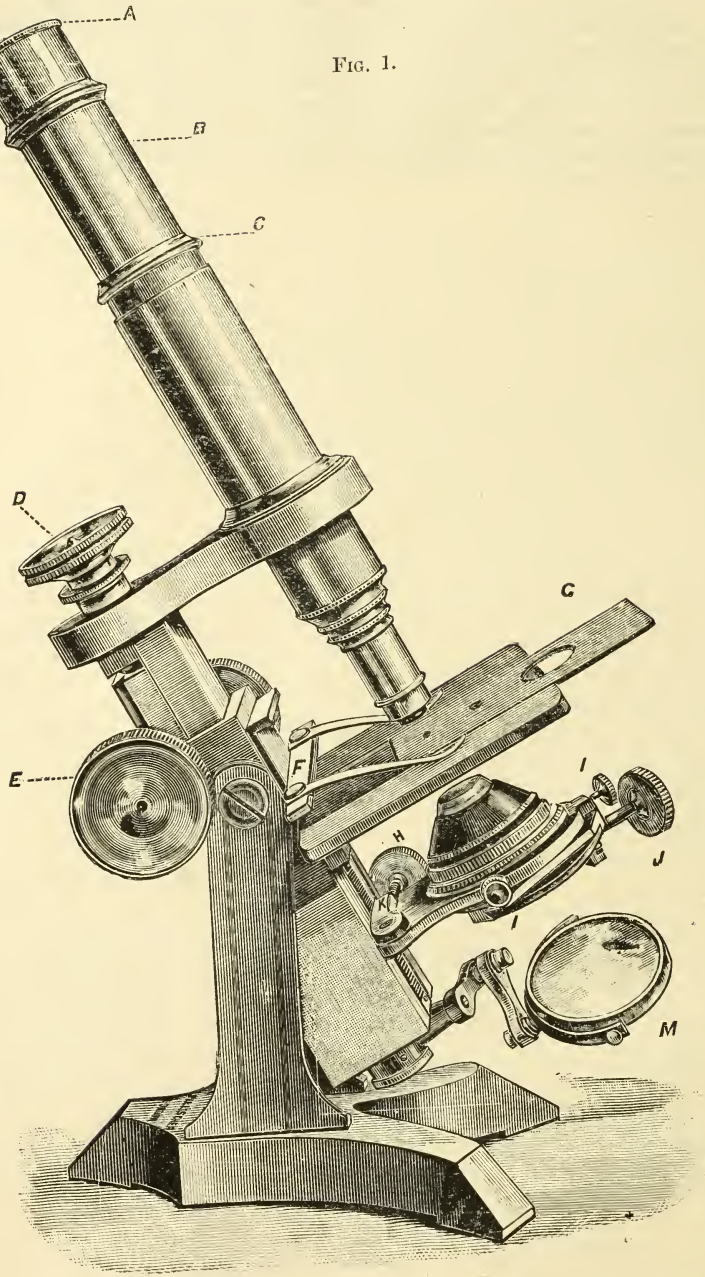
LONDON:

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, W.;

OF MESSRS. WILLIAMS & NORGATE; AND OF MESSRS. DULAU & CO.

Fig. 1.



MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

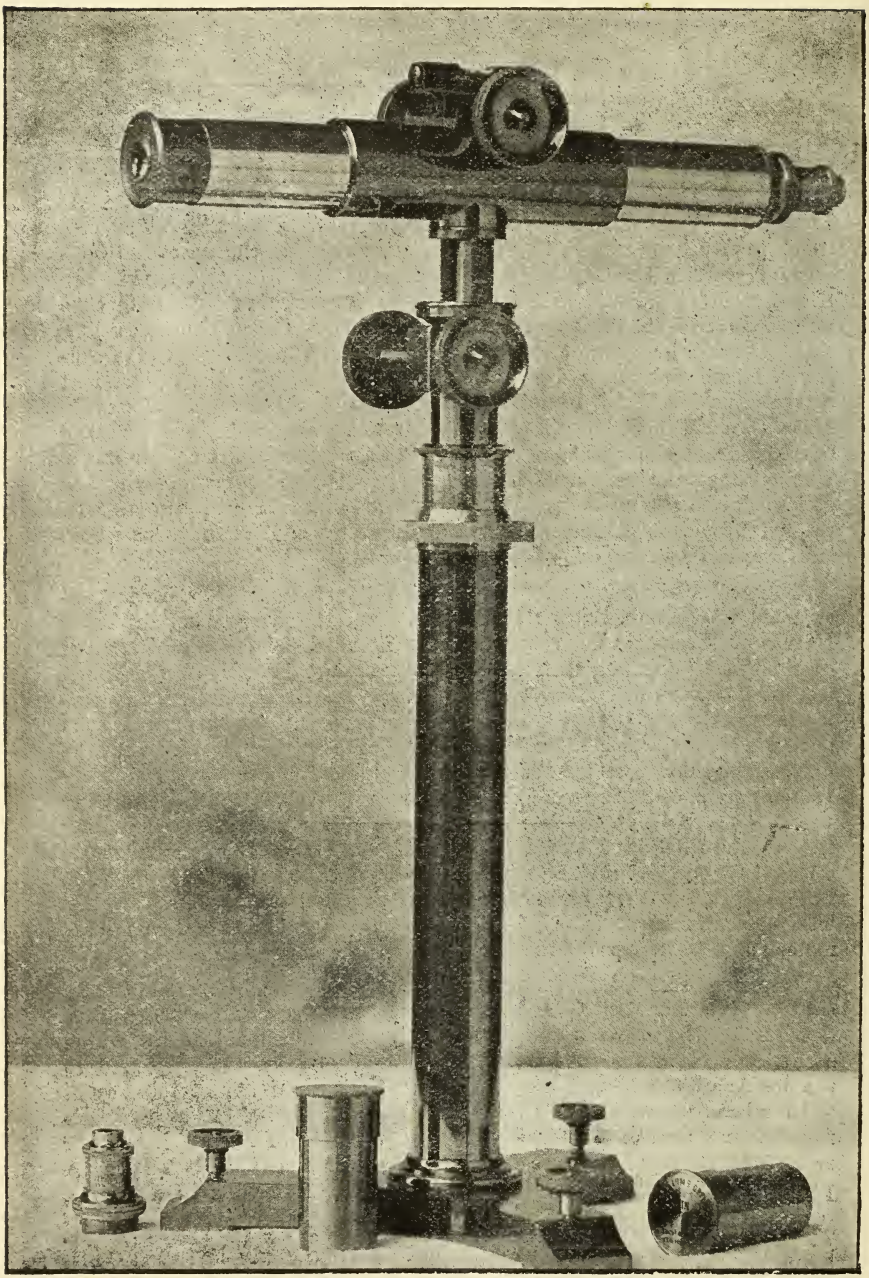
Pillischer's International Microscope.—This instrument (fig. 1) has the Continental length of tube when the joint B is drawn out; hence the title of "International." The pillar worked by the coarse adjustment E carries the fine adjustment D, and the two adjustments are therefore independent. C is a milled rim for pushing the whole tube up and down in its sleeve. A notable feature is the device for raising and lowering the spring clips, which are screwed to a bar F, thus forming a framework secured to a vertical slide flanged; the adjustment of the clips is effected by raising or depressing this flange. The stage has a thin sliding plate G pierced with three apertures for regulating the light, and the substage condenser has an iris and ring for stops. The substage can be placed excentrically to the optical axis by means of a rack and pinion operated by the milled head H, and can also be rotated by means of the milled head J. A pivot K enables the whole substage to be swung out of use.

Barnes' Horizontal Microscope.—This instrument (fig. 2) is constructed by Messrs. Bausch and Lomb from the designs of Professor Barnes of Wisconsin University, and is intended for the direct reading of the growth or movements of plant organs, &c. It will also be found useful in many other lines where a Microscope is required in a horizontal position. It consists of a nickelled tube with Society screw. An accurate spirit-level is attached, its axis being exactly parallel with the axis of the Microscope. Vertical adjustment is quickly effected by loosening the clamping ring shown near the top of the stand, permitting the Microscope-tube to be raised about 200 mm., or clamped at any intermediate point. The final vertical setting of the instrument is effected by vertical rack and pinion having movement of 75 mm. The base is fitted with three levelling screws for horizontal adjustment. The eye-piece is of 1-inch focus, and is furnished with a disc micrometer ruled to tenths of a millimetre across the entire field.

Improved Excelsior Dissecting Microscope.—This instrument (fig. 3), sold by Messrs. Bausch and Lomb, consists of a small wooden case 4 by 2 by $1\frac{1}{2}$ in. One end of the case is attached to the lid, which serves as a cover for the whole. A steel rod, $3\frac{3}{4}$ in. long, is fitted to the inside of the box, at one side of it, thus being out of the way of the forehead when focussing high- or low-power lenses. Rubber magnifiers of one, two, or three lenses, giving a range of magnifying power from 5 to 25 diameters, are arranged for adjustment on this rod. A plane mirror $2\frac{1}{4}$ by $1\frac{1}{4}$ in. is fitted to one end of the box in a groove,

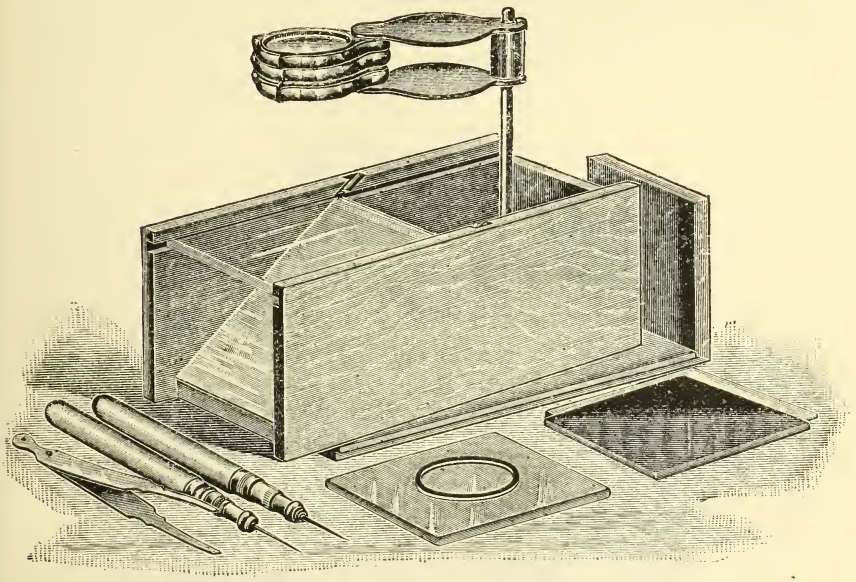
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

FIG. 2.



giving the proper angle. A glass stage $1\frac{5}{8}$ by $1\frac{3}{4}$ in. is adjustable in a groove near the top of the box, and can be replaced by a glass stage with cell, opal glass stage, or black glass stage, of the same size.

Fig. 3.



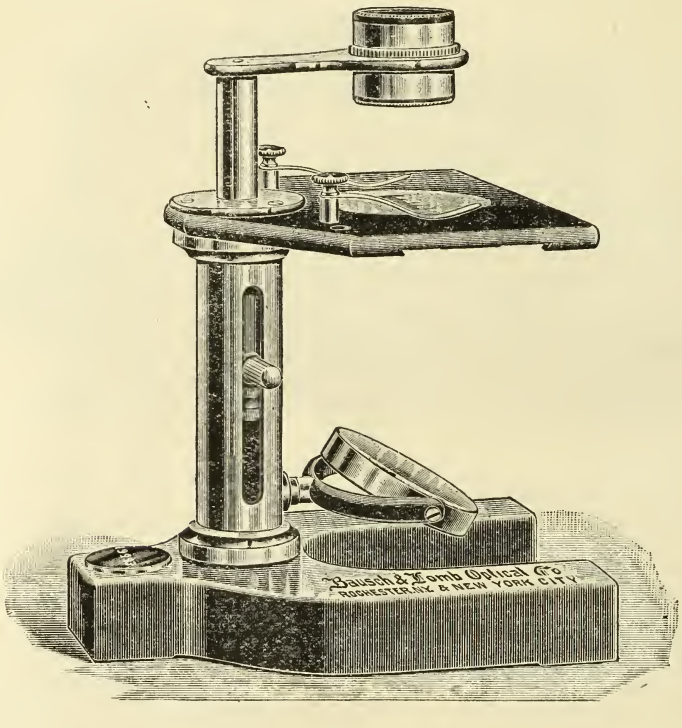
Bausch and Lomb's Educational Dissecting Microscope. — The popularity of this instrument has induced the makers to bring out an improved form (fig. 4). The base is of japanned metal, very heavy to secure stability. All other parts are heavily nickelled to prevent erosion by reagents. The stage is of large size, and the opening is provided with a glass disc. The lenses are carried by a metal arm movable about the stage, and are focussed by means of the knob shown at the side of the pillar, this method being entirely satisfactory for lenses of the powers used. Triplet, Coddington, or doublet lenses are supplied, but the two first are recommended on account of their superior defining power.

Improved Stage Construction. — Messrs. Bausch and Lomb have been paying special attention to this part of the instrument, and consider that their new stages are exactly at right angles to the optical axis, perfectly rigid under manipulation, possess perfectly plane surfaces, and are not affected by reagents. The surfaces of all stages, except in the cheaper stands, are of hard rubber. The metal part of the stage is recessed and covered with beaded studs. The rubber is forced into this depression while in a plastic condition, and vulcanised in such a manner that not only a mechanical but a chemical union takes place

between the rubber and the metal. This form of stage will never warp, as plates applied with screws will do, and retains its finish indefinitely.

Figs. 5 and 6 show how an iris diaphragm is used in the plane of the stage, either with or without the condenser, so as to give any desired size of aperture, even sufficient for the condenser to be used *through* it in oil-immersion contact with the slide if desired. The advantage of such a diaphragm is apparent, as it is thus in the only position at which the volume of light entering the objective can be varied without changing the aperture of the illuminating cone. Two forms have been

Fig. 4.



adopted: for some stands, a shallow mounting which screws to the underside of the stage and forms a part of it (fig. 6); and for all instruments provided with the complete substage, a deeper detachable form (fig. 7), A being the ring by which the diaphragm is operated.

Microscope with a New Mechanical Stage. — The accompanying figure (fig. 8) represents a Microscope made by Messrs. Watson and Sons, having a new form of mechanical stage designed by Mr. E. M. Nelson. The mechanism of the stage has been described in this Journal, 1888, p. 477, 1893, p. 236, and 1897, p. 185, with working drawings; but as yet no woodcut of the Microscope itself has appeared.

Bausch's New Microscope Stand.* — Mr. Edward Bausch has invented this stand (fig. 9) with the object of producing for school use

FIG. 5.

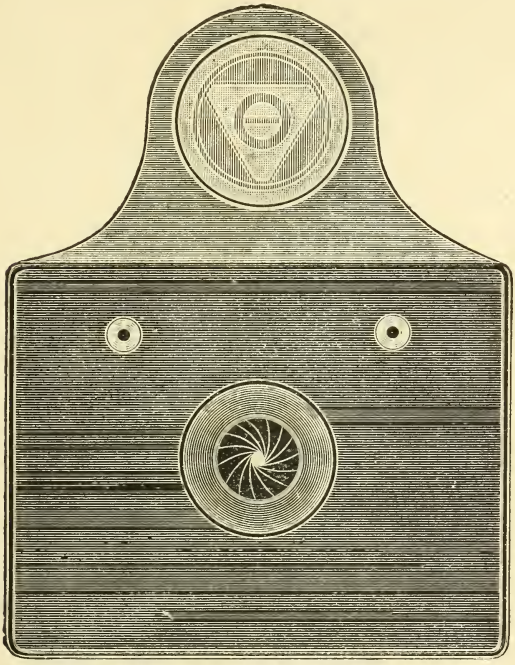
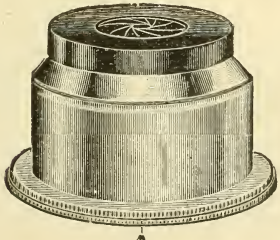


FIG. 6.

FIG. 7.



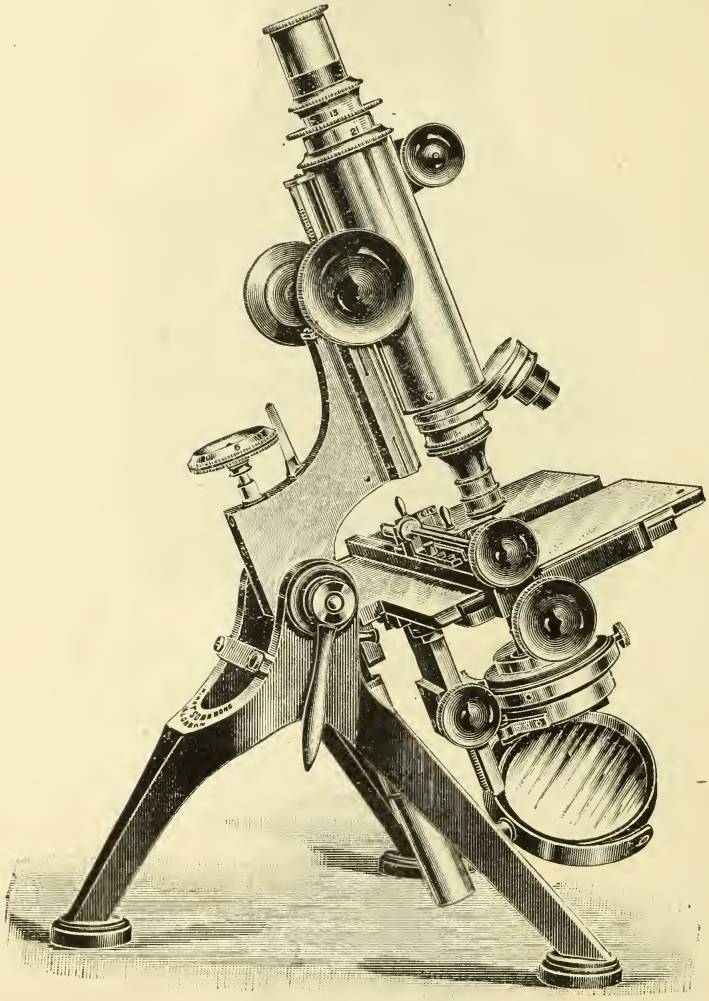
A

an article which shall combine both simplicity and cheapness of construction, and yet be a scientific instrument and not a toy. The coarse

* Journ. of Applied Micr., 1898, pp. 110–11 (1 fig.).

adjustment is attained by sliding the tube, and the fine by a micrometer screw. The qualities of a perfect fine adjustment are delicacy, rigidity, and permanency. Mr. Bausch considers that the European is generally admitted to be the best, but that its use in any simple instrument is

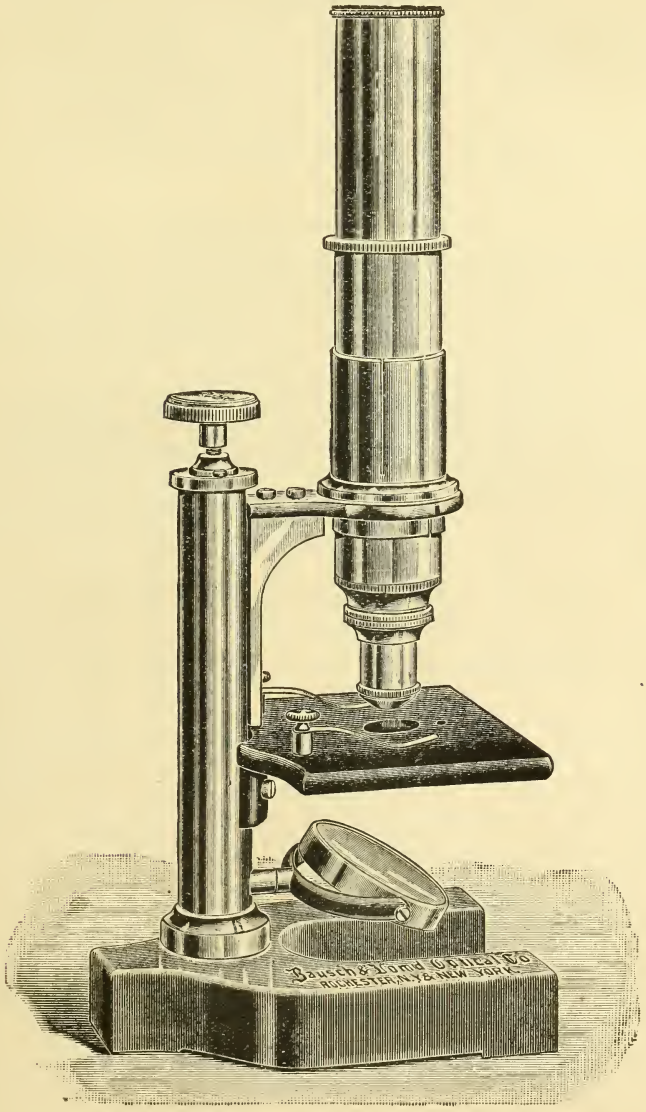
Fig. 8.



precluded on account of its considerable cost. He considers, however, that his form of fine adjustment proves an excellent substitute. The instrument to which he has applied it has a small japanned iron base, the pillar and arm is a single brass rod 7/8 of an in. in diameter, in

the upper half of which is recessed a V-way with a T cross-cut, to which the arm is fitted. This combines extreme rigidity with compactness.

Fig. 9.



Recessed into the lower end of the pillar is a spring which forces the arm upward against a micrometer-screw which is attached to the upper

extremity of the rod. In the lower end of the screw a hardened steel pin is recessed so that eccentricity of the screw cannot possibly be conveyed to the arm. Attached to the arm is a plate which receives the sleeve-tube in which the body-tube carrying the eye-piece and objective slides. The body-tube is of standard size, and of fixed length of 160 mm. The stage is fastened to the pillar rigidly, is of liberal proportions, and is provided with a revolving diaphragm. The dimensions of the instrument are as follows :—total length with objective and eye-pieces attached ready for use, 11 in. ; stage, $3\frac{3}{4} \times 3\frac{3}{8}$ in. The outside dimensions of the case are 11 in. high, $4\frac{1}{2}$ in. wide, $5\frac{1}{2}$ in. deep. The inventor speaks highly of the portability and working qualities of the instrument, as well as of its suitability for school use.

(2) Eye-pieces and Objectives.

Formulæ for Small-Apertured Objectives.*—Dr. H. Harting summarises the formulæ which have been developed by him elsewhere. They refer to the radii of a two-membered cemented objective of given qualities of glass, and are constructed for water- and dry-immersions.

σ_1 = the reciprocal of the working distance.
σ'_3 = the reciprocal of the focal distance from the last surface.
n_0 = refraction coefficient of immersion (in dry systems = 1).
n_1, n_2 = the refraction coefficients of the first and second lenses, calculated with reference to the D line.
$d\,n_0$, $d\,n_1$, $d\,n_2$ = corresponding dispersions between lines C and F.

Then

$$N_1 = \frac{d\,n_1}{n_1} - \frac{d\,n_0}{n_0}. \qquad L_1 = \frac{1}{n_1} - \frac{1}{n_0}.$$

$$N_2 = \frac{d\,n_2}{n_2} - \frac{d\,n_1}{n_1}. \qquad L_2 = \frac{1}{n_2} - \frac{1}{n_1}.$$

$$N_3 = -\frac{d\,n_2}{n_2}. \qquad L_3 = 1 - \frac{1}{n_2}.$$

$$s = \sigma_1 - \sigma'_3.$$

$$a_1 = +\epsilon\frac{N_2}{N_2 L_1 - N_1 L_2}. \qquad b_1 = \frac{N_3 L_2 - N_2 L_3}{N_2 L_1 - N_1 L_2}.$$

$$a_2 = -\epsilon\frac{N_1}{N_2 L_1 - N_1 L_2}. \qquad b_2 = \frac{N_1 L_3 - N_3 L_1}{N_2 L_1 - N_1 L_2}.$$

$$h_1 = L_1\left(\sigma'_3 + L_2 a_2 - \frac{a_1}{n_0}\right). \qquad k_1 = L_1\left(L_3 + L_2 b_2 - \frac{b_1}{n_0}\right).$$

$$h_2 = L_2\left(\sigma'_3 - \frac{a_2}{n_1}\right). \qquad k_2 = L_2\left(L_3 - \frac{b_2}{n_1}\right).$$

$$h_3 = L_3\,\sigma'_3. \qquad k_3 = -\frac{L_3}{n_2}.$$

* Zeitschr. f. Instrumentenk , 1898, pp. 331-5.

$$A = b_1 k_1 + b_2 k_2 + k_3.$$
$$B = b_1 h_1 + b_2 h_2 + h_3 + a_1 k_1 + a_2 k_2.$$
$$C = a_1 h_1 + a_2 h_2.$$
$$A' = b_1^2 k_1 + b_2^2 k^2 + k_3.$$
$$B' = b_1^2 h_1 + b_2^2 h_2 + h_3 + 2 a_1 b_1 k_1 + 2 a_2 b_2 k_2.$$
$$C' = a_1^2 k_1 + a_2^2 k_2 + 2 a_1 b_1 h_1 + 2 a_2 b_2 h_2.$$
$$D = a_1^2 h_1 + a_2^2 h_2.$$
$$S_1 = A\,Q_3^2 + B\,Q_3 + C.$$
$$S_2 = A'\,Q_3^3 + B'\,Q_3^2 + C'\,Q_3 + D'.$$

S_2 is to be equated to zero and the cubic equation for Q_3 solved, as the spherical aberration along the axis is *nil*. By suitable selection of the proper kinds of glass S_1, the expression for the satisfaction of the sine law can be indefinitely small. Along with the values of Q_3 got by equating either $S_1 = 0$, or $S_2 = 0$, there must be taken

$$Q_1 = a_1 + b_1 Q_3. \qquad f_1 = h_1 + k_1 Q_3.$$
$$Q_2 = a_2 + b_2 Q_3. \qquad f_2 = h_2 + k_2 Q_3.$$
$$f_3 = h_3 + k_3 Q_3.$$

And for control,

$$S_1 = \Sigma\, Q_\kappa f_\kappa. \qquad S_2 = \Sigma\, Q^2{}_\kappa f_\kappa.$$

$$\sigma_3 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3.$$

$$\sigma_2 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3 + \frac{n_1 - n_2}{n_1 n_2} Q_2.$$

$$\sigma_1 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3 + \frac{n_1 - n_2}{n_1 n_2} Q_2 + \frac{n_0 - n_1}{n_0 n_1} Q_1.$$

$\frac{1}{\sigma_\kappa}$ with regard to $\frac{1}{\sigma'_\kappa}$ is the distance of the intersection point of the ray refracted from the $(\kappa - 1)$th to the κth surface with the axis, and is measured from the vertex of the κth surface.

If ρ_1, ρ_2, ρ_3 are the reciprocals of the radii r_1, r_2, r_3, then

$$\rho_1 = \frac{1}{r_1} = \frac{Q_1}{n_0} + \sigma_1.$$

$$\rho_2 = \frac{1}{r_2} = \frac{Q_2}{n_1} + \sigma_2.$$

$$\rho_3 = \frac{1}{r_3} = \frac{Q_3}{n_2} + \sigma_3.$$

Controlling equations for h and k are

$$h_1 + h_2 + h_3 = \sigma'_3 - \frac{\sigma'}{n_0}.$$
$$k_1 + k_2 + k_3 = 0.$$

In the case of a dry system $n_0 = 1$, and

$$N_1 + N_2 + N_3 = L_1 + L_2 + L_3 = 0.$$
$$b_1 = b_2 = +1.$$
$$A' = A = 0.$$

And the reciprocal focal distance ϕ comes from

$$\phi = \frac{n_1 - 1}{n_1}(Q_1 - Q_2) + \frac{n_2 - 1}{n_2}(Q_2 - Q_3).$$

In order to pass from a system of infinitely thin lenses calculated as above to a system with finite thickness, one must calculate a paraxial ray passing through selected thicknesses d_1 and d_2 with ascertained radii, and form the expressions

$$\overline{Q}_\kappa = n_{\kappa-1}(\rho_\kappa - \sigma_\kappa) = n_\kappa(\rho_\kappa - \sigma'_\kappa).$$

$$\overline{\Gamma} = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^2 Q_\kappa \left(\frac{d}{}\frac{n_\kappa}{n_\kappa} - \frac{d}{}\frac{n_{\kappa-1}}{n_{\kappa-1}}\right).$$

$$\overline{S}_1 = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^3 Q_\kappa \left(\frac{\sigma'_\kappa}{n_\kappa} - \frac{\sigma_\kappa}{n_{\kappa-1}}\right).$$

$$\overline{S}_2 = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^4 Q^2_\kappa \left(\frac{\sigma'_\kappa}{n_\kappa} - \frac{\sigma_\kappa}{n_{\kappa-1}}\right).$$

Whence

$$\frac{h_\kappa}{h_1} = \frac{\sigma'_{\kappa-1}}{\sigma_\kappa} \cdot \frac{\sigma'_{\kappa-2}}{\sigma_{\kappa-1}} \cdot \ldots \cdot \frac{\sigma'_1}{\sigma_2},$$

and $\overline{\sigma}$, $\overline{\sigma'}$, $\overline{Q}$ are taken from the calculation of the paraxial ray.

$\overline{\Gamma}$, the expression of the chromatic aberration and $\overline{S_2}$ are no longer zero, whilst $\overline{\sigma'_3}$ becomes considerably greater than the σ'_3 belonging to the general calculation. Now with the values $\overline{Q}$ and $\overline{\sigma}$ taken from the through-calculation, the following equations are built up:

$$\frac{\delta \sigma'_3}{\delta Q_1} = \left(\frac{1}{n_0} - \frac{1}{n_1}\right)(1 + 2 d_1 \sigma_2 + 2 d_2 \sigma_3).$$

$$\frac{\delta \sigma'_3}{\delta Q_2} = \left(\frac{1}{n_1} - \frac{1}{n_2}\right)(1 + 2 d_2 \sigma_3).$$

$$\frac{\delta \sigma'_3}{\delta Q_3} = \frac{1}{n_2} - 1.$$

$$\frac{\delta \Gamma}{\delta Q_1} = N_1 - 2[d_1 Q_2 N_2 + (d_1 + d_2) Q_3 N_3]\left(\frac{1}{n_0} - \frac{1}{n_1}\right).$$

$$\frac{\delta \Gamma}{\delta Q_2} = N_2(1 - 2 d_1 \sigma_2) - 2 d_2 Q_3 N_3 \left(\frac{1}{n_1} - \frac{1}{n_2}\right).$$

$$\frac{\delta \Gamma}{\delta Q_3} = N_3(1 - 2 d_1 \sigma_2 - 2 d_2 \sigma_3).$$

$$\frac{\delta S_2}{\delta Q_1} = \left(\frac{1}{n_0} - \frac{1}{n_1}\right)\left\{\frac{3Q_1^2}{n_1} - 2Q_1\sigma_1 - Q_2^2\left(\frac{1}{n_1} - \frac{1}{n_2}\right) - Q_3^2\left(\frac{1}{n_2} - 1\right)\right.$$

$$+ 8d_1\sigma_2 Q_2^2\left(\frac{1}{n_1} - \frac{1}{n_2}\right) + 4d_1\sigma_2 Q_3^2\left(\frac{1}{n_2} - 1\right)$$

$$+ 8d_2\sigma_3 Q_3^2\left(\frac{1}{n_2} - 1\right) - 4d_1\frac{Q_2^3}{n_2}\left(\frac{1}{n_1} - \frac{1}{n_2}\right)$$

$$\left. - 4(d_1 + d_2)\left(\frac{1}{n_2} - 1\right)Q_3^3 + 4d_1\left(\frac{1}{n_2} - 1\right)\sigma_3 Q_3^2\right\}.$$

$$\frac{\delta S_2}{\delta Q_2} = \left(\frac{1}{n_1} - \frac{1}{n_2}\right)\left\{\left[\frac{3Q_2^2}{n_2} - 2Q_2\sigma_2 - Q_3^2\left(\frac{1}{n_2} - 1\right)\right](1 - 4d_1\sigma_1)\right.$$

$$\left. + 8d_2\sigma_3 Q_3^2\left(\frac{1}{n_2} - 1\right) - 4d_2 Q_3^3\left(\frac{1}{n_2} - 1\right)\right\}.$$

$$\frac{\delta S_2}{\delta Q_3} = \left(\frac{1}{n_2} - 1\right)\{3Q_3 - 2\sigma_2\}Q_3(1 - 4d_1\sigma_2 - 4d_2\sigma_3).$$

These magnitudes occur as coefficients in the following equations:

$$\Delta Q_1\frac{\delta\sigma'_3}{\delta Q_1} + \Delta Q_2\frac{\delta\sigma'_3}{\delta Q_2} + \Delta Q_3\frac{\delta\sigma'_3}{\delta Q_3} = \sigma'_3 - \bar{\sigma}'_3.$$

$$\Delta Q_1\frac{\delta\Gamma}{\delta Q_1} + \Delta Q_3\frac{\delta\Gamma}{\delta Q_2} + \Delta Q_3\frac{\delta\Gamma}{\delta Q_3} = -\Gamma.$$

$$\Delta Q_1\frac{\delta S_2}{\delta Q_1} + \Delta Q_2\frac{\delta S_2}{\delta Q_2} + \Delta Q_3\frac{\delta S_2}{\delta Q_3} = -S_2.$$

From these the three quantities ΔQ are to be calculated, and, when added to the $\bar{Q}$, define the Q: wherefrom, as before, follow the new radii, which, combined with the assumed thicknesses, produce a system free from spherical and chromatic aberration at the given working distance and tube-length, and satisfying the sine law.

Example: $n_0 = 1$.

$n_1 = 1{\cdot}57332.$ $\quad d\,n_1 = +\,0{\cdot}00998$ (heavy barium silicate crown).
$n_2 = 1{\cdot}62059.$ $\quad d\,n_2 = +\,0{\cdot}01714$ (ordinary silica flint).

$\sigma_1 = -\,0{\cdot}027778.$ $\qquad \sigma'_3 = +\,0{\cdot}005556.$

$\log N_1 = 7{\cdot}8023.$ $\qquad \log L_1 = 9{\cdot}5616\,n.$
$\log N_2 = 7{\cdot}6265.$ $\qquad \log L_2 = 8{\cdot}2681\,n.$
$\log N_3 = 8{\cdot}0243.$ $\qquad \log L_3 = 9{\cdot}5831.$
$h_1 = +\,0{\cdot}03307.$ $\qquad k_1 = +\,0{\cdot}2319.$
$h_2 = -\,0{\cdot}00185.$ $\qquad k_2 = +\,0{\cdot}0047.$
$h_3 = +\,0{\cdot}00213.$ $\qquad k_3 = -\,0{\cdot}2366.$

$$a_1 = + 0{\cdot}09904. \qquad a_2 = - 0{\cdot}1485.$$
$$S_1 = + 0{\cdot}05561\, Q_3 + 0{\cdot}00355.$$
$$S_2 = + 0{\cdot}07788\, Q_3^2 + 0{\cdot}009479\, Q_3 + 0{\cdot}0002835 = 0.$$

One root of the equation $S_2 = 0$ is $Q_3 = - 0{\cdot}05293$, and

$$Q_2 = - 0{\cdot}2014. \qquad r_1 = + 54{\cdot}56.$$
$$Q_1 = + 0{\cdot}01611. \qquad r_2 = - 7{\cdot}195.$$
$$S_1 = + 0{\cdot}0006072. \qquad r_3 = - 21{\cdot}11.$$

On the assumption that $d_1 = + 1{\cdot}5$, $d_2 = + 1{\cdot}0$, we get from the working out of the paraxial ray $\overline{\sigma'}_3 = + 0{\cdot}006176$, $\overline{\Gamma} = + 0{\cdot}00001279$, $\overline{S}_2 = + 0{\cdot}000001416$, and the correction-equations with logarithmic coefficients

$$+ 7{\cdot}4042\, \Delta Q_1 + 7{\cdot}1257\, \Delta Q_2 - 7{\cdot}4325\, \Delta Q_3 = - 4{\cdot}1511.$$
$$+ 7{\cdot}7721\, \Delta Q_1 + 7{\cdot}6383\, \Delta Q_2 - 8{\cdot}0500\, \Delta Q_3 = - 5{\cdot}1069.$$
$$+ 9{\cdot}5343\, \Delta Q_1 + 8{\cdot}2555\, \Delta Q_2 - 9{\cdot}5832\, \Delta Q_3 = - 6{\cdot}7928.$$

Whence

$$\Delta Q_1 = + 0{\cdot}000893, \qquad Q_1 = + 0{\cdot}04700.$$
$$\Delta Q_2 = + 0{\cdot}00237, \qquad Q_2 = - 0{\cdot}1993.$$
$$\Delta Q_3 = + 0{\cdot}002529, \qquad Q_3 = - 0{\cdot}05102.$$
$$\Gamma = + 0{\cdot}00000029, \qquad S_2 = - 0{\cdot}00000254.$$
$$r_1 = + 52{\cdot}03.$$
$$r_2 = - 7{\cdot}291.$$
$$r_3 = - 22{\cdot}00.$$

A calculation of the rays proceeding from the object, and inclined to the axis at 6°, 4°, 2°, and infinitely slightly, gave

Ray.	Intersection distance.	Logarithmic sine ratio.
C-axis	180·39	0·6869
F-axis	180·37	0·6868
D-axis	179·93	0·6858
D 2°	179·98	0·6857
D 4°	180·67	0·6867
D 6°	184·17	0·6936
C 6°	183·72	0·6926
F 6°	187·78	0·7009

By a slight trigonometrical adjustment, the aberration residue can be rendered negligible. The calculation for the second root value of Q_3 is carried out similarly; finally, both evaluated systems have to be investigated in their relation to extra-axial rays.

Centering of Lenses.*—Dr. Hugo Schroeder commences his paper on this subject by pointing out the obvious importance of accurate central

* Central-Zeit. f. Optik, 1898, pp. 161–2, 172–3, 182–3.

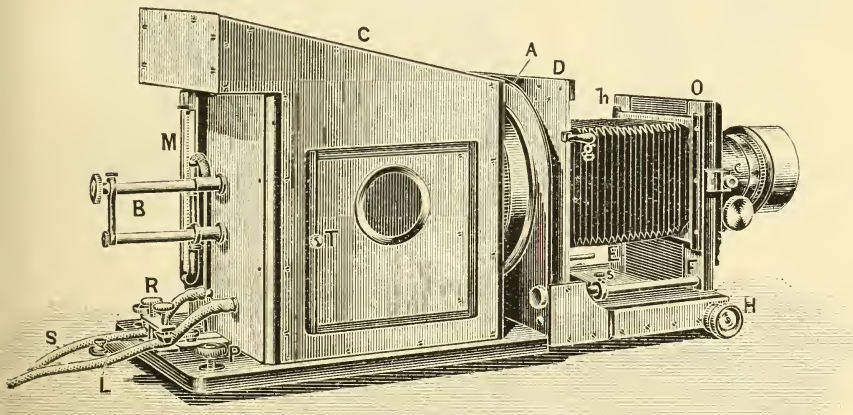
adjustment, and by expressing his surprise that so little is met with on the subject in optical treatises.

Faultless centering occurs when the thickest point of convex lenses (and the thinnest point of concave ones) lies in the centre of the circular periphery of the lens. Moreover, the line joining the two sphere-centres of the lens must be perpendicular to the two surfaces of the lens. A historical account of the means adopted by early opticians to attain these conditions is given. References are made to Prechtl's 'Praktische Dioptrik' (Wien, 1828), to Robert Smith's 'Optics' (1755), to Klügel (Wien, 1765), and to Fraunhofer's methods. It appears that Fraunhofer published nothing on centering, but the author has met with a traditional account of his manner of working. The paper contains (p. 173) an account of the method of centering large flattish lenses adopted by Ross.

(3) Illuminating and other Apparatus.

Behrens' New Projection Apparatus.*—Prof. Behrens' object was to produce an apparatus cheap, handy, portable, which should serve all but the highest purposes of demonstration. After discussing the advantages and disadvantages of the various luminants, he selects lime-light as the best for general use, but points out that the usual burner is faulty, and describes his design for improving it.

Fig. 10.

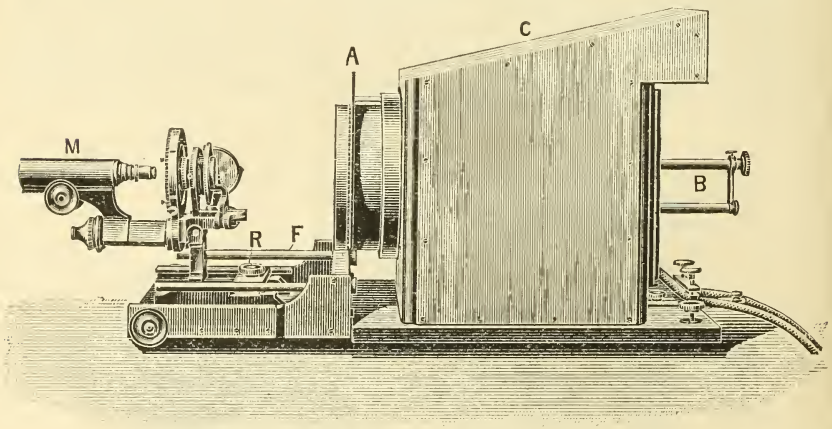


The general arrangement of the apparatus is shown in figs. 10 and 11. The only wooden parts are the mahogany base-board (67 × 26 cm.) and the objective-board O. The larger metal parts are of rolled aluminium, and the brass parts are nickelled. The camera C, internally lined with

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 7–23 (5 figs.).

asbestos, is erected on four solid brass pillars. The sliding door T, with smoked glass window, is only opened to light up the gas flame and to centre the light point with a micrometer-screw. But the camera is then kept closed, because complete regulation is effected outside of and at the back of the camera. B is the projecting part of the burner; M, a manometer for controlling the compressed oxygen; R, the fine adjustment for the gases introduced through the tubes S; P, a levelling screw; L, an aluminium arm leading into the camera, clamped by the screw *l*, and intended to regulate the rear lens of the three-lensed condenser. In front of the camera, fastened by a strong aluminium bar, is the condenser-carrier A, receiving both the front lenses of the condenser, which are therefore placed quite outside the camera, and get scarcely heated at all. They extend with their mounting to a circular opening in the front wall of the camera, and thus leave between themselves and this wall an air-space of 1 cm. clear, through which an extremely effective

Fig. 11.



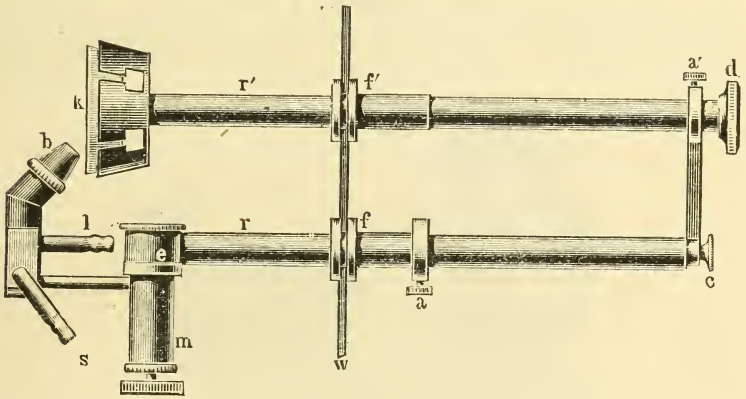
air ventilation is brought into the inner camera. Immediately in front of the condenser stands the diapositive-holder D, in which, by means of the clip *g* the carrier for the glass diapositives can be slipped in and out. D is shut off in front by a smaller aluminium plate, on which the leather bellows E is fastened, whose front aluminium frame slides on two metal runners of the objective-board O. On O, which can be moved backwards and forwards by means of a milled screw-head H, is a lateral micrometer screw *c*, which serves for centering the flame image.

The diapositive-carrier D is movable on two prismatic bars F in two directions by clamp-screws *s*, which bars move in the strong aluminium rail of the condenser-plate A. By relaxing *s*, the diapositive-carrier, the bellows, and objective-board can be removed; the front condenser lens is then completely free, and the apparatus can now be used for the projection of microscopic preparations (fig. 11). But if such objects as culture-tubes and plates, chemical reactions, &c., require to be projected, the objective-board and objective (without the bellows) are re-inserted, and these objects find ample room between A and O.

The *burner* is obviously an essential part of the instrument. The projected image only attains the maximum of sharpness and brightness when the light-source is formed by the condenser exactly in the centre of the rear primary plane of the projecting objective.

Fig. 12 shows the burner, which is intended to secure the following advantages:—(1) The large lime-plate is plane, and stands perpendicularly to the optical axis of the apparatus; (2) the whole burner arrangement is movable parallel to the optical axis; (3) the nozzle-opening is adjustable in every direction to the optical axis, especially perpendicularly, by means of a micrometer-screw. The supporter of the burner is the massive camera back-plate *w*, in which the brass nuts *f f'* are inserted, carrying the brass tubes *r r'*, movable on the release of the clamp-screw *a*. Both are connected by the cross-bar *a' c*, which can be fixed on *r'* by the clamp-screw *a'* and on *r* by the screw *c*. By the screw-head *d* the lime-plate K in its holder can be rotated in order to

Fig. 12.



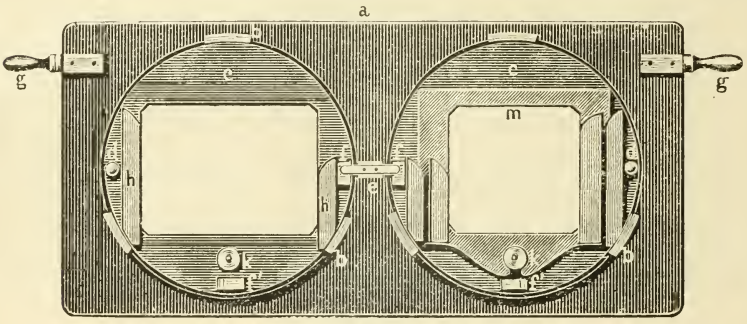
bring new portions of the lime into incandescence. To the tube *r* a copper ring *e* is screwed on, in which the micrometer-box *m* and at the same time the burner-nozzle *b* can be moved sectorwise; a similar movement, but perpendicular to the first, is imparted by *c*; and a micrometer-screw *m* allows a third very fine movement. It is therefore possible to bring the centre of the flame exactly in the optical axis, and by the pushing of *r r'* to bring it into the rear primary plane of the objective.

The *condenser* consists of a concavo-convex back-lens, of 13 cm. diameter, and two plano-convex front lenses of 16 cm. diameter. By means of the concavo-convex lens it was possible to give to the condenser a high numerical aperture, and consequently attain a great light intensity. By the use of an objective system of 25 cm. focus and 20-fold magnification, the N.A. amounts to 0·65. The condenser is also so calculated that the catadioptric secondary images are distributed evenly over the field, and completely uniform illumination is secured.

The *diapositive-carrier* is believed by the author to be of novel design.

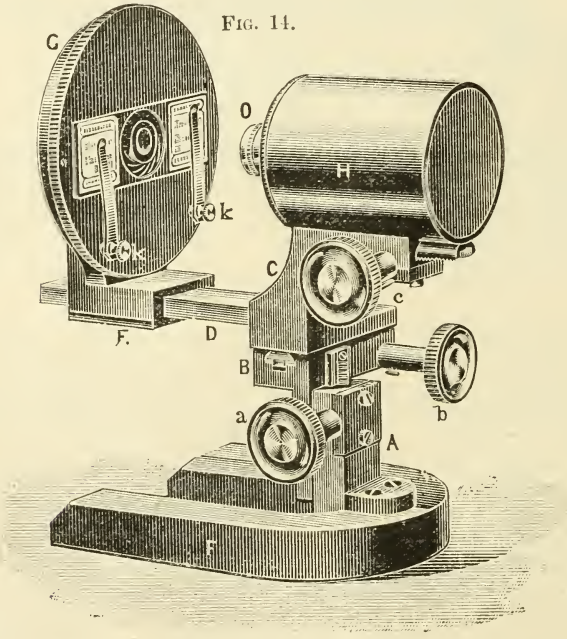
It consists of a lacquered aluminium plate (fig. 13), with two circular perforations of 13 cm. diameter. Two aluminium discs rotate in the

Fig. 13.



brass grooves *b b* by pressing the knob *d*. These discs are perforated rectangularly, and *h h'* are tires for the slides. The left-hand one can receive an upright or a lateral slide. To adapt it for the former the

Fig. 14.

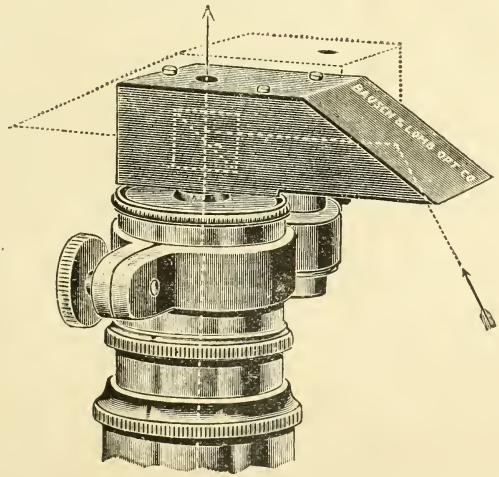


knob *d* is pushed down, thus releasing the catch *f*, and the disc rotates until *f'* catches in *e*. If smaller diapositives are to be used, a suitably sized frame *m* is slipped into *h h'*, as shown in the right of the figure.

The *objective-board* and *objective*, including the optical conditions for perfect projection, are described in detail, and are followed by a discussion of the ordinary method of projecting microscopic preparations by means of their photographs. But in fig. 14 the author explains how he projects from the microscopic preparation itself. The massive horse-shoe foot F is fastened on the objective-board by means of a groove and screw R (fig. 11), and can be moved forwards and backwards by the milled head H (fig. 10). On F (fig. 14) the short rectangular pillar A is firmly screwed, in which the cross-piece B is moved perpendicularly up and down by rack and pinion, operated by the screw *a*. The milled head *b* imparts a horizontal movement to the tube-holder. The short tube H has a clear diameter of 48 mm.; it bears a projection Microscope objective at O, and can be focussed on the micro-preparation by means of the milled head *c*. When D is fully extended, an objective of 12 cm. focus can be used. The object stage can be rotated, and has an iris of 25 mm. diameter. The stage, including E, is completely removable; special holders for other objects, e.g. for bacteria cultures, can then be inserted.

Abbe Camera Lucida.—Messrs. Bausch and Lomb bring out a simplified form of this accessory, in which, while the Abbe prism is used as in the large Abbe camera lucida, the mirror is reduced in size and is fixed. The prism and mirror are contained in a neat mounting which is attachable to the Microscope-tube by a clamping ring, and may be

Fig. 15.



swung back out of the way of the eye-piece as shown in fig. 15. A beautifully clear image of the object and of the pencil point is said to be obtained. One feature of this camera lucida is that by means of the clamping ring the distance of the prism from the eye-lens can be varied, and thus the camera used with various oculars.

Monochromatic Light.* — Dr. Wilibald A. Nagel indicates the various difficulties concerned in the employment of prisms for the obtaining of monochromatic light, and recommends instead the use of "*Strahlen-filtern.*" Of these he thinks fluids have many advantages over coloured glass or gelatin films. He gives a complete list for all parts of the spectrum of fluids which can be used for this purpose.

(4) Photomicrography.

Neuhass' Lehrbuch der Mikrophotographie.† — Dr. Neuhass has brought out a second edition of this book, in which he tries to bring the subject up to date. The work is divided into eight sections, viz. (1) The microphotographic apparatus. (2) Objectives and oculars. (3) The light source. (4) The illumination. (5) Arrangements for special purposes. (6) The negative image. (7) The positive image. (8) Preparations; significance of microphotography; microphotograms. This last subsection comprises a review of the chief microphotograms taken during the last ten years by operators of various nationalities. Several of the sections contain a historical subsection.

(6) Miscellaneous.

Theory of the Microscope.‡—Herr Karl Strehl grounds his paper on this subject upon the formulæ obtained by him in his 'Theory of the Telescope,' in conjunction with the proposition (Abbe, Dippel, Czapski, Strehl) that the Microscope = lens + telescope.

As a preliminary he refers to the papers of Lord Rayleigh§ and Lewis Wright.‖ He criticises Wright's view that "for irregular and unperiodic detail wide-cone illumination is the most useful, because it brings the object into a condition approximating to theoretical self-luminosity." He only admits this statement when an image of a self-luminous surface can be formed in the object-plane by means of an apochromatic condenser, whose N.A. is as much as possible greater than that of the apochromatic observation system. For the limit of fineness of resolvable detail is accidentally determined for self-luminous objects in the same way as for those objects which are illuminated with extremely oblique plane waves, and indeed depends only on the wave-length and the numerical aperture. For self-luminous objects he finds the limit given by $\zeta = (2 \cdot 95 : 2\pi) \cdot (\lambda : n \sin \alpha)$, and for extremely oblique light Abbe's theory gives $\zeta = \lambda : 2 n \sin \alpha$; both values are equal up to 6 degrees. Strehl's previous value of $\zeta = (3 \cdot 20 : 2\pi) \cdot (\lambda : n \sin \alpha)$ gives an experience limit of 3 to 4 degrees for the observer's eye. He admits that with this mode of illumination images may be less distinct, but that they are more truthful. He has found wide light-cones give a notable resolution of the finest details of butterfly scales, and agrees that *not only* in the case of coloured isolated structure-elements is such illumination advantageous. He points out that his statement, "the influence of spherical aberration has been considerably over-rated in objectives," was misunderstood by Wright, as he was only referring to telescope objectives.

* Biol. Centralbl., xviii. (1898) pp. 649–55 (with spectral maps).
† Bruhn, Braunschweig, 1898, 266 pp., 62 woodcuts, 2 autotypes, and 2 pls.
‡ Zeitschr. f. Instrumentenk., 1898, pp. 301–17. § Phil. Mag., xlii. (1896) p. 167.
‖ Op. cit., xlv. (1898) p. 480. Cf. this Journal, 1896, p. 681; 1898, p. 592.

On the Abbe theory the hinder part of the ray-path can be regarded as coming from a telescope objective, which, however, does not work with full aperture, but is rather covered up except for a row of little windows corresponding to the diffraction spectra. To these little windows must be ascribed an elementary surface. The achromatic undiffracted centre is a primary maximum, and the lateral chromatic images the discontinuous diffraction appearances. Therefore, to produce monochromatic microscopic images no Microscope is necessary; a telescope may be directed towards a point monochromatically illuminated, and the objective covered up except a large slit (primary maximum) and several small slits (secondary maxima). Such an arrangement works as a Microscope as soon as the totality of the wave-lengths is taken into consideration; for in this case the secondary maxima have constant distances from the primary maximum, which distances in the Microscope are proportional to the wave-lengths. His treatment is an enlargement upon Eichhorn's 'Bestimmung der Interferenzen von mehreren Isochronen und in gleicher Phase schwingenden Lichtzentren,'* both in depth and in scope: in *depth*, because Eichhorn treated the diffraction spectra as lying in *one* plane instead of on a spherical surface; in *scope*, because Strehl treats of the environment in space of the wave-centre, and includes spherical aberration, coma, cylindrical waves, distinction between direct and oblique light, and chromatic aberration. Moreover, he pays due heed to the laws of conservation of energy neglected by Eichhorn.

In discussing each subject he quotes the corresponding equations from his 'Theorie des Fernrohrs,' and deduces the following propositions.

Aplanatic image-formation.—(1) If a definite group of diffraction spectra be displaced on the spherical wave-surface, the inner and outer proportions of the microscopical image thereby formed are left unchanged.

(2) The microscopical image is achromatic in the focal plane, chromatic in the image plane and along the optic axis.

(3) The fineness of delineation in the microscopical image is, both in the focal plane and in the corresponding image-planes and along the optic axis, proportional to the wave-length of the light source.

(4) The fineness of delineation in the microscopical image is, in the focal plane and the corresponding image planes, inversely proportional to the linear extent of the group of diffraction spectra.

Chromatic aberration.—(5) The excellence of the microscopical image is attained by means of an integration over the various wave-lengths.

Direct illumination.—(6) If a primary maximum lies in the midst of a circle of secondary maxima, then is the microscopical image along the optic axis a regular simple periodic function of the spot—monochromatic light being assumed.

(7) If a primary maximum lies in the middle of a circle of secondary maxima taken by pairs of opposites, then complete images alternate with images of exactly opposite character along the optic axis at constant distances—monochromatic light being assumed.

(8) If a primary maximum lies in the midst of a regular polygon of secondary maxima, then the pattern of the microscopical image in the

* Jena, 1878.

image-planes is completely contained within the corresponding radial angle.

(9) If a primary maximum lies in the midst of a circle of secondary maxima taken by pairs of opposites, and linear periodic relations between x and y are possible for which the expression $\int \cos(x \cos w + y \sin w)$ takes a constant value, then the microscopical image in the image-planes assumes parallel bands of constant intensity at constant distance—in those directions to which the secondary maxima lie symmetrically when taken by pairs.

Strehl then discusses the special cases of *Synedra pulchella*, *Pleurosigma attenuatum*, and *P. angulatum*.

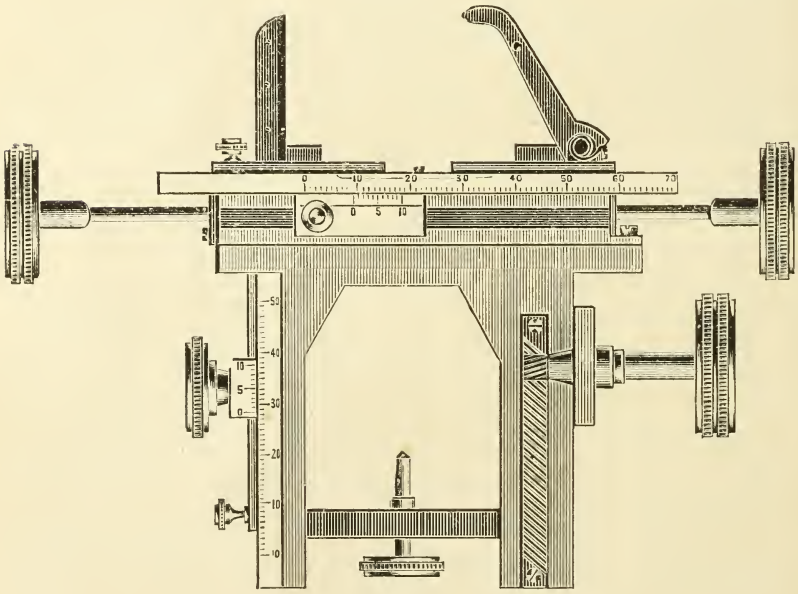
(10) *Oblique illumination.*—Here he assumes that the group of spectra consists of a polygonal arrangement of one primary and several secondary maxima.

(11) If the primary maximum forms a circle with the secondary maxima, then the microscopical image along the optic axis is independent of the spot.

The special cases of the same three diatoms are severally considered.

The subjects of astigmatism, cylindrical waves, spherical aberration, zonal refraction, and coma, are then similarly considered, but the results do not lend themselves to the enunciation of propositions.

Fig. 16.



New Stage Finder.*—Messrs. Koltzoff and Ivanoff propose a new form, which has been made for them by Reichert, of this accessory.

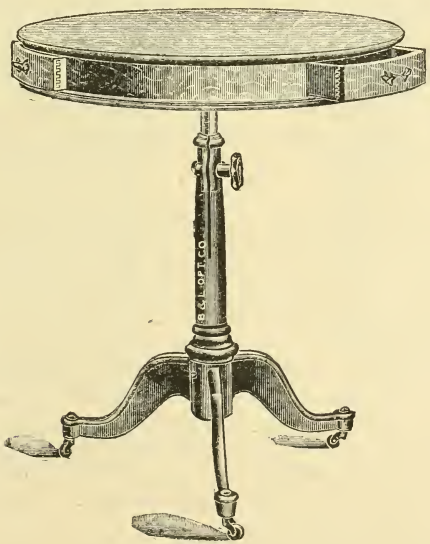
* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 3–7 (1 fig.).

Most finders labour under two disadvantages, viz. (1) inadjustability to different Microscopes for comparison purposes, owing to variations in stand and objective construction; (2) unreliability, even on the same Microscope, owing to the difficulty of securing a precisely similar adjustment. The authors' object is to obtain an absolute means of recording the position of any part of a preparation, and one which shall moreover be independent of any particular make of Microscope.

They propose to indicate such a position by means of co-ordinates measured parallel to the top and left-hand edges of the slide, and every adjustable stage lends itself to such measurements. The readings of the scales should be so altered that the indicator is at zero when the left edge of the slide is in the centre of the field of view. If any instrument does not happen to give zero under these circumstances, the reading should be carefully noted once for all and subtracted from the actual reading of any required point in the preparation. This will give one co-ordinate, and the other can be ascertained similarly. A simplification would be introduced if the scales were made movable for adjustment in the direction of their long axis. The figure (fig. 16) will make the authors' arrangements clear.

Microscopist's Table.—This piece of furniture (fig. 17), designed by Messrs. Bausch and Lomb, has a revolving top and vertical adjustments. It is made of solid quartered oak with japanned iron base. The top is

Fig. 17.



76 cm. in diameter, and has three drawers with brass handles. The table may be raised and lowered as desired from 79 cm. to 112 cm., and clamped in position by a heavy hand clamp, the adjusting bar being 3 cm. in diameter. The table is equally as stable as if supported on four

legs. The revolving top can, when desired, be clamped by a separate hand clamp.

Illustrated Annual of Microscopy.* — Among other interesting articles in this Annual may be mentioned especially :—

'Achromatics and Apochromatics,' by E. J. Spitta. A very interesting popular account of these lenses.

'Elementary Theory of the Microscope.' An excellent treatise by Mr. Conrad Beck ; contains a treatment of microscopical optics on the methods of Gauss.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Apparatus for Anaerobic Cultivation.‡—Herr L. Źupnik has devised an apparatus by which a perfect vacuum is secured. The main part of the apparatus is a cylindrical glass vessel K (fig. 18) having narrow tubes at both ends which can be closed by stop-cocks H_1 and H_2. The culture vessel is completely filled with a nutrient solution, and after inoculation the tap H_1 is closed. To the lower end is now fitted on, through the intermediary of a rubber joint *Sch*, a thick glass tube R 80–90 cm. long. The apparatus is now reversed, and the tube R completely filled with mercury. The end of the tube having been closed with the finger, and the apparatus restored to its former position, it is now plunged into a vessel W filled with mercury.

On removing the finger the mercury sinks, and a Torricellian vacuum is produced. The tap H_2 is now opened, the medium flows down, leaving an airless space above. After closing H_2 the tube R is removed and the apparatus placed in the incubator. According to the length and width of the tube R, any desired quantity of medium can be removed. In this way quite a large space may be left above the level of the culture medium. This serves for the collection of any gas required for chemical examination.

Apparatus for Cultivating Anaerobic Bacteria.§—Dr. S. Epstein describes an apparatus which he has used with success for a considerable period. As shown in the illustration (fig. 19), it consists of an Erlenmayer's flask A closed by a perforated rubber plug B. Into the perforation is inserted a glass tube expanded above at G and provided with a Bunsen's air-valve L. On the expanded portion of G rests a bell-jar T. The flask is filled with the medium, and the latter inoculated. The rubber plug is then pushed home. This causes the medium to rise in the tube as far as the valve. The air-valve L is made out of a piece of caoutchouc tubing by snipping it at V with scissors and thus forming an angular (<) valve. The bell-jar is filled with a 2 per cent. boric acid solution, so that the valve lies below the level of the fluid. The gases from the

* London, P. Lund Humphries & Co., Limited, 1898.

† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 267–70 (1 fig.).

§ Tom. cit., pp. 266–7 (1 fig.).

culture escape unhindered, but if necessary may be collected by inverting over the valve a eudiometer E filled with the boric acid solution.

Fig. 18.

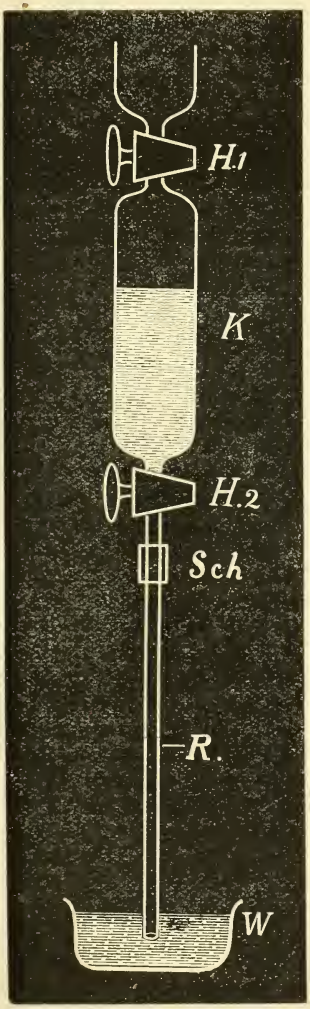
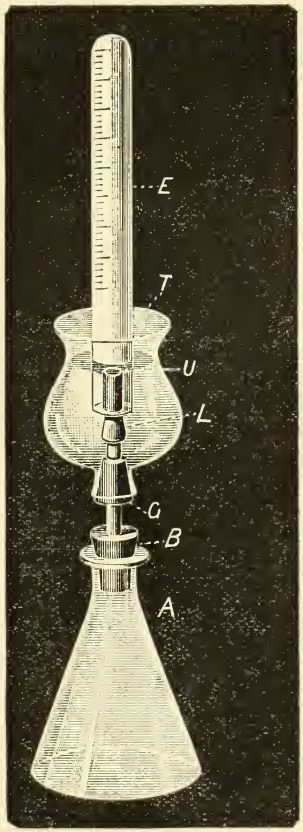


Fig. 19.



Pure Cultures of Amœbæ.*—M. J. Tsujitani has been able to obtain pure cultures of amœbæ on substrata containing bacterial products and dead bacteria. Three varieties of *Amœba lobosa* were used, and were cultivated in company with bacteria in the usual manner. The most convenient bacterium was the cholera bacillus. From these mixed cultures amœba cysts were obtained by dipping silk threads therein and

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 666–70.

then drying the threads in a sulphuric acid exsiccator. This killed off the cholera bacilli, leaving only living amœbæ in the cyst form. These cysts, when inoculated on gelatin or agar substrata, developed, but did not multiply. But by inoculating the cysts on a medium in which bacteria had been bred, they grew and multiplied, although they did not, as a rule, thrive quite so well as when living bacteria were present. With a bacillus isolated from hay, however, the results were practically as good as when the cultures contained living bacteria. The medium used was composed of 1–1·5 grm. agar, 20 grm. bouillon, and 80 grm. water; its reaction was alkaline. The medium was heated to 60°–70° to kill off the bacteria, and then used for the amœba cultures.

Cultivating Pleurococcus vulgaris.*—Herr M. W. Beijerinck cultivates *Pleurococcus vulgaris* in the following medium. Agar is soaked in distilled water until all the soluble organic bodies are dissolved out, and 2 per cent. thereof is added to the following mixture:—distilled water, 100 parts; ammonium nitrate, 0·05; potassium phosphate, 0·02; magnesium sulphate, 0·02; calcium chloride, 0·01. Over plates composed of the foregoing mixture is poured some of the material rubbed up in water. The material is derived from the green deposit on trees, roofs, walls, and hedges. The superfluous water having been poured off, the plate, carefully protected from dust, is placed in a window with a southern aspect. The green colonies show up in about three weeks. The author's first successful cultures were made in the winter of 1896, since which he has kept perfectly pure cultures, and these have remained constant and monomorphic.

(2) Preparing Objects.

Application of Engelmann's Method to the Examination of Animal Tissues.†—As long ago as 1881, Engelmann adopted a method which was capable of demonstrating the presence of very small quantities of oxygen. The reagents were putrefaction-bacteria, and the material green alga cells. A drop of the water was placed on a slide, a few alga cells were added, and then a cover-glass was put on. In a short time crowds of lively bacteria were found close about the alga cells. The addition of blood, muscle, &c., showed that the liveliness of the movements and the massing of the bacteria were dependent in the first place on the quantity of oxygen disposable for respiration, and in the second place, when this is copiously present, on the nature of the added nutrient material. Herr A. Exner has applied Engelmann's method to the examination of blood, voluntary muscle, heart muscle, fat, liver, thyroid, frog's ovary, spleen, cartilage, brain and spinal cord, nerve and retina, all of which gave a positive reaction; while bone, lung, skin, gastric mucosa, kidney, sub-maxillary gland of cat, pancreas and ovary of rabbit, were negative. The bacteria used were *Bac. fluorescens liquefaciens* and *B. aquatilis communis*.

Impromptu Method of making a simple Freezing Apparatus.‡—Mr. H. E. Durham gives the following prescription for extemporising a refrigerator for bacteriological purposes.

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 785–7.
† Sitzber. k. Akad. Wiss. Wien, cvi. (1897) pp. 58–65.
‡ Brit. Med. Journ., 1898, ii. p. 1801.

Take a moderately large tin, such as a biscuit tin, and a wooden box of sufficient size to give 3 or 4 inches clear space in every direction when the tin is placed within it. Put a layer of sawdust 3 or 4 inches deep at the bottom; stand the tin upon this, and fill the surrounding space with sawdust also. The various organs, after being removed with as much cleanliness as possible, are each wrapped in a clean cloth wetted (not wringing wet) with 1–500 $HgCl_2$, and further wrapped and sealed each separately in a piece of gutta-percha tissue (most easily done with a trace of chloroform); they are then put into one or more watertight tins (those 1/4 or 1/2 lb. tins in which some tobacco is sent out are admirable; they may be more securely closed by means of a paraffin candle and a warm poker). The tobacco tins are placed within the larger tin, together with pounded ice and common salt, in the proportion of 3 lbs. of ice to 1 lb. of salt. The lid is placed on the larger tin, and the wooden outer box filled up with sawdust. An apparatus which holds the above quantities of ice and salt will keep about 1/2 pint hard frozen for more than twenty-four hours. There can be no difficulty in obtaining these materials at a moment's notice. The maintenance of objects at a low temperature when bacteriological examination cannot be carried out completely on the spot, is essential for satisfactory results to accrue.

Demonstrating the Coccidia of Cuttle-fish.*—The specimens used by M. M. Siedlecki were obtained from the Gulf of Naples, and all the animals examined were found to be more or less infected. The parasites, localised in the digestive apparatus, are recognisable by the naked eye as white opaque spots in the posterior part of the intestine. Observations were made on fresh and also on fixed and stained specimens.

Fresh specimens were placed on cover-glasses the corners of which had been slightly melted in the flame of a Bunsen's burner. In this way the cover was supported on four footlets, and crushing of the preparations avoided. The specimen was immersed in sea-water or in intestinal juice, was broken up as little as possible, and then placed on a slide for examination.

Stained preparations were made from teased-out pieces and from sections, the former giving the best results. A piece of intestinal mucosa and submucosa, from 5 to 10 mm. square, was placed on a cover-glass, teased out in sea-water or in intestinal juice, and carefully spread over the whole surface of the cover. The cover was then placed film side down on the surface of the fixative solution. In this way the layer is at once fixed, and also caused to adhere to the cover. If the fluid (sea-water or juice) be in excess, the adhesion of the film will be imperfect, and some of the preparation will drop off; while if the film be allowed to dry before being fixed, the structure of the Coccidia is profoundly altered or destroyed.

The best fixative is a saturated solution of sublimate in sea-water to every 100 ccm. of which 3 to 5 drops of glacial acetic acid have been added; Flemming's and Hermann's fluids also gave good results. After fixation the films are washed in water, next in alcohols of increasing strength (30°, 50°, 70°, 96°, 100°), and then the preparations are ready for staining. The time required for immersion in the fixative is from

* Ann. Inst. Pasteur, xii. (1898) pp. 801–3 (3 pls.).

30 minutes to 1 hour; in the alcohols, 10 to 30 minutes, except in the absolute, which is 30 minutes to 1 hour. After the absolute alcohol the preparations are returned to 50° spirit.

For staining, Böhmer's hæmatoxylin was used. The preparations were immersed in a very dilute solution for 12–24 hours, and afterwards differentiated in 50° spirit faintly acidulated with hydrochloric acid. This treatment turns the colour red, but the blue hue is restored by washing in faintly ammoniacal 50° spirit.

For certain details Heidenhain's iron-alum hæmatoxylin is useful. The preparation may be contrast stained with eosin or with eosin and orange G. The preparations should remain in very weak solutions for 3–12 hours. For pieces which have been treated with Flemming's fluid, safranin is recommended.

Lactic Acid in Botanical Microtechnique.*—Though lactic acid was introduced into botanical microtechnique quite ten years ago, says Herr F. Krasser, it has been but little employed. In the hot condition it was used as a solvent, in the cold as a fixative. With glycerin lactic acid has certain properties in common; it is of syrupy consistence, it is as clear as water, it is miscible with water and alcohol, it forms soluble salts, and has the property of extracting water. On the other hand, while it is miscible with ether, glycerin is not. It penetrates vegetable tissues more quickly than glycerin. Both are clarifying, and in both chloral hydrate can be dissolved for raising the refractive indices. At ordinary temperatures lactic acid causes but little swelling of vegetable membranes and starch-granules; hence it is more suitable than glycerin and lactophenol for observing and preparing starch-granules and amylaceous tissue. Next to starch it is of service for examining different kinds of flour. A small mass of flour may be mixed with acid and examined directly, or the mass may be placed between cover-glass and slide and the acid allowed to run in. Tissues which contain aleuron-grains as well as starch can be equally well examined and preserved in lactic acid. For tissues containing fat and a pigment it does not appear to be suitable.

The chief value of lactic acid in microtechnique is as an observing reagent and preservative medium for starch, amylaceous tissue, and flour.

Cover-glass Preparations of Amœbæ.†—In order to obtain good preparations of amœba, M. J. Tsujitani uses the following method. A droplet of distilled water is placed on a cover-glass, then a small quantity of an amœba culture, and lastly a loopful of a saturated solution of hydrochlorate of quinine. After they have been mixed and spread out, the layer is allowed to dry in the air, and is then fixed in the alcohol-ether mixture. The preparation is stained with methylen-blue.

Decolorising Algæ.‡—Dr. H. C. Sorby has found that diluted formalin has a powerful action on the colouring matter of algæ, and has succeeded in so reducing the colour of some very dark spines as to be

* Zeitschr. d. allgem. österreich. Apotheker-Vereins, lii. (1898) No. 21. See Bot. Centralbl., lxxvii. (1898) pp. 89-90.

† Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) p. 670.

‡ 'Floreamus' (Sheffield), 1898, No. 4, p. 68.

able to prepare lantern slides which show the natural beautiful colouring and not mere dark shadows.

Preserving Medulla oblongata of Rabid Animals.* — Dr. E. J. Frantzius has found that for the experimental detection of rabies, it is sufficient to expose the spinal marrow of the suspected animal, and, having removed a piece from the medulla oblongata, to place this in a bottle filled with either glycerin or sterile water. When properly corked and packed in a wooden case, it is ready for transportation. All other precautions are unnecessary. Pieces of the central nervous system of rabid animals treated in this way retain the virus so effectively that animals may be successfully inoculated after several weeks' immersion. The instance of a brain immersed in glycerin remaining virulent on the 152nd day is quoted.

Detection of Blepharoplasts in Onoclea and Marsilia.†—Sections of *Onoclea Struthiopteris* in paraffin prepared a year beforehand, fixed by 1 per cent. chromic acid, and stained with cochineal-alum and Bismarck brown, were washed in xylol, absolute alcohol, and water, placed in 1 per cent. chromic acid for 24 hours, and then stained by Flemming's safranin-gentian-violet-orange preparation. Sections prepared in this way by Mr. W. R. Shaw, displayed an excellent distinction between cytoplasm and nucleus in the antherozoids which had collected in the mucilage before the open archegones. Male and female prothallia of *Marsilia vestita* and *quadrifolia* were treated in the same way with great success.

Killing and Preserving Marine Animals.‡—Dr. H. C. Sorby finds that by adding a small quantity of menthol to the sea-water in which marine animals are kept, they fully expand themselves, and finally die in a distended condition, and can be so preserved permanently in a 4 per cent. solution of formalin. In this manner he has preserved *Synapta* in its natural form and several species of sea-anemones beautifully distended. The author has also more fully developed a method of killing some animals with diluted glycerin, which is afterwards removed by water, and has thus been able to mount sundry worms in Canada balsam, so as to preserve even the minute blood-vessels filled with the natural red blood.

Technique of the Tuberculous Serum Reaction.§—For obtaining homogeneous cultures of tubercle bacilli suitable for demonstrating the agglutination phenomenon, MM. S. Arloing and P. Courmont recommend beef or veal bouillon with 1 per cent. peptone and 6 per cent. glycerin. The cultivation-flasks should be flat-bottomed, and the cultures should be frequently shaken. Cultivations from 8 to 12 days old are the most favourable for the reaction.

For observing the agglutination phenomenon satisfactorily, it is necessary to use blood-serum only. The serum is obtained by means of special tubes, or by centrifuging if there be no clot in the tubes. With each serum three mixtures of different strengths are prepared,

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 971–4.
† Ber. Deutsch. Bot. Gesell., xvi. (1898) p. 178.
‡ 'Floreamus' (Sheffield), 1898, No. 4, p. 68.
§ Comptes Rendus, cxxvii. (1898) pp. 312–5, 425–8.

1/5, 1/10, 1/20, i.e. one drop of serum to five of culture, and so on. The tubes are examined after 2, 10, and 24 hours. The effect may be observed with the naked eye or through the Microscope. In the former case there is a deposit, the rest of the fluid being clear. Microscopical examination is used for control.

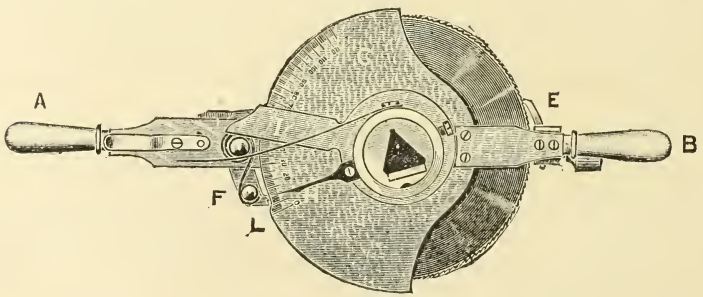
The clinical value of the reaction, as tested on tuberculous and non-tuberculous persons, is reported as follows. Of the tuberculous cases, 95 per cent. gave the reaction. In the non-tuberculous cases, composed of (*a*) persons suffering from diseases other than tuberculosis, and (*b*) of presumably healthy persons, positive results were also obtained. In group (*a*) 33 per cent. were positive, and in group (*b*) over 50 per cent. The inference drawn by the authors from these latter results is that they were evidence of latent tuberculosis.

While admitting the difficulty of the technique, the authors are very confident as to the value, from a clinical point of view, of the tuberculous serum reaction as an aid to the diagnosis of tuberculosis, especially in its earlier stages.

(3) Cutting, including Imbedding and Microtomes.

Minot's Automatic Precision Microtome.—The feed arrangement of this machine, as made by Messrs. Bausch and Lomb, is shown in fig. 20. It consists of a micrometer-screw, having pitch of 0·5 mm., which elevates the object-holder. The motion of the screw is transmitted to the object-holder through a triangular bar moving smoothly but firmly in a triangular channel, all lateral motion being eliminated by means of a wedge. The micrometer screw is provided at its lower extremity with two metal discs in contact, each having one hundred serrations, the acute angles of the upper disc pointing to the right, and

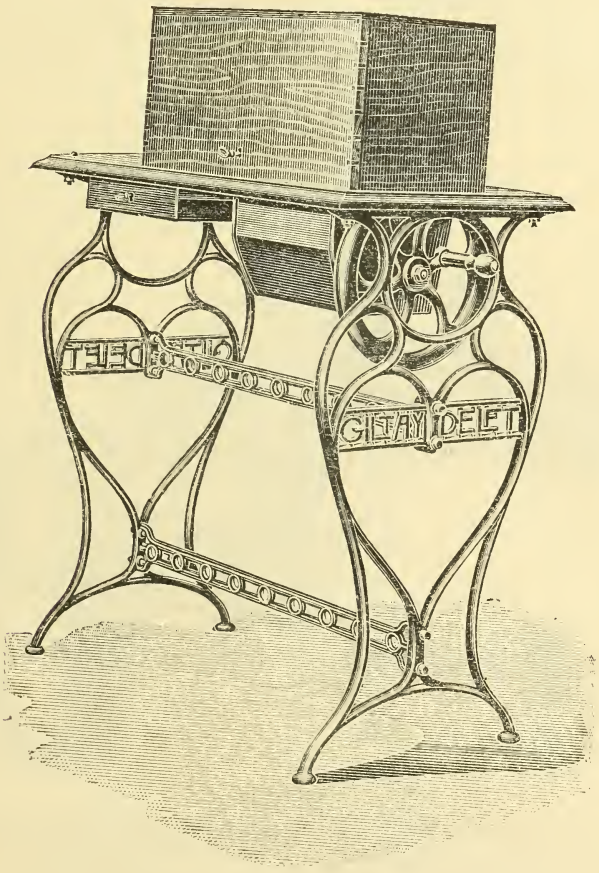
Fig. 20.



those of the lower to the left. The discs are revolved by means of the lever A, which is pivoted loosely on the axis of the micrometer-screw and provided with a pawl F. F is actuated by the small lever shown on the upper surface of A, so that when the actuating lever is thrown to the left, F engages the teeth of the upper disc, and motion of A to the right elevates the object. The spring ratchet E prevents any backward motion of the screw-head, and may be disengaged by means of the

thumb-screw shown. After the screw has been fed up to its greatest extent, it is quickly returned by bringing the actuating lever to the right, when a small pawl (not shown in figure because beneath the lever) engages the teeth of the lower disc, and motion of A to the left depresses the object-carrier. The amount of elevation of the object is controlled in an entirely automatic manner. The stop I is a rigid attachment, and is provided with an index H. C is a graduated disc,

Fig. 21.



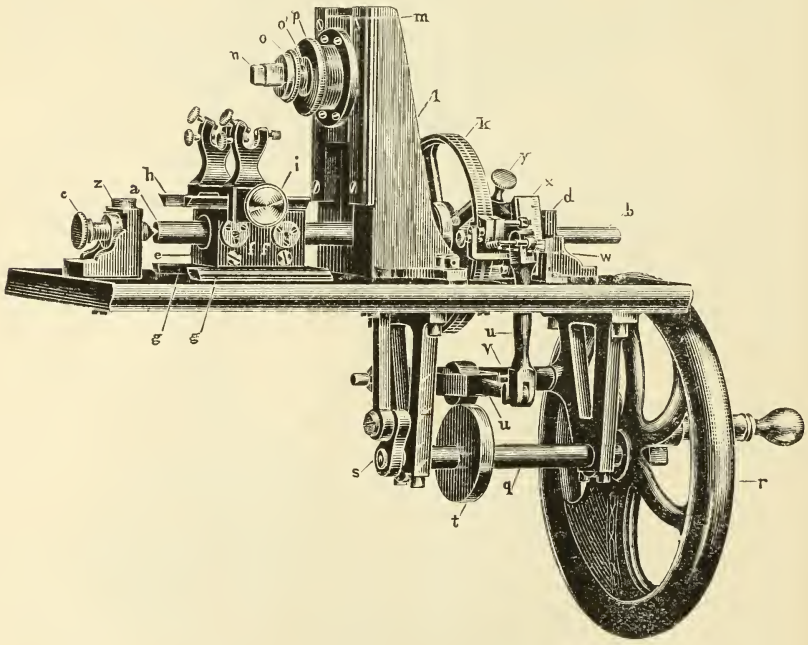
pivoted around the axis of the feed, and movable by means of the lever B. Two of the graduations on C correspond to one of the notches on the disc of the micrometer-screw.

Beginning at zero of the scale, the circumference of C has an inclined plane for the following purpose; the disc C being set so that the number indicating the desired thickness of section is opposite the index, the stop-post of A is held against the stationary stop I by the

long spiral spring; F engages a tooth of the upper disc. If now the lever A is moved to the right, F will continue to engage the tooth of the disc until the guide-post L comes in contact with the inclined plane on the margin of C, when the pawl F will be disengaged from the tooth of the disc exactly at the zero point of the scale. It will thus be seen that, no matter how far A may be moved, F will act only through a certain definite distance, governed by the position of the inclined plane of C, and that the amount of elevation of the object at each cut is definitely indicated by the position of the pointer H on the scale.

Some Improvements in the Reinhold-Giltay Microtome.*—A description of this instrument has already appeared in the Society's Journal,† and Dr. J. W. Moll now describes some improvements.

Fig. 22.



(1) The wooden *table* bearing the instrument is now replaced by one of cast iron, designed by Messrs. Gips, instructors at the Delft Polytechnic (fig. 21).

(2) *The reading-off apparatus.*—Fig. 22 shows the old form of the instrument, and will facilitate comprehension of the changes. By loosening the screw, the segment *x* can be adjusted so that at each stroke of the wheel K, 1 to 40 teeth can be rotated. The number of mikrons corresponding to the teeth is given by the indicator on the segment. The divisions of the segment are marked on its upper nickelled surface, and

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 23–9 (4 figs.).
† Cf. this Journal, 1893, pp. 706–11.

are therefore somewhat hard to see. Moreover the segment is too small, and the division lines therefore too close; and one has to bring one's head almost to the horizontal plane of the table. These inconveniences are remedied by the application of a different and larger segment. The

FIG. 23.

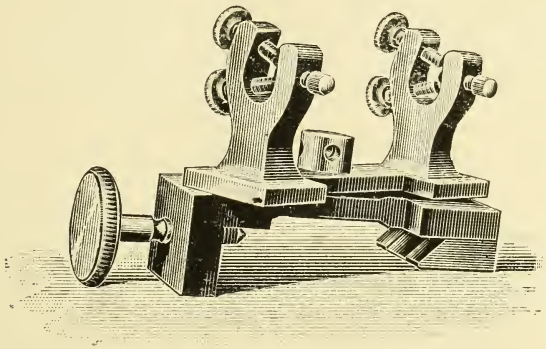
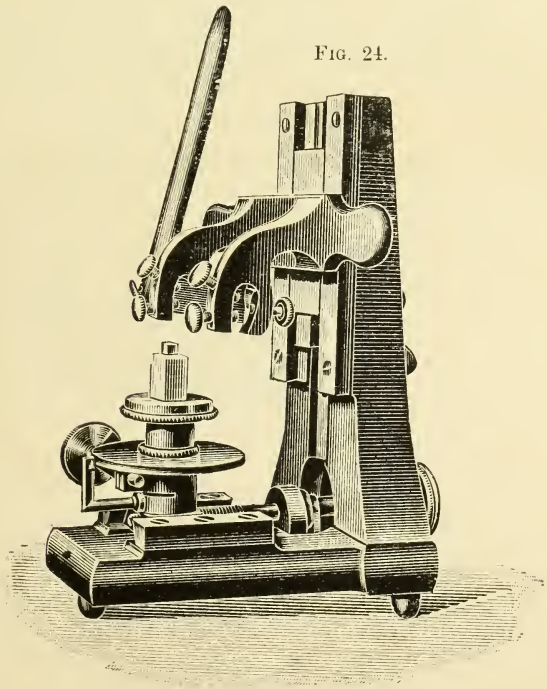


FIG. 24.



divided surface of the new segment is placed vertically, and is $1\frac{1}{2}$ times greater than before. Instead of on a shining metallic surface, the division lines are now marked in black on a white celluloid strip.

(3) *A knife-carrier rotatory about a vertical axis.*—The original in-

strument allowed only a backward and forward movement. The nature of the improvement is shown in fig. 23.

(4) *A shaping apparatus.*—It is very convenient to possess an apparatus capable of cutting the paraffin blocks into true rectangular forms; at the very least the opposite faces should be accurately parallel to the knife-blade. Fig. 24 shows this piece of auxiliary apparatus. The knife-holder slides in the swallow-tailed grooves of the vertical part of the cast-iron stand. Behind the runners of the knife-carrier is a vertical column space, which makes it possible to fix a square plug by means of a winged nut just visible on the right of the figure. As the knife-slide in sinking strikes on this plug, the extent of its fall can be accordingly regulated.

The horizontal slide for the paraffin block moves in swallow-tailed grooves, and is regulated by a milled head as shown. The cylindrical metal piece on which the paraffin saucer is fastened is a broad rotatory clamp-ring divided into quadrants; and this clamp-disc is rotatory on a second clamp-disc firmly secured to the slide; the adjacent milled head fastens both discs together, whereby the paraffin saucer is made fast. When one side of the paraffin block has been shaped, the quadrant disc is released, rotated 90°, and again fixed; thus a second side is shaped, and so on. For shaping the block an ordinary razor is used, but too broad a one should not be chosen, as a feather-edged blade breaks the block. It is best to incline the knife about 5° to the vertical. For this purpose a copper right-angled triangular plate is added to control the fixing of the knife.

(4) Staining and Injecting.

Staining the Capsules of Pneumococcus and of the Bacillus of Friedlaender.*—Mr. A. MacConkey recommends the following solution for staining bacterial capsules; the combination gives a clear image which photographs well. Dahlia 0·5 grm.; methyl-green (00 crystal) 1·5 grm.; saturated alcoholic solution of fuchsin 10 ccm.; distilled water to 200 ccm. The dahlia and methyl-green are rubbed up in a mortar with part of the water until dissolved, then the fuchsin is added, and finally the rest of the water.

Staining.—Prepare the film in the usual way. Flood the cover-slip with the stain, and hold over the flame until steam begins to arise. Then place aside for about five minutes, wash in water, dry, and mount in balsam. If the film be treated with acetic acid before staining, the result is not so good.

The solution is also a good general stain, especially for the Klebs-Loeffler bacillus and for *Bac. typhosus* and *Bac. coli communis.*

Permanent Stain for Starch.†—A very good and durable stain for starch may be obtained, says Mr. J. H. Schaffner, by the use of anilin-safranin and gentian-violet. (1) Anilin-safranin solution is prepared by mixing equal parts of anilin water and saturated alcoholic solution of safranin. (2) Two per cent. aqueous solution of gentian-violet.

Stain for 2–4 hours in the safranin, and from 2–8 minutes in the gentian-violet. The slides should be taken through the alcohols quickly. The stain is a purplish-red, and the cells look filled with the coloured starch-grains.

* Lancet, 1898, ii. p. 1262. † Journ. Applied Microscopy, i. (1898) p. 181.

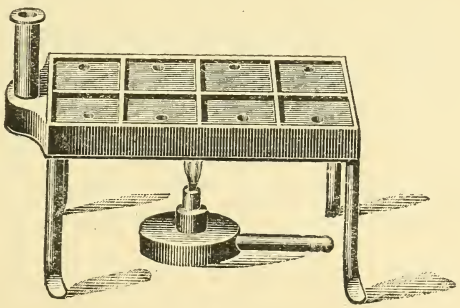
New Test for Cellulose.*—The ordinary reagents for cellulose may be divided into three groups:—(1) Iodine reagents. (2) Pigments such as orsellin B B, which stain in acid solution. (3) Pigments such as Congo, benzo-purpurin, brilliant-azurin, which require an alkaline reaction.

Instead of these, Sig. A. Cutolo recommends hydriodic acid of 0·45–0·60 Bé. to be used in the following way. The specimen to be examined, moistened with water or alcohol, is to be placed on a slide, and the excess of fluid removed by filter-paper. A few drops of the acid are then added and afterwards washed off. The preparation may now be examined; but if permanent staining be desired, it is advisable to add beforehand a few drops of iodised calcium chloride solution. If the latter be strong, the membranes assume a violet hue; if weak, a blue.

Staining Gonococcus.†—Dr. M. Weinrich advises staining *Gonococcus* by the following method, which is really Gram plus Bismarck brown. The fixed dried preparation is treated with Ehrlich's anilin-gentian-violet solution, or with Fraenkel's phenol-gentian-violet solution, for 1–3 minutes. It is then immersed in Lugol's iodo-potassic iodide solution for 1–3 minutes, after which it is decolorised in perfectly absolute alcohol. The alcohol must contain some crystals of cuprum sulph. exsicc. The last step takes from 1–1½ minutes. So far, no water is used; but when the Gram's staining is finished, the preparation should be washed in water, and contrast stained for 2–3 minutes in the following solution of Bismarck brown:—Hot distilled water 70; Bismarck brown 3·0; 96 per cent. alcohol 30; then filter. The *Gonococci* are stained brown and other bacteria violet.

Hot Staining Bath.‡—Herr Piorkowski has devised an apparatus for staining preparations with hot solutions. It consists of a quad-

Fig. 25.



rangular water-bath, the top of which is divided into square compartments for the reception of the staining fluids (see fig. 25).

A number of preparations may be treated at the same time. The chimney serves both for filling the bath and for the escape of the steam.

* 'L'Orosi,' 1897, p. 303. See Zeitschr. f. angew. Mikr., iv. (1898) p. 205.

† Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 258–65.

‡ Deutsch. med. Wochenschr., 1898, No. 20. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 902–3 (1 fig.).

The apparatus will be found extremely useful for staining tubercle bacilli, spores, and flagella.

Staining the Malaria Parasite.* — Dr. Nocht states that neutral polychrome methylen-blue makes an effective addition to the ordinary double stain of eosin and methylen-blue for the malaria parasite. The staining solution is made by mixing 1 ccm. of neutral polychrome methylen-blue with an equal quantity of water, and then dropping in saturated aqueous solution of methylen-blue, until the solution is of a dark-blue colour. In a second capsule are mixed 3–4 drops of a 1 per cent. aqueous solution of eosin, and 1–2 ccm. of water. To the latter the methylen-blue mixture is added drop by drop until the eosin solution has become quite dark blue.

Method for Double Staining Flagellata, Fungi, and Bacteria.†— Dr. H. Ziemann finds that a satisfactory double staining can be effected in 20–40 minutes by using 1 part of 1 per cent. methylen-blue solution (Höchst) mixed with 5 to 6 parts of a 0·1 per cent. eosin solution (eosin A G or B A Höchst). By adding borax to the methylen-blue solution, the staining becomes more effective and rapid. Four different solutions are enumerated. (1) 1 part methylen-blue, 1 part borax, and 100 water; (2) 2 parts borax; (3) 2·5 parts borax; (4) 4 parts borax. The first of these behaves very much in the same way as the solution without borax; but the last three, when mixed with 4 parts of 0·1 per cent. eosin solution, impart a satisfactory staining in 5 minutes. If the preparations become overstained with blue, this can be easily reduced by means of 0·1 eosin solution.

(5) Mounting, including Slides, Preservative Fluids, &c.

Micro-Cements for Fluid Cells.‡—In a note on this subject Mr. C. F. Rousselet, after mentioning the difficulty he has found in permanently sealing micro-cells containing a watery fluid, recommends the closing of cells containing dilute formalin as the preservative fluid; first with a coat of cement made by mixing two-thirds of dammar in benzol and one-third of best gold size; then three or four coats of gold size (pure); and finally a coat of Ward's brown cement. Clark's spirit-proof cement, previously recommended, has failed to prevent the evaporation of watery fluid, while for spirit mounts it as good as ever.

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 839-43.
† Tom. cit., pp. 945-55 (1 pl.).
‡ Journ. Quekett Micr. Club, vii. (1898) pp. 93-7.

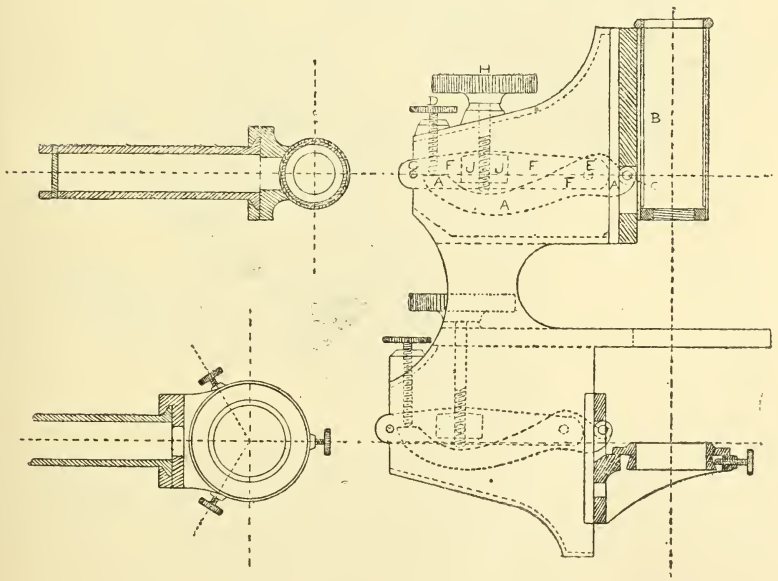
IV.—*A Microscope with New Focussing Mechanism.*

Designed by Keith Lucas.

(*Read 21st December*, 1898.)

The instrument of which a representation is given in figs. 27, 28, was constructed primarily with a view to steadiness and rigidity. It was partly for this object that a system of focussing the body-tube and substage was adopted, which effected both coarse and fine adjustments in each case by means of a single planed slide. It will be seen that the consequent reduction of planing is likely to affect also the cost of production of the instrument.

Fig. 27.



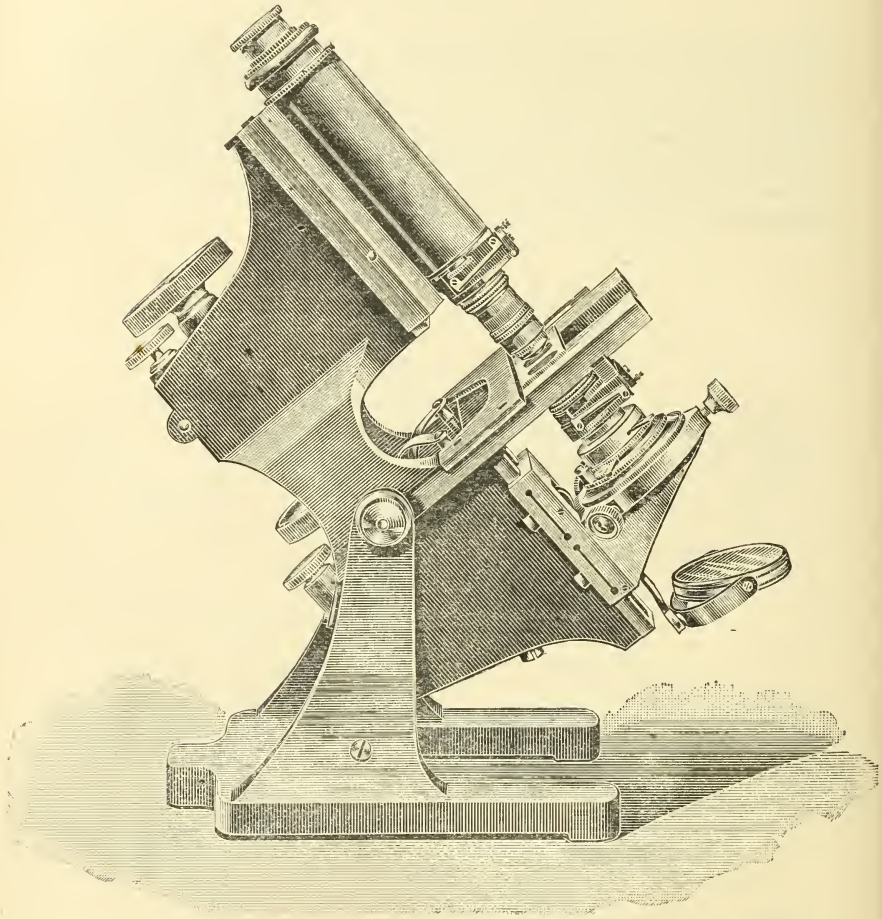
¼ Full Size.

The novelty of the instrument consists essentially in the mechanical arrangement of the coarse adjustments of the body-tube and substage.

The fine adjustment is effected in the way common to many modern instruments. A lever A (fig. 27), contained in the main casting or "limb," engages at one end C with the body-tube B, while the other end is controlled by a micrometer screw D. The fulcrum E

is situated comparatively near to the body-tube, the motion of the micrometer screw being thus reduced. The coarse adjustment is effected by raising and lowering the fulcrum of the fine adjustment lever. This is done by a second lever F, whose fulcrum G lies beyond that end of the fine adjustment lever furthest removed from

Fig. 28.



the body-tube. This coarse adjustment lever is controlled by a screw H working into a nut J placed one-third of the lever's length from its fulcrum. In this way the motion of the coarse adjustment screw is imparted in an increased form to the fine adjustment lever. Since then the motions of both coarse and fine adjustment screws are imparted ultimately to the end C of the fine adjustment lever which

engages the body-tube, it is evident that the body-tube requires only one planed slide for both adjustments. In order to render the levers more compact, the coarse adjustment lever is made of two separate plates, between which the fine adjustment lever lies. A spring, not shown in the drawing, keeps the body-tube firmly pressed against the end of the lever C.

The milled heads controlling both adjustments lie close together at the back of the instrument, in a convenient position for the hand. To give clearance for the milled head of the substage coarse adjustment, the limb is divided into two parts from the stage upwards for a distance of about two inches. This arrangement is found also to give the stage greater rigidity relatively to the limb.

It is a noteworthy feature of the instrument that all the milled heads controlling the body-tube and substage have their bearings in the main casting; consequently the pressure of the hand on the heads cannot affect the adjustment of focus. This offers an obvious advantage over the ordinary Jackson model with rack-and-pinion; for in the latter the milled heads of the coarse adjustment are almost invariably carried by the fine adjustment slide.

The description of the focussing arrangements of the body-tube applies throughout equally well to those of the substage. The motions are precisely similar, the levers being in fact interchangeable. To ensure rigidity, the limb, stage, and tail-piece are made in one casting.

In the first experimental instrument made, the fulcrum of the fine adjustment lever was raised directly by a screw, without the interposition of a second lever. This arrangement, though perhaps simpler, was abandoned in the instrument shown before the Society, since it was found not to give a sufficiently fast motion to the coarse adjustment. In the instrument shown, five revolutions of the coarse adjustment head, or two hundred and eighty of the fine, move the body-tube through an inch. The range of motion of the coarse adjustment is an inch and a half, that of the fine an eighth of an inch. Since the motion is limited only by the compressibility of the spring used, and not by the levers themselves, a larger range could probably be obtained without difficulty, were it considered necessary. The levers, independently of the spring, would admit of a motion of two inches and a half. The range at present obtained is, however, found sufficient for all work with ordinary objectives.

Other details of the instrument, such as the foot, the stage, and substage, are more or less of ordinary patterns, and call for no special comment.

NOTES.

[Under the head of Notes, it is intended in future to publish in the *Journal*, at the discretion of the Editor and Publication Committee, any brief and original communications that may be presented to the Society by our Fellows on the Construction of the Microscope, Microscopic Optics, subsidiary Microscopic Apparatus, and kindred subjects.—Editor.]

Notes on Colour-Illumination, with Special Reference to the Choice of Suitable Colours.

By Mr. Julius Rheinberg.

(*Read* 15*th February*, 1899.)

"In the exhibition of objects in multiple colour-illumination before you this evening, I have endeavoured to keep two ends in view. The first was to have as varied a selection of colour-discs as possible; the second, to show as varied a set of objects as possible. The latter seemed to me the more important, and you will find on the tables specimens of physiological and botanical subjects, crystals, fibres, fabrics, insect structures, diatoms, living rotifers, &c., shown by the three different systems.

"The last time I had the honour of bringing colour-illumination before your notice, only two methods were available; but since that time I have come across a third, which, to distinguish it from the high-power or diffraction method and the low-power or refraction method, may be conveniently termed the composition method; it is equally applicable to all powers, and there is no restriction to the cone of light used, as in the first-named methods. It consists of the employment of a disc in the condenser, having preferably a red centre and a green rim, which, when the quantity of green is correctly adjusted by means of the iris-diaphragm to the quantity of red of the central spot, together form white light, so that, without an object in the field, the latter appears practically white. When an object is in the field, though the background is white, the different parts of the object itself do not catch the red and green light in the right proportion to form white light, and the object itself appears coloured, edges and prominent parts coming out in the green colour of the oblique green light thrown upon them, whilst small perforations and other less prominent parts which do not catch the more oblique light to the same extent, appear in red.

"The reason a green disc with red centre is most suitable for this method of illuminating, is because the intensity of coloured rays entering the eye appears to vary with their obliquity. As the red part of the spectrum affects the eye so much more strongly than

the other part, the red part of the disc needs to have given to it the special opportunity of affecting the eye in the strongest possible way; therefore the central portion of the disc must be assigned to this colour. *Vice versâ* I have not been able to obtain satisfactory results.

"I may here be permitted to say a few words as to the colours which I have found most suitable for discs for the other kinds of illumination.

"As regards the low-power method, it is essential for good results to keep the central portion of the disc of a colour not too luminous. On this account blue and green are preferable to red, and the most generally useful disc appears to be a malachite-green spot, an "Oxford" blue spot, and an olive-green. If a red ground is used, care must be taken to lessen its brilliancy by narrowing the band of the spectrum which it passes. This can be done by superposing a green; as almost all greens will, curiously enough, be found to transmit a certain range of rays in the red portion of the spectrum. It will be found in general to be a much more convenient way of getting at a good colour for central spots, to superpose different colours, and get at the result by subtraction as it were, than by adding two or three layers of the same colour. For the peripheral portion of those discs in which two colours are employed, red or orange will be found most useful, though almost any colour, no matter whether a pure or a mixed spectrum colour, will do, so long as it is sufficiently luminous relatively to the central spot.

"As regards the choice of discs, it will be found that opaque and thick sections are better seen when a disc is used having both rim and centre coloured; in fact there is a striking difference in the clearness of such objects as seen with a double coloured disc compared with their appearance when discs with centre coloured only are used. On the other hand, the latter kind of disc is usually preferable for diatoms and thin sections.

"Now, with regard to the preparation of discs for use above the objective in the high-power or diffraction method, the colours used for the central spot should not be too dark. It is essential for the most perfect performance of the disc that its central spot should allow a certain range of colours to pass through it common to the peripheral portion. By this means the untoward diffraction effects seen when the dioptric rays are stopped out with a black spot, are evaded and avoided. A light blue or a light green, which, as is well known, usually pass a wide range of the other colours of the spectrum, are to be most recommended for the central spot; a red should only be employed in the centre, when the peripheral portion of the disc is left uncoloured.

"With regard to the choice of discs for viewing particular objects, those with a red periphery, having the centre either coloured light blue or left uncoloured, are most suitable for relatively opaque and thick sections, whilst discs with a blue rim are best where it is a case

of wanting to see the finest structure; the reason for this being, of course, that the blue rays diffracted from very fine structure may be just grasped by the objective, whilst the corresponding red ones may be just outside its cone.

"In some previous papers I have mentioned that discs for use above the objective might be made by cementing two cover-glasses together by Canada balsam, filmed surface inwards. Further trials have shown, however, that such discs are inferior in use to single cover-glasses covered with collodion, for anything higher than 1/3 in. objective, because the thickness of the double glass affects the correction of the lens too much, even when fitted with correction collar. With a thin single glass, the corrections are not appreciably disturbed, and can be compensated for entirely by the correction collar and tube-length.

"Reverting now to the employment of colour-discs in the condenser, I should like to show you my latest illuminator (fig. 29). You will observe it consists of a box, open at the ends, fitted under the condenser, in which there are a number of metal carriers, which can be pulled out or pushed in quite independently of one another by means of little handles. So that they may slide freely, each carrier is separated from the next by a sheet of celluloid. Each carrier has two circular apertures, the one being fitted with a colour-disc or other stop, the other one being left free. The kind of stop is indicated on the handle. The openings in the carriers are so arranged that when the apparatus is closed all the free openings coincide, so that illumination can be effected in the ordinary way. When any other illumination is required, it is only necessary to pull out the particular stop or combination of stops, each stop being in accurate position when pulled out as far as it will go. The special thing about the particular illuminator I have here, is that the edges of the carriers are turned over, so that the gelatin or other stop can be slid into them freely, and therefore easily centered.

"Though the illuminator is bulky in the hand, it packs away under the stage of the Microscope, so as to be out of the way, and in use it is very convenient for rapidly comparing the effects of different stops.

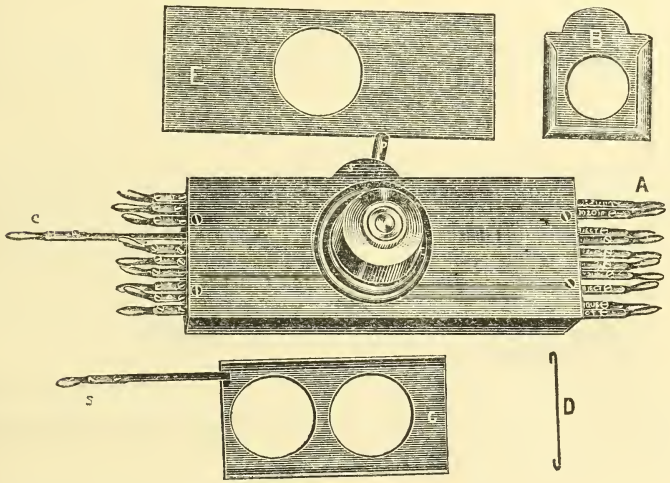
"A good *large* source of light is the best when low-power or the composition method of illumination is resorted to. This may be obtained by using the bull's-eye in the usual way, or by placing a piece of ground glass immediately in front of the luminant, and dispensing with the bull's-eye. Personally I always use a Welsbach light, with a piece of ground glass just in front. In this way the source of light, besides having considerable extent, is a truly plane surface, and this I think is a great advantage over any source of light of irregular shape such as a lamp flame. Indeed, if I may say so, I believe insufficient attention has been given to using a plane surface of light in general microscopic work; which is curious enough, con-

sidering the attention given to the aplanatism of condensers. Surely the one demands the other.

"I have, in conclusion, only to add that we are indebted to Messrs. W. Watson and Sons and R. and J. Beck, Ltd., for the loan of the Microscopes displayed this evening, whilst a number of the slides are from the collection of the Society.

"To most of the cards at the sides of the Microscopes, a colour-disc is attached, exactly the same as the one employed in the instrument; and by holding the cards against the light, the colours can be examined."

Fig. 29.



A, Colour illuminator, with Abbe 1·4 N.A. condenser, seen from top, showing one carrier, *c*, pulled out; *p*, pointer of iris diaphragm; *s*, projecting part of a special carrier B, which can be pulled out altogether, and any kind of stop inserted as required.

C, One of the metal carriers, top view; *s*, screws for affixing little metal plate or coloured piece of gelatin, indicating kind of stop.

D, Cross section of metal carrier.

E, One of the sheets of celluloid separating the carriers.

Stops on left-hand side.

1. Matt ground celluloid spot.
2. Black central spot.
3. Blue „ „
4. Red „ „
5. Green „ „
6. Red spot, green periphery (composition method illumination).
7. Large red spot, green periphery, (composition method illumination).
8. Black and white quarters.
9. Clear annulus in black stop.
10. Malachite green screen.

Stops on right-hand side.

1. Black annulus, 5–15 mm. diameter.
2. „ „ 10–20 mm. „
3. Blue periphery, clear centre.
4. Red „ „ „
5. Green „ „ „
6. Yellow „ „ „
7. Red and green halves, clear centre.
8. Blue and red quarters „ „
9. Adjustable oblique light stop.
10. Adjustable slot.

N.B.—For low-power colour illumination the top lens of condenser must be removed.

TABLE OF COMPARISON OF THE THREE METHODS OF COLOUR-ILLUMINATION.

Method.	Colour-differentiation dependent	Available with	Chiefly suitable for	Cone of light from condenser used.	Colour-disc placed	Cone of light transmitted by central differentially coloured part of the colour-disc.
1st, referred to as high-power or diffraction method.	Chiefly on diffraction.	All powers.	Medium and high powers.	Narrow compared to objective cone.	Above or between lenses of objective.	Narrow compared to objective cone.
2nd, referred to as low-power or refraction method.	Chiefly on refraction and reflection.	Low powers.	Low powers.	Much wider than objective cone.	In sub-stage condenser.	Equal or slightly exceeding objective cone.
3rd, referred to as composition method.	Chiefly on position and form of the different parts of the object, without diffraction playing any determining part. In exceptional cases, however, wholly due to diffraction.	All powers.	Medium and high powers.	Any cone at will, greater than that passed by central spot of colour-disc, and not exceeding objective cone.	In sub-stage condenser.	According to circumstances; any cone less than objective cone.

A list of the objects exhibited under multiple-coloured illumination will be found on p. 215.

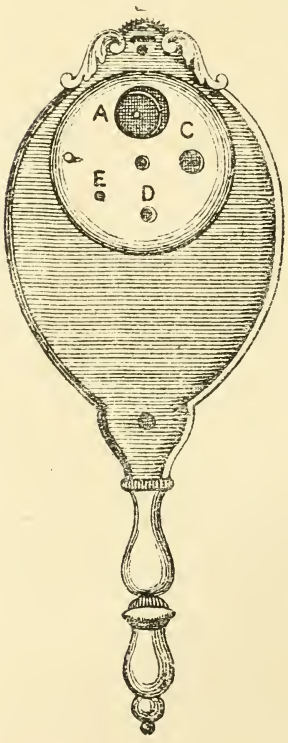
MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

A. Instruments, Accessories, &c.*

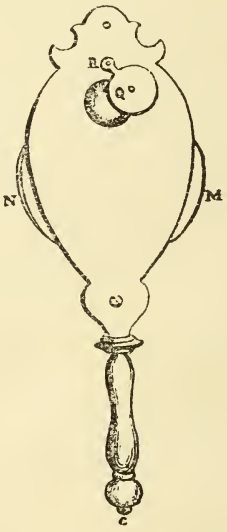
(1) Stands.

Fig. 30.



Evolution of the Microscope.†—Mr. E. M. Nelson has now published Part 2 of his monograph on this subject. The following is a list of the instruments described, arranged chronologically.

Fig. 31.



* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Journ. Quekett Micr. Club, vii. (1898) pp. 98–118 (14 figs.). Cf. this Journal, 1897, p. 332.

1702. Really belongs to Part 1, and should be placed between Hartsoeker's and Wilson's screw-barrel Microscopes. Fig. 30, which is a back view, shows an oval wooden plate; on the other side is a similar plate which holds the lens opposite the aperture A. Between the plates is a rotatory multiple object-holder (M N, fig. 31), the object being inserted in apertures in the circumference of the disc. Focussing is accomplished by means of the milled head B, which is attached to a screw regulating the distance between the two plates; one of these carries the lens, and the

Fig. 32.

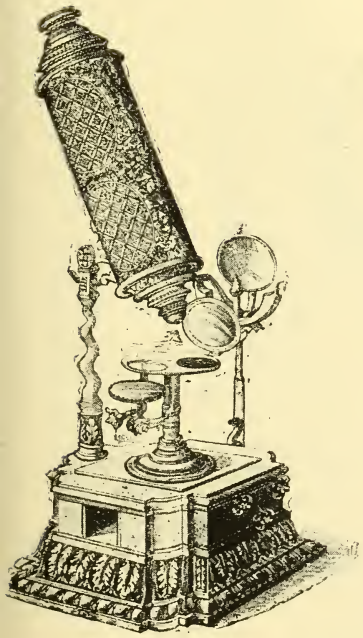
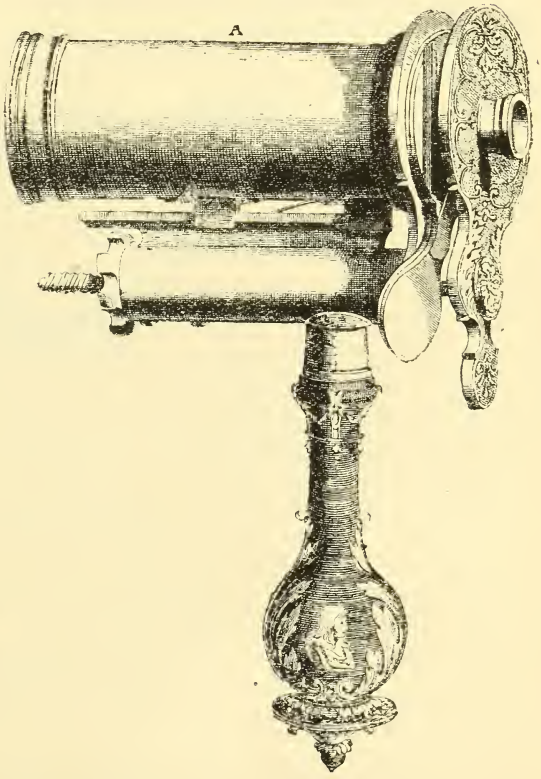


Fig. 33.



other the rotary object-holder. The great point of interest is the rotating wheel of graduated diaphragms, A B C D E (fig. 30), placed on the side of the object remote from the lens. This is the first instance of this useful and still surviving appliance.

1710. We meet a crude estimate of aperture; for Conradi says that the aperture of his object-glass was equal to a mustard seed. He also used a negative amplifier between the objective and eye-glass: this is the first notice of a Barlow lens.

1715. (Fig. 32.) In Hertel's Microscope the mount is of the "telescope stand" type, the inclination in arc being regulated by screw

and nut. This is really a throw-back to an older type; for J. Marshall's (1704) Microscope possessed an inclinable limb carrying both body and stage, and was therefore far in advance of the telescope mount.

The important point about this Microscope is the adaptation of a mirror, which now appears for the first time; it also has a mechanical stage.

1718. Fig. 33 shows Joblot's simple Microscope. The ornamented plate carries the lens, the focus being adjusted by the nut and screw; the plate next the ornamental one is a concentric rotary stage. The mechanical details of this stage are well thought-out and properly sprung (fig. 34). The instrument is a decided advance on any preceding simple Micro-

Fig. 34.

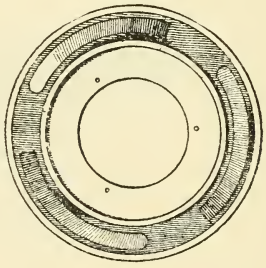
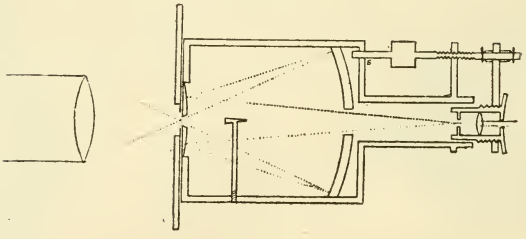


Fig. 35.



scopes, not only on account of the mechanical contrivance of the concentric rotating stage, but also for an optical one, viz. the placing of a diaphragm at the end of the tube.

Prof. Joblot also designed compound Microscopes; these, although their exteriors are ornate and of good artistic design, are of a very crude type; they possess, however, a concave lens in the covering cap of the eye-piece. This, when mounted in place of the convex eye-lenses, turned the instrument into what is now called a Brücke lens.

1736. Barker's catoptric Microscope, exactly like a Gregorian telescope, but of bad design.

1738. Smith's catoptric (fig. 35), very efficient of its class. It is

like a Cassegrainian telescope, with this difference, that both mirrors are pierced with a hole through their centres. Dr. Smith calculated four of these Microscopes, the main difference between them being in the amount of spherical aberration they possessed. He also describes a substage condenser. This Microscope was not surpassed either theoretically or practically for about eighty or ninety years.

1738. Culpeper and Scarlet's "Double Reflecting Microscope" is the first instance of an English Microscope with an illuminating mirror (fig. 36). Baker, in his description of this instrument in 1743, adds a

Fig. 36.

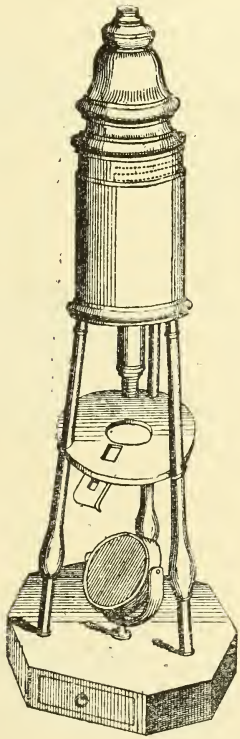
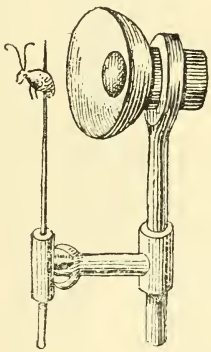


Fig. 37.

Fig. 38.



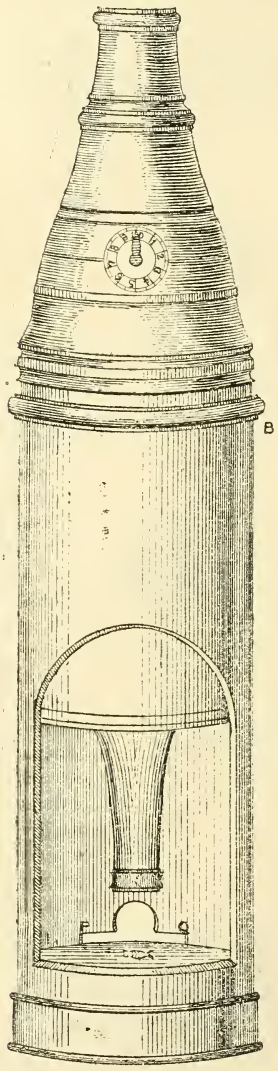
conical diaphragm of black ivory (fig. 37). A brass diaphragm of this form was subsequently made by Cuff, Marston, Adams, and in 1798 by Jones. Chevalier placed a graduated wheel of diaphragms at the lower end of the cone (1823), so that this peculiar form of diaphragm had an innings of about eighty years.

The Culpeper and Scarlet model remained the popular form for seventy years.

1738. In this year Dr. Lieberkuhn introduced his well-known form of reflector for the illumination of opaque objects; fig. 38 is a copy of a figure in a book by P. van Musschenbroek (1739).

1739. Benjamin Martin's Pocket Reflecting Microscope with a micrometer. The instrument was dioptric: the word "reflecting" applies solely to the illuminating mirror. Fig. 39 shows that it was of an entirely novel design; the focussing was performed by a push-tube at B; for illumination the outer tube was cut away in front, and a mirror placed at the bottom; there was also a wide aperture P Q cut through the opposite side of the outer tube for the purpose of allowing slides to be passed through. One of the novelties was a rough micrometer fitted in the focus of the eye-lens, with an attached dial for the purpose of registering tenths of a revolution of the screw. Subsequently the outer tube was prolonged, making what is now called a drum-foot, in which a mirror was placed; afterwards it was mounted on three legs, after the manner of the Culpeper.

Fig. 39.



1740. B. Martin's Universal Microscope was of crude design, exhibiting a throw-back to the telescope mount.

1740. Lieberkuhn's Solar Microscope, or, as we should now say, Projection Microscope. The apparatus, mounted on a ball-and-socket in a window, was originally pointed at the sun; but Cuff (1743) greatly improved it by attaching an elementary form of heliostat (see E, fig. 40). In 1746, Adams adapted his Microscope stand in a very ingenious manner to his projection apparatus, thus forming the earliest prototype of the projection and photographic instruments of the present day.

1742. Fig. 41 shows a scroll form of mount on a circular wooden foot, a great improvement over the complete telescope mount; but we see the last remnant of a partial telescope mount; for the Microscope could be turned round on the pin C D laterally, so that it might be pointed to the sky or to a candle flame. This form of instrument, as made by Adams, had the scroll in sections for the sake of portability, and, mounted on a square box foot, became very popular; it was still sold by Jones in 1798.

1743. Lindsay's Microscope (fig. 42) is a simple Microscope with a mirror. It has four points of interest: first, its extreme portability; secondly, its excellent workmanship; thirdly, it is the first Microscope in which we meet with a mechanical

arrangement for changing the power; fourthly, it is the first Microscope patented. The date of the patent is 1743; but the inventor states that he designed and made it in 1728. If this earlier date could be established, it would be the earliest known instance of an English Microscope with a mirror. The Royal Microscopical Society possesses an excellent example of this Microscope, dated 1742, and numbered 22.

Fig. 40.

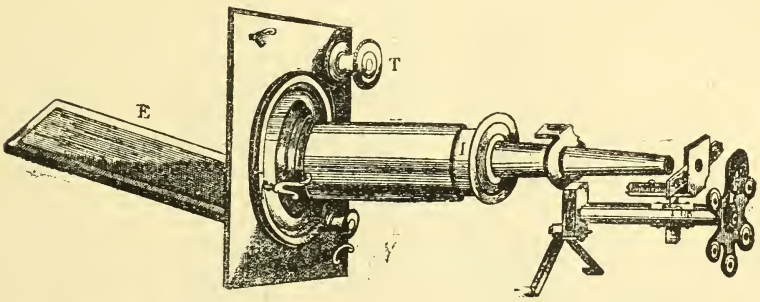


Fig. 41.

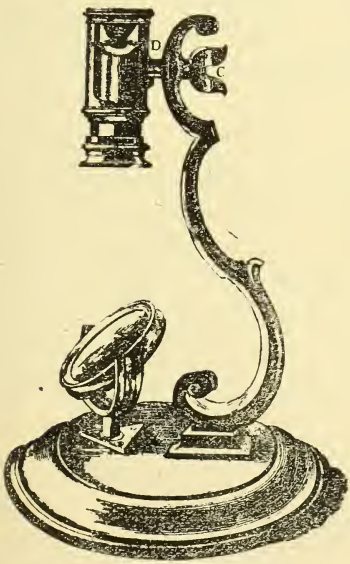
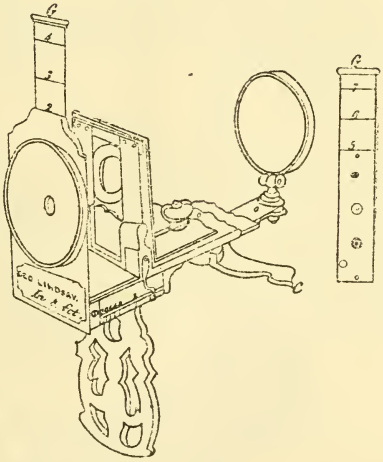


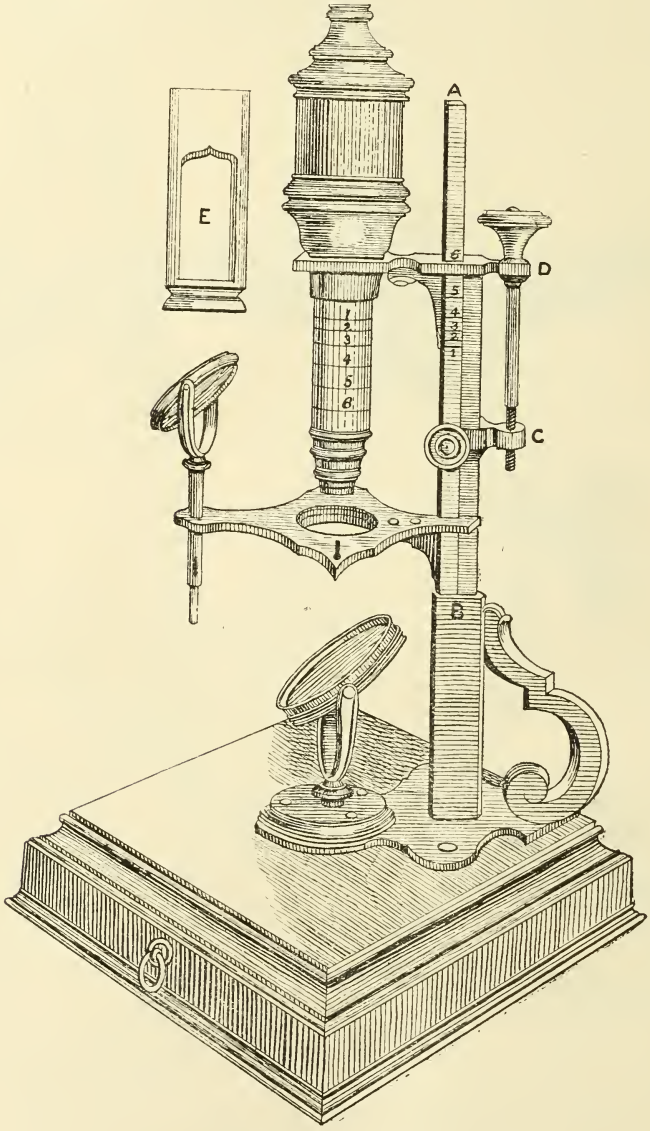
Fig. 42.



1744. Cuff's Microscope (fig. 43). The post A B is fixed to a square box foot, and the stage is fixed to this post. The bar behind and parallel to the post, to which the limb D carrying the body is attached, slides in the socket B. The thumb-screw in front clamps C, which is fixed to the movable bar, to the post A. The method of focussing is therefore simple and effective. The thumb-screw is loosened

and the movable bar is placed to the figure engraved on the post A, corresponding to the number of the objective on the nose-piece. The

Fig. 43.



thumb-screw is then clamped tight, and further focussing performed by the fine adjustment D C.

Powell's Iron Microscope.—We have received from the President, Mr. E. M. Nelson, the following description of, and remarks on, Powell's Iron Microscope, exhibited by him at the meeting on February 15th. The accompanying figures (figs. 44 and 45) are the first illustrations that have been published of this beautiful and very useful model. It was the invention of that eminent mechanician, and father of the modern Microscope, the late Hugh Powell, an admirable portrait of whom we are able to present to our readers in the present part.

FIG. 44.

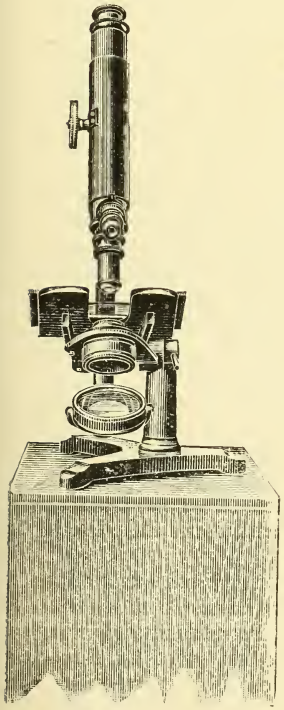
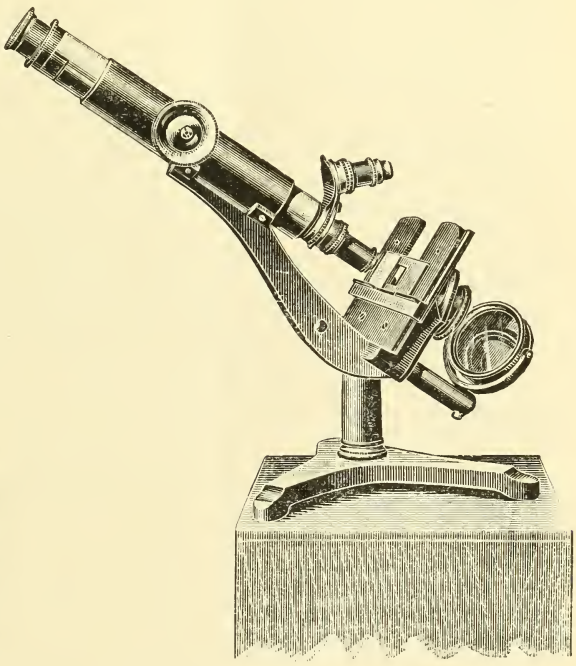


FIG. 45.



"The date of this instrument is about 1838–40, and a more thoroughly practical and serviceable model, for the work it is intended to do, has never yet been designed.

"The chief peculiarity in this Microscope is at once apparent, viz. that it is mounted at the side of a pillar, instead of on the top of a pillar, or between two pillars. There are three important points gained by this form of mount:—(1) stability, (2) free access to substage and mirror on the right-hand side, (3) compactness.

"Powell was wiser than our Continental friends, who, in order to avoid the Scylla of bulkiness, have run into the Charybdis of instability.

"But some critic may observe that this stand is not so compact as the large Continental forms. In reply to this it may be pointed out that this

Microscope is much larger, for it measures no less than 11 in. from the eye-cap to the objective front, and its stage area is 15·9 sq. in., viz. half as large again as that of the largest Continental instruments. The question may be asked, if a Microscope having a body and a stage of the above length and area were to be mounted on a horse-shoe stand of the Continental form, what size and weight of stand would be required, so that both instruments might have the same amount of stability when inclined in any position?

"This Microscope originally had a circular hole in the stage, but in 1880 I had the brass cut away to the front, in order that the slide might be more easily tilted by the finger against the objective front, so that the working distance might be ascertained. By this means an oil-immersion 1/12 of any aperture can be quickly and safely brought into focus by means of the coarse adjustment alone. In 1882, Messrs. Swift and Son made a Microscope for me with a similar form of stage; this is figured in the Journal R.M.S., 1883, p. 554, fig. 94. I have other Microscopes made on the same plan, and all give complete satisfaction. This form of stage is now largely adopted.

"The stage has a plain sliding bar, sprung; this works so smoothly that it can be moved by the pressure of the finger acting only on one side.

"The second peculiarity is that the Microscope has no fine adjustment. Powell always insisted that the quality of the fine adjustment was one of the most important factors in determining the perfection of a Microscope. He also gave it out as an axiom that a Microscope, fitted only with a good coarse adjustment, was better than one which had, in addition to the coarse adjustment, a rickety fine adjustment.

"In this he was perfectly right. I can remember that my second Microscope had a worthless short lever nose-piece fine adjustment; the result was that the fine adjustment was never used at all, focussing was performed solely by means of the coarse adjustment; the fine adjustment was therefore only in the way, and contributed instability to the nose-piece, and it is perfectly clear that the instrument would have been far better without a fine adjustment.

"Powell was unwearied in his efforts to perfect the fine adjustment, and the perfection to which it has been brought in the modern Microscope is wholly due to him. As a matter of history, Powell's fine adjustments were in advance of the requirements of the lenses of his day, which had very low optical indices; in illustration of this, let me point out that a Microscope of his, with stage focussing, made in 1838, works a modern oil-immersion apochromatic of 1·43 N.A. with steadiness and precision. When the apochromatics were brought out by Prof. Abbe in 1886, the Continental fine adjustments had all to be revised, because they were so defective that they were incapable of focussing these new lenses with large optical indices; while Powell's, on the other hand, were quite equal to the emergency, although constructed upwards of thirty years previously.

"My own opinion is, and has for long been, that a direct acting screw fine adjustment (other than a differential),* however well constructed,

* The differential screw fine adjustment was first applied to a Microscope by Nobert; see Monthly Micr. Journ., 1869, p. 324. It was first suggested by Dr. Goring in 1830.

is quite incapable of fully developing the image given by an oil-immersion apochromatic with a large optical index. In opposition to this it may be urged that most biologists and histologists use Microscopes of the Continental pattern; to which I reply that biologists and histologists always work their objectives down, and never up; by this is meant that an oil-immersion 1/12 is used where a 1/2 or a 1/4 ought to be sufficient. A lens used with a small cone is a lens 'degraded.'

"Now, as a general rule, biologists and histologists use the three-lens Abbe chromatic condenser, which only yields an aplanatic cone of 0·5 N.A., consequently an oil-immersion 1/12, however great its excellence, can only be used as a 'degraded' lens with such a condenser. A fine adjustment however is only put on its metal when a 3/4 cone is employed; you may be perfectly certain therefore that those Microscopists who are content with the efficiency of the direct acting screw fine adjustment, never employ a 3/4 cone, and use only 'degraded' objectives.

"Far be it from me to minimise the value of the work done by any biologist or histologist, but I think that the above remarks are called for, because it is tacitly assumed that, if any microscopist has discovered any biological object with a lens 'degraded,' therefore that method and apparatus must necessarily be capable of performing the highest and most critical microscopical work.

"Another misconception also is rife, viz., that the highest type of instrument must be the combination of a dissecting and observing Microscope; for we have been repeatedly told that because Strauss Durkheim designed, for the dissection of the Coleoptera, a Microscope which had the level of its stage four inches above the table, therefore four inches is the proper height for all Microscope stages. This is wholly an error, because the combination of two incompatible things cannot yield the best possible results for each. The best observing Microscope will never make the best dissecting one, and *vice versâ*.

"In this Microscope we have an interesting feature, viz. an early example of the 'Jackson' limb. The funny thing is that what is now known as the 'Jackson' limb was not invented by Mr. Jackson; for it was Mr. J. J. Lister who designed this form of limb, and it first appeared in a Microscope made for Mr. Lister by Tulley. The Microscope was completed on May 30th, 1826. Mr. Tulley states, in a pamphlet published about that time, that '. . . the instrument and its apparatus was suggested and made from original drawings by my friend J. J. Lister, Esq., whose ingenuity and skill in these matters are very generally acknowledged.' It should be also noted that Mr. Lister's Microscope had 'a combination of lenses to act as condenser under the object'; it also possessed an internal lens to erect the image; in this last point clearly predating Strauss Durkheim. You will also notice that the tube-rack coarse adjustment, and the limb of Powell's iron Microscope are copied from Mr. Lister's instrument which, like Powell's, also had no fine adjustment.

"The question now arises, what was Mr. Jackson's invention? It consisted in the ploughing of the slide which carried the body and that which carried the substage, in one plane, and out of one solid piece of metal. In this connection it is stated,* that 'in this way the axis of

* Trans. Microscopical Society of London, 1861, p. 37.

the instrument is perfectly continuous, and no centering or adjustment is required.' Mr. Jackson also introduced the double pillar; the carefully turned and correctly proportioned pillar was very likely to emanate from one who was well known to be such an expert with the lathe and other mechanical contrivances. You will notice that Mr. Jackson's improvements were far later in point of time than those of Mr. Lister; for if you will examine Mr. James Smith's Microscope that was made to the order of the Microscopical Society of London and delivered in November 1841,* you will see that it has the Lister limb, but neither the Jackson ploughed groove nor the Jackson double pillar.

"Thus a matter is explained, which for long I have been unable to understand, viz.:—why did Messrs. Smith and Beck never supply centering motions to the substages of their former models? The whole thing is clear now; for at the time those Microscopes were designed the necessity for extreme accuracy in centering had not arisen. When, however, objectives increased in power and aperture, centering gear was provided, in the form of an adapter which held the substage condenser, and which fitted into the substage. Other makers, who were not hampered with the idea of the sufficiency of the Jackson ploughed groove, fitted centering motions to the substage itself, and thus dispensed with the adapter. For the future, I intend to call all such mounts as the one before you this evening, by the name of the 'Lister limb,' for he most certainly was its inventor.

"The question will be asked, why did Mr. Lister take the trouble to invent a new form of stand, when he had the excellent models of Jones of Holborn ready to his hand? The answer to this is that just at the close of non-achromatism, the prevailing idea was that every first class Microscope should be, in the terminology of those days, both single and double, or as we should now say, simple and compound. Microscopes were therefore constructed with this idea in view; and to meet the requirements of a single Microscope, the transverse arm was pivoted so that the single lens might be made to traverse quickly over a stage, in the same way as a 'loup' on a modern dissecting stand does at the present time. In addition to this, the acting portion of the arm could be lengthened or made shorter, either by a sliding arrangement, or, as in the most highly finished instruments, by rackwork.

"Now it is obvious that all these movements were conducive to instability, especially when the compound body was screwed on to the arm above the single lens. Mr. Lister designed his rigid limb with the view of correcting these errors in the instruments of his time.

"In this he showed great foresight; for he evidently recognised the fact that the introduction of achromatism would so enhance the capabilities of the compound Microscope as to render its combination with the simple Microscope simply impossible, and therefore he determined that his instrument should be a compound Microscope, and that only. We of to-day may find certain points in his design deserving of criticism, such for instance as the steadying rods fixed to the eye-end, which evidence want of poise, &c.; but then we must charitably remember that the man who makes no mistakes makes nothing, and must give Mr. Lister

* Microscopical Journal, by Cooper and Busk, for 1842, frontispiece.

the credit of the invention of this improvement in the Microscope stand, which is to-day of such great service. The improvements effected by him in achromatic objectives for the Microscope are already acknowledged.

"In the same casting as the Lister limb there is a V-shaped bracket 7/8 in. thick; to the upper side of this bracket the stage is screwed, and to its lower side a plate parallel to the stage. This lower plate carries a sprung tube, which forms the substage. In this substage I have a push-tube focussing adapter, which carries a Zeiss 'improved aplanatic lens × 10'; this lens makes a very suitable achromatic condenser for the powers used on this Microscope. As the lens merely slides into a sprung tube, it can be easily removed for its ordinary use as a 'loup.' Below the adapter is a Gifford's screen.

"This condenser requires no diaphragm, because the objectives on the rotating nose-piece are a Zeiss a a, and a Reichert 8 mm.; with the first the condenser gives a full cone, which the a a stands perfectly well, and with the second a 3/4 cone, at which point the 8 mm. performs at its best. The magnifying powers are 70 and 170 diameters respectively, the diameter of the field being $8\frac{1}{2}$ in.

"A Microscope of this description will be found very useful, not only for rough work, such as the examination of unmounted objects, and for roughly searching finished slides, but also for a hack Microscope, as a companion to a larger instrument on which critical work is being performed. I am told by biologists who have done a large amount of Microscope work, that the employment of a second Microscope is preferable to the use of a rotating nose-piece on the larger instrument. This I can well understand, because when the condenser has once been adjusted for critical illumination with a high power, it is very annoying to have to disturb it for lower-power work.

"*Dimensions of Powell's Iron Microscope.*

Body, 8 in. (203 mm.); diameter, $1\frac{1}{8}$ in. (28 mm.).

Spread of foot, $7\frac{1}{2} \times 6$ in. (190 mm. × 152 mm.).

Distance of optic axis from table when the Microscope is placed in a horizontal position, $5\frac{1}{2}$ in. (140 mm.).

Stage, $4\frac{3}{8} \times 3\frac{5}{8}$ in. (111 mm. × 92 mm.).

Height of stage from table, Microscope being in a vertical position, $4\frac{3}{4}$ in. (120 mm.).

Rack extension, $2\frac{1}{4}$ in. (57 mm.).

Cut in stage, wide, $1\frac{3}{10}$ in. (33 mm.); depth, $2\frac{1}{2}$ in. (63 mm.).

Distance from eye-cap to front lens, 11 in. (280 mm.).

Weight, $6\frac{1}{2}$ lb. (3 kg.).

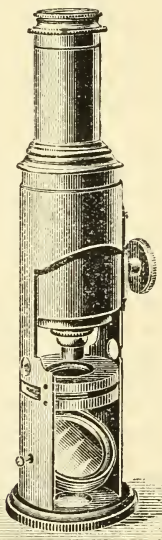
The brasswork is finished bright, and the ironwork japanned green; cork is plugged in the feet."

Martin Microscope.—Fig. 46 illustrates a Microscope alleged to have been made by Benjamin Martin, and presented to the Society last year by Mr. Alfred George Fryett, of Melbourne, Australia. This has evidently been evolved from B. Martin's first Microscope, which he called

a "Pocket Reflecting Microscope," * an account of which was published in 1739.†

In the library of the Society is a collection of B. Martin's tracts (1765), in which an improvement of his "Pocket Reflecting Microscope" is figured, pl. 2, fig. 13. This improvement consisted in prolonging the tube, and placing below the stage a mirror, capable of being inclined, for the purpose of illuminating transparent objects. Note that the term "reflecting" applies solely to the mirror used for the purpose of illuminating transparent objects, and does not imply that the instrument was on the catadioptric principle.

Fig. 46.



Martin's improved Microscope is now known as the drum-foot; it is still made in France, and is occasionally to be seen in our toy shops. This form of Microscope was adopted by Fraunhofer (1816),‡ Oberhäuser (1835, patented 1837), Lerebours (1838).

Martin's second improvement consisted in the adaptation of the Culpeper and Scarlet tripod foot, a form which has long since passed away. This is figured in his 'Optical Essays,' fig. 21, no date (bound up with his tracts).

The Microscope in fig. 46 is a later form of his drum Microscope, further improved by the addition of a rackwork coarse adjustment. This Microscope is neither signed nor dated. B. Martin died in 1782, and the instrument appears to be of a much later date than that. The box contains a cut of the instrument, with a descriptive text, in which it is called Martin's Microscope; but it does not appear to be older than the first half of the present century.

Early Form of Ross Microscope.—Messrs. Watson and Son have very generously presented an interesting and early form of a Ross Microscope to the Society (fig. 47). The Microscope is on the Lister model, fitted with a rack-and-pinion coarse, and a short-lever nose-piece fine adjustment, the fine adjustment screw being at the side, instead of in its usual position, the front of the body.

The stage has rectangular mechanical movements, both being performed by rack-and-pinion, the heads of both the pinions being placed

* This Microscope is figured in a book in the library of the Society, viz. 'A Treatise on the Microscope,' by B. Martin, 1742, fig. 1; also in Journ. Quekett Micr. Club, vii. (1898) p. 11, fig. 20.

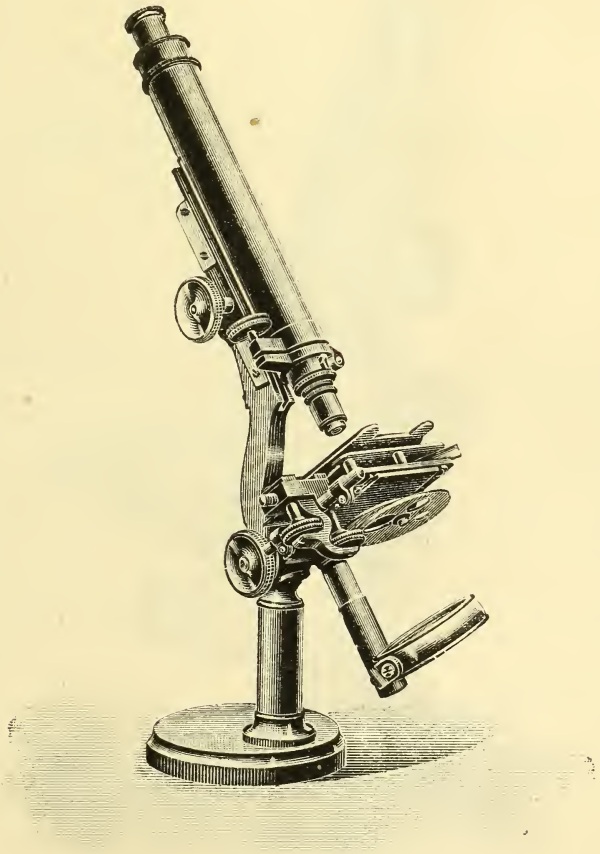
† For this date see 'Adams on the Microscope,' second edition, 1798, p. 21, footnote.

‡ For this date see 'Les Microscopes et de leur usage,' C. Chevalier, 1839, R.M.S. library.

in a vertical position below the stage. It will be observed that on account of both movements being performed by rack-and-pinion, an equal speed is obtained for each. The slide-holder is of the non-concentric rotary type. There is no substage proper, but a sliding plate carrying a rotary wheel of diaphragms is fitted instead of one.

The foot is particularly interesting; it is circular with the vertical

Fig. 47.



pillar attached excentrically to it; the base rotates so that great stability can be secured when the Microscope is used either in a vertical or inclined position.*

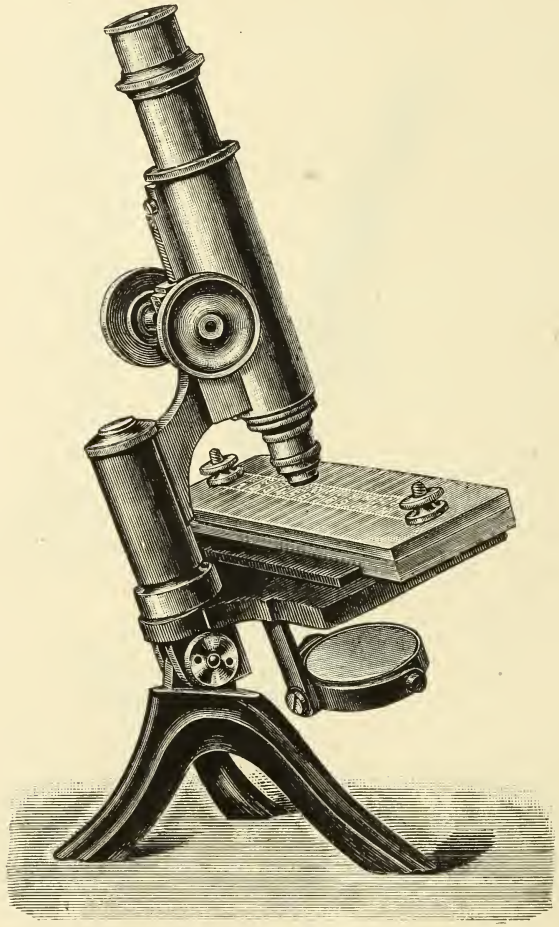
This Microscope is signed And^w. Ross, and has his address,

* For the earliest form of this often reinvented adaptation see a Microscope by J. Cuff, *circa* 1765, figured Journ. R.M.S., 1898, p. 675, fig. 117.

33 Regent Street, Piccadilly, engraved on it; it is also numbered 33. Probable date, 1842, 43.

Hartnack's New Microscope for Flesh Inspection.— In external build this instrument resembles somewhat the English model. It is

Fig. 48.

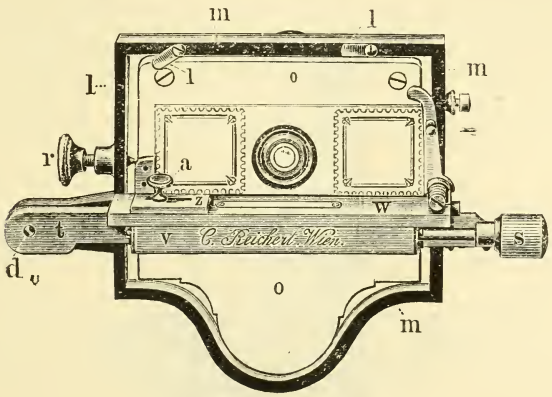


fitted with a specially broad table-plate (170 × 80 mm.), in order more conveniently to explore a compressorium with a larger number of preparations. The adjustment is by rack-and-pinion.

Reichert's Mechanical Stages.—Fig. 49 is a less expensive form of the stage already figured in our Journal, 1893, p. 527, and can also be used with smaller stands. It is a combination of sliding bar and

mechanical stage. The object is moved from side to side by the milled head *s*; *s*, acting as a lever, also enables the object to be moved from top to bottom of the stage.

Fig. 49.



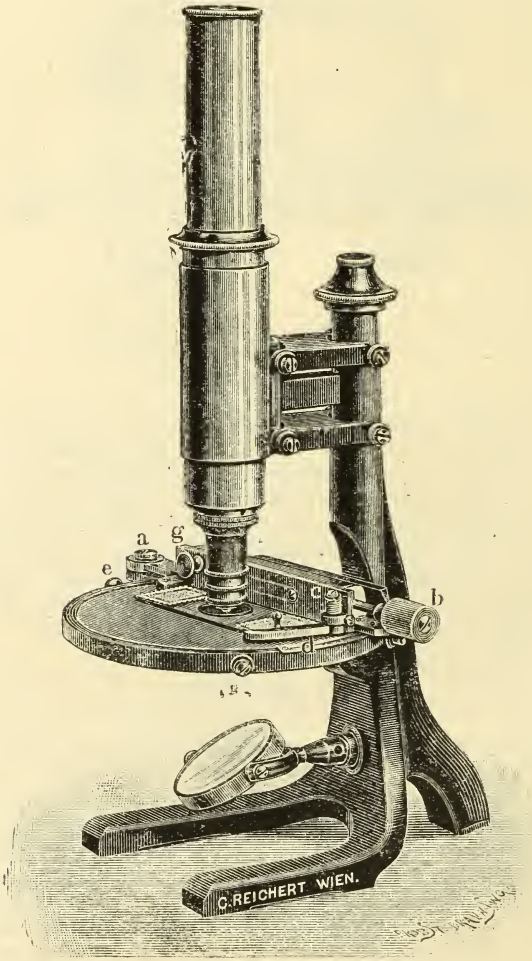
Reichert's Cheap Stand.—Fig. 50 shows a stand called No. VII. by this firm. It is said to be an excellent stand for many purposes, for medical, botanical, and other students, and for examination of meat for trichinæ. It is not inclinable—no disadvantage for some work—and Reichert strongly recommends it to those requiring a low-priced instrument. The coarse adjustment (not shown in figure) is by rack-and-pinion, and the fine by micrometer screw on Roberval's principle. It has a large round stage and a plane and concave mirror. If a sliding-tube coarse adjustment is substituted for the rack-and-pinion, a further economy is introduced.

Price, with rackwork coarse adjustment, 2*l.* 10*s.*; with sliding-tube coarse adjustment, but without mechanical stage, as in fig. 50, 1*l.* 14*s.*

Folding Dissecting Microscope.—Messrs. Bausch and Lomb's instrument bearing this name (fig. 51) is compact and portable. It has all the elements of the ordinary dissecting Microscopes, and besides these, the important feature that, when folded, it is brought into a very small compass. The base is japanned iron. The stage is of brass, blackened; it has spring clips and, in its centre, a removable glass disc with millimetre scale ruled upon it. It is of convenient height, so that any amount of work may be done without fatigue. The arm holding the lenses is adjustable in the triangular rack-rod, and has the Society's screw, thus permitting the use of low-power objectives as simple magnifiers. The mirror is detachable from the base, and can be readily attached to the stage for illumination of opaque objects. In folding, the rack is brought down and the arm detached; the stage swings backward on the pillar and the base on the stage, so that the space occupied is merely the size of the base and thickness of base, stage, and arm.

Paul Meyer's Dissecting Stand (Improved Form).—This (fig. 52) is one of Messrs. Bausch and Lomb's instruments, and is the largest dissecting stand made by them. The metal parts are brass throughout, polished and nickeled. The base is of unusually large size, and heavily

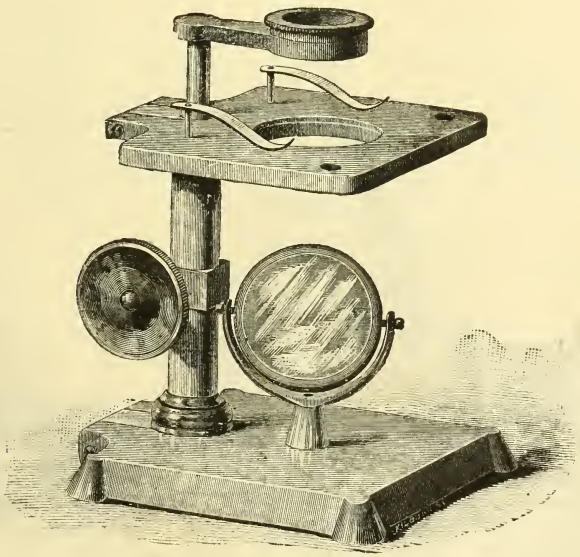
Fig. 50.



leaded to ensure stability. The stage plate, 90 × 105 mm. in size, is of polished plate glass, resting on a metal frame into which the spring clips are also fastened, thus making the entire surface of the stage free and available for work. Dishes may be cemented to its surface, for

reagents used upon it, without fear of damaging it in any way. The mirrors are very large, 68 mm. in diameter, plane and concave. The usual somewhat cumbersome methods of securing black or white backgrounds are superseded in this stand by a plate, black on one side, white on the other, hinged to the stage frame, just beneath the front left-hand corner, by means of an arm of the proper length to bring the plate (black or white side up as required) directly in contact with the lower surface of the stage, or permitting it to be carried outward, beneath and against the hand-rests. When transmitted white light is wanted, the arm of the plate is brought to the vertical position and the white side of the plate used as a reflector, as this arrangement of the plate does not

FIG. 51.



in any way interfere with the illumination or the use of the camera lucida.

The lenses are focussed by means of diagonal rack-and-pinion of extremely long range, acting on a triangular rod. The working distance may be increased to 125 mm. by means of a second rod attached to the arm and adjustable in the main focussing rod.

Bausch and Lomb's New Complete Substage. — Figs. 53 and 54 show the substage closed and separated. It has been especially designed to afford greater stability and convenience than are usually attained. The entire substage is supported on a heavy metal bar joined to the main arm of the Microscope, and to which it is attached by slide with rack-and-pinion, whereby the whole substage may be adjusted with reference to the Microscope stage. The substage is composed of three

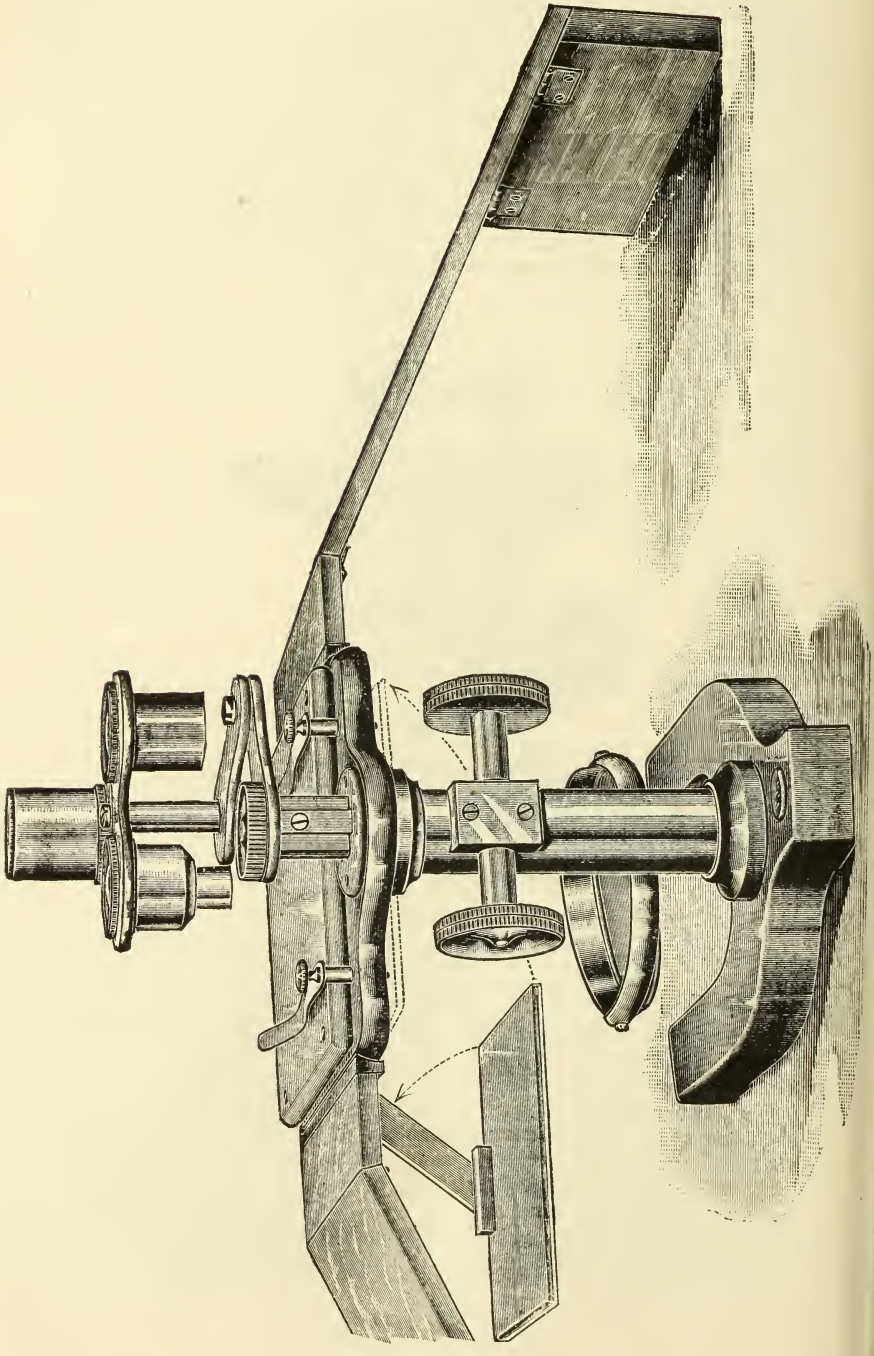
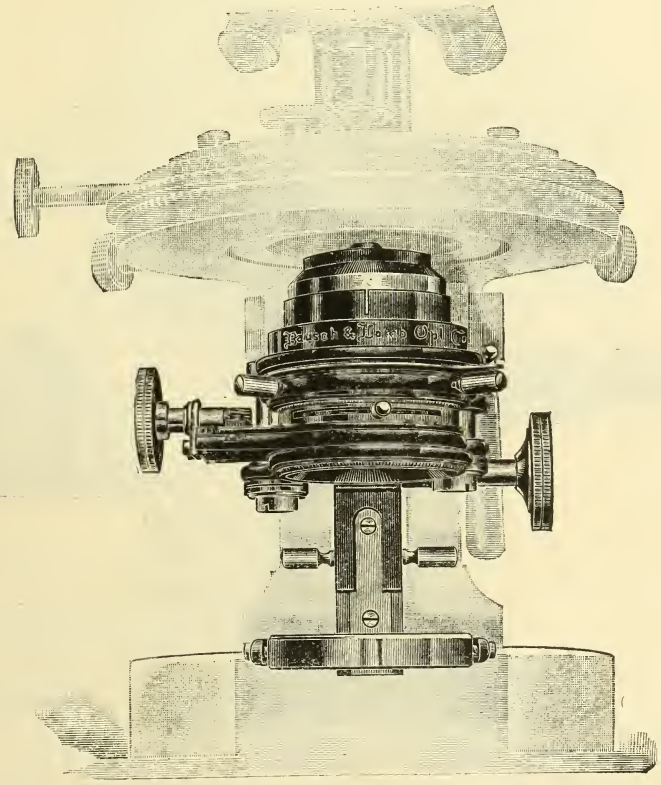


Fig. 52.

parts arranged one above the other. The upper part consists of a fixed ring, supporting the removable iris diaphragm. This diaphragm is operated by a lever, easily accessible from the front of the substage, and is so arranged as to come directly in contact with the object-slide if desired, thus being in the most effective position for use without the condenser. When the condenser is in use, this iris can be used to limit the volume of light entering the objective without limiting the angle of the illuminating cone. This method of controlling the light is of the

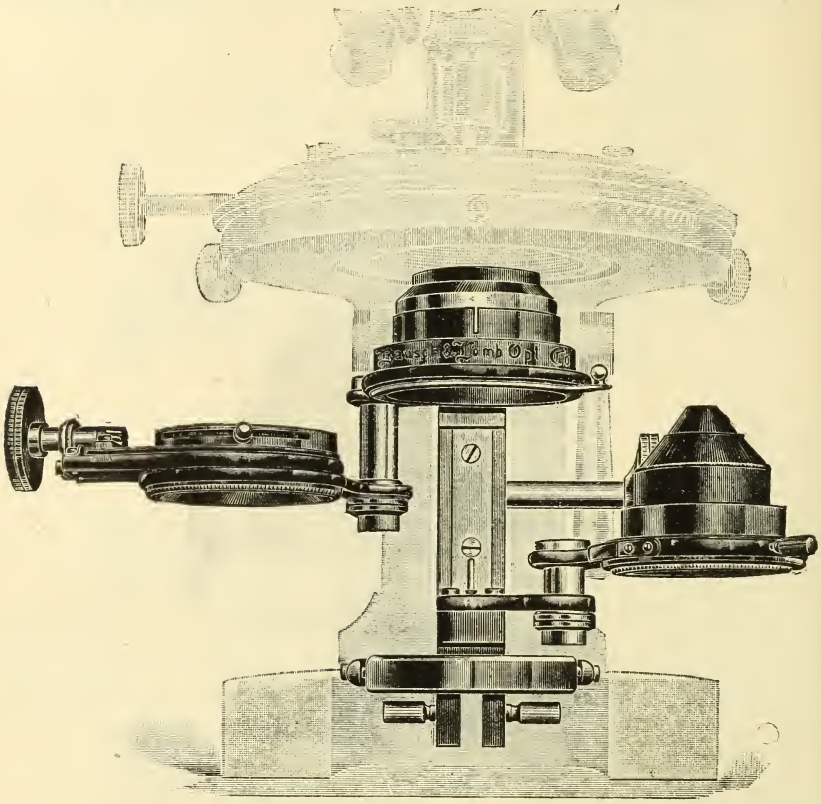
Fig. 53.



utmost importance in the examination of highly refractive transparent bodies, such as living bacteria, &c. The middle section of the substage is movable vertically on the main substage axis, and consists of a ring, with centering screws, carrying an Abbe condenser 1·20 N.A. The condenser ring swings laterally to the left of the instrument in such a manner that the condenser is entirely out of the path of rays from the mirror, and is also perfectly free for changing accessories. The condenser ring, the arm on which it is carried, and the sliding support, are

all of the most stable construction, so that there is perfect rigidity and accuracy of centering throughout. The vertical adjustment of this section of the substage permits the condenser to be brought in immersion contact with the object-slide, or to be placed in any other position desired without reference to the position of the upper iris diaphragm. The

FIG. 54.



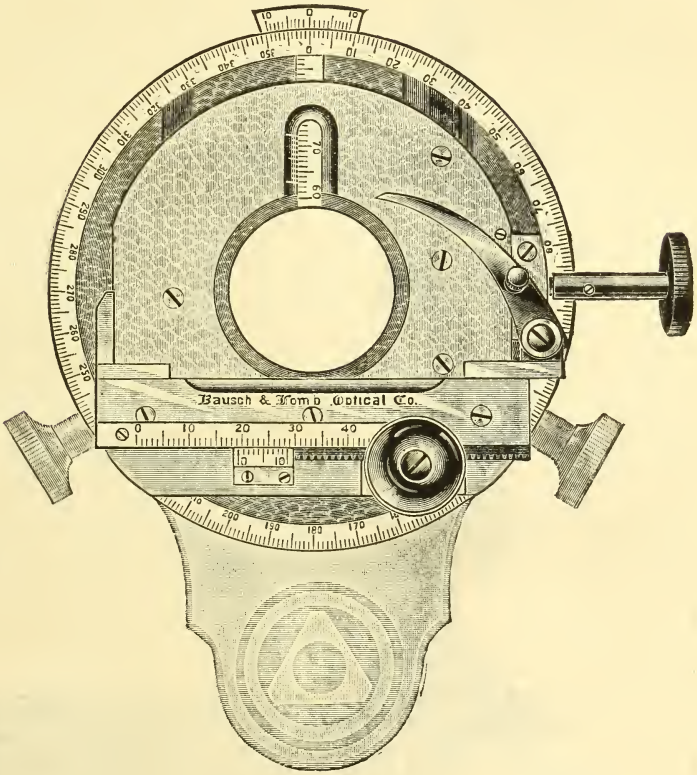
lower section of the substage carries the large iris which is used below the condenser. This diaphragm may be swung from under the condenser to the right of the instrument. It is so mounted that it may be rotated upon its own axis, and is laterally movable by rack-and-pinion when oblique illumination is desired.

Bausch and Lomb's Revolving Mechanical Stage.—The entire stage (fig. 55) rotates on its axis, the circumference being divided into 360 degrees, and provided with vernier reading to tenths of a degree.

The rectangular movements and object-carriers are the same in construction as those of the "Attachable Mechanical Stage." The gradua-

tions are placed so as to be viewed conveniently, and have verniers reading to tenths of a millimetre.

Fig. 55.



(3) Illuminating and other Apparatus.

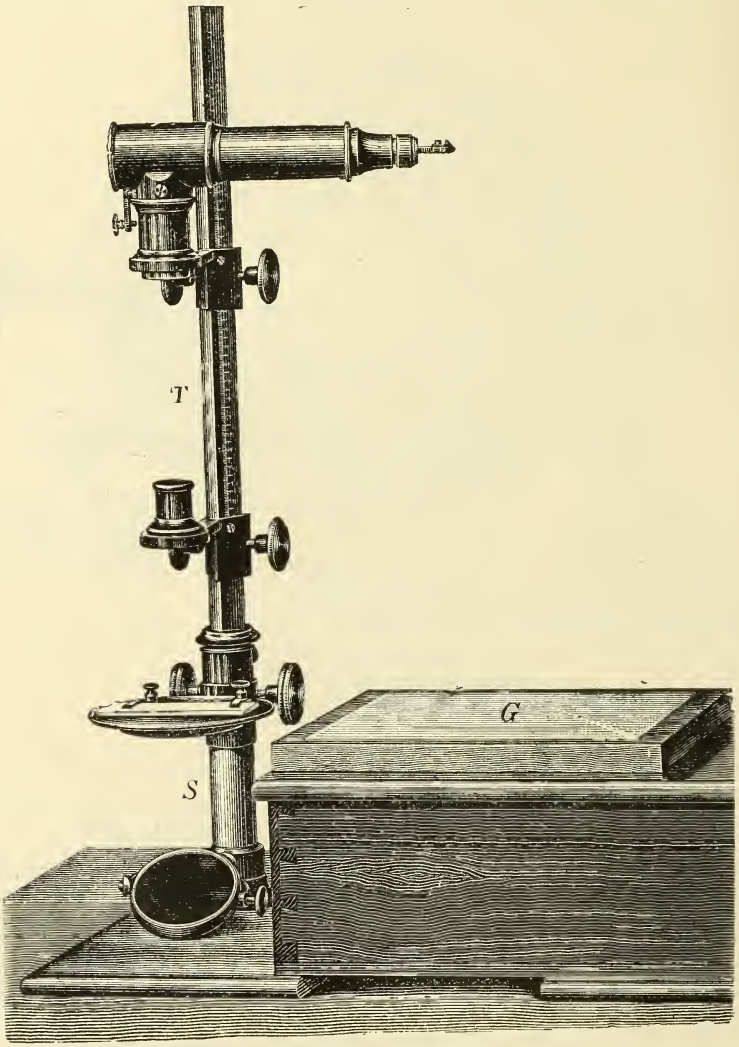
Hartnack's Embryograph.—This instrument is mainly a more compact form of one designed by Professor His, of Leipzig, and is intended for outline drawing under low powers, with the advantage of changing easily from a given scale to any other. One of Oberhäuser's cameras is combined with a small photographic objective of such a kind that both these articles can be moved up and down on a 60 cm. long, graduated guide-bar T, and their mutual distance can be altered within comfortable limits. The foot of the guide-bar bears the sliding object-table and below that a Microscope mirror.

Fig. 56 shows the instrument mounted on a foot-board; but this is now replaced by an iron foot, thus increasing the stability. The ground-glass plate G serves as the drawing surface, and is placed at a suitable

height on the adjoining box. All the parts of the apparatus can be packed away within a box 38 by 22·5 cm. and 9·5 cm. high.

The apparatus allows a magnification of 4–75 diameters.]

Fig. 56.



Hammarberg's Object Net Micrometer.*—Dr. Hans Berger, of Jena, gives an account of the instrument invented and described by the late Dr. Hammarberg, a Swede, in his work on the pathology of idiocy. The

* Zeitschr. f. Instrumentenk., 1899, pp. 303–10 (3 figs.).

inventor's object was to compare the number of nerve-cells in 0·001 cubic mm. of brain of normal and weak-minded individuals.

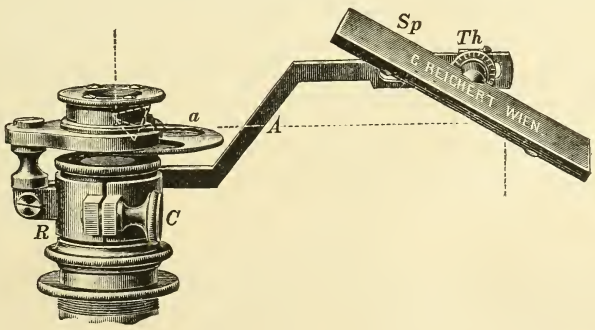
Hammarberg's method was to dispense with ocular micrometers, and instead to use the positive image of a 1 square cm. glass plate divided into 0·25 square mm., the image being thrown by a convex lens on to the preparation. The advantage of the arrangement is that, by increasing or lessening the distance of the lens, the image of the graduated plate on the preparation can be enlarged or reduced, and that this picture becomes an integral part of the preparation; magnification, therefore, by the objective and ocular does not alter the ratio between the preparation and the scale. The glass plate is so arranged that each little square on the object is exactly 0·01 sq. mm. An inconvenience arising from spherical aberration in the peripheral parts is avoided by selecting a central portion. After counting the cells in a certain number of squares, those in ten consecutive serial sections of 10 μ thickness, or in five of 20 μ, are counted. This total is divided by the proper number of squares, and the quotient gives the number in 0·001 cubic mm. of brain cortex.

Dr. Berger, having found the method satisfactory in brain investigations, describes the details of the apparatus, and thinks that the idea is capable of further microscopic application.

This ghost-micrometer was invented by Dr. C. R. Goring,* and was reinvented by Dr. G. W. Royston-Pigott,† and again by Prof. A. E. Wright.‡

Reichert's New Form of Drawing Apparatus.—Fig. 57 shows this apparatus, which can be used with dissecting Microscopes and poorly lighted opaque objects as well as for ordinary work.

FIG. 57.



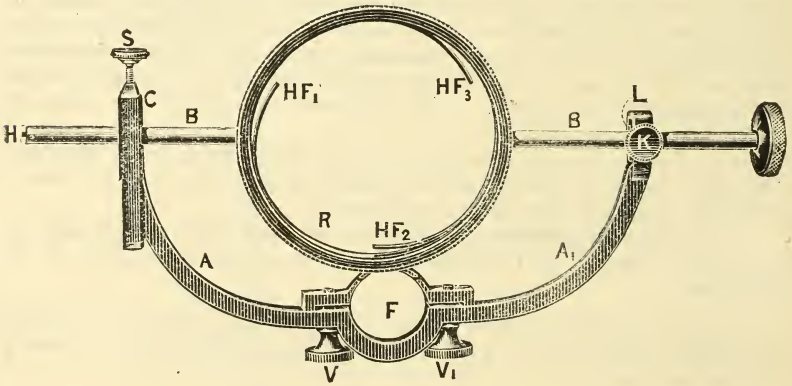
(4) Photomicrography.

Culture Dish-holder for Microscopic and Photomicrographic Purposes.§—This has been made by the Zeiss firm to Dr. W. Gebhardt's

* Micrographia, 1837, p. 51. † Monthly Micr. Journ., 1873, pp. 2 and 51.
‡ Of this Journal, 1897, p. 245.
§ Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 155–9 (1 fig.).

designs, and is intended to obviate the many difficulties incident to the fixing of the dishes on ordinary Microscope stages. The designer considers that a satisfactory holder should be capable of the three following motions:—(1) a radial push-motion; (2) a rotation; (3) a central lateral movement of at least 5 mm. in each direction, apart from the due centering of the culture layer. Fig. 58 shows how these requirements were perfectly attained. On a hollowed-out piece F, fastened by two screws V V_1 to the prism flange of the Microscope, there extend antlerwise two bent arms A A_1. The extremity of A_1 carries a threaded socket L, and the extremity of A is arranged for the adjustment. L receives the

Fig. 58.



axle B, which is firmly clamped by the tightening of the screw K. The centering arrangement C consists of a brass block with a double concave perforation (∏ in long. section), whose least cross-section receives the axle B without loose play. The axle B is interrupted in its midst by a ring arrangement R, formed of an inner and an outer part. The outer simple ring is of cylindrical cross-section, and its inner diameter about 105 mm. Within this ring (milled) is a second, much thinner, fitted with three clamps HF_1, HF_2, HF_3, tipped with cork or vulcanite, for reception of the dish.

When in use the ring arrangement R lies flat on the object-table.

Spitta's Photomicrography.*—This work, published by the 'Scientific Press,' is mainly a reprint of the articles which recently appeared in the 'Pharmaceutical Journal' and were abstracted in this Journal.† The book is got up attractively, with forty-one half-tone reproductions and sixty-three text illustrations. The size is a large quarto, and some useful appendices are inserted. All theoretical discussion has been avoided, with the hope of producing a practical manual, the embodiment of the author's experience. The half-tone reproductions are the work of Messrs. Dent and Co., of Clapham.

* London, Scientific Press (Lim.), 1899, 4to, 163 pp.
† Cf. this Journal, 1898, p. 591.

(5) Microscopical Optics and Manipulation.

A Treatise on Photographic Optics, by R. S. Cole.*—The contents of this book are well described by its name; for its scope embraces a discussion of the optical principles and optical difficulties of photography. In one sense it is not a practical manual, for it only incidentally notices applications of the art, and does not even make a reference to photomicrography. It avoids the ground of the ordinary handbook to photography, and does not trouble itself with the composition of solutions, the make of stands, or with manipulative details at all. But within its limits it is very practical, and is written with a clearness and a mastery of the subject that must place it high on the list of works of a similar nature. All points of theoretical interest connected with light and lenses are thoroughly explained, and are then elucidated by a conclusive experiment performed usually with quite ordinary apparatus. The mathematical treatment is simplified as much as possible, but not so much so as to be unintelligible, and is invariably followed by a well-chosen numerical example fully worked out, so that no reader need be in perplexity about the meaning of a formula. But while no mathematics are used beyond the simplest trigonometry, the principles underlying those parts of the subject requiring more elaborate mathematical analysis are clearly stated, and the experimental illustrations remove all uncertainty. In this way such difficulties as "least circle of aberration," "astigmatism," are freed from their usual obscurity. The illustrations are very numerous and well drawn, and the type is excellent. In his preface the author states that he has tried to avoid producing a book which should be useful only to the professed mathematician and physicist, but the mode of treatment will commend it to all interested in optics. A possible improvement in a second edition would be an appendix on optical bibliography. The contents of the book are in seven chapters:—i. On Light (pp. 3–38). ii. Elementary Theory of Lenses (pp. 39–121). Thin and thick lenses are very fully discussed on the Gauss method; magnification; combinations; Dallmeyer's telephotographic lens; perspective; swing-back. iii. Aberration (pp. 122–89). Spherical, including astigmatism; chromatic. iv. Correction of Aberration and Design of Lenses (pp. 190–204). v. Lens Testing (pp. 205–50). Tourniquet System; Kew system. vi. Exposure, Stops, and Shutters (pp. 251–93). vii. Enlargement, Reduction, Depth of Focus, and Halation.

(6) Miscellaneous.

Pakes' Cover-glass Clip for making Blood-films.—This consists of a block of mahogany, B, fig. 59, with a strip of cork let in flush with its upper surface. The brass spring plate A grips the cover-glasses C upon the cork, and holds them fast.

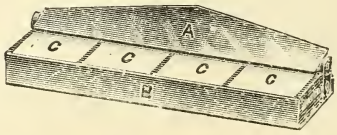
The advantages of this cover-glass clip over the forceps usually employed are:—that more than one cover-glass can be streaked with blood at a time; that it is possible to obtain a single layer of blood-discs; and that the cover-glass is not so liable to get broken.

The clip was devised by Mr. W. C. C. Pakes, of Guy's Hospital

* London, Sampson Low, Marston and Co., 330 pp., many illustrations.

bacteriological laboratory, who finds it exceedingly convenient to streak the blood upon the cover with the edge of a machine-cut cigarette paper.

Fig. 59.



Modifications of an Aseptic easily Sterilisable Glass Syringe.* — Dr. S. Glücksmann describes two modifications of the Haegler-Passavant injection syringe. This syringe consists of a graduated glass tube, pointed at one end for the cannula, and a glass piston-plunger. On pushing up the plunger the fluid frequently returns, escaping at the posterior end. This inconvenience is avoided by the device shown in fig. 60, at R. The modification consists in having a groove at the posterior end, so that any return fluid collects therein and does not escape.

Fig. 60.

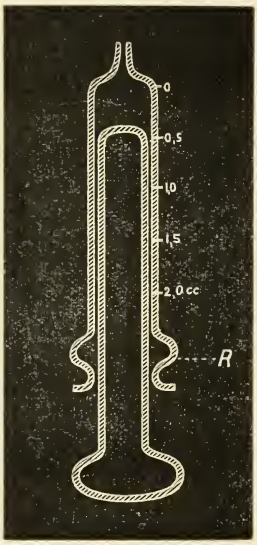
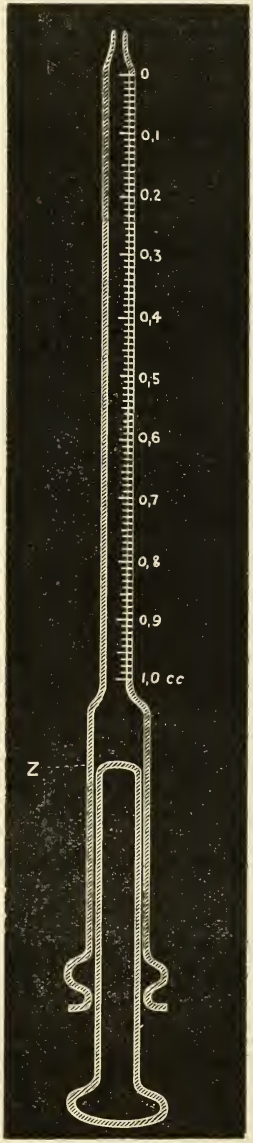


Fig. 61.



Another modification is shown in fig. 61. As will be seen by comparing the two illustrations, the second modification consists in an

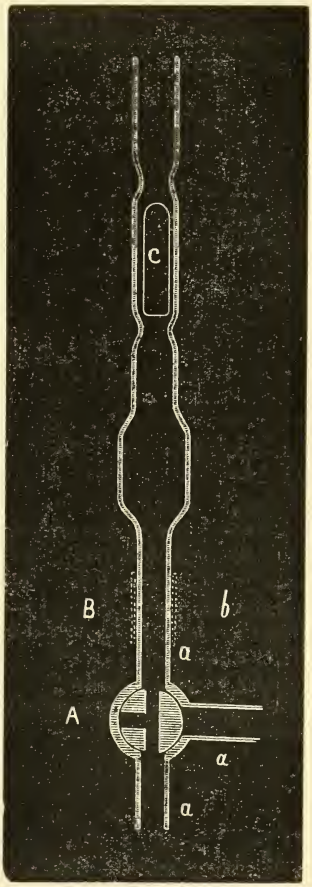
* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 18–9 (2 figs.).

elongation of the nozzle in the form of a fine pipette marked with 100 divisions. This shape is intended for the injection of quantities which may be as minute as 0·01 ccm.

Z is a mark indicating the place to which the piston should be withdrawn before introducing the injecting fluid.

Improved Filter for Microscopical Water Analysis.* — Mr. D. D. Jackson has devised an attachment to the Sedgwick-Rafter filter which obviates the chief defect of the original apparatus. By the older process many Protozoa escaped enumeration, and this difficulty has been got over by means of the attachment to the filter-funnel, which holds back a definite quantity of the original water in the funnel. This attachment consists of a prolongation of the filter-tube, and is closed at the bottom by means of a solid rubber stopper. A smaller tube is connected with the main tube by a T-joint, and rises just to the level of the 6 ccm. mark on the funnel. This tube is of such a height that when the solid rubber stopper is in place, all the water may filter through the sand, except five cubic centimetres.

Fig. 62.



Automatic Measuring Pipette.† — Herr F. Kern describes an automatic pipette for measuring off definite quantities of germ-free fluids. Its chief advantage is that it can be worked by one person. It consists of three parts (fig. 62):—a T-shaped glass tube with a three-way tap at A, a reservoir, and a float-valve *c*. The reservoir may be made in one piece with the three-way tap, or connected at B by a rubber tube. The float *c* has its upper end rounded off to fit into the narrowed part of the reservoir, and so close the upper aperture. The reservoir is filled from below by siphon action; and as the fluid rises, the float is pushed up so that it closes the reservoir when the latter is full. The horizontal tube is connected with the long arm of the siphon, and the vessel containing the fluid with the short arm. The action is started by sucking at the upper end of the pipette. When the reservoir is full, the tap is turned to the left so that the fluid is evacuated below. This done, the tap is returned, after which the apparatus fills itself. For different quantities of fluid, reservoirs of different sizes are required. An apparatus similar in principle was described by Kuprianow.‡

* Technology Quarterly, xi. (1898) pp. 241–5 (1 pl.).
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 75–7 (1 fig.).
‡ Cf. this Journal, 1894, p. 400.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Coloured Nutrient Media.†—Dr. C. J. Rothberger records in tabular form the results of his experiments with bacteria on coloured nutrient media. In all, some thirty-five different pigments were used. Three groups of bacteria were inoculated on agar tubes coloured with the different pigments. The bacterial groups were vibrio, coli, and Friedländer. For the details the original should be consulted.

Apparatus for Anaerobic Plate Cultures.‡—Herr A. Klein has devised an apparatus for anaerobic cultivation, which combines the use of the vacuum air pump and pyrogallic acid for the removal and absorption of air. On a ground-glass plate is placed a bell-jar 18 cm. in diameter and 30 cm. high. At the top is an aperture plugged with a caoutchouc stopper perforated for the insertion of a glass tube, which is connected with the air pump.

At the bottom of the bell-jar is placed a flat glass pan which just fits into the bell-jar. In this are placed 2·5 grm. of pyrogallic acid. Inside the bell is also placed a small apparatus composed of two U-shaped tubes supported on a metal stand. One end of each tube is closed and the other open. The small tube is filled with mercury, and is provided with a scale for registering the pressure in the bell-jar. The closed limb of the wide tube is quite filled, and the short limb partially filled, with 60 per cent. caustic potash solution. To the latter limb is connected a siphon, wherein the caustic potash solution stands a little higher than in the short open leg of the tube. When the pressure has sunk to the attainable minimum, the potash solution in the open limb and in the siphon has risen high enough to bring the siphon into action; the potash solution is thus brought into contact with the pyrogallic acid in the pan. As soon as the siphon is empty, the tube at the top of the bell-jar is clamped, and the apparatus is ready to be placed in the incubator. There is sufficient room inside the bell-jar for ten Petri's capsules.

The advantages claimed for this apparatus are that it is ready for use in less than ten minutes; there is complete removal of oxygen, as is indicated by the colour of the caustic potash solution; it works with perfect certainty.

Cultivation Medium for Bacillus of Hooping Cough.§—In the course of a long description of a bacterium found in the sputum of cases of pertussis and identical with the microbe already described by Czaplewski and Hensel,‖ Dr. O. Zusch states that he has obtained very favourable cultivation results from the use of ascites or anasarka-glycerin-agar. This medium answers better than the Loeffler's serum employed by Czaplewski and Hensel.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 15–17, 69–75.

‡ Op. cit., xxiv. (1898) pp. 967–71 (2 figs.).

§ Tom. cit., pp. 721–7, 769–79 (1 pl.). ‖ Cf. this Journal, 1898, p. 227.

(2) Preparing Objects.

New Preparation for Rapidly Fixing and Staining Blood.*—Dr. L. Jenner has introduced to histological technique a solution which works admirably as a blood-film fixative and stain. It is made in the following way:—Equal parts of a 1·2 per cent. to 1·25 per cent. solution of Grübler's water-soluble eosin, yellow shade, in distilled water, and of a 1 per cent. solution of Grübler's medicinal methylen-blue in distilled water, are mixed together in an open basin and thoroughly stirred with a glass rod. After 24 hours the mixture is filtered, and the residue dried either in the air or in an incubator at (not exceeding) 55° C. When quite dry the residue is scraped off the filter and powdered. It is then again shaken up with distilled water and washed on a filter, and after having been dried again is powdered. For use, 0·5 grm. are shaken up with 100 ccm. of pure methyl alcohol, and the filtrate used as the fixative stain. The solution keeps well.

The stain may also be made by dissolving the eosin and methylen-blue in methylic alcohol, and mixing them in the proportion of 125 ccm. of a 0·5 per cent. solution of eosin and 100 ccm. of a 0·5 per cent. solution of methylen-blue.

Cover-glass preparations are made by pouring a few drops of the solution on the dry film, and allowing the solution to act for one to three minutes. The stain is then poured off, and the cover-glass rinsed in distilled water until the film assumes a pink hue (5–10 seconds). The cover-glass is then dried, preferably in the air. The red discs are terra-cotta coloured; the nuclei of white corpuscles blue; the platelets mauve; the granules of the polymorpho-nuclear white cells and of myelocytes are red; those of the basophile or mast cells dark violet; and bacteria, filariæ, and malaria parasites blue.

The inventor claims for the new method that it demonstrates more plainly, readily, and simply than those in general use.

(3) Cutting, including Imbedding and Microtomes.

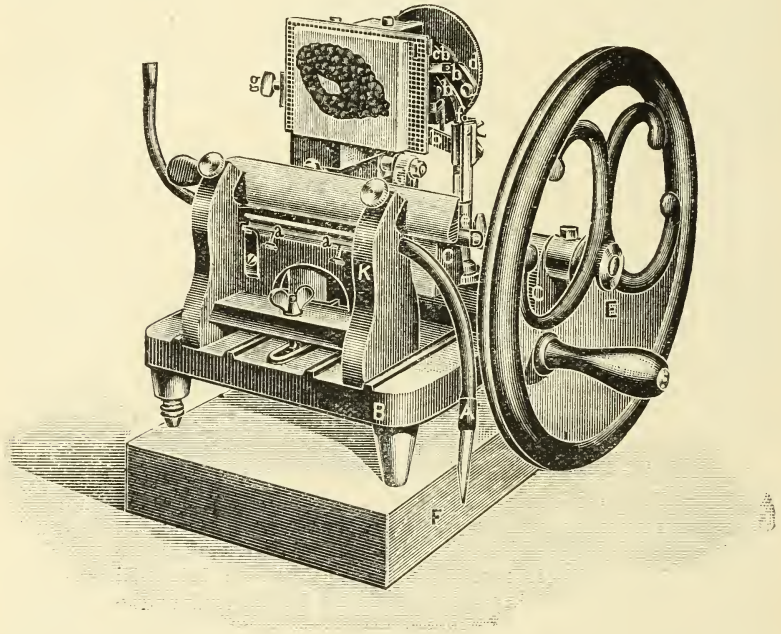
New Large Model Zimmermann Microtome.†—Dr. van Walsen describes this instrument, which has been constructed especially for the cutting of such large objects as brain-hemispheres. As will be seen from figs. 63, 64, it closely resembles the well known Minot-Zimmermann type. The cast-iron base-plate B is 24 by 30 cm., and on its right hinder quadrant are two short vertical pillars C C, in whose upper portion a horizontal axis D is inserted. The axis is operated by the wheel E, whose scollops are necessary in order to attain the requisite balance. The working is delightfully regular and easy, in spite of the rather great weight (33 kg.). The size of the wheel renders it necessary to set the machine either on the edge of a table or on a specially made wooden block (as in fig. 64). At its left end the horizontal axis is connected with the excentric lever G, whereby the rotation of the wheel produces a vertical movement of that part of the instrument which carries the object and the screw-adjustment. G has a groove parallel to its length (fig. 64), in which the small horizontal arm can

* Lancet, 1899, i. pp. 370-1.

† Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 145–55 (2 figs. and 1 pl.).

be fixed in any desired spot by means of the screw (visible in fig. 64). The adjustment can be read off by the millimetre graduations marked on the lever. In this way the movements of the slide can be reduced, if desired, and the instrument adapted to smaller sections without the consumption of much time. Object-tables are supplied in various sizes, the largest being 13 by 10 cm. I, in fig. 63, shows the largest size table, and in fig. 64 a smaller one. The upper surfaces of the tables are divided by millimetre-broad streaks into 2 by 2 mm. squares, useful not only for strong attachment of the paraffin blocks, but also for their shaping. The screws partly visible in fig. 64 effect the adjustment of the object by rotation about three principal axes. The application of the knife

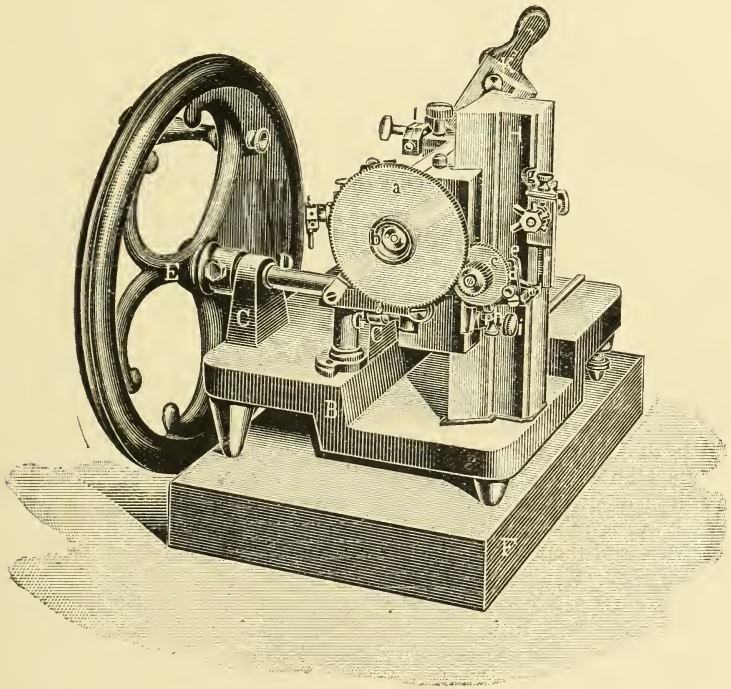
Fig. 63.



to the object can be done in rough adjustment either by pushing the object-table along a horizontal axis or by pushing the knife-holder. The final application requires the micrometer-screw. Three knife-holders are supplied; two for paraffin (K, fig. 63); one for celloidin (K, fig. 64). On the base-plate are on each side two grooves, which render impossible any deviation of the knife sideways or backwards. The knife-holder has a movement from front to rear of 8·5 cm., and can be fixed in any position on the base-plate by means of the screw visible in fig. 64. A caoutchouc tube A, whose purpose is to regulate the temperature of the knife and local section, runs along the knife-back, and is approximated to the knife, as required, by the screws *a*, *a*. The advantage of a rise in the local section temperature is that ribbon-

formation is facilitated, that section thickness can be varied within rather wide limits, and that resistance to the knife-action is reduced. Steam or hot water may be employed as the heat agent; and attachment can be made to a reservoir of constant pressure or temperature. Great attention has been bestowed on the means of the automatic propulsion of the preparation. The upper arm of a jointed lever *b*, *b*, *b*, *b* bears on its left end a catch which engages with the small toothed wheel *c* (fig. 63). The wheel is connected with the micrometer-screw, and serves the relatively rougher advance of the preparations. A stroke of the coarse adjustment corresponds to an advance of the preparation

Fig. 64.



of about 1/150 mm., as the micrometer-screw has a pitch of 1/2 mm., and the wheel 75 teeth. The movements of the lever are occasioned by the impact against the pins of a star block connected with a vertical pillar *e* (fig. 64). According to the position of the star, the wheel is advanced 1, 2, 3, 4, 5, 6, 9, 12, or 15 teeth, which correspond to the advance of the preparation of 6, 13, 20, 26, 33, 40, 60, 80, and 100 μ. The reading-off of the adjustment is by a millimetre scale whose indicator is visible to the right below *f* in fig. 64. The upper triangular part of the pillar is rotary, and is movable in the lower circular part, so as to put the parts out of action (as in fig. 64). The object can be fixed on any desired position of the slide by means of the screw *g*.

The knob *h*, with the wheels *a* and *c*, constitute the fine adjustment. The knob *h* indicates whole or half mikrons, and another screw *b* unites the wheel *a* with the micrometer-screw. The connection between the two wheels *a* and *c* can be raised, and the latter afterwards depressed; the screw *i* serves for fixing it. Photographs of some of the sections obtained accompany the description.

Rapid Method of Paraffin Imbedding.* — Dr. S. H. Champlin's method is as follows. A piece of fresh tissue the thickness of a thin or medium slide is suspended in absolute alcohol from 2–2¾ hours. It is then placed in benzol-cedarwood oil mixture until semi-transparent (usually from 10–30 minutes). It is next immersed in melted paraffin heated to between 47° and 50° C. This paraffin is a mixture of one part hard paraffin (50° C.) and two parts soft paraffin (40° C.) After the bath, which takes from 5–30 minutes, the specimen is imbedded in melted paraffin (two parts hard and one part soft paraffin) and allowed to cool slowly until semi-solid, when it should be rapidly cooled in ice water. The sections are fixed to the slide with Mayer's albumen mixture; passed through benzine and 90 per cent. alcohol; stained with China blue or bleu de Lyon, and afterwards with safranin; and mounted in balsam.

The safranin solution is made by adding 1 part of 40 per cent. formalin to 4 parts of saturated aqueous solution of safranin.

The entire process can be carried out in 3½–4 hours.

(4) Staining and Injecting.

Three Staining and Mounting Methods.†—Elise Wolff gives the following modification of Weigert's fibrin and bacteria method. (1) The alcoholic solution of gentian-violet is mixed with a saturated aqueous solution of lithium carbonate instead of with anilin-water. The solution must be made fresh when required for use. For staining fibrin, two thirds of lithium carbonate solution and one-third gentian-violet solution are required. In this the preparations are immersed for 3 or 4 minutes, and then in the iodine solution for 1–1½ minutes. They are decolorised first in pure anilin and afterwards in anilin-xylol (2–1). The preparations are extremely permanent. For bacteria, one-third lithium carbonate solution and two-thirds staining solution are required. In this the preparations are stained 5 or 6 minutes, or longer.

Instead of gentian-violet, a saturated alcoholic solution of fuchsin may be used, but the staining time must be extended to quite 10 minutes. The authoress is accustomed to celloidin sections which are stuck on by Aubertin's method.‡

(2) A good nuclear staining for material hardened in Müller's fluid or Benda's solution (nitric-acid-bichromate of potash solution) is obtained by immersing the sections for 24 hours in very dilute Böhmer's hæmatoxylin. After this the sections (if the materials have been hardened in Müller) are immersed in another quantity of the same hæmatoxylin solution, to which so much 5 per cent. aqueous solution of oxalic acid

* Journ. Applied Microscopy, ii. (1899) pp. 229-30.
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 310–2.
‡ Cf. this Journal, 1897, p. 174.

is added as not to visibly alter the colour. Usually one drop of the acid to a Petri's capsuleful of solution is sufficient. After some minutes the sections may be washed in tap water. When the preparations have been fixed by Benda's method, caustic soda is used instead of oxalic acid.

(3) Though thionin is a very instructive staining reagent, it is capricious, and does not last well as a rule. This untoward event is due, the authoress thinks, to the mounting medium. Colophonium or Canada balsam, applied by heating a little piece in the flame and using it while hot, is advised; as by this device preparations will keep for at least a year without obvious alteration. Toluidin is also said to be a suitable medium for mounting sections stained with thionin.

Modification of Van Ermengem's Method for Staining Flagella.* —Dr. H. M. Gordon has stained the flagella of *Micrococcus melitensis* and *Bacillus pestis* by Pitfield's and Van Ermengem's methods, but the latter, with the following modifications, gives the best results. The reducing agent, i.e. the tannin and gallic acid solution, must be several weeks old. The specimens should be left double the prescribed time in the mordant, for from 1½–3 minutes in the first silver solution, from 2–3 minutes in the reducing agent, and in the last silver solution until the film begins to darken. Sometimes good preparations are obtained by washing in distilled water between the baths, and sometimes it is advisable to reverse the order of the baths.

Modification of Pitfield's Method for Staining Flagella.†—Mr. R. Muir gives the following modification of Pitfield's method for staining flagella.

(A) The mordant. Filtered 10 per cent. aqueous solution of tannic acid, 10 ccm.; saturated aqueous solution of sublimate 5 ccm.; saturated aqueous solution of alum, 5 ccm.; Ziehl-Nielsen phenol-fuchsin, 5 ccm. The mixture is to be centrifuged or allowed to stand all night. The clear fluid is then pipetted off. It will keep for one or two weeks.

(B) The stain. Saturated aqueous solution of alum, 10 ccm.; saturated alcholic solution of gentian-violet, 2 ccm. The solution will keep for two or three days.

To stain the film, flood the surface with the mordant, heat until vapour arises, and allow to steam for about one minute. Wash in running water for about two minutes, and then dry over the flame. Flood the surface with the stain, heat, and wash as before.

If black stained preparations be preferred, treat with Gram's iodine solution for one minute, dry over the flame, and mount in balsam.

The advantages claimed for this method over Van Ermengem's are:— that it is more simple to work; that it forms very little precipitate on the film; and that the organisms and their flagella appear to retain their natural proportions.

Sudan iii. in Botanical Microtechnique.‡—Dr. L. Buscalioni has investigated the staining reactions of Sudan iii. on vegetable tissue. Sudan iii., or Biebrich scarlet, is a brick-red powder, insoluble in water and alkalies, soluble in alcohol, chloroform, ether, fatty and ethereal

* Lancet, 1899, i. pp. 688–9 (1 pl.).
† Journ. Pathol. and Bacteriol., v. (1898) pp. 374–6. Cf. this Journal, 1893. p. 133.
‡ Malpighia, xii. (1899) pp. 421–40; Bot. Centralbl., lxxvi. (1898) pp. 398–9.

oils, in xylol, and in boiling acetic acid. It is extremely soluble in sulphuric acid, but then turns a dark-green colour. It has long been employed as a stain for animal fat. The author has examined its reactions towards vegetable tissues, and states that it is excellent for cutin, suberin, resin, and wax, which it stains a deep red. Cellulose membranes, collenchyme, and mucous membranes are unaffected. Woody tissues either do not stain or assume a blue-violet hue, and occasionally (Orchideæ) a faint red. The contents of cells, nuclei, protoplasm, starch-granules, and tannin do not stain; but oil, resin, and the contents of laticiferous vessels stain bright red. Chlorophyll-grains are stained a faint red, though certain minute granules within the grains are deeply coloured (*Cycas*, &c.). The reaction to spore-membranes and pollen grains is variable.

Sudan iii. may be used alone or in conjunction with eau de Javelle. Preparations are permanent.

New Stain for Tubercle Bacilli.*—Dr. M. Dorset has discovered that Sudan iii. is a good stain for tubercle bacilli. The preparations, films, or sections are first treated with 80 per cent. alcoholic solution of Sudan iii. for 5 or more minutes; the excess of stain is removed with 70 per cent. alcohol, and the preparations contrast stained, if necessary, with methylen-blue.

Sudan iii. appears to be quite a specific and selective stain for tubercle bacilli. Even when smegma and tubercle bacilli are mixed together, the new stain picks out only the tubercle bacilli.

Method for Ripening Hæmatoxylin.†—Prof. H. F. Harris prepares a ripened solution of hæmatoxylin as follows. 1 grm. of hæmatoxylin crystals is dissolved in 10 grm. of absolute alcohol. 20 grm. of ammonium or potassium alum are dissolved by the aid of heat in 200 ccm. of distilled water. The two solutions are mixed at once or after 24 hours, and 0·5 grm. of mercuric (red or yellow) oxide is added; the mixture is heated to boiling and then quickly cooled. The liquid at once assumes a dark-red colour, and may be at once used for staining. Sometimes a precipitate occurs after a few days, but after filtration does not re-form to any extent. On account of its reducing property chloral was added to some of the staining fluid; after a year this was found to be free from precipitate.

Method for Staining Secondary Degeneration in Nervous System.‡—The most important defect of Marchi's method, says Herr Ch. K. Busch, is associated with the slight penetrating power of osmic acid, which often does not reach the deeper layers. This defect may be remedied by diluting the osmic acid solution with a solution of iodate of soda, which prevents the osmic acid from decomposing too quickly, and permits it to penetrate into the tissue. A preparation (1·12 cm. thick) hardened in formol is placed in a mixture of osmic acid 1, sodium iodate 3, distilled water 300, for 5 to 7 days; then alcohol of increasing strength.

* New York Med. Journ., lxix. (1899) pp. 148–9 (1 pl.).

† Micr. Bull., xv. (1898) p. 47.

‡ Neurol. Centralbl., xvii. (1898) p. 476. See Zeitschr. f. wiss. Mikr., xv. (1899) p. 373.

The sections show the same staining as is produced by Marchi's method, but the normal tissue is clearer, and in consequence the degenerated parts stand out more clearly, and are easily recognised with the naked eye.

New Blood Stain.*—Mr. L. H. Prince obtains excellent results from the following mixture:—Saturated solution of toluidin blue 24 parts; saturated solution of acid fuchsin 1 part; 2 per cent. solution of acid eosin 2 parts. The solutions are made with distilled water, and the ingredients mixed in the order given. Only the supernatant fluid is used. When fresh, the solution stains in 30–60 seconds, but after 10–12 weeks 5–7 minutes are required to get a good result. The films are better fixed by heat than by sublimate solution or by the alcohol-ether mixture.

Method for Staining Bacterial Capsules.†—Herr Kaufmann recommends the following procedure for staining capsules of bacteria.

Stain for some hours at a moderate temperature, or for 2 hours at 35°, with Loeffler's methylen-blue. Wash in water which has been made alkaline with a few drops of strong caustic potash or caustic soda. Carefully dry the preparation, and then treat with 0·5 per cent. nitrate of silver solution. Wash in alkali-water. Stain for 30 seconds in fuchsin solution (1 vol. saturated alcoholic solution to 20 vol. distilled water). Wash in alkalised water. Dry, and mount in balsam.

Occasionally, capsules may be stained if the silver nitrate be omitted; and 0·25 per cent. sulphate of copper solution acting for one minute also effects the staining of capsules, but there is no contrast. The important point in the process is the washing in alkalised water. The microbes treated were *Micrococcus tetragenus*, *Pneumococcus lanceolatus*, *Bacillus Pneumoniæ Friedlaender*, *Bacillus capsulatus* Pfeiffer, and *Bacillus Anthracis*. The advantages claimed for this method are (1) the contrast staining, the bacterial body being blue and the capsule red; (2) the permanence of the preparations.

Staining Gonorrhœal Secretion with Anilin Mixtures.‡—Herr Lanz gives the following mixture for staining *Gonococcus*. It is composed of thionin and fuchsin; the gonococci pick up the thionin, the cell-protoplasm the fuchsin, while the nuclei are stained with a mixture of the two. The solution must be made fresh each time. The solutions are saturated ones in 2 per cent. carbolic acid, and are mixed in the proportion of 4 thionin to 1 fuchsin. A quarter of a minute is usually sufficient for staining; the preparation is decolorised by washing in water.

Staining Nerve-tissue with Gold.§—Herr S. Apáthy has stained nervous tissue for some years by the following method. He has used gold compounds before and after the fixation of the tissue. In the first or fore-staining method, fresh tissue is placed in the dark in 1 per cent. solution of aurum chloratum flavum ($AuCl_4H + 4H_2O$) for 2–24 hours.

* Micr. Bull., xv. (1898) pp. 42-3.

† Hyg. Rundschau, 1898, No. 18. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 32.

‡ Deutsch. med. Wochenschr., 1898, No. 40. See Centralbl. Bakt. u. Par. 1te Abt., xxv. (1899) p. 152.

§ Mittheil. a. d. Zool. Stat. zu Neapel, xii. (1897) pp. 495–748 (10 pls.).

The specimen is then transferred to 1 per cent. solution of formic acid for 24 hours. During this time the preparation must be exposed to the light, and for 6–8 hours to direct sunlight. The preparations are to be mounted in gummi syrup (gum dextrin) or in strong glycerin.

When the preparations are fixed, the following method is adopted. The objects are fixed in sublimate or sublimate-alcohol. The sublimate is removed by iodopotassic iodide solution, and then the objects are transferred to strong alcohol, after which they are immersed in the following solution of iodine 0·5 per cent., iodide of potassium 1 per cent. in 95 per cent. alcohol, until the solution becomes yellow. After all the iodopotassic iodide has been removed by absolute alcohol, the object is imbedded in the usual way, and series of sections made.

The sections on the slide are immersed in 1 per cent. solution of aurum chloratum flavum for 24 hours. The sections are next immersed in distilled water for a short time, and then placed in tubes filled with 1 per cent. formic acid for 24 hours. After removal the sections are washed in distilled water and mounted in glycerin or balsam.

(6) Miscellaneous.

Method for Restoring the Spiking of Anthrax.*—Mr. R. Muir has found that the "spiking" of *Bacillus Anthracis* may be restored by making a culture from an old non-spiking organism on freshly prepared blood-agar tubes, and incubating for 24 hours at 37° C. Subcultures from this in 10 per cent. gelatin-pepton are incubated for two days at 20°, and then show the spiking well.

Orienting very Small Objects.†—Dr. R. W. Hoffman gives a modification and improvement of Patten's method for orienting very small objects. Instead of paper the author uses strips of glass, about 2–2·5 cm. long and 0·5–0·75 cm. broad, upon which the objects are stuck, and employs Patten's adhesive as an imbedding mass. The collodion-clove-oil mixture is made by putting equal parts of collodion and clove oil into a wide-mouthed bottle and allowing it to stand for about 24 hours in an airy place. It is next treated with xylol, which produces a perfectly clear and yellowish substance. The chief advantage of this adhesive-imbedding medium is that orienting becomes easy, more especially if the object be well stained. The objects are placed in position with needles. If necessary fine lines are easily scratched on the glass.

Metal-Mixture for Adhering to Glass.‡—A metal-mixture which will adhere firmly to glass and can be used for soldering glass together is made by mixing 95 per cent. tin and 5 per cent. zinc. The melting-point of this alloy is about 200°. The glass is previously heated to this temperature, and then the mixture spread over by means of the soldering iron. An alloy of 9 parts tin and 1 part aluminium may be used for the same purpose; but it has the disadvantage of having a higher melting-point, viz. 390°.

Double Capsule fo Bacteriological Purposes.§—Herr A. Bau has devised a capsule which is intended to prevent the access of germs from

* Journ. Pathol. and Bacteriol., v. (1898) p. 374.
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 312–6. Cf. this Journal, 1894, p. 534.
‡ Internat. Patentbureau. See Zeitschr. f. angew. Mikr., iv. (1898) pp. 218–9.
§ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 645–6 (1 fig.).

the outside. The capsule proper has a double rim, the intervening furrow or channel being intended for the closing material. The cover, which dips into the channel, has the edge bent down so as to more effectually prevent entrance of germs. Very much the same result would be attained by using three capsules of different diameters, the one of middle size being used as the cover.

Sensitive Litmus-Paper.*—According to Herr Sachs, in order to obtain a sensitive litmus-paper, it is necessary to remove the brown-violet pigment from the litmus; and he recommends that, after the litmus has been macerated for 12 hours in water, the strained fluid should be evaporated down in a water-bath to the weight of the litmus used. It is then to be diluted with three parts of 90 per cent. alcohol, and after having been acidulated with hydrochloric acid, to be allowed to stand for 48 hours. The azolitmin is then found as a brown sediment deposited on the bottom of the vessel, while the violet pigment remains dissolved in the alcoholic fluid. The precipitate is washed with acidulated water until the filtrate, tested with ammonia, gives a blue colour without a trace of violet. It is then dissolved in ammonia in the proportion of 1 to 3·5, neutralised, and used for saturating bibulous paper. To render this solution durable, 10 per cent. alcohol should be added.

Delicacy of the Biological Test for Arsenic.†—Dr. F. Abba highly recommends Gosio's test for arsenic. This test consists in growing *Penicillium brevicaule* in contiguity with a piece of the suspected substance. If arsenic be present, the odour of garlic soon becomes apparent. The test is not only delicate, but rapid, and has been used by the author for detecting the presence of arsenic in urine, paper, gas, and hides. The procedure is simple. Two or three pieces of potato with a hole in the middle are placed in a Petri's capsule. Into each hole is inserted a small piece of the suspected material (say a piece of hide or skin 1 cm. long by 0·5 cm. broad), and the whole sterilised for 20 minutes at 115° C. When cool, about 0·5 ccm. of water in which are suspended spores of *Penicillium brevicaule* is poured over the potato. The culture is kept at room temperature, and when opened in 24 hours, the characteristic smell of garlic is perceptible.

The result may be hastened by incubating at 37°; but in this case, and more especially if several examples are being tested at the same time, the atmosphere of the laboratory becomes so impregnated with the garlicky odour as to render it difficult to say from which capsule the smell proceeds. As an example of the delicacy of the test, the author states that he cut from the same skin two pieces, one 5 sq. cm. and the other 1 sq. mm. in area, and examined the former by Marsh's test and the latter by Gosio's. The chemical test failed, while the biological succeeded.

* Wiadom. Farmac.; Pharm. Zeitschr. Russl., 619. See Zeitschr. f. ang. Mikr., iv. (1898) p. 215. † Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 806-8.

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

A. Instruments, Accessories, &c.*

(1) Stands.

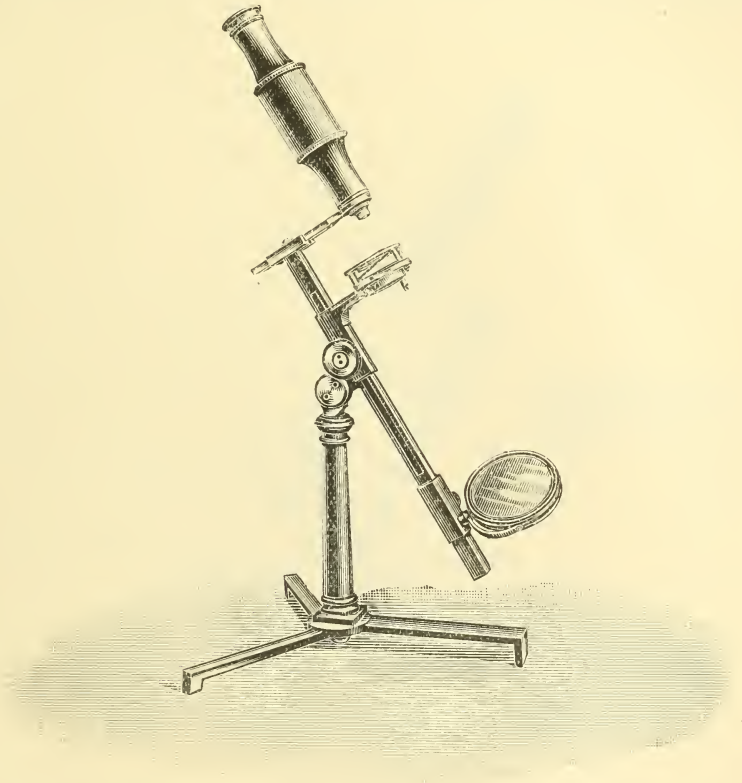
Two Old Microscopes.—At the meeting held on May 17th the President called attention to two old Microscopes which had just been presented to the Society. The first, which was given by Mr. J. M. Offord, was signed "Adams," and was a very interesting model, which filled up a gap in the historic collection of the Society's cabinet (fig. 72). The history of the Microscope stand might be divided into three epochs. The first might be called that of the telescope mount, because the stage was quite disconnected from the body, and the Microscope was pointed to the object in precisely the same way as a telescope. Hooke's and Hertel's models are examples of this type. The second epoch began with John Marshall's Microscope in 1704. This Microscope had its body and stage attached to a limb, the limb having a joint at its lower end, where it was attached to the foot. In this class may be put all non-inclinable Microscopes, as they are evidently the same as the type when the Microscope is used in a vertical position. Examples of this class: John Marshall's; Benj. Martin's large Microscope, both being in the collection; the non-inclinable Continental modern stand; and the small Microscopes sold in toy shops. The Microscope of the third kind, which is the model chiefly used at the present time, was designed by an anonymous nobleman, and made by Adams in 1771. In this instrument the body, stage, and mirror were fixed to a bar, which was attached by a joint to the top of a pillar. The joint was of the quadrant rack form, actuated by an endless screw, in fact an adaptation of the Gregorian telescope mount common at that date. There have of necessity been variations in details; the cumbersome rack joint has been superseded by the compass joint; the pillar and flat tripod have been replaced by either the Powell tripod, or the Continental horseshoe foot, or the bent claw foot; but nevertheless the principle remains the same, and this model has slowly but surely thrust out all other forms.

The point to which the President called special attention is that we have hitherto found no Microscope, description, or figure of this last class of Microscope between the time it was invented, in 1771, and 1797, when it was adopted by Jones, the successor to Adams. We have here, however, a signed example by Adams which proves that this form of Microscope was made prior to 1797. It is true that a similar instrument

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

(class 3) is figured in Rees' Cyclopædia, 1819, and called "Benjamin Martin's Microscope"; but it is highly probable that this is only a trade term; for we have no other evidence that Benjamin Martin adopted this construction. Benjamin Martin died in 1782, and the late and finest example of his work which is in the collection of the Society, is of class 2. This Microscope, whose probable date is about 1785–95, is the earliest type we have of class 3, which is that of the modern Microscope.

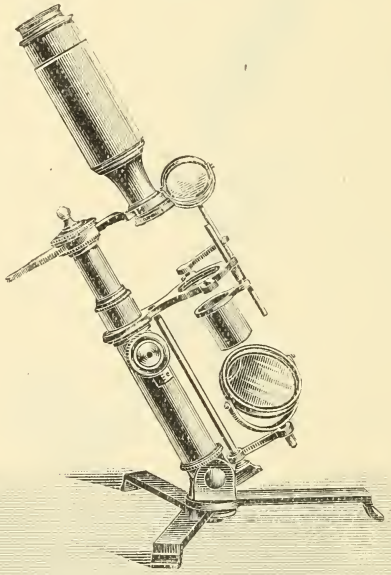
Fig. 72.



A second Microscope (fig. 73) has been very kindly presented by Dr. Dallinger. It is of class 2, and conforms very closely to a model made by Benjamin Martin in 1776. Unfortunately it is not signed, but the workmanship of the Microscope is evidently of that period, and might well be Martin's work. It will be seen at once that we have here a model of some importance; for it will be noticed that it is a body focusser, in contradistinction to the stage focussers so prevalent at that date. The following is a brief description:—The pillar is hinged at the bottom to a folding tripod; a tube can be extended out of this pillar for about an inch by means of rackwork; from this rack tube a third one may be

pulled out for a distance of two or three inches; there is a line drawn vertically down this third tube, and a mark engraved on the second tube; when this line is opposite the mark, it indicates that the body is in a line with the centre of the stage. Here the pulling or pushing tube acts as the coarse, and the rackwork as the fine adjustment. The stage is fixed, but both "forward" and "motion in arc" over the stage are given to the body. These motions of the body over the stage were derived from Ellis's Aquatic Microscope, made by Cuff in 1755, and were highly thought of at that time. The last Microscope so fitted was one designed by Mr. W. Valentine, of Nottingham, and made by Andrew Ross

Fig. 73.



in 1831. The motion in arc was however not given up until later, and to a partial extent still survives in Powell's No. 1.

With regard to the optical portion of this instrument, we find an elaborate eye-piece. It will be remembered that it was pointed out in the description of a Benjamin Martin Microscope last year,* that the eye-lens was broken up into two lenses of equal foci, the first being a crossed, and the other a plano-convex lens. In this one we have a further development; for the plano-convex lens is again broken up into two plano-convex lenses of 3 in. foci. The equivalent focus of these three eye-lenses is 1 in., that of the field-lens 3 in., and the

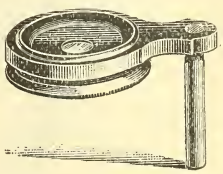
* Cf. Journ. R.M.S., 1898, p. 474, fig. 81.

distance between them 2 in. So we have here a most complicated form of Huyghenian eye-piece, consisting of no less than four lenses.

A short distance from the end of the nose-piece we have an equi-convex lens of 5½ in. focus; this, as was stated before, is really the back lens of all the objectives; for when the power is changed it is only the front lens of the objective that is altered. These front lenses, which are six in number, are mounted in a well-made and convenient rotating nose-piece, (A rotating nose-piece of a cumbersome form was made by Adams in 1746, and was fitted to his "Universal Double Microscope.") This compound Microscope consists therefore of six lenses, the largest number probably ever fitted to a non-achromatic Microscope.

There is another piece of apparatus of much interest, viz. a ring with a bar fixed at right angles to it. This can be used for either substage or superstage illumination. For substage illumination a biconvex lens, of 2 in. focus, is burnished into a short piece of tube which screws into the ring; the bar attached to the ring slides through a socket in the stage (see fig. 73), the whole forming a crude substage condenser capable of being focussed. When superstage illumination is required, the lens and its tube are removed, and a lieberkuhn substituted for them; the rod is inserted in the socket in an opposite direction, so that the lieberkuhn is brought immediately over the object on the stage. It will be noticed that the one lieberkuhn is made to do duty for all the powers (fig. 74).

Fig. 74.



This combined sub- and superstage illuminator was employed by Jones in his "Most Improved Compound Microscope," and is figured in the 1798 edition of Adams on the Microscope, but this is the earliest example yet recorded of it. The pivoted superstage, with three holes in it, which was fitted to all Benjamin Martin's Microscopes, and which was also adopted by Adams and Jones, is unfortunately missing, but a place is fitted to receive it in the packing in the box.

Some possessor of this instrument has been trying to compensate the non-achromatism of the objective by the use of a screen; for there is a piece of green glass roughly cut to fit the tube of the substage condenser. This must be a very early, if not the earliest, instance of a screen.

The Microscope presented to the Society by Dr. Dallinger is full of interest, and is the earliest example of a rackwork limb Microscope in its collection.

Ross's New Model Medical School and Educational Microscope.—This instrument (figs. 75 and 76) has been specially designed for the use of demonstrators, teachers, and medical, dental, veterinary, and pharmaceutical students. It is a modification of the well-known Ross Eclipse stand, and is intended to provide students, at the outset of their career, with a thoroughly good instrument at a small initial outlay, but admitting of subsequent addition of parts without structural alteration, and rendering it ultimately capable of doing the most advanced work. Its construction is substantial, and all its different parts are well fitted, and it will be found perfectly steady in all positions, even when used with the highest power objectives. The stage is sufficiently large to

bring into the field of view every portion of a bacteriological cultivating trough, being $2\frac{1}{2}$ in. from centre to pillar. An entirely new but simple

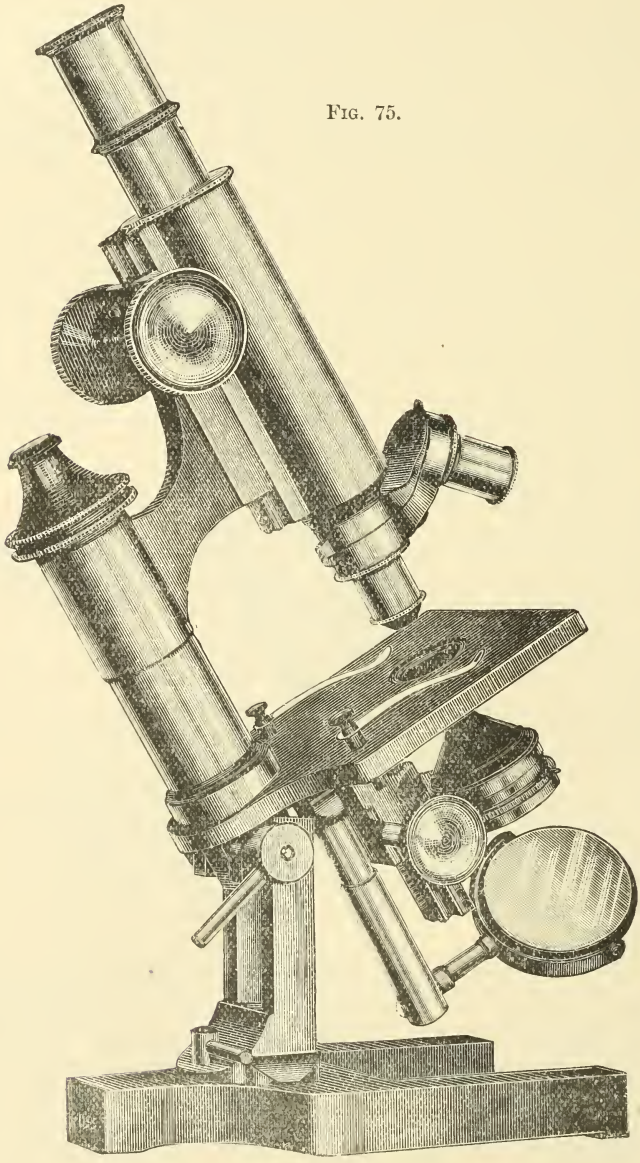
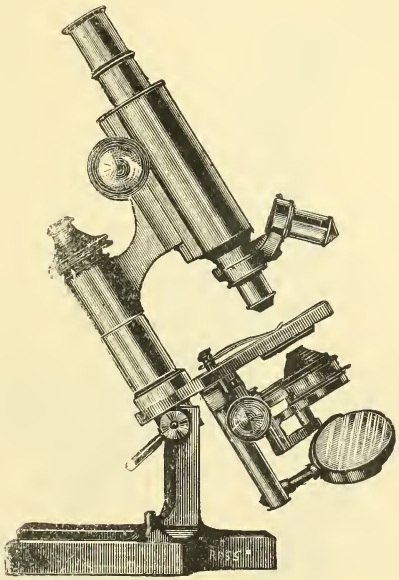


Fig. 75.

device has been applied to the substage for the manipulation of the Abbe condenser and iris diaphragm independently of each other. By this

means they are readily removed out of the optic line, thus effecting a great saving of time. The foot of the instrument can be made to reverse and lock, so as to bring the longest spread under the body-tube, when the instrument is to be used in a horizontal position for photography or drawing.*

Fig. 76.

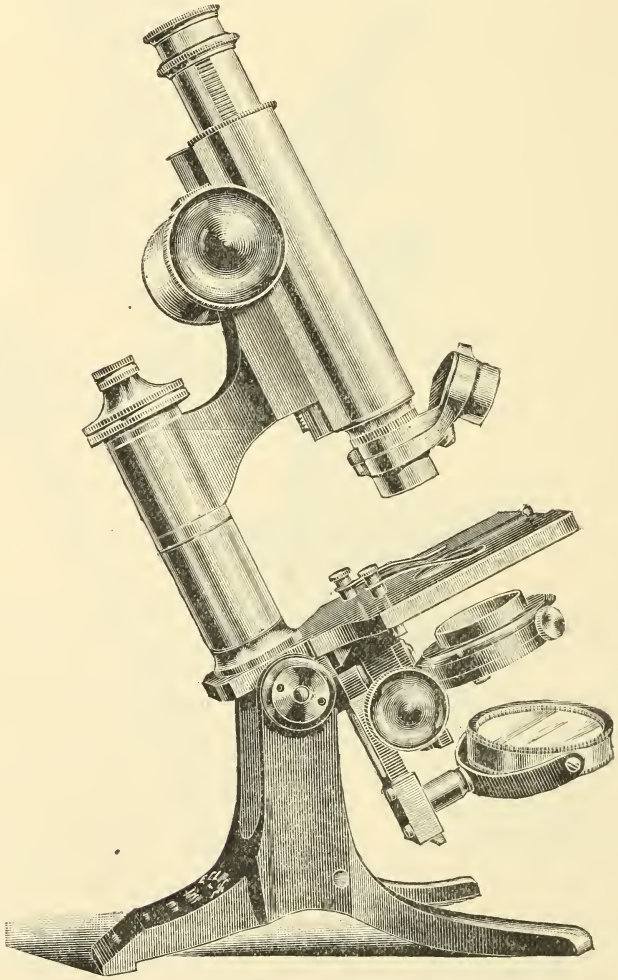


Ross's New Bacteriological Microscope.—This Microscope (fig. 77) has been specially designed for bacteriological study, and is one of the steadiest ever constructed for this purpose. The inclination to tilt, prevalent in many stands, is obviated by mounting on a patent modified tripod foot or a circular foot. This patent tripod gives a much greater spread than the ordinary tripod, but requires less space in the packing case, because the hind toe is made to fold forward between the two fixed front toes when not in use. The circular form of foot has the short stout pillar, supporting the upper part by a substantial knee-joint, situated towards the margin of the ring, which brings the whole weight centrally upon the foot when the instrument is in the upright position. When inclined, the centre of gravity is again brought directly over the foot, by rotating the pillar upon a reliable fitting at its base, so that absolute steadiness is secured. This is maintained with the body and limb in the horizontal position, so that the Microscope is particularly well adapted for photomicrography. The stage is firmly fixed between

* This principle of the reversing foot was invented by Cuff, *circa* 1765 (see Journ. R.M.S., 1898, p. 675, fig. 117); it was used by Andrew Ross in 1842 (Journal, 1899, p. 215, fig. 47), adapted to a horseshoe foot by Sidle and Poalk in America in 1880 (Journal, 1880, p. 523, fig. 39), and by Maclaren here in 1884 (Journal, 1884, p. 111, fig. 9.)—Ed.

two main parts, and its aperture is of the horseshoe form, which affords convenient space for the finger to lift the slide, so as readily to bring the oil in contact when an immersion lens is used. This stage is provided, at desire, either with clip springs or a sliding dovetail clip with rectangular divisions.

Fig. 77.



The fine adjustment is of the most solid construction, and yet is extremely sensitive, and is so made that it is entirely covered at all points, thus preventing the possibility of injury by dust. The micrometer screw works directly in the centre of its fitting, and its milled head reads to 1/500 in. The draw-tube is graduated to millimetres.

The instrument is fitted with a new centering substage, having both coarse and fine adjustments; so that when using high powers with the Abbe condenser, the most accurate focus can be obtained with the least amount of trouble.

Bausch and Lomb's Continental (Grand Model) Microscope.—The large body-tube of this instrument (fig. 78), especially constructed to permit a large cone of light to pass from the objective, fits this stand especially for photomicrography. The base, of horse-shoe type, is extra heavy, and has the back claw prolonged so as virtually to form a tripod base, which is entirely stable in any position of the Microscope. The stage is of unusually large size, measuring 126 mm. in diameter, and is fitted either with a vulcanite plate or a mechanical stage; in either case the stage is revolving, and with centering screws, whereby the geometrical centre of the stage may be made to coincide accurately with the optical axis of the objective. The heads of the centering screws are provided with graduations and index, and with a series of lines recording the number of revolutions of the screw. It is claimed that these extra graduations make this the only Microscope provided with revolving mechanical stage, with which it is possible to record accurately the position of any given object, in such a manner that it can be referred to again if the instrument shall have been used *ad interim* for other work. The mechanical stage is readily interchangeable with the plain revolving stage. To effect the change, it is merely necessary to loosen the centering screws and substitute one stage for another.

The fine adjustment is an improved triangular bar adjustment; and in order to give increased delicacy in manipulation, the head of the micrometer screw is made extra large, and has a concavity at the apex in which to rest the index finger for greater steadiness. The circumference is graduated to 100 parts, permitting measurement of the thickness of objects under observation.

The coarse adjustment is by diagonal rack-and-pinion, the advantage of the diagonal teeth being that much greater delicacy of movement is secured, together with greater lasting qualities, as three teeth engage at all times, and with a shearing contact, instead of in the jarring fashion as with the straight rack. The sleeve carrying the draw-tube is removable when using the stand for photography.

American Type Microscope.—Fig. 79 represents Messrs. Bausch and Lomb's "Universal" pattern of this instrument. A large bronze pillar, jointed for inclination, is fitted on a brass tripod base, and a heavy thumb-screw (not shown in the figure) secures the instrument in any desired position. The coarse adjustment is by diagonal rack-and-pinion of long range. The fine adjustment is by micrometer screw, working in a steel nut on the triangular bearing of the arm. The head of the micrometer screw, silvered and graduated, is provided with an indicator. The main tube has two graduated draw-tubes sliding in the cloth-lined main tube. The stage has concentric revolving motion and removable spring clips. The large-sized mirrors are plane and concave; both these and the substage with its dome diaphragm are separately adjustable on their respective bases; the circular bearings of these are large, and are graduated to degrees and silvered. Mirrors and substage bars have

Fig. 78.

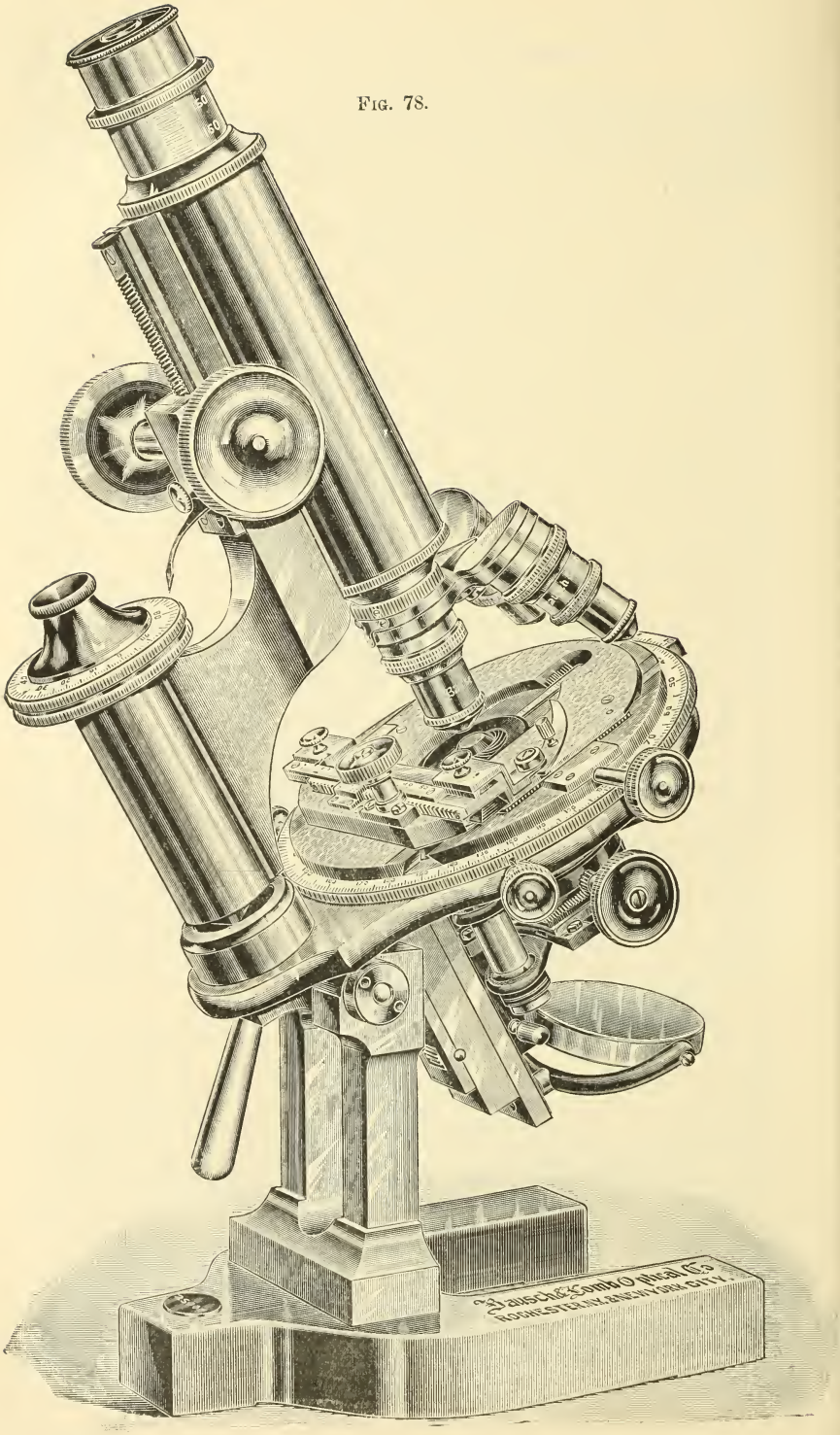
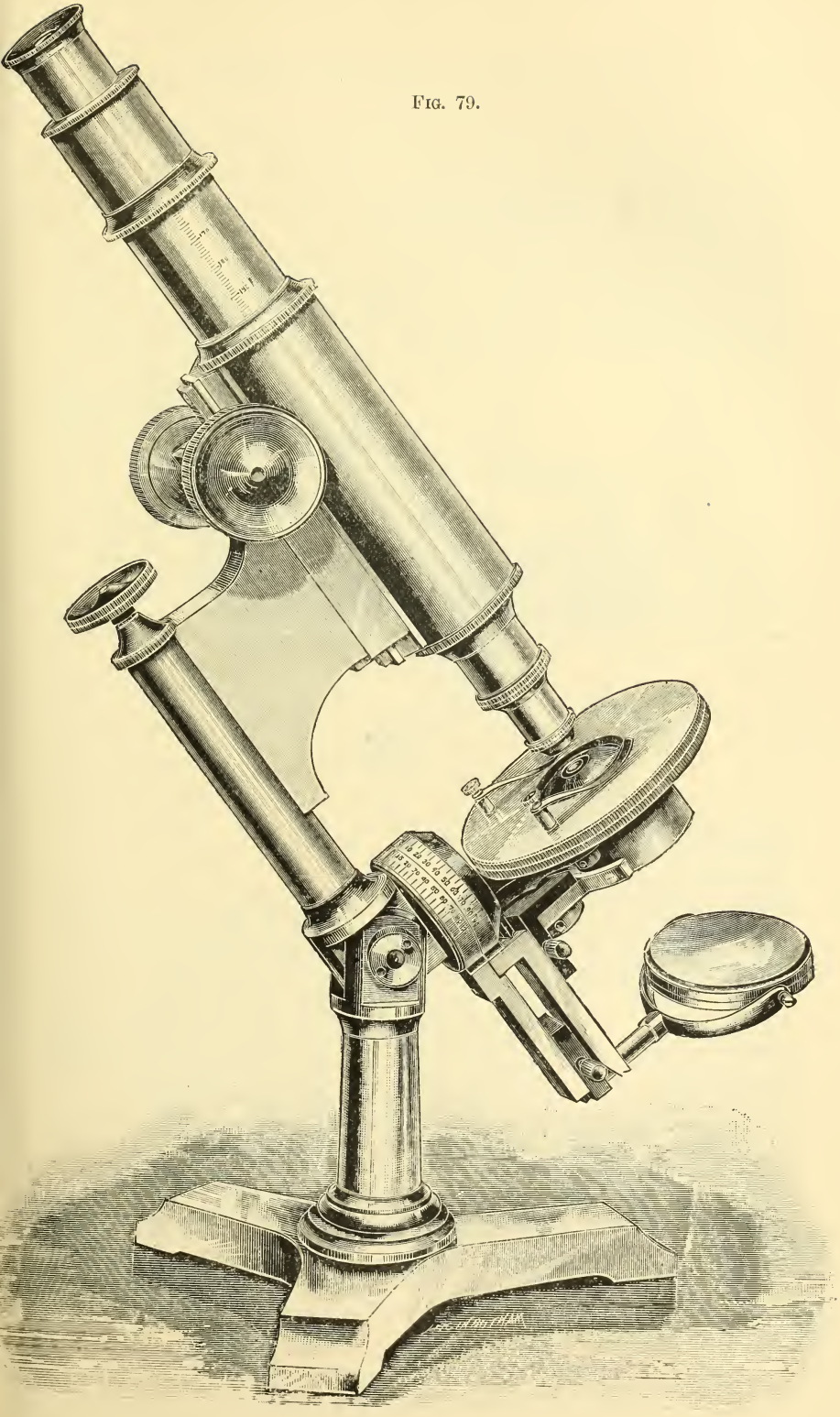


Fig. 79.



their axes in the plane of the stage, and move independently of one another or together, to any obliquity below or *above* the stage. A steel pin for centering the substage accompanies the instrument.

Sayre's Pocket Dissecting Microscope.—Figs. 80 and 81 show the instrument sold under this name by Messrs. Bausch and Lomb. It consists of a palm-piece or handle, of such length that the lens and object to be examined can be held comfortably and easily in one hand, while the other hand is left free to dissect the object, or to spread out its parts. The arm or post is cylindrical, is very light, and is so hinged and socketed that it can be placed in any position and turned at any

Fig. 80.

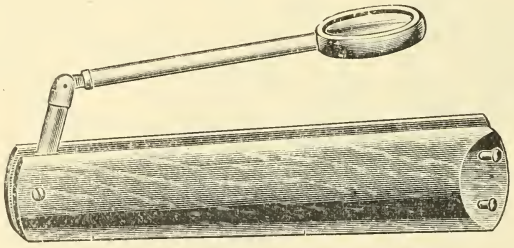
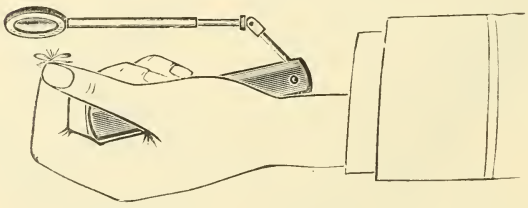


Fig. 81.



angle. The lens is of excellent quality, and is inserted upon a small post about the length of the palm-piece, so as to allow it to be placed over the object examined, when held between the thumb and forefinger of the hand which holds the Microscope. The instrument will also lie firmly on the table, as the handle is provided with a thin piece of metal which, when turned at right angles to the handle, supports it and the lens in an upright position. Thus the instrument can be used for low-power dissections. The arm and lens can be folded into the groove in the palm-piece, when the instrument resembles a pocket-knife.

Bausch and Lomb's Attachable Mechanical Stage.—Figs. 82 and 83 represent a new mechanical stage, which the designers believe will prove capable of preserving its delicacy of adjustment even after prolonged wear and tear.

The rectangular movements are both by rack-and-pinion, as all efforts to produce a perfect worm-screw movement have been unsuccessful. The rack-and-pinion is preferable, as it is perfectly reliable as to wearing qualities, is more sensitive than the screw, and gives equal speed to both movements. Millimetre graduations, with verniers, are

FIG. 82.

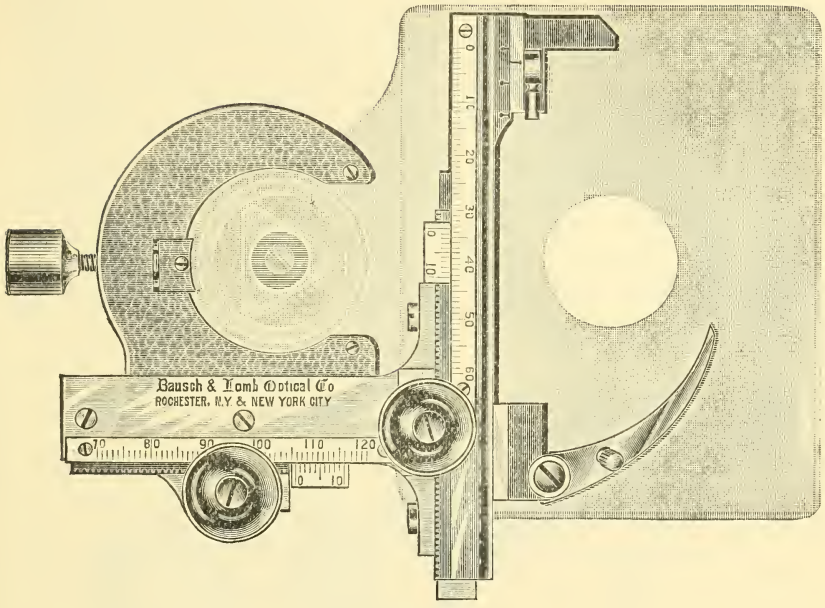
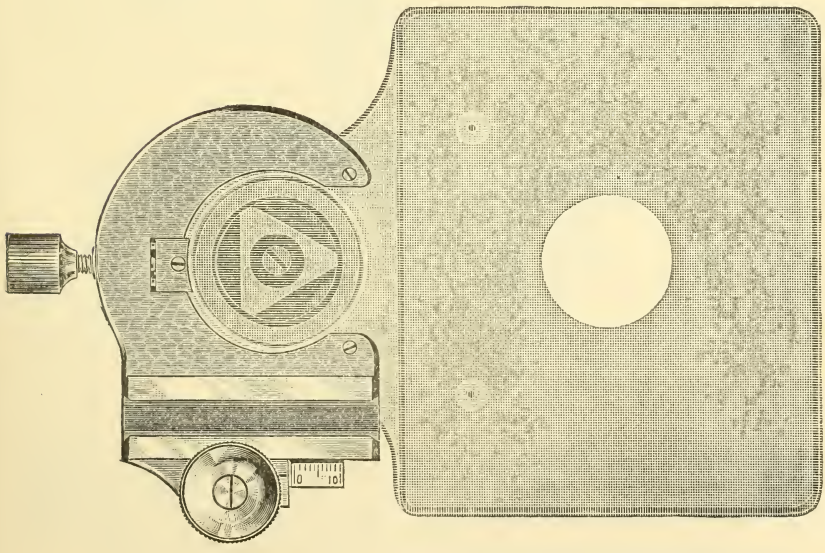
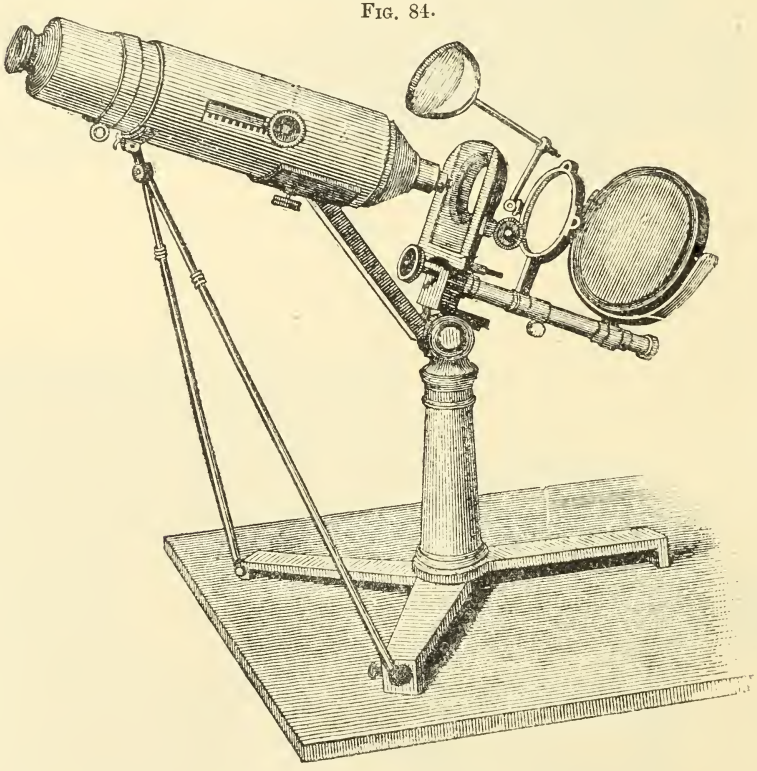


FIG. 83.



attached to both movements. The object-carrier is so arranged that the slide rests upon the surface of the Microscope-stage, and may be used in immersion contact with the condenser if desired. The stop against which the slide rests is adjustable, permitting the use of slides of various sizes. The object-carrier has an extraordinary range, the movements being 35 and 60 mm. respectively. The stage is held in place on the Microscope by a solid metal clamp, open at one side, which slips upon the base washer of the arm of the Microscope, in such a manner that the simple tightening of the thumb-screw at the back locks it immovably. The clamping device may be left attached to the Microscope permanently, and the object-carrier removed by simply racking it out of the slide. This feature is of great value, as the mechanical stage is necessary for search work, counting, &c., while an unobstructed stage is required when examining bacterial cultures in culture dishes, using watch-glasses on the stage of the Microscope, &c.

Fig. 84.



Powell's Iron Microscope.—The President sends us the following addendum to the account of Powell's Iron Microscope, which was exhibited at the February meeting *:—"I have found the origin both of the

* See p. 209 and figs. 44 and 45 of the current volume of the Journal.

peculiar shaped foot and of the joint at one side of the pillar. These constructions first appeared in a 'single-lever Microscope,' designed by C. Varley, and made by H. Powell in 1843. The gold Isis medal of the Society of Arts was presented to C. Varley for this Microscope. We are now able to place the date of Powell's Iron Microscope between the above date, 1843, and 1848, when the first published account of it appeared; the date therefore given in my original communication was too early.

"The accompanying block (fig. 84) unfortunately arrived too late for insertion in its proper place on p. 211 of the last number of the Journal. It is a cut of an important Microscope; as it is the first compound *achromatic* Microscope made in this country. It was made by Mr. Tulley from original drawings supplied by Mr. J. J. Lister, and it was completed on May 30th, 1826. It is of interest to note that the substage held a combination of lenses, or what we should now call a chromatic substage condenser."

GATES, DR. ELMER.—**Million-fold Magnification.**
[This is stated to be obtained by use of low-power lenses, and by substituting a second Microscope for the ocular of an ordinary Microscope.]
Amer. Mon. Micr. Journ., XIX. pp. 189–202 (1 pl. and 1 fig.).

VAN HEURCK, DR. H.—**Étude sur les objectifs apochromatiques.**
[The form of lens figured in this paper is that of the old apochromats when they were first introduced, and not that of those now manufactured.]
Ann. Soc. Belge de Microscopie, XXIII. (1899) pp. 41–73 (1 pl. and 9 figs.).

WALLACE, DR. JAS.—**Eye-piece for photographing through the Microscope.**
Micros. Bull. (Philadelphia), 1899, p. 8 (1 fig.).

(3) Illuminating and other Apparatus.

Direct-Vision Spectroscope.—This small direct-vision spectroscope (fig. 85) has been sent to us by Mr. C. L. Curties. It is on a new model, inasmuch as the eye-piece is jointed; this permits a large amount of dispersion to be used together with a high-power eye-piece.

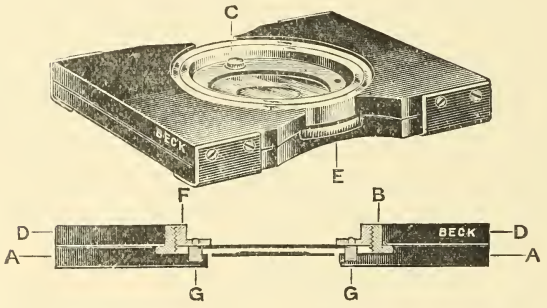
FIG. 85.

By means of the joint the spectrum can be searched low down in the red and high up in the violet, so that the A and H lines can be brought into the middle of the field. The slit is of very good quality, and the sodium lines are shown sharply divided. It is in every way suitable for microscopical work, and can be readily adapted to an eye-piece.

Davis' New Ebonite Reversible Compressor.—This instrument (fig. 86), manufactured by Messrs. Beck, is specially designed for the examination of living objects, and consists of a lower ebonite plate A, which in the centre has a circular hole recessed to receive a circular brass ring B, resting loosely in the recess. On the recessed portion of A is carried an oblong thin glass held in position by two screws, one of which appears at C. Two end plates D D slide on to the plate A,

and hold the ring B loosely in position, allowing it to be revolved by means of its milled flange, which projects at E. Within the ring B is screwed a brass disc F, which carries the upper thin glass, and which

Fig. 86.



is attached by the screws G G. The screws G G and C fitting into holes in the lower plate A, and the disc F respectively, prevent the disc from revolving; and, when the ring E is turned, the two thin glasses are moved toward or away from one another.

The slides D D and the ring B, together with the disc F, are removed for arranging the object on the lower cover glass; and when replaced, by revolving the ring at E, any desired amount of compression may be obtained. The object having been arranged, either side may be examined with equal facility, as the compressor is reversible.

When a very small object is to be examined, a small circular cover glass should be cemented with Canada balsam to the lower cover-glass, and the object is thus confined to the centre of the field.

Fig. 87.

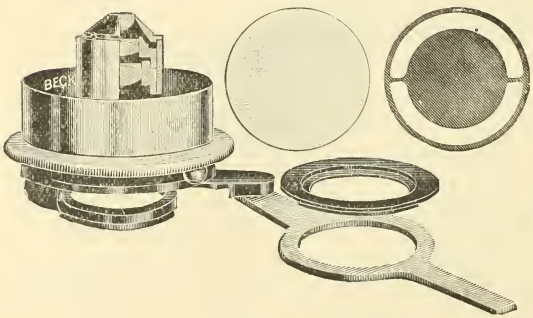
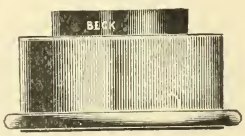


Fig. 88.



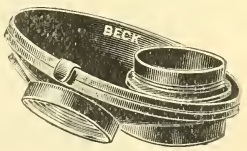
Beck's Achromatic Condenser.—This piece of apparatus is designed as a well-corrected condenser suitable for the most delicate high-power investigation. It has an aperture of 1·00 N.A., or the maximum that

can be obtained without having the front of the condenser in immersion contact with the under surface of the slide. It has an aplanatic aperture of 0·90 N.A., that is to say, the whole of the light included in 0·90 N.A. is brought accurately to a point. The front lens is removable to make a low-power condenser. In the mount (fig. 87) the optical portion may be used as shown, or may be unscrewed and screwed into the bracket provided for the purpose at the bottom of the mount, and the whole condenser reversed. An iris diaphragm and a swinging arm with rotating fitting for coloured glasses or stops are provided.

The condenser may also be supplied at a cheaper rate in a plain mount with iris diaphragm, as shown in fig. 88.

Beck's New Triple Nose-piece.—This is shown in fig. 89. Its great advantage is its dust-excluding properties, and it is also low-priced. The material throughout is bright lacquered brass, and the nose-piece is accurately centered, and is so constructed that no dust can enter the back of object-glasses when left in position continuously on the Microscope.

Fig. 89.



The Rational Use of Dark-Ground Illumination.*—Dr. Gebhardt, in this paper, points out the neglect by scientists of dark-ground illumination, although he admits that botanists not infrequently use it. He thinks that this neglect is partly due to the incompleteness of the methods hitherto in vogue, notably to the deficiency of application of objectives of moderately large aperture. He points out that it is now possible, on the basis of the means furnished by Abbe's illuminating apparatus, almost even without further aids, to render objectives of high aperture serviceable to dark-ground illumination. The method depends principally on the fitting of suitable diaphragms to the objectives. But, without special occasion, no stopping-off of dry objectives ought to occur, while with immersions it is always necessary.

After numerous experiments with Zeiss' apochromatics, it was ascertained that the optimum image was got for the aperture 0·30 with a stopping-off of about 0·10 to 0·15; for aperture 0·65 with about 0·20–30; and that these afforded a sufficient penetration and flatness of the field, without the aperture becoming too much reduced for most purposes which require this flatness. With the aperture 0·95 two different diaphragms proved the best, one of about 0·30 and another of 0·60–70, according to whether it was desired to lay more stress on the flatness of the field or on the aperture. With achromatics similar proportions were obtained. With all objectives a considerable gain in light results from the water (or better the oil) immersion connection of the upper condenser-lens with the under side of the object-slide. With strong objectives of 0·70 upwards this is unattainable, if the full opening ought to be used, and in working with them the uniform use of a very intense light (e.g. sunlight) is advised.†

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 289-99 (3 figs.).

† This device is not new. Stops were fitted to objectives for this purpose by Wenham, circa 1850, examples of which are in the Cabinet of the Society.—Ed.

KEELEY, E. J.—**Neglected Feature in the Construction of Achromatic Condensers.** [The author suggests the employment of a correction collar with an achromatic condenser. A condenser with adjusting collar has been designed by Mr. E. M. Nelson, and described in this Journal, 1895, p. 230, fig. 32.]
Micros. Bull. (Philadelphia), 1899, pp. 5–6.

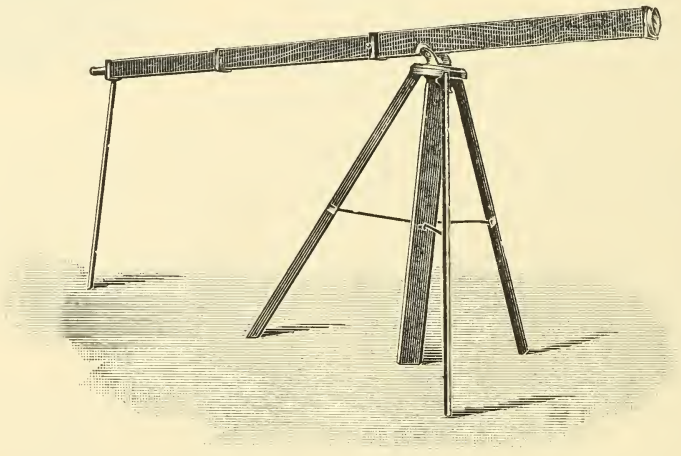
„ „ **Some simple Methods for producing Vertical Illumination.**
Micros. Bull. (Philadelphia), 1899, pp. 7–8.

(6) Miscellaneous.

Early Achromatic Telescope.—The President has sent us fig. 90, and the accompanying description of a very early achromatic telescope in his possession made by John Dollond.

This telescope is interesting from the circumstance that the achromatism of the Microscope was derived from that of the telescope. The telescope was first achromatised by Mr. Chester Moor Hall in 1733, but he appears to have kept the invention to himself, as he did not publish anything about it.

FIG. 90.



Achromatism was independently discovered by John Dollond, a Spitalfields silk-weaver, who studied mathematics and optics, and who gave up the weaving business in 1752 to join his son Peter Dollond, an optical instrument maker in Vine Court.

John Dollond, in 1757, investigated the laws of dispersion, and the next year the Copley Medal of the Royal Society was awarded to him for his invention of achromatism. As John Dollond died in 1761, the date of this telescope may be placed between the years 1758 and 1761.

It is 4 in. in aperture, and 10 ft. in focus. The body is composed of three square mahogany tubes, which slide one within the other; there are spring bolts fixed to two of them which shoot when the tubes are either fully extended or quite closed. The eye-piece is a Huyghenian, with a push tube focussing; the power is 100.

The stand is somewhat peculiar. In the centre of the tripod there is

a vertical triangular box, from which extends a long triangular ratchet bar; at the upper end of this bar a rotating brass head is fitted; this holds the trunnions of the telescope. The weight of this triangular ratchet bar, together with that of the telescope, is counterpoised by three weights attached to catgut lines passing over three pulleys at the top of the triangular box. The great focal length of the telescope renders it necessary that its point of support should be considerably raised above the level of the ground.

The object-glass is still in excellent condition, and it yields a sharp and well-defined image.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Method for Making the Three Principal Artificial Media.†—Mr. H. W. Hill, in the following table, gives directions for making nutrient media based on the recommendations of a bacteriological committee.

		Boil 30 grm. thread agar in 1 litre of water for half an hour. Make up loss by evaporation to a weight of 1000 grm. Cool and solidify.
Nutrient Broth.	Nutrient Gelatin.	Nutrient Agar.
1. Infuse lean meat twenty hours with twice its weight of distilled water in refrigerator: Say 1000 grm. meat. 2000 grm. water.	Ditto.	Infuse lean meat 20 hours with its own weight of distilled water in refrigerator. Say 1000 grm. meat. 1000 grm. water.
2. Make up weight of meat infusion (and meat) to original weight by adding water, i.e. to 3000 grm.	Ditto.	Ditto, i.e. to 2000 grm.
3. Filter infusion through cloth to remove meat.	Ditto.	Ditto.
4. Titrate and record reaction of filtrate. Say reaction + 2·2 per cent.	Ditto.	Ditto. Say reaction + 4·2 per cent.
5. Weigh infusion. Say 1800 grm.	Ditto.	Ditto. Say 900 grm.
6. Set infusion on water-bath, keeping temperature below 60° C.	Ditto.	Ditto.
7. Add peptone, 1 per cent., 18 grm. Add salt, 0·5 per cent., 9 grm.	Ditto, and sheet gelatin, 10 per cent. 180 grm.	Add peptone, 2 per cent., 18 grm. Add salt, 1 per cent., 9 grm.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. † Journ. Applied Microscopy, ii. (1899) pp. 301–4.

Nutrient Broth.	Nutrient Gelatin.	Nutrient Agar.
8. After ingredients are dissolved, titrate; reaction probably + 2·3 to + 2·5.	Ditto; reaction probably + 4·0 to + 5·0	Ditto; reaction probably + 4·5 to + 4·7.
9. Neutralise (Fuller's method).	Ditto.	Ditto.

To the 900 grm. of meat infusion (containing now peptone and salt also) add 900 grm. of the 3 per cent. agar jelly described at head of this column. Since agar is neutral, the reaction is unchanged.

10. Heat over boiling water (or steam) bath 30 minutes.
11. Restore weight lost by evaporation to original weight of filtered meat infusion, i.e. that on which the percentage of peptone, salt, &c., were calculated—1800 grm. in *each case*.
12. Titrate—reaction probably + 0·3 to + 0·5.
13. Adjust reaction to final point desired—generally to + 1·5 per cent.
14. Boil 5 minutes over free flame, with stirring.
15. Add water, if necessary, to make up loss from evaporation to 1800 grm.
16. Filter through absorbent cotton, passing the filtrate through the filter repeatedly until clear.
17. Titrate to determine whether or not the desired reaction has been maintained.
18. Tube and sterilise.

Preparation of Nutrient Agar.*—Dr. T. Yokote recommends the following method for making nutrient agar, on the ground that no special apparatus is required, and that the procedure is rapid and easy. 500 grm. of minced or scraped meat free from fat or gristle are immersed in 1 litre of pure water, and the mixture thoroughly shaken up. The vessel is then placed on a sand-bath and heated at first slowly, and afterwards boiled for 1½ hours. The fluid is then filtered through paper. To 1 litre of the filtrate 15 grm. of powdered agar are added, and the mixture heated anew for about an hour, after which 10 grm. peptone and 5 grm. of salt are added. When thoroughly dissolved, the solution is treated with soda or caustic soda until it has a faint though distinct alkaline reaction. When it has cooled down to 50°, the whites of two eggs are added, and the whole thoroughly well shaken. The mixture is then heated for 1½–2 hours, care being taken that the temperature of the sand-bath near the flask is not less than 110° C. During this time the water lost by evaporation must be replaced. The next step is to strain the solution through an ordinary filter. The time occupied by filtration need not exceed 5 minutes, and the time for the whole procedure should not exceed 6 hours.

Nutrient Starch Jelly.†—Dr. E. F. Smith recommends a medium of which the following are the ingredients. (1) Three grm. of dried potato-starch are put in a test-tube along with 10 ccm. of the following

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 379–80.
† Op. cit., 2te Abt., v. (1899) pp. 102–4.

fluid. (2) The fluid is a modified Uschinsky's medium:—distilled water 1000 grm.; ammonium lactate 5 grm.; sodium asparaginate 2·5 grm.; sodium sulphate 2·5 grm.; sodium chloride 2·5 grm.; potassium phosphate (K_2HPO_4) 2·5 grm.; calcium chloride 0·1 grm.; magnesium sulphate 0·1 grm.

Instead of this fluid, Uschinsky's medium without the glycerin may be used, and instead of potato-starch, rice or any other kind of starch.

After thoroughly stirring up the starch in the fluid, the tubes are placed in a dry oven, where they are heated on 5 or 6 consecutive days for 2–3 hours at a temperature ranging from 75° to 85°. After the second heating it is advisable to put 2 ccm. of distilled water in each tube, to replace that lost by evaporation.

This medium keeps well, and is adapted for fungi and bacteria. It is especially suited for studying the diastatic action of bacteria.

To this starch-jelly, assimilable kinds of sugar may be added, and may be used for testing the nutrient value of various sugars, gums, or alcohol. Such substances must be added and dissolved before the starch. The author uses 500 mgrm. to each 10 cm. of fluid.

New Method for Cultivating Diphtheria Bacilli.*—Dr. A. Joos recommends his serum-agar as an infallible medium for the cultivation of diphtheria bacilli. It is prepared by mixing 300 ccm. of blood-serum with 50 ccm. of normal soda solution, and 150 ccm. of distilled water or bouillon. The mixture is placed in a flat-bottomed flask, and then heated for 2–3 hours in a water-bath at a temperature of 60°–70°. The temperature is then raised to 100°, or what is still better, the flask is placed for one-half to three-quarters of an hour in a steam steriliser. An equal quantity (500 ccm.) of peptonised bouillon and 20 grm. agar are now added. The solution is filtered while hot, sterilised for a quarter of an hour in an autoclave at 100°–110°, and then distributed into Petri's capsules. In making the foregoing, the only precaution necessary is not to raise the temperature too quickly, lest the albumen of the serum be coagulated.

The chief advantages claimed for this medium are that diphtheria bacilli invariably develop on it; streptococci never, and staphylococci scarcely at all. A diagnosis may be arrived at frequently in 5–6 hours, and always under 15 hours' incubation.

Cultivation of Leprosy Bacillus.†—Herr C. H. H. Spronck obtained from the tissues and bone-marrow of two cases of leprosy cultures on neutralised glycerin potato, which became visible after 10 days. The cultures contained rodlets which were longer and thicker than leprosy bacilli, and were more easily decolorised after staining in the usual way. The bacillus was also cultivated on Loeffler's serum and agar at 37°, but there was no growth at room temperature. Transfers from potato cultures were always unsuccessful.

Positive results were obtained with the serum reaction, the strength of which varied from 1 in 60 to 1 in 1000.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 296–304, 351–7 (10 figs.).

† Weekblad v. h. Nederlandsch. Tijdschrift v. Geneeskunde, Deel ii. (1898) No. 14. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 257–8.

Medium for Bacteriological Examination of Water.*— Herren W. Hesse and Niedner give the following as the most suitable medium for water examination:—agar 1·25 per cent.; albumose (Herdgen) 0·75 per cent.; distilled water 98 per cent. This medium does not require correction for acid or alkali.

Protogen as Culture Medium.†—Herr J. Laboschin recommends protogen, on the grounds that most bacteria do better on it than on other albuminous media, and that it is more easily manipulated. The author at first made his own medium by beating up the whites of eggs with twice their bulk of water. Afterwards he used the Höchster protogen. Of the latter, 10 grm. were mixed with 3 grm. salt and 1000 ccm. of meat water. This produced a clear transparent medium.

(2) Preparing Objects.

Collecting and Preserving Diatoms.—The following hints on this subject are given by Dr. R. Lauterborn.‡ Among fixing reagents, Flemming's chromo-aceto-osmic acid, and sublimate in either water or alcohol solutions, demonstrate the most delicate structural features of the nucleus and cytoplasm during division. Picro-sulphuric acid, followed by a hæmatoxylin stain, gives excellent pictures of the chromatic elements of the nucleus. A 1 per cent. osmic acid solution serves, in unstained preparations, to bring out the arrangement of the cytoplasm, the chromatophores, and other inclusions of the cell. A 45 per cent. solution of iodic alcohol is recommended for the study of the so-called "red granules" of Bütschli. After remaining about 15 minutes in the fixing solution, the diatoms were passed, before staining, through alcohols of increasing strength up to absolute, and then through alcohols of decreasing strength to distilled water. The most useful stain is a weak solution of Delafield's hæmatoxylin; safranin is useful in demonstrating the centrosome and nucleoles. When stained, the specimens were passed successively through 35, 70, 95 per cent., and absolute alcohol into oil of cloves. It is possible to stain the diatoms to a certain extent during life in a very weak solution of methylen-blue (1 in 100,000), in which they live for days. For magnification, a Seibert apochromatic objective of 2 mm. focal length was usually employed, in combination with a No. 12 ocular, giving a magnification of about 1200.

Methods for Demonstrating Structure of Protoplasm.§ — In his paper on the structure of the protoplasm of human epidermal cells, Dr. Karl Herxheimer devotes a special section to technique. He hardened fragments of skin in 10 per cent. formol solution for 48 hours, washed in water, placed in 70 per cent. alcohol for 24 hours, and in absolute for the same time. They were then soaked in a mixture of alcohol and ether for 2·3 hours, imbedded in celloidin, and sectioned. Various stains were tried, of which the most novel was a basic anilin pigment—"cresylechtviolett," which was employed in concentrated

* Zeitschr. Hygiene, xxix. (1892) No. 3. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 392.

† Inaug. Diss. Freiburg, 1898, 34 pp. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 391. ‡ F. R. Rowley in 'Natural Science,' xiii. (1898) pp. 415–6.

§ Arch. f. Mikr. Anat., liii. (1899) pp. 510–46 (1 pl.).

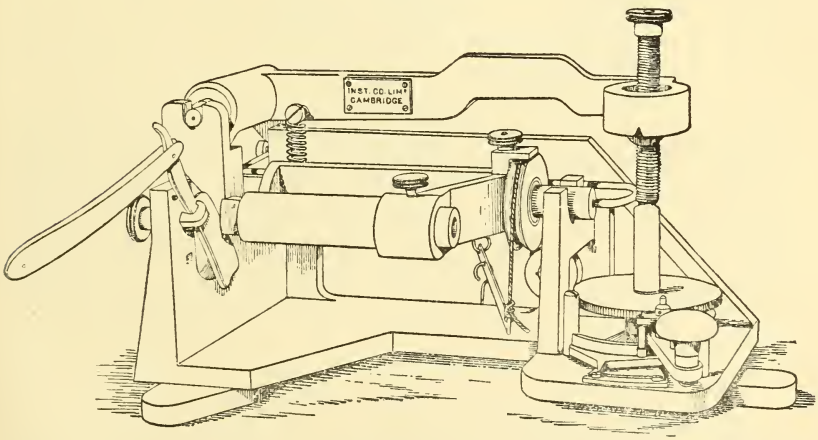
aqueous solution. It is very suitable for use after hardening in formol.

Microscopic Preparations of Copepoda.*—Copepoda are most easily collected, says Mr. C. D. Marsh, by means of a dredge, the mouth of which is covered with a cone of coarse wire gauze to keep out weeds, &c. For histological purposes, Copepoda are best killed by some one of the osmic acid preparations; for other purposes alcohol is the best reagent. The best staining results are obtained by immersion in dilute picrocarmine for 1–3 days. For dissecting Copepoda, it is advisable to place the animals on a slide and replace the alcohol by glycerin. Farrant's medium is recommended for mounting; the preparations can be transferred directly from the glycerin to the Farrant.

(3) Cutting, including Imbedding and Microtomes.

Rocking Microtome to cut Flat Sections.†—The Cambridge Scientific Instrument Company has produced a new pattern microtome to cut truly flat sections (fig. 91). It differs from the original rocking microtome in several respects. Larger sections can be cut, the tube holding the paraffin block being 30 mm. in internal diameter. The forward movement of the object towards the razor will allow of an object 12 mm. long being cut up without readjustment of the object-holder. A graduated

Fig. 91.

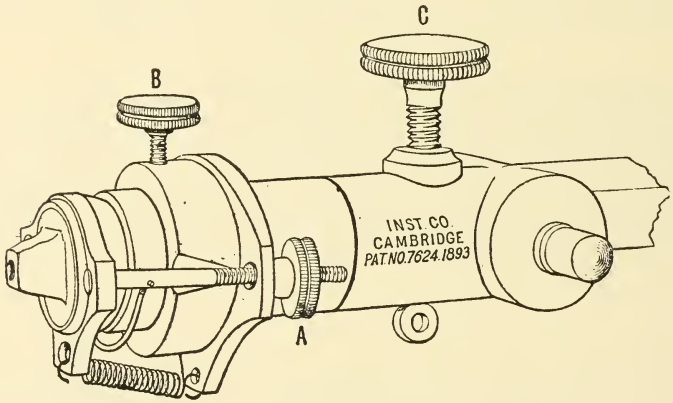


arc gives the thickness of the sections in thousandths of a millimetre. The object can be raised and fixed in a position clear of the razor, and the improved clamp is used for fixing the object-holder. The razor can be clamped either at right angles to the movement of the object or in a diagonal position for giving a slicing cut. The new instrument retains the essential features of the old rocking microtome,‡ but the arrangement is different, on account of the modification of the design.

* Journ. Applied Microscopy, ii. (1899) pp. 295–6.
† Cambridge Sci. Inst. Co.'s List, 1899, pp. 83–4 (1 fig.).
‡ Cf. this Journal, 1885, p. 549.

Improvements in the Cambridge Rocking Microtome.* — The Cambridge microtome has been improved by the addition of a new clamp and an adjustable object-holder (fig. 92). Either the simple tubular holder or the orientating apparatus is firmly clamped to the rocking arm by a small turn of a screw C. The advantages of this arrangement are that when the screw is loosened, the holder slides with perfect ease, giving an easy adjustment of the object towards the razor, and the connection of the rocking arm is very rigid. By means of the adjustable holder the object can be placed in the exact position for

Fig. 92.



cutting sections in the desired plane. The body of the holder consists of a tube of the same size as the ordinary tubular object-holder, and it is fixed to the rocking arm in the same manner. The object is placed in a hemispherical cup, which is firmly pressed against the open end of the tube by means of two screws, one of which is shown in the figure at A. When these screws are tightened up, the cup is turned about a vertical axis. If the head of the screw B is turned, the cup rotates about a horizontal axis. Thus the object can be rotated independently about a vertical or a horizontal axis.

(4) Staining and Injecting.

Simple Method for Staining Spores.†—The procedure recommended by Herr A. Klein is based on the observation that spores when in a moist condition are easily penetrated by pigments. A loopful of a 24 hours old culture of (say) anthrax is emulsified with two or three drops of salt solution in a watch-glass. To this emulsion is added a similar quantity of phenol-fuchsin recently filtered and freshly prepared, and the mixture thoroughly stirred. The watch-glass, covered with another, is heated over a burner to vaporisation for 6 minutes. After removal some of the fluid is dipped out and films made. These are

* Cambridge Sci. Inst. Co.'s List, 1899, p. 81 (1 fig.).
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 376–9.

allowed to dry in the air, and then fixed by passing twice through the flame. The next step is to decolorise in 1 per cent. sulphuric acid for 1–2 seconds. The films are now washed in water, after which they are contrast-stained in very dilute alcoholic solution of methylen-blue for 3–4 minutes. The preparations are then washed in water, dried, and mounted in balsam.

Staining Bacterial Spores.*—Dr. G. Catterina gives the following method for staining the spores of *B. anthracis*, &c. The spores are spread on cover-glasses, and fixed in the flame or in nitric acid fumes for 10–15 minutes. The preparations are then carefully washed with water, after which they are stained with Roux's fluid (methyl-green 1, 70 per cent. alcohol 10, water 90), heated to boiling. The addition of some more methyl-green imparts a better staining. The preparations are washed in water, and then stained with cold phenol-fuchsin solution. After this they are washed in water, 50 per cent. alcohol, and water again. The preparations are inspected in water.

Staining Bacteria in Tissues.†—Dr. C. Money states that the results from treating sections in the following manner are extremely good. The sections are first stained in picro-borax- or alum-carmine, and then in gentian-violet or methylen-blue to which 2–3 drops of formalin to a watchglassful of the solution have been added. The staining solution is then heated until it begins to vaporise. The excess of stain is washed off with water, and the preparations decolorised in 90 per cent. alcohol. It is advisable not to leave the preparations too long in formalin-gentian solution, because the decoloration becomes tedious.

Staining Plague Bacillus.‡—Dr. G. Boccardi gives the following as a good double stain for the plague bacillus in blood and pus preparations. Stain for 10 minutes in alcoholic or aqueous solution of eosin; wash in water, stain for one minute in weak methylen-blue solution (1–1000 water).

Staining the Granules in White Corpuscles.§ — Dr. G. Boccardi stains the granules in white corpuscles as follows. Fix the film for 5 minutes in osmic acid vapour. Immerse for a few seconds in peroxide of hydrogen diluted with five times the amount of water. Wash in water. Stain for 10–15 minutes in 1 per cent. aqueous solution of eosin, then for half a minute to a minute in methylen-blue solution. By this procedure the small neutrophile granules are stained red.

Method of Staining Mucous and other similar Cells.‖—The tissues, stomach, intestine, &c., says Dr. E. W. Carlier, should be fixed in sublimate or picro-sublimate, and after-hardened in alcohols of increasing strength. The sections should be washed in iodo-potassic iodide, and afterwards in water. The sections are stained on the slide in 0·5 per cent. aqueous solution of methylen-blue, patent B, for 10 minutes. The surplus stain having been washed off, the sections are treated with 0·6

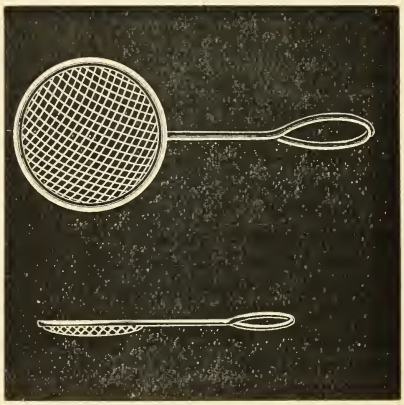
* Atti Soc. Veneto-Trentina, iii. (1898) p. 435.
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 424.
‡ Riforma Med., 1897, No. 168. See Centralbl. Bakt. u. Par., 1te Abt., xxv (1899) p. 237.
§ Tom. cit., p. 237.
‖ Proc. Scot. Micr. Soc., ii. (1897–8) p. 212.

per cent. solution of potassium bichromate until they assume a violet colour. They are then washed in water, dehydrated in absolute alcohol, cleared in xylol, and mounted in balsam. By this method the mucigen granules are stained violet, and the rest of the cell blue.

The mucous cells of salivary glands are not stained by this method. The preparations fade very quickly, but the method is valuable for the study of mucigen granules.

Apparatus for Heating Staining Solutions.* — Dr. O. Korn describes with considerable amplitude an apparatus for holding a watch-

Fig. 93.



glass filled with staining solution over the flame. As the illustration shows (fig. 93), it much resembles a spoon, with a shallow wire-sieve bowl.

(6) Miscellaneous.

Simple Method for Detecting the Typhoid Bacillus.†—Herr Piorkowski states that by means of the following procedure a certain diagnosis of enteric fever can be made from the stools within 20 hours. Healthy urine, of sp. gr. 1020, is collected for 2–3 days, by which time it has acquired an alkaline reaction. The urine, mixed with 0·5 per cent. pepton and 3·3 per cent. gelatin, is boiled for an hour in a water-bath and then at once filtered, after which it is distributed into tubes. The tubes are plugged with cotton-wool, and steam sterilised at 100° for 15 minutes. The sterilisation is repeated next for 10 minutes. Three tubes are inoculated with typhoid fæces; the first with 2 loopfuls, the second with 4, and the third with 6–8. The plates are now laid, and when set must be kept at a temperature of 21°–22°.

By this procedure the yellowish-brown round colonies of *B. coli* and

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 422–3 (2 figs.).
† Tom. cit., p. 319.

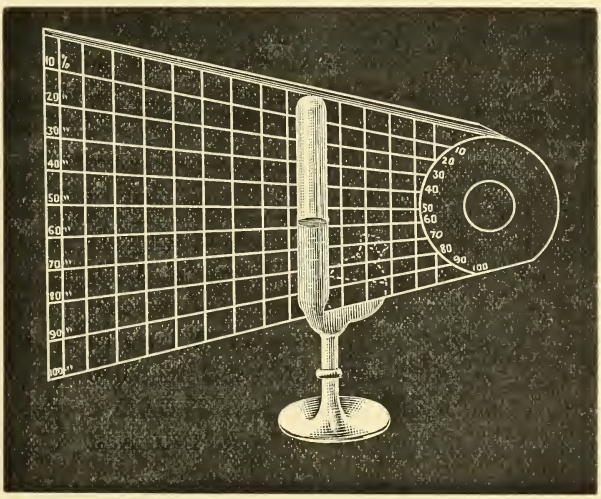
the small transparent colonies of the typhoid bacillus on the first plate are easily distinguishable in 20 hours under the Microscope. On the second plate, after 36 hours the typhoid colonies are yellowish, with markedly irregular margins, while the coli colonies are still round.

Keeping Mosquitoes alive.—Dr. Bancroft * has found that mosquitoes can be kept alive, after feeding once on human blood, by suspending a banana in the vessel in which the insects are confined. The banana should have the skin partially removed, and be renewed every fourth or fifth day. In this way the insects can be kept alive for upwards of six weeks. This fact may be useful to those experimenting with mosquitoes and blood parasites.

Mr. C. V. Creagh † states that he has kept mosquitoes alive and well by feeding them on a mixture of sherry and sugar. The mixture consisted of about a saltspoonful of dry sherry and an equal quantity of brown sugar, and was changed every 2 or 3 days. A small quantity of water should also be supplied. An inverted finger-glass, placed on coarse flannel to afford ventilation, forms a good cage.

Gasometer for Fermentation Tubes.‡ — The apparatus (fig. 94), devised by Mr. W. D. Frost, consists of a piece of triple-plated tin, cut in the shape indicated, about 8 in. long, 6 in. wide at one end, and 2 in.

Fig. 94.



at the other. About 1/2 in. of the upper edge is bent over at a right angle. The lines are ruled in with ink, and then the surface is brushed over with shellac. The perpendicular lines are about 1 cm. apart, and the nine radiating lines divide these into ten equal segments. The

* Brit. Med. Journ., 1899, i. p. 828. † Tom. cit., p. 1062.
‡ Journ. Applied Microscopy, ii. (1899) pp. 263–4 (1 fig.).

figures at each end indicate the percentage. The percentage volume is easily read off by resting the turned-over edge on the top of the closed arm of the tube, and moving the apparatus along until the lower edge rests on the neck connecting the arms. The apparatus, though chiefly intended for Dr. Th. Smith's fermentation tube, might be used for other similar apparatus.

Incubator for Maintaining Constant Low Temperatures.* — Dr. E. H. Wilson and Mr. R. B. F. Randolph have devised an apparatus for maintaining a constant low temperature (20° C.), adapted for work involving the use of gelatin and for storing stock-cultures and media.

The apparatus consists of an ordinary incubator enclosed in a wooden box. On the top of the box is an ice-tank, from which the ice-water is distributed in a uniform manner over the inner chamber. When the temperature gets too low, an electric regulator brings into action an electric stove; and when the temperature gets too high, another contact cuts off the heat. The regulators are so adjusted that the critical interval is quite short, allowing only a maximum variation of 0·5° C.

Detection of the Nectary in Flowers.†—Prof. P. Knuth finds that a very useful mode of determining the position of the nectary in flowers, i.e. of the exact spot where the excretion of sugar takes place, is to boil the entire organ either with Fehling's solution, or with Hoppe-Seyler's sugar reagent, ortho-nitro-phenol-propiolic acid; in the latter case a deep-blue deposition of indigo takes place in the presence of grape-sugar. He describes the localisation in this way of the nectary in a number of flowers.

Heavy Fluid suitable for Separating Mineral Mixtures.‡—For the fluids composed of iodine, mercury, cadmium, &c., which suffer from the common fault of being easily decomposed, Herr Muthmann has had the good fortune to obtain a good substitute in acetylen tetrabromide. It is a colourless compound which boils at 137° C., and possesses a specific gravity of 3·0011. The fluid is insoluble in water; it is soluble in ether, with which mixtures of any desired gravity can be prepared.

Antitoxic Action of Carmine.§—Dr. Stoudensky states that when powdered carmine is mixed with tetanotoxin, the action of the texin is suspended. The fluid used consisted of carmine in physiological salt solution and tetanotoxin. The antitoxic action is lost if the carmine solution be heated to 100°–120°, or if alkali be added.

If the carmine-toxin mixture be filtered, the filtrate contains no toxin. But though the carmine has fixed the toxin, the latter is not destroyed, for it may be extracted by maceration in distilled water. The antitoxic effect of the carmine is stated to be due to phagocytosis, as there is a smart reaction at the injection site. Here leucocytes accumulate and englobe the carmine particles, and along with these no doubt the toxin, which, though not chemically destroyed, is rendered inert.

* Brooklyn Med. Journ. See Micr. Bull., xvi. (1899) pp. 1–4 (2 figs.).

† Bot. Centralbl., lxxvi. (1898) pp. 76–83.

‡ Zeitschr. f. Krypt. (München), xxx. p. 73. See Zeitschr. f. ang. Mikr., iv. (1898) pp. 213–4.

§ Ann. Inst. Pasteur, xiii. (1899) pp. 126–8.

Carmine has a similar effect on diphtheria toxin. A carmine-diphtheria mixture containing ten fatal doses of toxin excites no intoxication.

Method of making Type Slides for Opaque Objects with Removable Covers.*—Mr. D. B. Scott describes this method of constructing a slide divided into 300 spaces of varying sizes. For the details of the procedure the original should be consulted.

* Journ. Quekett Micr. Club, vii. (1899) pp. 167–70 (2 figs.).

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

A. Instruments, Accessories, &c.*

(1)] Stands.

Reichert's New Polarising Microscope.—The stand (numbered 1 in catalogue) is large model (fig. 97), and is fitted with a square vulcanite plated stage, 100 × 100 mm. The body rotates about the optical axis, the coarse adjustment is by rack-and-pinion, and the fine with new delicate micrometer screw. Abbe's illuminating apparatus and iris diaphragm are supplied; the mirrors are plane and concave; and the instrument is adjustable in all positions. The polarising apparatus is after Ebner and Drasch, and is easily affixed to the stage, the divided circle being just as easily applied to the rim of the upper joint. The polarising apparatus is also easily removed, so that the instrument is available for ordinary histological and bacteriological work as well as for the finest investigations in polarised light, or for testing objectives with regard to their optical properties in polarised light.

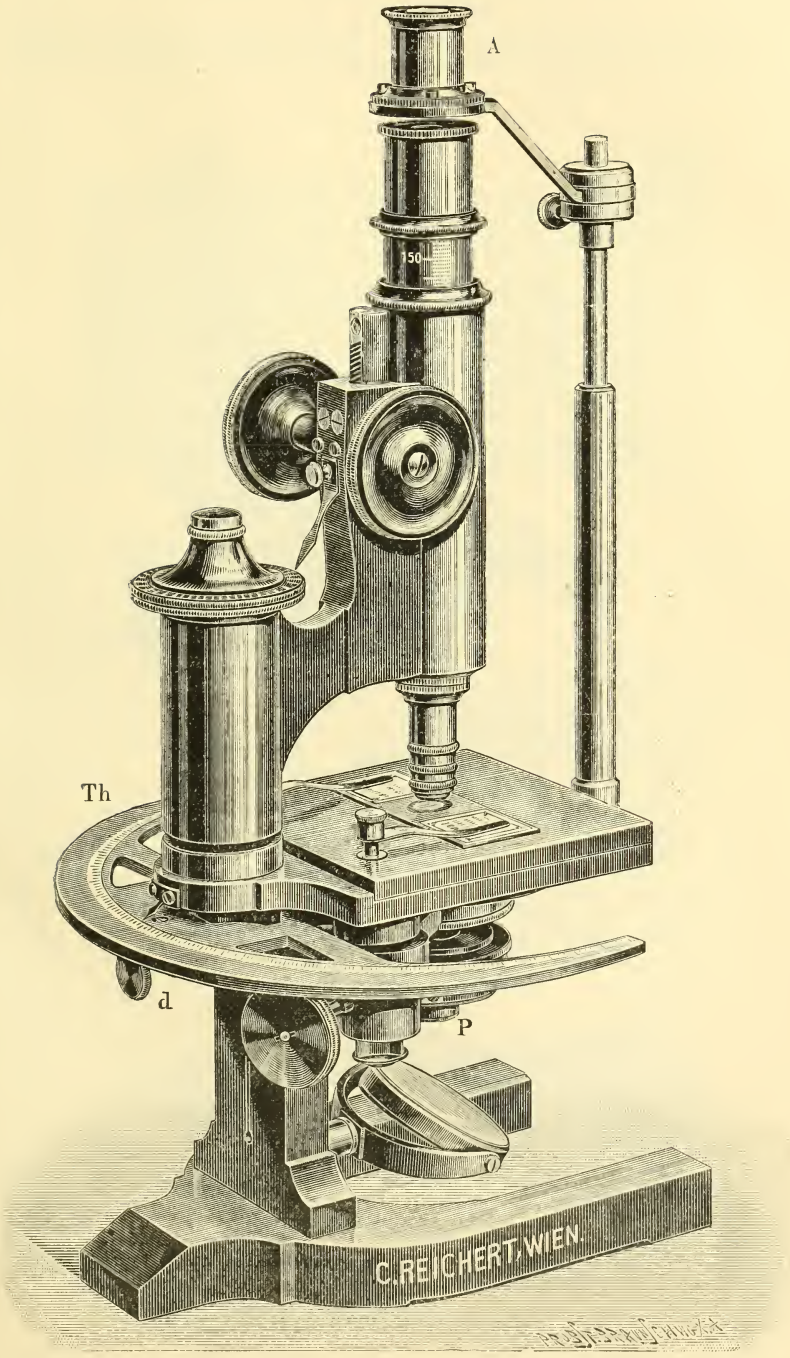
Reichert's "Austria" Microscope.—This stand (No. iii. in catalogue) is a well-made form of cheap Microscope (fig. 98). It has the so-called "English" black lacquered tripod foot, is compact in every part, and, though small, is a thoroughly practical instrument, and is strongly recommended to medical students. The coarse-adjustment is by rack-and-pinion, the fine by a new form of micrometer screw. The stage is $3\frac{1}{4} \times 3\frac{3}{8}$ in., ebonite plated, with substage raised and lowered by screw at side. The instrument is fitted with an Abbe chromatic substage condenser with iris diaphragm and plane and concave mirrors.

Reichert's New Pocket Microscope.—This instrument (catalogue number 24*a*) is intended for meat inspection (fig. 99). It has a push-tube movement and micrometer screw. It is supplied in a suitable pocket case.

Reichert's Polarising Hand Microscope.—This is numbered 31*c* in the catalogue, and is intended for use in demonstration classes. The polarising apparatus is so arranged that it can easily be removed, and observations may then be taken without it. The adjustments are by push-movements of the tubes (fig. 100).

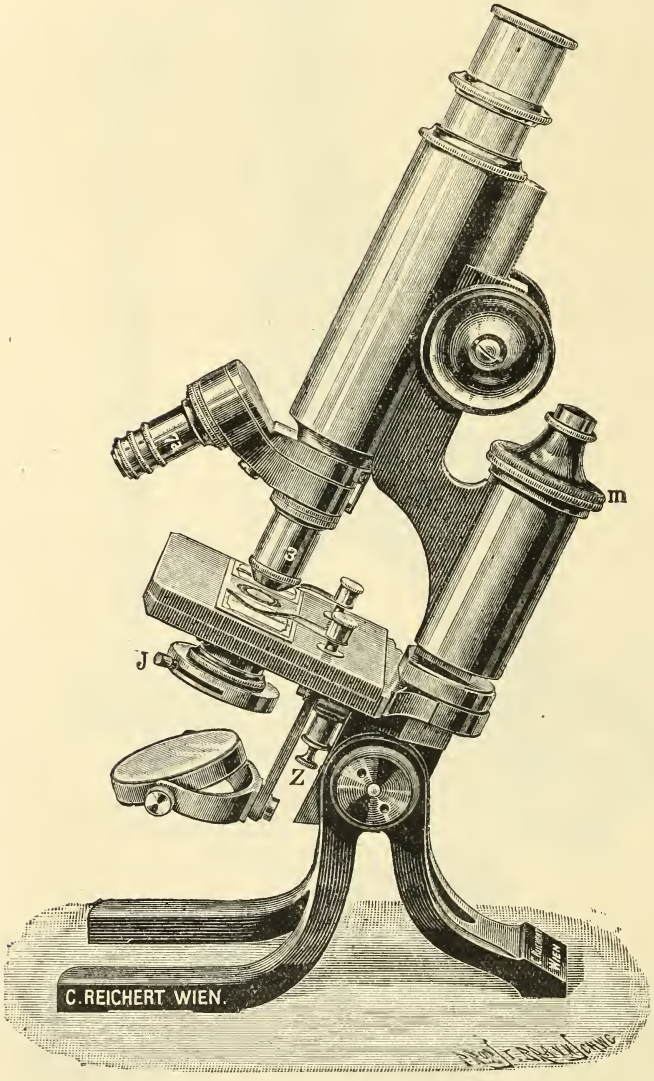
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Fig. 97.



Eternod's New Large Model Mechanical Stage.*—Messrs. Leitz have made this piece of apparatus (fig. 101) to Prof. Eternod's design,

Fig. 98.

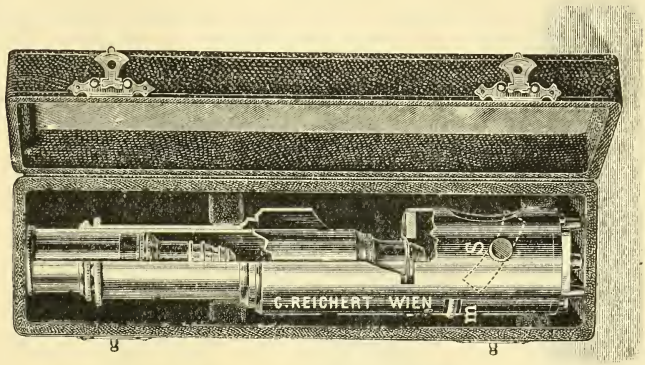


which has rectangular movements of 62 and 42 mm. respectively, and is especially adapted for the examination of serial sections.' [To

* Zeitschr. f. wiss. Mikr, xv. (1899) pp. 417–19 (1 fig.).

facilitate the lateral movement of 62 mm., a small crank *a* has been inserted in the right-hand milled head, and a notch in the vertical

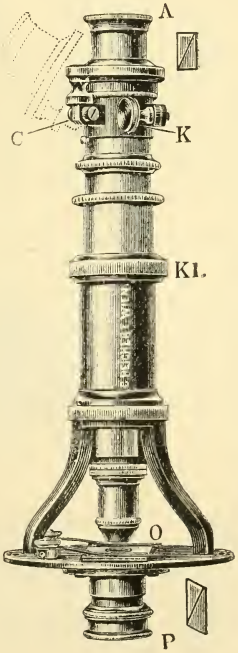
Fig. 99.



column allows the full extent in the other direction. The inventor has found the stage of great assistance, especially when he wished to draw by the camera lucida the developments in a series of sections.

Adaptation of Greenough's Binocular to the Ordinary Microscope.* — Prof. Eternod criticises Greenough's binocular as a valuable piece of apparatus, but bulky, embarrassing, and costly. Messrs. Zeiss have however supplied him with the binocular tube and lenses, which he has succeeded in fitting to an ordinary stage, and thus reducing the binocular to the rank of a simple accessory. A rackwork (fig. 101, *b*), prepared by his assistant, Mr. Jaccard, provided the necessary attachment, and it was found very convenient to be able to use the instrument in a slanting position. Moreover Abbe's illuminating apparatus exactly suited it, and the inspection of objects in series, such as embryo sections, gained a precision unattainable with a single tube.

Fig. 100.



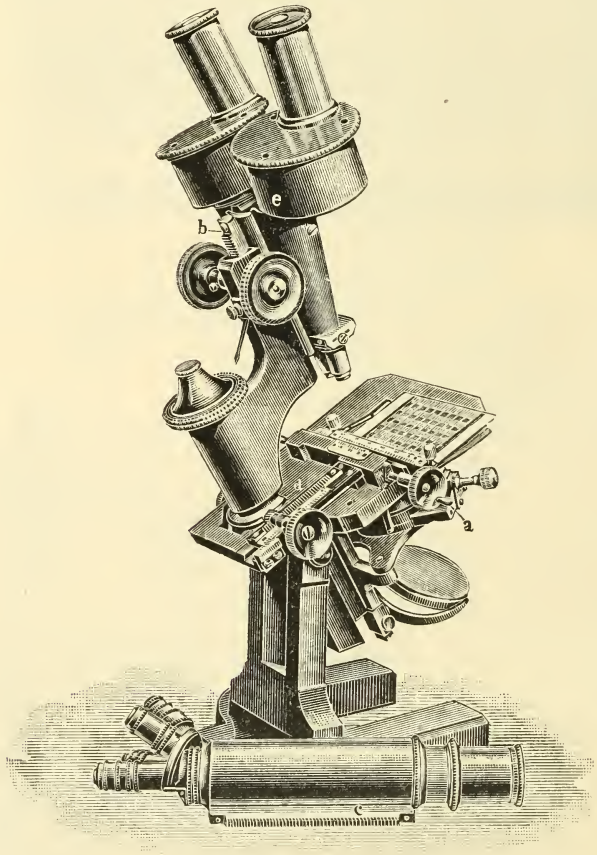
Reichert's New Coarse Adjustment.—The principle is the rack-and-pinion (fig. 102), which is made of gun-metal specially hardened, and a very important feature is the springing with adjusting screws, *a*, *b*, *c*, for tightening up. The tube-mount is regulated by *a*, and the pinion by *b*, *c*; thus the unavoidable wear and tear can be compensated for.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 419-21.

(2) Eye-pieces and Objectives.

Primitive Form of Lens-correction.—An interesting old adjusting 1/8 objective by Andrew Ross, which formerly belonged to Prof. Lindley, the second President of this Society (1842, 43), has been presented by his son, the Master of the Rolls. It will be remembered that, owing to Mr. J. J. Lister's paper on the two aplanatic foci of an objective, published

Fig. 101.



in 1836, Mr. Ross was, next year (1837), able to point out that, by means of lens distance, the aberration caused by the thickness of the cover-glass could be corrected. Two years after this, viz. in 1839, we have a drawing * of the mechanism by which this correction, or lens distancing, was effected; it will be unnecessary to describe it, as it is the ordinary screw-collar actuating the front lens of the objective. In

* 'Penny Cyclopædia,' Art. Microscope.

1841 Mr. James Smith graduated the collar, and in 1871 (published 1873) Dr. R. L. Maddox caused the mechanism to actuate the back lenses instead of the front, which is the form of correction at present in use.

Now, if we turn to the figure (fig. 103) we shall find a very early and primitive form of correcting lens. The tube carrying the front

Fig. 102.

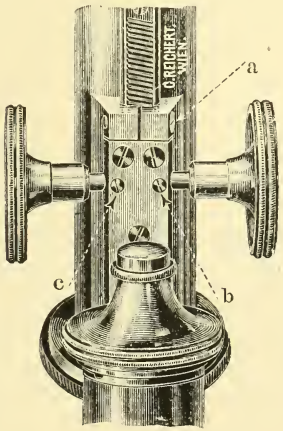
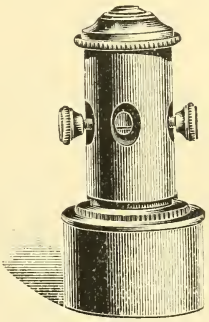


Fig. 103.



lens slides on an inner tube; it can be clamped in any position by the screws at the sides; the line in the little hole in the front indicates its position, and is the prototype of the "covered" and "uncovered" lines of later times. This interesting and very rare object-glass can safely be dated 1838. (The larger cylinder at the base is the lid of its box upon which it is standing.)

Effect of Cover-glass Thickness on the Performance of Wide Aperture Dry Objectives.* — Mr. F. J. Keeley, of Philadelphia, in discussing this subject, points out the well-known fact that even an adjustable objective will do better work at certain cover-glass thicknesses and tube-lengths than at others. This frequently arises from the fact of the adjustment having been made for a cover of greater thickness than the one actually used by the observer. In such cases another cover of suitable thickness attached by a drop of immersion oil to the fixed cover will procure a resolution of the object.

Nomenclature of Objectives. — Mr. F. Howard Collins, F.R.M.S., sends us a communication on this subject, containing a proposal, on which he invites discussion. After pointing out how little the true character of objectives is described by the present system of designating them alphabetically—a system whose value differs with every maker—he recommends an extension of the notation now so successfully used with eye-pieces. His proposal is to call them by the initial

* Micr. Bull. Philadelphia, 1899, pp. 12-13.

magnification they give if used as a single lens at the distance of distinct vision, or 10 in. This magnification, in addition to focal length and numerical aperture, should be engraved upon the mount. He thinks that in time the statement of magnification would be recognised as the proper description of the lens; and that the operator would gain greatly by knowing exactly the quality of his apparatus.

White, Jona—**More about Achromatic Condenser Construction.**
[The author advocates use of slides of medium thickness.]
Micr. Bulletin (Philadelphia), April 1899, pp. 9–11.

Keeley, F. J.—**Some further Discussion on Achromatic Condensers.**
[Adjustability of objectives and condensers advocated.]
Micr. Bulletin (Philadelphia), April 1899, p. 11.

(3) Illuminating and other Apparatus.

Electrically Heated Stage. — Reichert's electrically heated stage, exhibited at the Meeting of the Society on May 17th, is represented in figs. 104, 105.

It consists of a stage and a contact-breaker. The stage is a metal case, 24 mm. high, containing a coil which is connected with the main circuit m^2 n^2, and filled with paraffin oil. The regulator consists of a contact-thermometer R *r*, fig. 104, encased in the stage, and an electro-magnetic contact-breaker contained in a separate box. The contact-thermometer is connected with the electro-magnet, and closes and opens the circuit of the battery B, which goes to the electro-magnetic contact-breaker. This latter closes and opens the main circuit.

When putting the apparatus into action, attention is to be paid to the following points:—(A) The heating of the stage is effected by the main circuit; (B) The regulation of the temperature is effected by the auxiliary current.

A. *Heating of the Stage.*—(1) The main circuit is connected with the contact-breaker by means of the cable S*t* S*t'*, the current thus entering the battery. (2) The contact-breaker is connected with the stage by means of the cable T T'. The current enters the stage, and heats the paraffin oil and thus the whole stage.

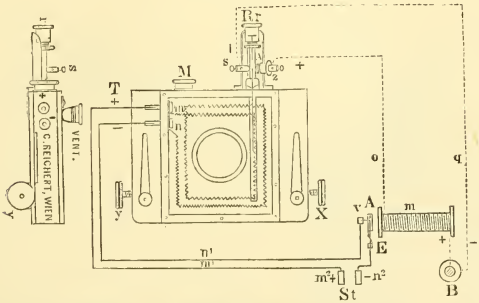
B. *Regulation of the Temperature.*—The battery is connected at R with the contact-thermometer at R'. If now the mercury of the thermometer is made to rise by the heating of the stage, and thereby touches the platinum in this thermometer, the main circuit is interrupted. The temperature then begins to fall, the mercury-column again contracts, and the main current passes once more through the stage, and the temperature begins to rise again, the mercury-column again reaches the platinum, and the circuit is once more interrupted. This process is again and again repeated.

The most important point for keeping the stage in action, is to connect the cables well with the stage and the contact-breaker. For this purpose the parts belonging to each are marked by corresponding letters, thus the pin A fits the opening at A; the pin B fits the opening at B, &c. &c. The black cable belongs to the black contact; the yellow cable to the yellow contact.

Through the coil there passes but a very weak current (0·2 ampère). The contact-thermometer being very sensitive, there is no difficulty in

maintaining constancy of temperature within 0·1° C. Experimentally, it has been shown that a certain temperature can be maintained constant for days. In adjusting the stage for the certain temperature, say 37° C., all that is needed is to pass the main current through the coil until the thermometer reads 37°; the screw R *r*, with its platinum point, is then turned inwards until a click of the electro-magnetic contact-breaker indicates that the platinum point and the mercury are in contact. The apparatus is now regulated for a constant temperature of 37°. In order to adjust the regulator for a higher temperature, say 45° C., it is only necessary to turn the screw R *r* back until the thermometer indicates the

Fig. 104.



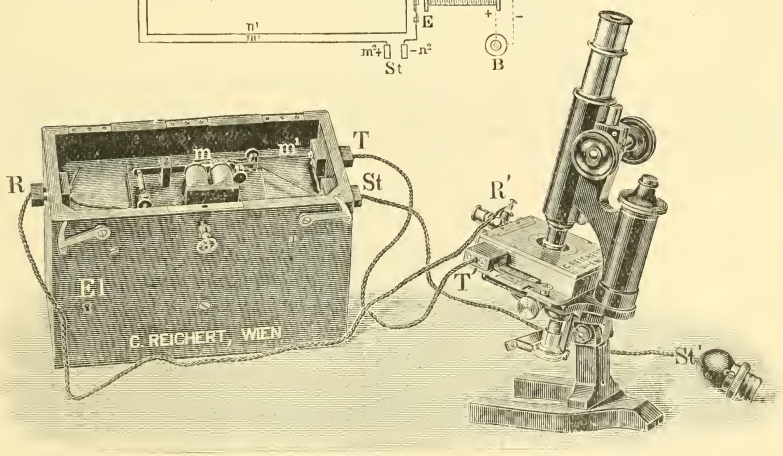


Fig. 105.

desired temperature. The transition from a higher to a lower temperature is effected in the simplest way by breaking the main current for a short time until the temperature falls to the required point; the platinum point is then placed at the degree which indicates the desired temperature. In the event of the temperature falling below the required point, it is only necessary to turn the screw R *r* slowly back; this causes the temperature in the stage to rise again; and as soon as the required temperature is reached, the screw is slowly turned inwards until the clicking of the magnet indicates the completion of the circuit. The apparatus is thus adjusted for a constant temperature.

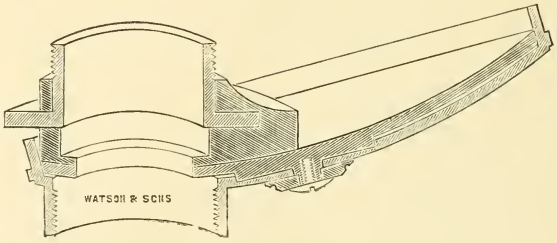
From the preceding it will be seen that this electrically heated stage possesses the following advantages:—

(1) It can be rapidly adjusted for a certain temperature, which can be kept constant within 0·1° C.

(2) The temperature can be raised or lowered, and again rendered constant, by simply turning the adjustment-screw of the contact-thermometer.

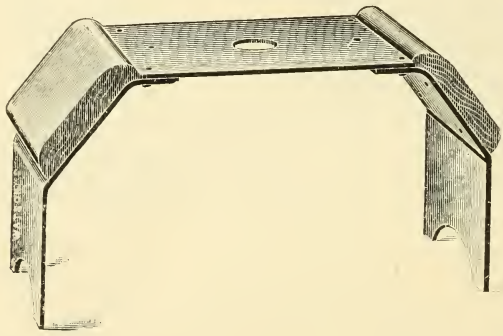
Dust-proof Triple Nose-piece.—In Fig. 106 we give a drawing of Messrs. W. Watson and Sons' triple nose-piece, designed for the purpose of protection from dust. The total diameter of the nose-piece is 2 inches and an eighth.

Fig. 106.



Watson's Table-Stage. — Fig. 107 represents the table-stage designed by Mr. G. T. West, and made by Messrs. Watson and Sons, exhibited at the Meeting of the Society on May 17th, and described on p. 355 of this Journal.

Fig. 107.



(4) Photomicrography.

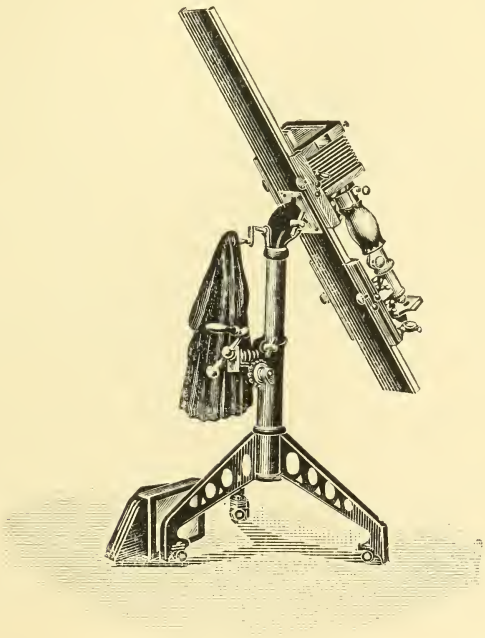
Bitting's Photomicrographic Apparatus.*—Mr. A. W. Bitting intends his apparatus to meet all the needs of laboratory work.

Fig. 108 shows the instrument in an inclined position. The apparatus

* Proc. Indiana Acad. Sci., 1897, pp. 78–80 (1 fig.).

consists of an upright cast-iron post supported by three cast legs, and in it slides the elevating post, worked by a sprocket wheel. The upright post with its legs is 28 inches high ; the elevating post is of equal length, and is made of two-inch steel tubing. Upon the top of the elevating post is a head-post, which receives the bed-plate for carrying the camera and Microscope. The head-post is turned to exactly fit the tube, and permits the bed-plate to be revolved on its horizontal axis. The bed-plate is 60 inches long and $5\frac{1}{2}$ inches wide, and consists of a piece of 3/16 in.

Fig. 108.



rolled steel, to which are riveted two dressed half-inch steel tubes. These tubes are placed near each edge, and give rigidity as well as serving for guides for the camera and Microscope carriages. In the centre of the bed-plate is a rack for the adjustment of the camera and Microscope. The bed-plate is arranged to rotate upon its vertical axis. The stand is provided with castors so adjusted that it may be thrown off its legs with the foot. The apparatus can be used in the vertical or horizontal position, or at any inclination.

(5) Microscopical Optics and Manipulation.

Ward, R. Halsted, M.D.—**Localising Microscope Objects.**
[Advocates the noting of their angular position in terms of a clock-face.]
Micr. Bulletin (Philadelphia), April 1899, p. 12.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Observation Media.†—M. J. Amann recommends the following media as suitable for clarifying and observation purposes.

(1) *Chloralphenol* is prepared by mixing 2 parts of chloral hydrate and 1 part of pure phenol. This makes an oily fluid, which begins to crystallise at 10° C. The refractive index is 1·5241. It possesses good clearing properties, and delicate histological elements are little, if at all, contracted. For the fixation and rapid demonstration of nuclei, e.g. *Oscillatoriæ*, it is especially useful. It is an excellent dehydrant, and the technique is simple. The living object placed on a slide when treated with chloralphenol is simultaneously killed, fixed, cleared up, and dehydrated. The first quantity should be poured off, and replaced by another. If the specimen be thick or stained or woody, the medium may be heated, and then replaced by balsam added drop by drop.

(2) *Chlorallactophenol* is composed of 2 parts by weight of chloral hydrate, 1 part of pure phenol, and 1 part of lactic acid (sp. gr. 1·21). This is an oily fluid miscible with water. In all proportions $N_D = 1·4932$. It clarifies well, and is especially suited for herbarium material, to which it restores the original form. The refractive index can be raised by the addition of salicylate of soda: chloral hydrate 4 parts, phenol 4 parts, lactic acid (sp. gr. 1·21) 2 parts, salicylate of soda 1 part.

(3) *Lactochloral* is a mixture of equal parts of chloral hydrate and lactic acid; $N_D = 1·4796$. It clears up well, and can be used for dry material.

(4) *Chlorphenol*, *p*-monochlorphenol (4–1), has a refractive index of 1·5671. It clears up vegetable preparations very strongly, the cell-membrane becoming almost invisible. It is extremely valuable for observing the polarisation picture of organic preparations. It is an excellent dehydrant, does not contract delicate tissues, does not cause the cell-wall to swell up, nor does it affect the colour of chlorophyll.

(5) *Chloralchlorphenol* is a mixture of equal parts of chloral hydrate and *p*-monochlorphenol. It is a thick oily fluid miscible with water, and has a refractive index of 1·5491. It possesses, though in a higher degree, the same properties as chlorphenol.

(6) *Lactochlorphenol* is composed of 1 part of lactic acid and 2 parts of *p*-monochlorphenol. Its refractive index is 1·5265.

(7) *Chlorallactochlorphenol* is composed of equal parts of *p*-monochlorphenol, chloral hydrate, and lactic acid. The refractive index is 1·4995. Preparations treated with this medium, and intended to be mounted in balsam, must be dehydrated with chloralchlorphenol.

(8) *Copper media.* In order better to retain the green colour of preparations, a saturated solution of copper chloride in the proportion of two per thousand may be added to any of the foregoing media.

(9) *Chinolin* has a refractive index of 1·6218, and is very suitable for diatom preparations.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Zeitschr. f. wiss. Mikr., xvi. (1899) p. 38–44.

Gelatin Culture Media.*—Dr. Erwin F. Smith gives the following hints on the use of gelatin culture media:—The melting point of nutrient gelatins increases as more gelatin is added; it decreases on addition of acids and alkalies, and by long boiling. Grape or cane-sugar added to nutrient gelatin frequently restrains or entirely prevents liquefaction, at the same time stimulating growth. For this reason gelatin should be made with beef broth free from sugar. Owing to the fact that commercial gelatin contains salts which are neutral or alkaline to litmus, but which retard the growth of many organisms, the gelatin medium should first be rendered neutral to phenolphthalein, after which, if desired, it may be acidified to particular acids. A commercial gelatin of uniform character, and washed free from all inhibiting acid substances, is a desideratum.

Raffinose as a Food-Material for Aspergillus.†—M. H. Gillot finds Raulin's fluid‡ the best culture-medium for *Aspergillus niger*. If raffinose is substituted for the saccharose, it is equally consumed by the fungus. *Aspergillus niger* secretes a diastase capable of inverting raffinose, which is completely consumed, the resulting products being dextrose and gelactose. Oxalic acid is also produced, increasing the acidity of the culture-fluid.

Nutrient Media containing Salivary Gland and Mucin.§—Dr. G. Mayer made an elaborate series of experiments to test the effect of the presence of salivary gland and mucin in nutritive media on the growth of micro-organisms. The results are collated in nine tables in which are contrasted the growth of some dozen pathogenic microbes in simple bouillon and agar, with the growth on bouillon and agar containing salivary gland or mucin. The results are shortly summed up as follows. The flesh of young well-nourished animals, especially that of the calf, is better suited for microbic growth than that of other and older animals. The development on salivary gland is better than that on muscle, and at the same time characteristic growth appearances are favoured and promoted. Mucin prepared from bile exerts a somewhat inhibitory action on the development of microbes.

The glands were obtained from different animals, calf, ox, horse, pig, sheep, dog. They were first of all very finely minced, then covered over with an equal bulk of water, and allowed to macerate for 24 hours in the cold. The mass was then pressed, and the thick mucoid fluid thus obtained was steam sterilised for half an hour. The fluid, which is whitish, slightly opalescent, quite neutral, or with only a faintly alkaline reaction, was used alone or mixed with 1½ per cent. agar.

The mucin employed was prepared from bile. It is a yellowish-grey powder which becomes sticky on the addition of fluid. It is soluble under 70° C. to about 0·7 per cent. in water. This was inspissated by evaporating down in a water-bath at 60°–70°, and, after having been

* Bot. Gazette, xxvii. (1899) p. 128.

† Acad. R. Belgique, Bull. Sci., 1899, pp. 211–26.

‡ Water 1500 ccm.; tartaric acid 4·0 grm.; ammonium nitrate 4·0; ammonium phosphate 0·6; potassium carbonate 0·6; magnesium carbonate 0·25; zinc sulphate 0·07; iron sulphate 0·07; potassium silicate 0·07; sugar-candy 70 grm.

§ Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 747–56, 815–26.

sterilised, was mixed with meat-pepton-agar or with bouillon, or used by itself.

Making Blood-Serum Slants.*—Dr. E. C. Levy describes an improvement in the technique of making blood-serum culture media. The serum, obtained from the usual source and in the usual way, is run into sterilised test-tubes, a filling funnel or 50 ccm. burette being used for the purpose. Each tube is stopped with a sterilised cork rammed in above the cotton-wool plug. The corks are then tied in. After this, the tubes are placed on the slant in a shallow wire tray. Inside an Arnold steriliser is placed a wire basket, and on this another is laid flat. On the latter is laid the tray with the tubes. A towel is then thrown over the steriliser, the inner lid and outer jacket of which are dispensed with. In 10–20 minutes after getting up steam, the serum will be found coagulated evenly and without any disfiguring bubbles.

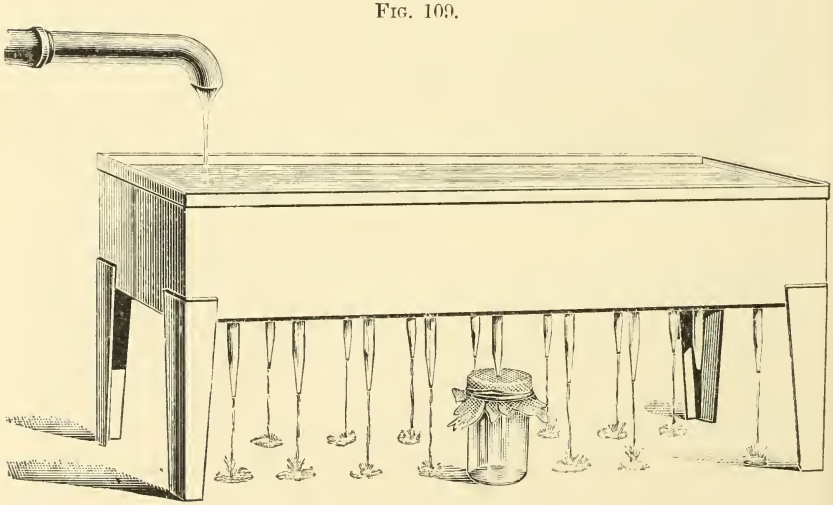
The corks, which should be of the best quality and one or two sizes larger than will easily go into the mouth of the tube, are softened and sterilised in an Arnold steriliser in 20 minutes. In order that the corks may be tied in, the test-tubes must be lipped.

Surplus serum may be kept for future use by pouring it into a well-stoppered bottle, and covering it with a layer 2–3 mm. thick of chloroform. It is then thoroughly shaken. In this way serum is said to keep indefinitely.

(2) Preparing Objects.

Washing Apparatus.†—Mr. E. J. Durand describes a tank which is effective for washing material fixed in chromic acid, Flemming's fluid,

Fig. 109.



&c. It consists (fig. 109) of a trough supported on four legs, and provided with a cork bottom perforated with holes for glass tubes drawn

* Journ. Applied Microscopy, ii. (1899) pp. 360–3 (3 figs.).
† Bot. Gazette, xxvii. (1899) pp. 394–5 (1 fig.).

out to a point at the lower end. When the material is ready for washing, a fine-meshed cloth is stretched over the mouth of the bottle and held in place by a rubber band. The bottle is then placed beneath the trough, and one of the tubes lowered until the pointed end projects through the cloth into the bottle. The water passes off through the meshes of the cloth. A convenient size for the trough, which may be made of tin, is 6·25 cm. deep by 8·75 cm. by 29·5 cm., so as to fit the ordinary sheet of insect cork. The space beneath is 7·5 cm. high. The cork should be at least 1 cm. thick. The holes are 1·8 cm. from the edge and 3·75 cm. apart. This will allow of eighteen 25 mm. bottles being washed at once. The glass tubes are 6·75 long with an inside diameter of 3 mm.

New Preservative Method for Plankton Flagellata.* — Herr O. Zacharias succeeded in fixing *Uroglæna* balls in a mixture of two volumes saturated boric acid solution and three volumes of saturated sublimate solution so satisfactorily that they were afterwards preserved in dilute formol or alcohol without detriment. To the freshly taken plankton was added about one-third its bulk of the mixture, and after about three hours the material was carefully washed on a gauze filter. The material was finally preserved in 2 per cent. formol or in 50 per cent. alcohol, afterwards changed to 70 per cent.

The same method may be adopted if Dinobrya be in the plankton catch.

Diatoms and Loricata are well fixed by the mixture, but it is not advisable to use it for small Crustacea. The latter are better treated with chromacetic acid.

Gaylord's New Apparatus for Liquid Filtration by Gas Pressure through Bacterial Bougies.† — Dr. H. R. Gaylord, of Buffalo University, describes his apparatus as an improvement and modification of Given and Campbell's, described in 1895; it also resembles D'Arsonval's. The application of air pressure has the advantage that the liquid, after filtration, is led into a vessel, out of which the gas (CO_2) given off through the bougie can immediately escape. As the gas escapes outwards from within, the entrance of bacteria-laden air is rendered impossible.

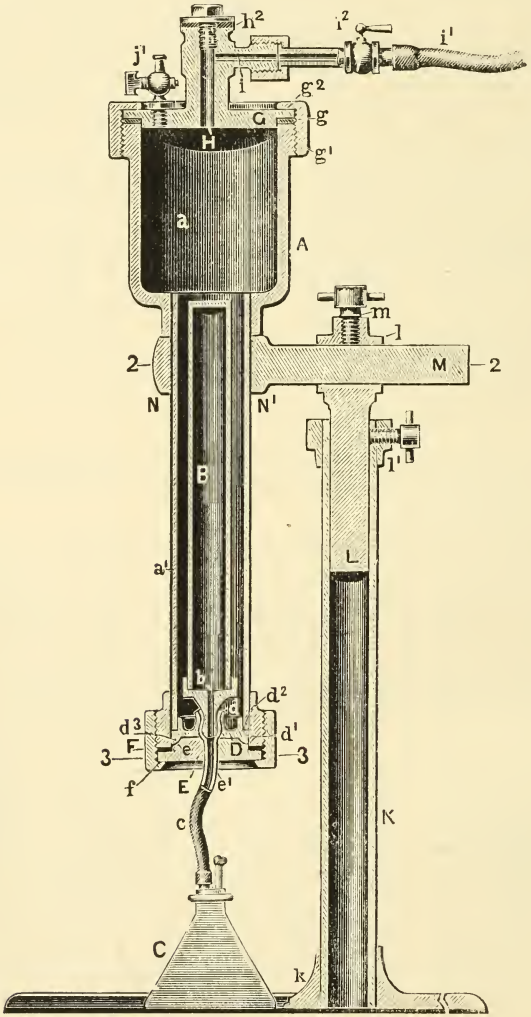
The apparatus (fig. 110) consists in its upper part of a wide chamber for the reception of the liquid to be filtered; while in the lower part, containing the bougie, it is narrower. The material is copper, and its pressure resistance about 300 lb. The pressure is applied from a cylinder charged with carbonic acid; and the apparatus is adapted for Pasteur's and Borkfeldt's bougies of the usual size. The bougie B has its exit at *b*, and is surrounded by a caoutchouc tube *c*; D is the caoutchouc Pasteur stopper; the flask C has a doubly bored stopper, the tube *c* passing through one of the openings, and a plug of wadding closing a glass tube inserted in the other. The glass tube on which *c* is fitted is kept in its place and firmly clamped by the ring F. There is sufficient space between E and the end of the filter, so that when the ring F is almost screwed up, the pressure on the stopper D at d_1 becomes

* Zool. Anzeig., xxii. (1899) pp. 70–2. See Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 67–8.

† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 427–32 (5 figs.).

intensified owing to the pressure within the filter, the jaws d of the caoutchouc stopper are pressed firmly against the vent, and all escape of gas and liquid prevented. The large upper opening is closed by the lid G, kept in position by the metal ring g_1, g_2 and the washer g.

Fig. 110.



This lid is perforated by two orifices, H and j_1. The liquid to be filtered is poured in through H after removal of the screw h_1; and the pressure is communicated from the above-mentioned cylinder through the tube i_1 and controlled by the cock i_2. In filling, the cap h_1 is

unscrewed and the vent j_1 opened; the gas escapes through j_1 as the liquid enters through l_1; the cap is then firmly screwed on and filtering can begin.

Fig. 111.

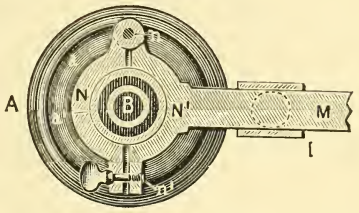
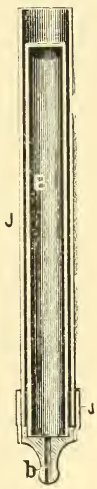


Fig. 112.

By means of an arm M (fig. 111), the apparatus is held in a clamp-ring N_1; and the arm is hinged at n so that the apparatus may be removed for sterilisation and easily cleaned. The arm forms part of a hollow tripod stand, and can be raised up and down in a tube K; it can also be rotated, and clamped in any desired position by the screw l_1.

Fig. 113.

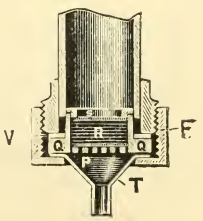


In order to sterilise small quantities of liquids, the bougie can be jacketed in a glass tube (fig. 113) of suitable diameter. A caoutchouc band J_1 is passed round jacket and bougie, and the whole placed in the filter. This application is very advantageous.

Fig. 112 shows a cross-section of E surrounded by the ring F, and of the caoutchouc tube c penetrating through the opening e_1 of E.

For the filtration of a litre of blood-serum 5 to 10 minutes suffices, and the end of the process is indicated by the passing of the acid through the bougie and the frothing-up of the liquid in the flask C. The cock i_2 is then shut off and j_1 opened; the pressure being thus released and the process completed. The tube c is closed by a pinch-cock and, together with the flask C, removed.

Fig. 114.



If it should be desired to filter also the liquid remaining in the filter, the apparatus is inverted so that the liquid runs into the large upper part, the bougie is removed and the jacket tube J inserted; the apparatus is thus restored to its first position, whereby the liquid enters J, and the filtering goes on as before.

By the arrangement shown in fig. 114, such liquids as agar-agar, &c., can be fitered. In this case a metal-piece Q replaces the bougie. Q is perforated and can be covered by fine muslin and several layers of filter paper, any free space being filled with asbestos wool, pressed down by a well-fitting cap S. T is a funnel, and V a

washer. 25 lb. of air-pressure suffices to filter a litre of agar-agar in ten minutes, and the usual clarification with white of egg is unnecessary.

Modification of the Celloidin Series Method. — Prof. F. Dimmer * uses a gelatin solution instead of the sugar solution. Some 16 grm. of gelatin are dissolved in 300 grm. of warm water. This solution is then poured over large glass plates, previously warmed and placed in a nearly horizontal position. The thin films, protected from the dust, dry in about two days. The sections are removed from the knife in the usual way and placed on the gelatin plates and kept moist with 70 per cent. alcohol. When a plate is full of sections the excess of alcohol is removed by covering the surface with a piece of closet-paper and pressing out the fluid. The sections are then covered with photoxylin solution (photoxylin 6, absolute alcohol and ether *ā ā* 100 ccm.). When this is about dry, the plate is immersed in water at 50°–55° C. When the plates are set free from the glass, they are easily picked up on closet-paper and transferred to a staining or clarifying fluid.

The modification devised by Mr. J. S. Kingsley † consists in hardening the collodion-saturated mass in chloroform, and when firm placing the block in a mixture of 1 part carbolic acid and 3 parts xylol. The sections are cut with a razor flooded with the xylol-carbolic acid, transferred to a slide, and mounted directly in balsam.

Bacteriological Notes.‡—(1) Herr London has found that if cover-glass preparations of the cholera vibrio be treated with a mixture composed of 1 part of an alcoholic solution of picric acid and 2 parts of water for one minute, and then washed in water for 15 minutes, the cholera vibrios are stained by the picric acid. All other bacteria are decolorised.

(2) The above-mentioned picric acid solution may be substituted for the iodopotassic iodide solution in Gram's method.

(3) Clove-oil water is better than anilin-oil water for making Ehrlich's fuchsin solution. There is no precipitate, and in the dark the fuchsin solution will keep for two months.

(4) A 1 per cent. solution of thionin stains the tissues blue and the bacteria violet. Hence this metachromatism may be made use of with advantage for staining bacteria in tissues.

(5) The author recommends the use of karagen plates made like gelatin plates for the culture of Amœbæ.

Use of Acetone in Histology.§ — Dr. P. A. Fish states that the action of acetone on pyroxylin is more intense than that of the ether-alcohol mixture used for dissolving celloidin. It is also a fixing, hardening, and dehydrating agent. Hence it may be used as follows:— Fix in 70 per cent. acetone; dehydrate in strong acetone; soak in 4 per cent. acetone-collodion; then in 8 per cent. acetone-collodion.

New Nissl Method.‖—Dr. J. R. Lord makes sections of fresh tissue with a freezing microtome, and fixes the sections in the following solu-

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 44–6.

† Journ. Applied Microscopy, ii. (1899) p. 325.

‡ Arch. Biol. Wissensch. St. Petersburg, 1898, p. 319. See Centralbl. Bakt. u. Par., 1te Abt. xxv. (1899), p. 839.

§ Journ. Applied Microscopy, ii. (1899) pp. 322–4.

‖ Journ. Mental Science, xliv. (1898) pp. 693–700 (1 pl.).

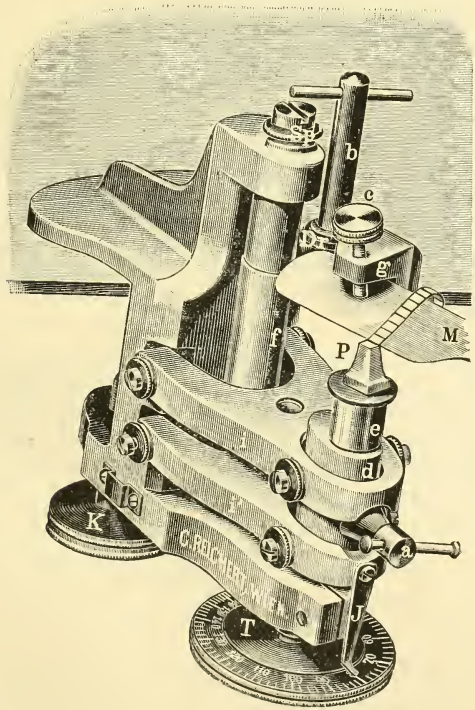
tions:—Saturated aqueous solution of picric acid 50 per cent.; 6 per cent. solution of formol in water 50 per cent.

The sections are floated on the fixative dropped on the slide, and after 5–15 seconds are floated back on water. They are then returned to a slide, on which some 0·5 per cent. methylen-blue, patent B, has been pipetted. The slide is heated until a bubble appears, and is then allowed to cool. The excess of stain is washed off and the preparation heated with 10 per cent. anilin oil in absolute alcohol until no more stain is given off. The section is then mopped up with blotting-paper, and cleared with origanum oil, the last traces of which are removed with benzin. It is finally mounted in colophonium prepared by heating the resin in a porcelain capsule together with a very little benzin. The colophonium is smeared over the surface of the section with a glass rod. A cover-glass is imposed and the preparation heated until the cover-glass is in position.

(3) Cutting, including Imbedding and Microtomes.

Reichert's Microtome with Conical Bearings.— This (fig. 115) is intended for paraffin sections and for small histological objects. It has

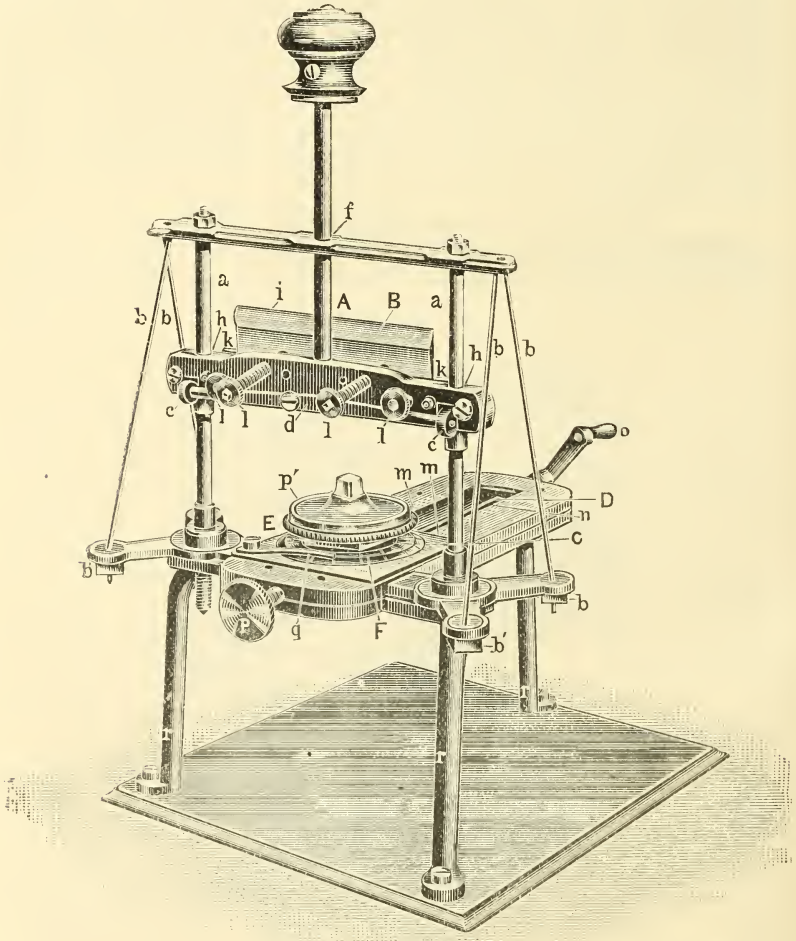
Fig. 115.



an adjustable knife-carrier, a micrometer-screw for raising the object, a screw for clamping to table, a screw for holding the object firmly, a simple freezing apparatus, and a razor.

New Apparatus for Cutting Paraffin Cubes.* — Such pieces of apparatus are usually accessories of the microtome, more or less troublesome to manage, and dangerous to the fingers. Prof. Eternod, with the help of his assistant, M. Jaccard, has tried to design a special instrument for this purpose, consisting (fig. 116) of (1) a guillotine A,

Fig. 116.



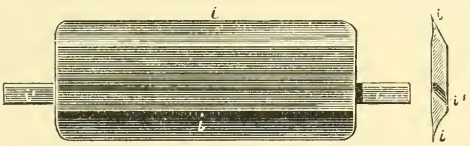
with vertical slides; (2) a razor B; (3) a horizontal carrier C, (4) moved by a screw of special precision D; (5) surmounted by the bearer E of the plug-carrier; (6) a graduated and pivoted dial F giving the exact angle required for the sections.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 421–5 (5 figs.).

The guillotine A moves up and down two perfectly straight steel bars a, a, which act as slides and are kept rigid by guys b, b, b, b, each controllable by a special nut b', b', b'. To render the movement more exact or delicate, the guillotine is provided with two rollers c, c, mounted on a strong steel spring d, which exerts a sufficiently strong pressure on the steel bars. The regular movement of the guillotine is, moreover, secured by making the handle pass through a hole f on a higher level than the sliding-holes $h\,h$ of the guillotine.

The razor B (fig. 117) is formed by a blade of fine steel with two cutting edges i, i; it is thick, scarcely flexible, and is provided with two

Fig. 117.



ears or trunnions for fixing to the guillotine. Fixing is attained by slipping the razor into two oblique notches $k\,k$. Immobility and obliquity are accomplished by manœuvring four screw-bolts, placed two and two on the body of the guillotine l, l, l, l.

The horizontal carrier C bears two lateral notches which engage in two long and solid horizontal slides m, on which certain graduations allow the determination in advance of the precise width desired for the paraffin blocks, so as to produce ribbons of required length, and of the required number of sections for the said length.

The precision screw D, moved by a crank O, displaces horizontally the carrier with the paraffin block. This screw has a thread interval of about half a millimetre, and is kept exactly in its place, without unsteadiness, by a screw p, whose hollowed-out end receives the end of the precision screw.

The horizontal carrier C is surmounted by a supporting piece E, intended to receive the ordinary block-bearers p' formed of a disc fitted with a metallic stem, on which the paraffin blocks have been previously soldered. A hole bored in E receives the butt of the block-bearer, steadied by a small bolt; neither hole nor bolt is visible in the figure.

Around the base of E is a graduated dial F, regularly notched for receiving the catch of a special spring q. By means of these graduations, notches, and spring, the paraffin blocks can be accurately set at various angles, and cut geometrically to the desired form. The supporting piece and dial, really one, turn upon a pivot accurately centered in the carrier. A small index, not visible in the figure, reads off the dial graduations and section angles.

The two razor-edges are 8·5 cm. long, and the total height of the instrument is 35 cm.

In the orientation of series-sections on the slide, Prof. Eternod states that the best plan is to cut the paraffin blocks into accurately right-angled parallelopipeds, and afterwards slightly cut away the sharp

angles (fig. 118). The sections should be placed on the slide, the same number in each row, and if possible, in five rows of ten each (see fig. 119). In reconstruction it is easy then, by help of the mechanical stage, to select the sections by fives or tens.

Fig. 118.

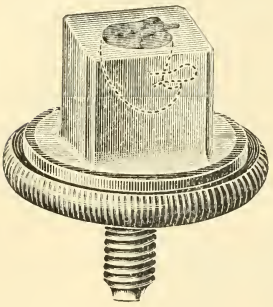
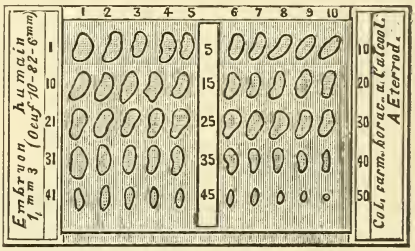
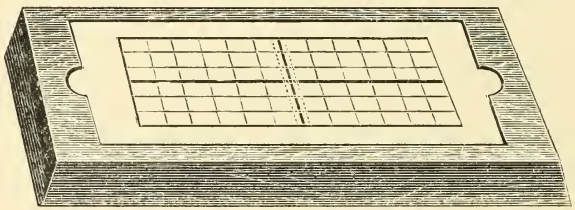


Fig. 119.



To facilitate the setting-out of the sections, a small wooden tray (fig. 120), hollowed out to the exact size of the object-slide and marked with lines, will be found very convenient for placing the ribbons, and for covering them with the glass slide. It is very useful to number the

Fig. 120.



rows of sections on slips of gummed paper, so as to avoid error in numbering the drawings made by the camera lucida. Moreover, the slips are some protection against breakage.

Levison, W. G.—**Photographed Ocular Micrometers.**

[The author has found these in some respects to be more satisfactory for use with any objective than ruled micrometers.]

Ann. New York Acad. of Sci., Dec. 1898, pp. 405–6.

(4) Staining and Injecting.

Combined Fixing and Staining Method.*—Herr M. B. Wermel recommends the following formol staining solutions:—

(1) Methylen-blue F.A.—Methylen-blue, saturated alcoholic solution 30 ccm., formol 2 per cent. aqueous solution 100 ccm. The preparations are treated for 5 to 8 minutes, then washed, dried, and mounted.

(2) Eosin F.—Eosin 1 per cent. solution in 60 per cent., alcohol

* Medizinskoë Obosrenie, 1897, pp. 829-33. See Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 50-4.

100 ccm., formol 10 per cent. aqueous solution 20 ccm. If used for staining blood, the blood is smeared on the slide with a strip of paper. It is dried in the air, and the solution is then dropped on. After 2 minutes the excess of staining solution is poured off, and on the still damp preparation is dropped methylen-blue F.B. After another two minutes the preparation is thoroughly washed with water, dried, and mounted in balsam.

(3) Methylen-blue F.B.—Methylen-blue saturated aqueous solution 1 part; formol 4 per cent. aqueous solution 1 part. When staining pus or gonococci in urine, the air-dried film is first treated with eosin F., and after two minutes is thoroughly washed with water. It is then treated for 30 seconds with an aqueous saturated solution of methylen-blue diluted before use in the proportion of 1–3. The preparation is then carefully washed with water.

For staining by Gram's method, gentian-violet F. is used.—Gentian-violet 10 per cent. alcoholic solution 10 ccm.; formol 2·5 per cent. aqueous solution 100 ccm. The preparation is first treated with the gentian-violet F. solution for 5 minutes, and then with the iodopotassic iodide solution for 2 minutes. This is followed by decolorising in 10 per cent. alcoholic solution of aceton. After having been washed in water, the preparation is contrast stained with Bismarck-brown for 30 seconds. It is again washed in water, and dried.

Staining Solutions made with Pyroligneous Acid.* — Herr E. Burchardt gives the following formulæ for staining solutions containing pyroligneous acid:—

(1) Pyroligneous acid hæmatoxylin.—Pyroligneous acid 130·0 parts; potash alum 2·0; hæmatoxylin 0·5. The alum is first dissolved in the pyroligneous acid, and then the hæmatoxylin dissolved in strong spirit is added. After exposure to light for 12 days the solution is ready for use. It is a permanent stain, but the staining power decreases with lapse of time. The strength of the solution may, however, be restored by the addition of a little pyroligneous acid. The solution is useful for staining either in mass or in section. The pieces or sections are to be transferred directly from alcohol to the stain, wherein they remain for 12 hours or longer, according to their size. On removal they are thoroughly washed in 50 per cent. alcohol, and then treated in the ordinary way.

(2) Pyroligneous acid carmine.—Carmine Xr: pyroligneous acid 100 parts; carmine 2. The mixture is to be heated slowly over a small flame, evaporated down to one-half, and filtered when cold. The pieces to be stained are immersed in the solution for 12–24 hours, and then washed in 50 per cent. alcohol. Next they are differentiated in alum-alcohol (50 per cent. alcohol saturated with alum). This takes 2 or 3 days; after this they are washed in 50 per cent. spirit, and treated in the usual way.

Carmine Pr.: Pyroligneous acid 100 parts; carmine 3; potash-alum 0·5. Evaporate down to one-half, and filter when cold. Stain for 2–24 hours, and wash in 50 per cent. alcohol.

Carmine Xr + Pr (double carmine): Mix equal bulks of the foregoing.

* Arch. f. Mikr. Anat., liii. (1898) pp. 232–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 453–5.

Stain for 6–24 hours, and then soak in 50 per cent. alcohol for 1–12 hours. Sometimes it is expedient to differentiate in alum-alcohol.

(3) Pyroligneous acid cochineal. — Pyroligneous acid 100 parts; cochineal 4; potash-alum 0·5. Boil down to one-half and filter. Immerse for 12–24 hours, soak in 50 per cent. alcohol, differentiate in alum-alcohol, and proceed as usual.

Weigert-Pal Staining of very young Brains.*—Herr A. Dölken gives the following procedure for staining the brains of very young animals by the Weigert-Pal method. Sections of about 50 μ thick (in rats and mice they should be not more than 30 μ), are cut, and placed for more convenient manipulation on photoxylin plates. They are then placed in cold hæmatoxylin solution (Pal) for 4–5 days, after which they are incubated in the staining solution at 37° for 2 hours. When cold they are immersed in tap water for 6–8 hours, and then in alkaline distilled water (2–3 drops KHO to 1 litre) for a quarter of an hour. The sections are next decolorised in permanganate of potash solution, about 0·5 per cent., until the undeveloped non-medullated areas are just beginning to become transparent. After having been well washed in distilled water, they are immersed in 1 per cent. oxalic acid solution until the non-medullated spots look pale brown, the cortex and nuclei being somewhat darker. Thereupon they are washed in distilled water, after which the fibres appear dark blue, the cortex and nuclei light brown to yellow, the undeveloped non-medullated places pale yellow to white.

The material should be fixed in 5–10 per cent. formaldehyd or in ethylaldehyd for 2–4 weeks, and then hardened in bichromate for 5–7 months.

New Method of Staining Malaria Parasites.† — Dr. Futcher and Dr. Lazear recommend the following new combination of old methods for staining malaria parasites. The dried films are to be fixed in freshly made formalin-alcohol (4–5 drops of 10 per cent. formalin to 10 ccm. of 95 per cent. alcohol). Immerse for 1 minute, then wash in water, blot, and dry. Stain for 10–15 seconds in a saturated solution of thionin in 50 per cent. alcohol, of which 20 ccm. are added to 100 ccm. of 2 per cent. carbolic acid. Then wash, blot, dry, and mount in balsam.

Staining Spinal Cord Cells.‡—Mr. E. P. Sargent recommends the following procedure for staining the principal elements in the spinal cord of *Ctenolabrus cœruleus*. The material is fixed in 10 per cent. and afterwards in 5 per cent. formol. After having been washed in water, it is immersed for 24 hours in 5 per cent. solution of copper sulphate. It is then sectioned, and the sections, which had been placed on slides, are stained for 15–30 minutes in the following mixture:—Phosphor-molybdic acid 10 per cent. solution 1 ccm.; hæmatoxylin crystals 1 grm.; chloral hydrate 10 grm.; water 400 ccm.

The preparations are then washed, dehydrated, cleared up, and mounted in the usual way. The nerve-fibres, neuroglia, and dendrites of the ganglion-cells are well stained.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 443–5.
† Johns Hopkins Hosp. Bull., x. (1899).
‡ Anat. Anzeig., xv. (1898) pp. 212–25 (10 figs.).

Staining Method for Differentiating Leprosy, Smegma, and Human and Avian Tubercle Bacilli.*—Dr. E. J. Marzinowsky records some observations which tend to show that the bacilli of human and avian tuberculosis, of leprosy, and smegma, can be differentiated by a simple staining procedure. The stains used were ordinary carbol-fuchsin and Loeffler's methylen-blue. *Bac. tuberculosis hominis* does not stain by this method. *B. tuberculosis avium* is easily stained, i.e. it retains the red after having been treated with the methylen-blue solution. *Bac. lepræ* is easily stained, but is decolorised by longer action (10 minutes) of the methylen-blue. *Bac. smegmæ* takes the red stain. Thus, while human tubercle bacilli do not stain at all, the other three do, and these are differentiated by the action of the methylen-blue.

Modified Flemming Stain.†—Mr. H. F. Roberts states that basic fuchsin (1 per cent. aqueous solution) can be satisfactorily substituted for safranin in the Flemming triple stain, and frequently gives a more brilliant red. The manipulation is the same. Slides are best left in the fuchsin overnight, and excess extracted with 35 per cent. alcohol. The extraction is slow enough to be easily controlled.

Modification of the Unna-Tanzer Method for Staining Elastic Fibres.‡—The modification suggested by Sig. F. Livini is a combination of Unna's old and recent orcein methods, and consists of two solutions: (1) Orcein 1 part, hydrochloric acid 1 part, absolute alcohol 100 parts; (2) 95 per cent. alcohol 20 parts, hydrochloric acid 0·1 part, distilled water 5 parts. Thirty drops of the first solution are mixed in a watch-glass with 5–10 ccm. of the second. In this mixture are placed sections of material fixed in sublimate or alcohol. The watch-glass must be covered over to prevent evaporation. The sections remain in the solution some hours or overnight. They are then washed 3 or 4 times in 90 per cent. alcohol, dehydrated, cleared up in origanum-oil, and mounted in balsam. The sections may be after-stained with hæmalum, borax-carmine, &c. if necessary.

Modification of Neisser's Stain for Diphtheria Bacilli.§—Mr. F. Tanner and Dr. A. C. Coles recommend the following modification of Neisser's method. (1) The films from a culture or membrane are spread on slides or cover-glasses, preferably the former. (2) Next fix in the ordinary way by heat or by immersion for a few minutes in equal parts of ether and absolute alcohol. (3) Stain in methylen-blue solution (1 grm. dissolved in 20 ccm. of 96 per cent. alcohol, and mixed with 950 ccm. water and 50 ccm. glacial acetic acid) for 10–30 seconds. (4) After washing, immerse in Gram's iodine solution for 10–30 seconds. (5) Wash in water and stain in vesuvin solution (vesuvin 2 grm. dissolved in 1000 ccm. of boiling distilled water); filter for 10–30 seconds. (6) Dry, and mount in Canada balsam.

Thus stained diphtheria bacilli appear as slender rods of a yellowish-brown colour, containing a granule at each end and sometimes also in the centre.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 762–4.

† Bot. Gazette, xxvii. (1899) p. 398.

‡ Monitore Zool. Ital., vii. (1896) pp. 45–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 476–7.

§ Brit. Med. Journ., 1899, i. p. 1213.

(5) Mounting, including Slides, Preservative Fluids, &c.

Method for Exhibiting Polyzoa.* — Prof. M. Hartog recommends that Polyzoa and other small animals should be mounted in a hanging drop of water on the under side of the cover-glass, luted on to a cell of paraffined millboard. In this way evaporation is prevented, so that *Lophopus* and other Polyzoa may be preserved for 48 hours.

Fluorides of Sodium as Fixatives and Preservatives.† — Herr G. Marpmann calls attention to the fixative and preservative properties of the fluoride and bifluoride of sodium. Solutions of both salts attack glass, the polish of which is destroyed. They are antiseptic, and are more agreeable to work with than either formalin or sublimate. The bifluoride solution is miscible with gelatin solutions.

The following formulæ are given:—

For fixing lower organisms: sodium fluoride 0·5 part; sodium bifluoride 2·0; water 100.

For fixing animal tissues: sodium fluoride 5 parts; sodium chloride 5–10; water 100; or sodium bifluoride 5, water 100.

For mounting reptilia: sodium bifluoride 5 parts; glycerin 50; alcohol 100; water 400.

In the foregoing, the colours of snakes and frogs are well kept, and the animals retain their elasticity better than in sublimate or formalin.

For preserving organs, &c.: sodium bifluoride 5 parts; sodium chloride 30; water 300.

For preserving embryos: sodium bifluoride 4 parts; formol 1; water 100.

For hardening glands and central nervous system: Müller's fluid 100 parts; water 100; sodium bifluoride 5; formol 5. In 4–5 days the objects are sufficiently hardened, and should then be treated with alcohol.

Demonstrating Hæmogregarina Stepanowi.‡—M. A. Laveran recommends the following method for examining the endoglobular parasites of *Cistado europæa*. Blood is smeared on a slide, and when dry is immersed in picric acid for 20–30 minutes. It is then washed in water and stained. Flemming's fluid fixes equally well, but the staining is not so good. The staining solution used was as follows:—Saturated aqueous solution of methylen-blue 2 ccm.; distilled water 4 ccm.; aqueous 1 per cent. solution of eosin 8 drops. The mixture must always be freshly prepared. The objects remain in the solution 6–12 hours, and, after having been washed in water, are rapidly dehydrated in absolute alcohol and mounted in balsam.

Toluidin blue and carbol-thionin also give very useful preparations.

Methyl Salicylate in Histological Technique.§ — M. F. Guéguen recommends the introduction of methyl salicylate into histological technique. It is a colourless fluid with an aromatic odour and a refrac-

* Illustd. Annual of Microscopy, 1898, p. 48.

† Zeitschr. f. angew. Mikr., v. (1899) pp. 33–7.

‡ C.R. Soc. Biol., v. (1898) pp. 885–9. See Zeitschr. f. wiss. Mikr., xv. (1899) p. 461.

§ C.R. Soc. Biol., v. (1898) pp. 285–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 455–6.

tive index of 1·537. Its sp. gr. is 1·18. It mixes in any proportion with alcohol, benzol, toluol, xylol, sulphuric ether, chloroform, and petroleum ether. It would be a suitable medium for saturating objects with paraffin. Fixed and dehydrated tissues are immersed in a mixture of methyl salicylate and absolute alcohol. The proportion of the former is increased until the pure salicylate is reached. The object is saturated when it becomes transparent and sinks to the bottom of the fluid. The paraffin is to be added gradually. Methyl salicylate clarifies the tissues well, and does not affect anilin dyes.

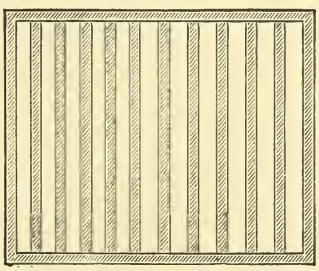
Use of Methylen-blue in Anaerobic Cultivation.*—Prof. G. Kabrhel, taking advantage of the well-known property of reducing agents to decolorise methylen-blue, has devised a method whereby methylen-blue is used as an indicator of the presence or absence of oxygen. The indicator is, of course, intended as an adjunct in the cultivation of anaerobic organisms. The indicator is a test-tube filled with sugar-gelatin coloured with alkaline methylen-blue.

The apparatus used consists of a large bell-jar with a stop-cock at the top. The bell-jar is placed on a flat glass plate, and the two are joined by a mixture of two parts fat and one part tallow. Inside the bell-jar are placed two pans containing pyrogallol, one on top of the other, and separated by strips of glass. The pans are surmounted by a series of uncovered and inoculated capsules. The indicator, which is also placed inside, is not plugged with cotton-wool, and is fixed up with some of the fat-tallow mixture. Caustic potash is added to the pyrogallol, and the stop-cock connected with a hydrogen generator. The excess hydrogen is allowed to escape through a small hole in the tallow-fat junction of the bell-jar and plate. If all conditions have been properly fulfilled, the methylen-blue will be regularly and thoroughly decolorised in about 36 hours.

(6) Miscellaneous.

Apparatus for Preserving Celloidin-Blocks.†—The box constructed for Dr. R. Borrmann for preserving a large number of celloidin-blocks

Fig. 121.

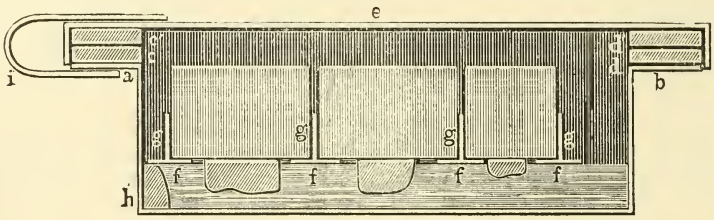


stuck on wood or cork, is made of galvanised iron, and measures 30 by 23 by 3·5 cm. The pan (fig. 122) has a wide lip *a*, *b*, and is surmounted by a lid *e* held on by a clamp *i*. *c' c*, *d' d* are felt pads.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 555-61 (1 fig.).
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 433-7 (2 figs.).

The pan is divided into a number of parallel compartments by means of a grating (fig. 121). The grating is supported by feet *h*, and, as is seen in fig. 122, each septum is T-shaped, so that a number

Fig. 122.



of shelves are formed upon which the blocks rest. The pan is filled with spirit up to the level of the shelves. In fig. 122 only four out of the twelve divisions are shown.

New Microscopical Cell.*—Mr. Hardy has introduced a new cell called the Vitreous, from the fact that the cell is fused on to the glass slip, thus making it one homogeneous whole, and obviating the risk of the liquid oozing out or the cell curling or moving. The cells are made in various sizes.

Globigerina Shells in Polarised Light.†—Herr W. Schauf states that Globigerina shells, both recent and fossil, when examined in parallel polarised light with crossed nicols, show a dark cross and one or more coloured rings in each chamber. The arms of all the crosses are parallel to one another and to the rotation plane of the nicol. The double refraction is negative.

Fig. 123.

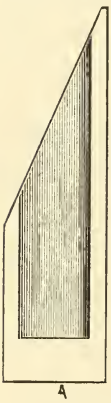
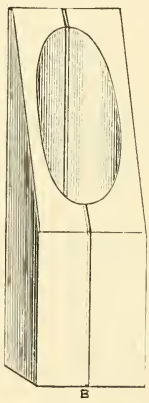


Fig. 124.



Mould for making Gypsum Blocks.‡—Mr. T. Bowhill describes a mould for making gypsum blocks intended for yeast cultures (figs. 123, 124). As will be seen from the illustrations, the cast is cylindrical with a long oblique surface. The two halves of the mould are held together with a rubber band, and, the internal surface having been smeared with paraffin, the plaster is poured in. When the mass has become hard, the block is removed and put in a test-tube along with a little water, and sterilised.

* English Mechanic, lxix. (1899) p. 277.
† Ber. Senckenberg. naturf. Gesellsch. Wiss. Abhandl., 1898, p. 27.
‡ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 287–8 (2 figs.).

PROCEEDINGS OF THE SOCIETY.

Meeting of the 21st of June, 1899, at 20 Hanover Square, W. The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of the 17th of May last were read and confirmed, and were signed by the President.

The List of Donations to the Society—exclusive of exchanges and reprints—received since the last Meeting was submitted, and the thanks of the Society were voted to the Donors.

	From
Board of Agriculture, Annual Report of Proceedings under the Diseases of Animals Acts, for the year 1898. (8vo, London, 1899)	*The Board of Agriculture.*
Dr. Henri Van Heurck, Traité des Diatomées. (4to, Anvers, 1899)	*The Author.*
Prof. Ettore de Toni, Diatomee del antico corso Plavense, (4to, Padova, 1899)	*The Author.*
1/8-in. Objective made by Andrew Ross for the late Prof. Lindley	*The Right Hon. Sir Nathaniel Lindley.*

The President exhibited an old 1/8 objective, made by Andrew Ross, which had been presented to the Society by the Master of the Rolls. It was an interesting and very rare form of objective, constructed probably about the year 1838, which possessed a very primitive form of lens adjustment. As lens correction was first invented in 1837, and screw collar correction came into use in 1839, very few objectives of this pattern could have been made. This particular one had a special interest for them, because it formerly belonged to the father of the donor, Prof. John Lindley, the second President of this Society (1842–3). He felt sure that the Meeting would give Lord Justice Lindley a very hearty vote of thanks for the presentation (see p. 436 and fig. 103).

The President said he had received a new coarse adjustment from Messrs. Watson and Son who had acted very promptly upon a suggestion made by him in a paper he read before the Society in March last, and had sent the result to show that with a loose pinion it was possible to have a rackwork that would work without "loss of time." If it showed signs of wear, the second rack could always be stepped a little more, which would put it in perfect adjustment again.

The thanks of the Society were given to Messrs. Watson for sending this model for their inspection.

A paper by Mr. Jas. Yate Johnson, entitled 'Notes on some Sponges belonging to the Clionidæ, obtained at Madeira,' was taken as read, it

being explained that, being chiefly descriptive of species, it would not be likely to interest the Meeting apart from the illustrations and references, although doubtless it would be a valuable addition to the communications published in the Journal for purposes of reference. Six slides of spicules, &c., in illustration of the paper were exhibited by the Society under Microscopes in the room.

The thanks of the Society were voted to Mr. Johnson for his paper.

There being no other paper on the Agenda, the President called the attention of the Fellows present to an exhibition by Mr. Beck of portions of various wild flowers shown with low powers under a number of Microscopes in the room, which he thought would be inspected with pleasure and interest. Many of them certainly made very pretty objects, and the Meeting was greatly indebted to Mr. Beck for bringing them down and showing them under so many instruments, which he had lent for the occasion.

The President reminded the Fellows that the Meeting would be adjourned for the customary summer vacation, and that their next Meeting would accordingly not take place until October 18th. He wished them all a very pleasant holiday, and hoped they would be able during the recess to find abundance of material for some good papers.

It was announced that the rooms of the Society would be closed from August 18th to September 18th.

New Fellows:—The following were elected *Ordinary Fellows*:—Mr. Walter Heasman, Dr. William J. Stevenson.

The Meeting then resolved itself into a Conversazione, at which the following Instruments, Objects, &c. were exhibited:—

The President:—An old 1/8 in. Objective, made by Andrew Ross; a New Coarse Adjustment.

The Society:—Six Slides illustrating Mr. Jas. Yate Johnson's paper.

Mr. Conrad Beck:—Exhibition of Wild Flowers under the Microscope.

Mr. Chas. Rousselet:—*Notops ruber.*

MICROSCOPY.

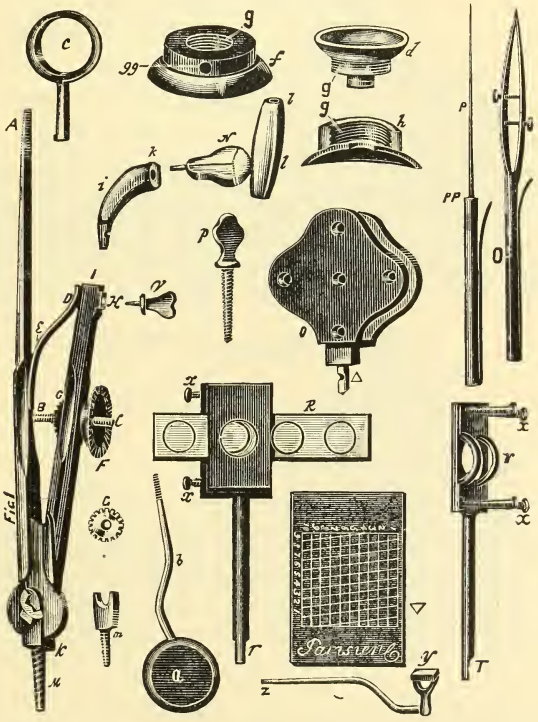
[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

A. Instruments, Accessories, &c.*

(1) Stands.

The Compass Microscope.—In an old German work on the Microscope by Martin Frobenius Ledermüller,† occurs a series of plates illustrating Russwurm's "Universal Microscope," which appears to have been

Fig. 125.



a combination of compass and tube Microscopes in an unusual number of forms. Its claim to "universality" seems to have lain in its adaptability to viewing opaque, liquid, transparent, and anatomical objects.

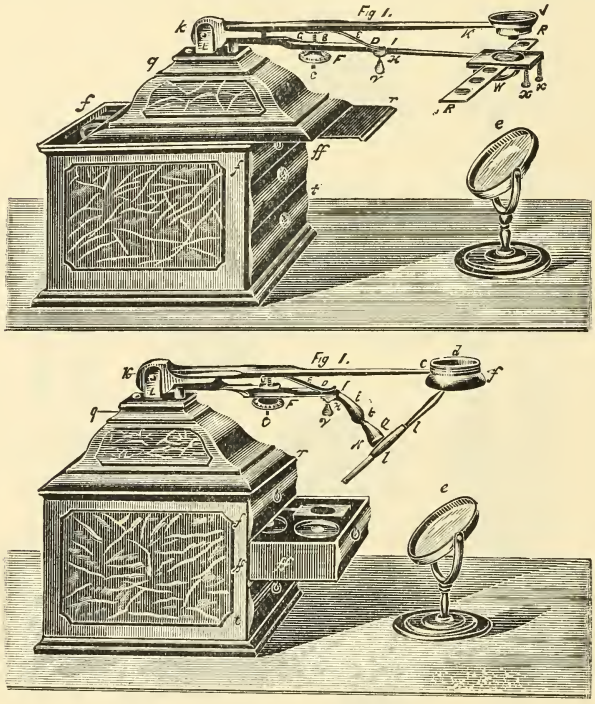
Figs. 125–129, reproductions of the original plates, show the in-

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† 'Mikroskopische Gemüths- und Augen-Ergötzung,' Nürnberg, 1763; Sammlung ii. pp. 21–9 (pls. xi–xv.).

strument in its different forms so clearly that but little description is needed. Fig. 125 contains the compass, or skeleton of the apparatus, and the accessories, which will be recognised, in their various combinations, in the other figures. The parts, when fitted together and set upon the box-lid as a stand, made instruments suitable for viewing (1) transparent or liquid objects (fig. 126, upper), (2) opaque objects (fig. 126, lower), (3) anatomical objects (fig. 127). The Microscope was simple, and the only lens used was set in a circular frame *d*, inserted into a ring *c*. If the object was transparent or liquid (fig. 126, upper) this arrangement with the help of an adjustable glass mirror *e*, was sufficient; but in the

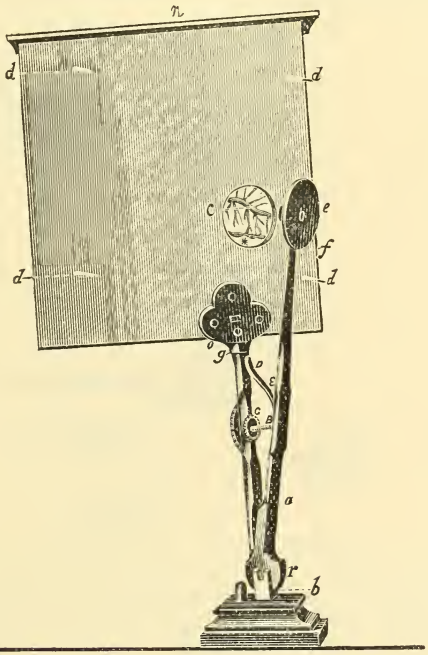
Fig. 126.



case of an opaque object, a perforated concave silver mirror *h*, *g* was screwed on to the under side of *d*, and the light, first reflected from the mirror *e*, was then again reflected on the object (fig. 126, lower). The screw-thread *g* for securing *h* to *d* was long enough for adjusting the focus of the concave mirror. Thus the opaque object was not only illuminated on both sides, but received a maximum of light from above. The concave mirror is shown in section at *h*, and in perspective at *f*; *g g* is the screw-hole for fixing lens-cap and mirror on to the compass leg. The little stage for holding the slides R was made of three plates, between the upper two of which the slides were placed, and the spiral springs on

the pins x acted as clamps. The curved bars under the lower plate were for a glass tube of liquid, and in this case the springs clamped the two lowest plates. Two reversible tablets (Y, a), white one side, black the other, were provided for opaque objects. The reversibility was attained in Y (a small round ivory tablet) by suspending it on two small pivots in a brass bracket at the end of the crooked arm z. With the large tablet a, reversibility was attained by a single pivot, and the arm b was crooked so as to make a always horizontal. O is a pair of forceps also intended for opaque objects. The micrometer ∇ is a Parisian inch divided into a decimal scale, and was intended for estimating the magni-

Fig. 127.



fying power. The whole apparatus was fitted on the lid of a box, which contained drawers for the reception of the various parts when not in use.

Fig. 127 shows the "anatomical" arrangements, after the manner of Lieberkühn's "Anatomical Magnifying Machine" (1745). At the back of a board a frog's web or other such object was spread out, and the lens of the Microscope arranged so as to explore all the parts opposite the perforation.

Fig. 128 shows how an extension of "universality" in the form of a tube Microscope could be arranged for those who preferred such an instrument. The tube was screwed into the ring b, and a second ring working radially from a centre-joint d received the lens. This second ring could be swung aside and the lens changed when desired; the

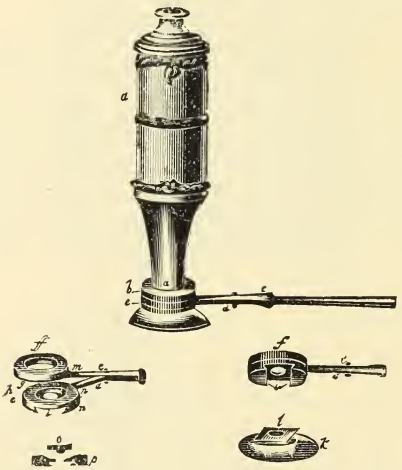
concave perforated mirror could be slid into a notch in the lower face of the ring. The details are shown in separate cuts: *o* in the left-hand lowest cut is the lens. There was no eye-piece, the length of the tube being merely a guide for the position of the observer's eye.

The lamp and stand, depicted in fig. 129, appear to have been Russwurm's idea, although (as he admits) the glass globe filled with water was adapted from the method of Hooke (1660).

The date of the letter in which Russwurm sends the drawings of his Microscope to Ledermüller is December 5, 1761.

Adams' Compendious Pocket Microscope. — The cut of this old Microscope (fig. 130) is copied from the 'Micrographia Illustrata' by G. Adams, 4th edition, 1771. It is interesting to note that this is the model to which Benj. Martin added his improvements in 1776.* It will

Fig. 128.



be observed that both have folding tripod feet; both have compass joints at their bases for inclination; both are body focussers by rack-and-pinion; both have body movements over the stage by lateral swing in arc and sliding bar, after the plan of Ellis' Aquatic Microscope (made by Cuff in 1755). Adams calls this Microscope an abridgment of his Variable Microscope; now this Variable Microscope, which was first described in this same edition of the 'Micrographia,' was, we are told by Adams, designed by a nobleman who did not wish his name to be published; and as this Variable Microscope more nearly conforms to the Microscopes of the present day than any of those preceding it, microscopists ought to be much indebted to this anonymous nobleman for the form of the instruments they now use.

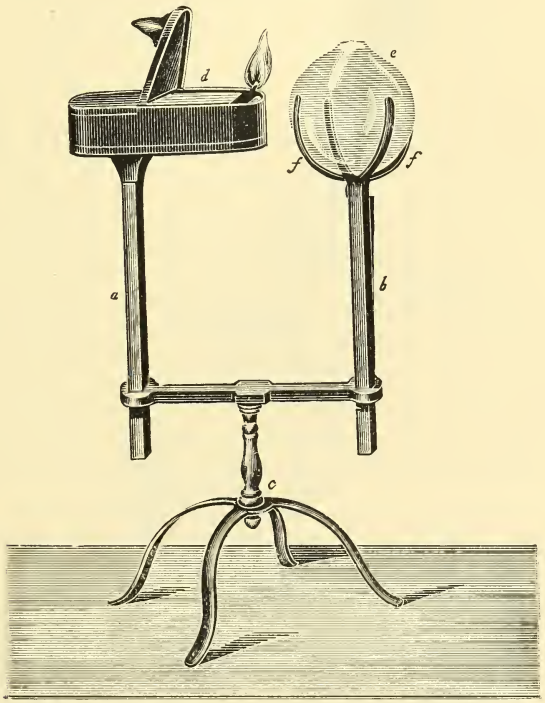
The main alteration that we find in the Compendious Pocket Microscope is a radical one, and consists in the transference of the compass

* See this Journal, *ante*, p. 326, fig. 73.

joint from the top of the pillar to the bottom; this from our present point of view must be considered a retrograde step.

This Microscope is, as we have already mentioned, a body focusser, so also was the Variable; but the Variable was hampered with a fine adjustment movement mounted on the same slide; therefore a clamping nut had to be released to throw the fine adjustment out of action when the rackwork coarse adjustment was used. There can be no doubt that the suppression of the fine adjustment effected an improvement; for a good rackwork coarse adjustment was quite sufficient to focus any non-achromatic objective of that time.

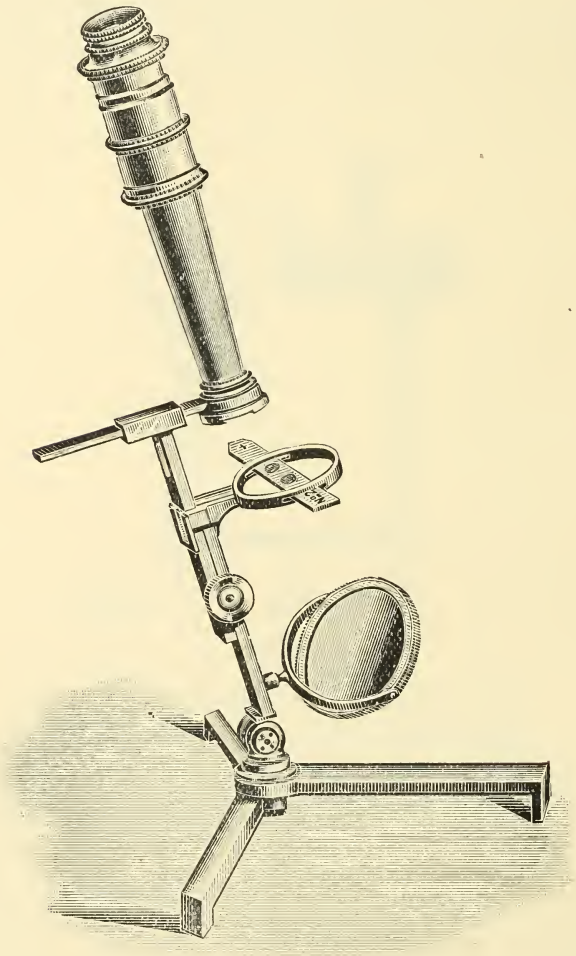
Fig. 129.



The optical part of this Microscope was similar to that of the Variable, and consisted of a double eye-lens, a field-lens, and another lens lower down the body, which, as we have stated before, formed the back lens of the objective, the alteration in power being effected by changing the front lens of the objective only. It is probable that this arrangement of the optical part of the instrument was due to Benj. Martin; though, so far as is known, the first publication of it is in the account of the Variable Microscope. At the end of the nose-piece a dove-tailed slot is seen, into which slides a plate containing six powers. This is the first instance we have of such a contrivance fitted to a compound Microscope; but it

will be remembered that a sliding plate of powers was employed by G. Lindsay * in his simple Microscope, patented in 1743, but alleged to have been made as early as 1728. These are all the points to be re-

Fig. 130.



corded in this instrument; it will, however, be of interest to compare it with that of Benj. Martin.

In the optical part we noted that Benj. Martin doubled the field-lens

* Journ. Quekett Micr. Club, vii. (1898) p. 115, fig. 22.

of his eye-piece, with the view of reducing the spherical aberration. By mounting the objective fronts in a wheel instead of in a slide, Martin effected a great improvement, and so became the inventor of that useful appendage, the rotating nose-piece.

Now, as these early Microscopes were largely used as simple Microscopes, a long extension of rackwork would be necessary, which, judging from the cut, the Compendious Pocket Microscope certainly did not possess, and it is more than probable that the draw-piece added by Martin was for the purpose of remedying this very defect.

The improvements effected by Martin in substage and superstage illumination were of course a distinct advance.

In conclusion, Adams' Compendious Pocket Microscope is important because it undoubtedly led up to Martin's model of 1776, which was one of the best and most practical of old non-achromatic Microscopes, and of which, thanks to Dr. Dallinger, we have such a fine example in our Cabinet.

Fine Adjustment of the Microscope.* — A treatment, mainly historical, of this subject appears over the signature "M." At the commencement of this century, micrometer movement was confined to the stage; for the last forty or fifty years it has been applied to the upper part of the stand. Such stands, closely resembling those in present use, were already constructed in 1839 by Charles Chevalier, and improved by his son Arthur Chevalier. Strauss' "Grand Microscope" possessed coarse and fine adjustment, rotatory object-stage, and a movable slide in each direction, besides apparatus for central and oblique illumination, a reflecting mirror for incident light, a camera lucida, an objective stage micrometer, and an eye-piece micrometer. The tube was mounted on a horseshoe foot, and arranged for oblique inclinations. The well-known Parisian opticians, Trécourt, Bouquet, and Oberhäuser, worked to this model, and in 1857 the latter entered into partnership with his nephew, E. Hartnack, who since 1860 has conducted the business alone. Oberhäuser and Hartnack then for a long time controlled Microscopy, because they produced a combination of the best mechanical execution and optical design. By means of his immersion system of 1860, No. 10 with 1·6 mm. focus, and No. 11 of the year 1864 with 1·2 mm. focus, Hartnack surpassed all known objectives (even the English), which possessed even a smaller focus but a much smaller interval (*Abstand*), and were therefore not so well adapted for practical use.

The first large system, No. 11, was produced by Hartnack for Prof. Henry von Heurck in Antwerp, who has published a very favourable report upon it in the first volume of the 'Annales de la Société Physiologique d'Anvers.'

By means of these stands the original micrometer movement of the stage was quite superseded; all better instruments were provided with a fine adjustment, which was placed in the arm of the tube-holder.

Only cheap stands now show a fine adjustment by oblique movement of the object-stage; obviously this cannot be applied to stronger systems, because the object must lie nearer to the upper lens aperture than to the lower, and consequently cannot be symmetrically adjusted.

* Zeitschr. f. angew. Mikr., July 1898, pp. 86–90.

However, on old stands by Plössl, Merz, Goring, Pritchard, and others, it may be seen how for a long time the greatest trouble was taken to bring the fine adjustment of the object-stage to an exact and practical perfection. So long as the stands are restricted to the usual dimensions, there is no reason in particular for compelling us to abandon the good and sure movement by prism adjustment; but if the dimensions of the stand should be increased, then necessity would compel us to again fit the adjustment to the stage. These ideas have occupied the author for some years; and at last Herr Paul Thate, of Berlin, has constructed for him a small model of this movable micrometer stage. The object-stage has a diameter of 20 cm., and might have more—a size which, although necessary for the observation of large sections, would yet render a suitable stand very massive and awkward.

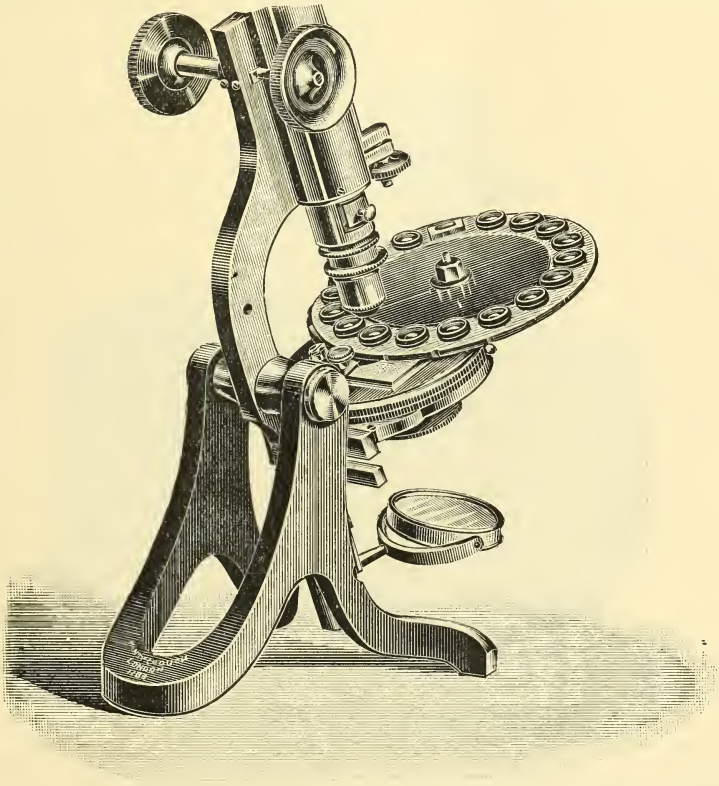
For such an instrument the Pacini model of 1845 offers itself as a suggestion. The tube is set on a three-sided prism, so that the rays which have passed through the object are reflected at an angle of 30°, and hence the oblique position of the tube need not be worked by means of the movement of the stand. Thus the great advantage is gained of being able to place the preparations horizontally. Pacini moves the stage by a micrometer-screw, which is fastened to the stand, and possesses a short inclination to the movable disc. This micrometer movement is not exact enough to satisfy modern demands. If the stage is moved, it is obviously required that every movement of the stage must be strictly central. There must be no shaking of the object; there must be steady up-and-down motion, without being in the least brought out of the axial setting. Such a motion can be attained by fitting an inner cylinder to the object-stage, and fixing it with clamps, so that it can be moved up and down by means of a screw-disc. This screw-disc is placed round the cylinder and fixed in a slot, so that the rotation of the screw raises and lowers the cylinder. The larger the dimensions the finer is its movement, and every difference in height can be read off on the disc, which is provided with scales. The mechanical arrangement is less complicated than other contrivances which have been, and perhaps will yet be, applied to the upper stand if the need for large stands should become more marked. It is already a hindrance that the movable tube hangs on the same part which encloses the whole fine adjustment, and many a micrometer movement has been ruined by inadvertently lifting the Microscope by the arm. But the beginner will always use the arm for gripping the Microscope.

The application of the Porro system to microscopy will give a further stimulus to the production of new stands. The oculars will first be constructed out of prisms, which, just as in the case of telescopes, will procure their highest optical adaptability, and similarly will permit a shortening of the tube, and will attain with the strongest magnification a brilliant and large field of view. One ought to see the attention of the up-to-date Microscope constructor directed to the combination of Porro's oculars with large object-stages and with the most delicate adjustment motion of the object-stage.

We are by no means at the end of the constructive adaptability of our optics and mechanics, and many a discovery yet slumbers in the workshops of our Microscope makers.

Flint's Class Microscopes.*—Dr. James M. Flint has devised these instruments for class or public exhibition of slides not requiring very high magnifying powers. Dr. Flint says that his first appliance for this purpose was an accessory to the ordinary Microscope stand, and consisted of a circular plate of pasteboard (fig. 131) made to revolve upon a pivot attached to the stage, the plate carrying a series of objects mounted upon small discs or small squares of glass; but this arrangement

FIG. 131.



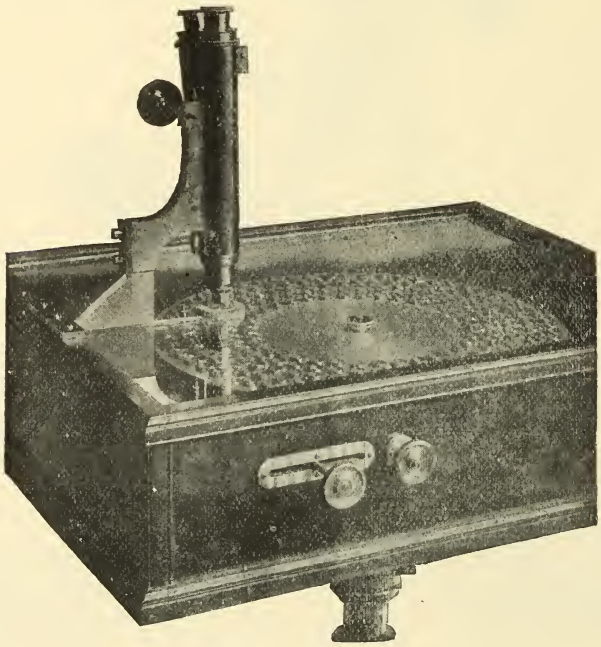
was only suitable for class use under the immediate supervision of the instructor.

Fig. 132 shows the form of the instrument adapted for public use. The principle of the rotatory stage has been developed by enlarging the circular plate, enclosing it securely in a box with a glass top upon which the Microscope is fastened, giving a rotatory motion to the stage by means of a friction roller operated by a rack-and-pinion controlled by another milled head in close proximity to the former. By a com-

* Ann. Report of Smithsonian Institute, 1896, pp. 96 and 7 (4 pls.); Scientific American, May 6, 1899, p. 282 (3 figs.).

bination of the two movements any portion of the plate may be brought under the Microscope, and any number of objects arranged thereon may be brought into the field in succession. The objects being enclosed in the box are secure from injury; the movement of the Microscope for focal adjustment is limited by stops, so that the object cannot be entirely lost to view; the eye-pieces are screwed in so that they cannot be stolen, and the instrument is practically safe from everything but malicious mischief. The instrument was made originally for exhibiting foraminifera, which were mounted in concave brass discs without stems for insertion in the holes of the rotatory stage. For transparent objects the

Fig. 132.

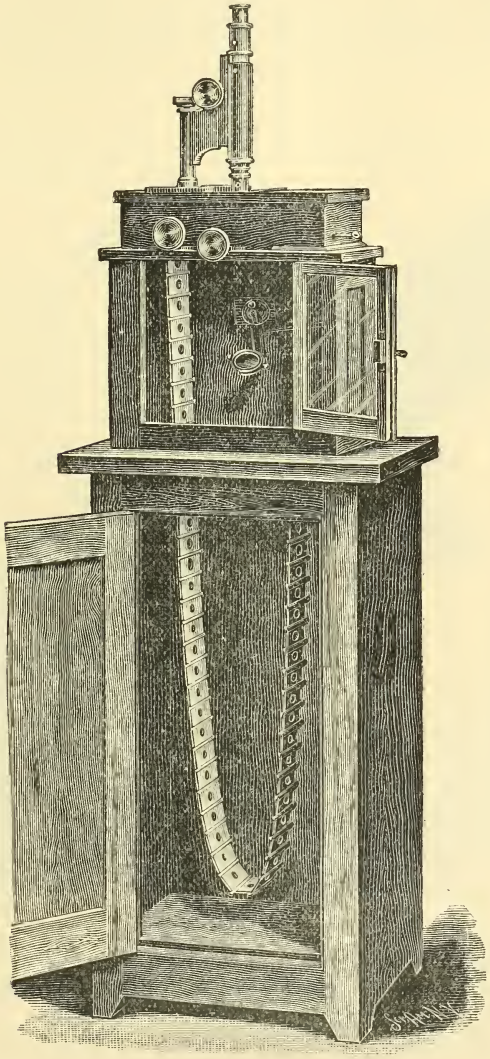


stage must be perforated for upward reflection of the light from the mirror below. The instrument now in use in the museum was made in the year 1890, has been modified in a few details since, and has successfully endured manipulation by thousands of inexpert hands of children as well as adults, without injury, and this without attendant supervision of any kind.

In figs. 133, 134, Dr. Flint shows a different form of apparatus intended for the exhibition of series. An indefinite number of slides are attached to an endless band of linen by means of thin brass holders which allow the slides to be changed when desired. This linen band passes over two rollers mounted upon a light brass frame which occupies the place of the stage of an ordinary Microscope. The loops of the

band hang free. One of the rollers has a projecting pivot with a milled head by means of which it may be rotated, and the two rollers are connected by a narrow belt at each end. As the rollers are made to revolve,

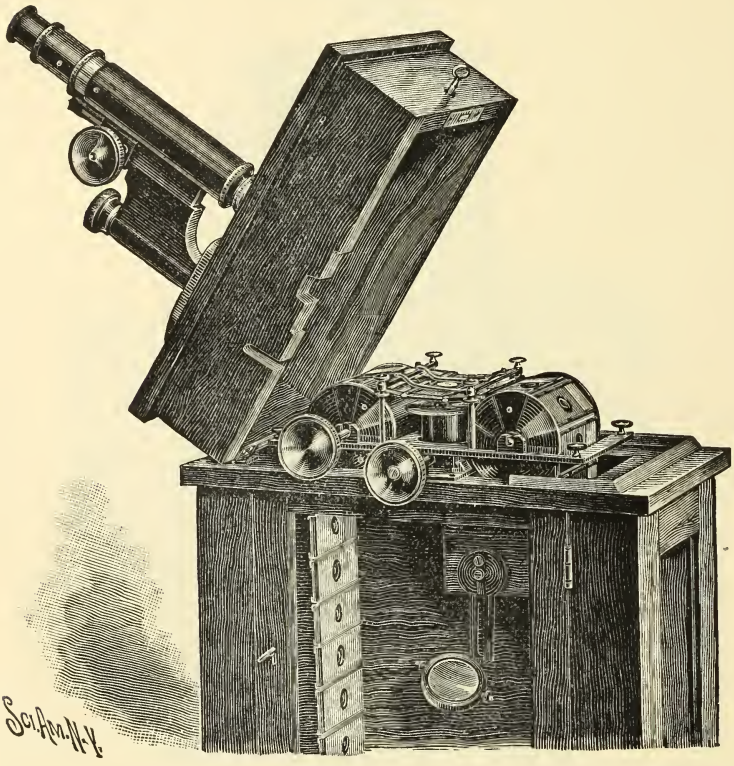
Fig. 133.



the band carrying the slides passes horizontally under the Microscope, resting meanwhile upon the two narrow belts, and being kept at a definite distance from the objective of the Microscope by two guides, which press upon the slides from above. The brass frame rests upon a grooved bed-

plate which permits a lateral movement of the frame. This lateral motion is controlled by a screw, operated by means of a second milled head in convenient proximity to the one giving the to-and-fro motion. The advantages of this form of apparatus are that ordinary glass slides may be used, and that the focal distance is not disturbed by differences in their thickness. The only disadvantage is that the mechanism is somewhat more delicate and complicated than in the other instrument, and requires some little protection from the thoughtless violence of

FIG. 134.



curious children. Microscopes copied from the original have been in use for several years and have proved perfectly satisfactory.

The writer in the *Scientific American* describes a valuable improvement intended to prevent injury to the instrument from violent twisting of the milled head, which controls the lateral movement of the frame after the frame has been brought up against the stops in either direction. This is effected by slightly tapering the pivot of the screw governing the movement, and attaching the head by friction only, the amount of friction being regulated by a set-screw in the end, so that,

before a dangerous strain can be put upon the frame, the head turns harmlessly upon the pivot.

An earlier form of the instrument was described by Dr. Flint in 1892.* Another inventor of a rotatory disc was Dr. Taylor, whose device was noticed in our Journal.†

For the illustrations to this abstract we are indebted to the courtesy of the editor and publishers of the *Scientific American*.

HAGER, H.—**Das Mikroskop und seine Anwendung.** (The Microscope and its Application.)
8th edition, by C. Mez. Berlin (Springer), 1899, 8vo, 335 pp. and 326 figs.

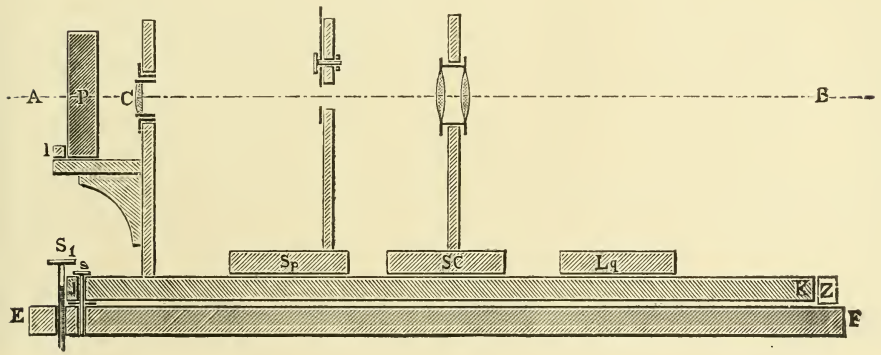
LEISS, C.—**Die optischen Instrumente der Firma R. Fuess, deren Beschreibung, Justirung, und Anwendung.** (The optical instruments of Messrs. R. Fuess: their description, adjustment, and application.)
Leipzig (Engelmann), 1899, 233 figs. and 3 pls.

(3) Illuminating and other Apparatus.

Köhler's Apparatus for Uniform Illumination.‡—The object of this apparatus, manufactured by Zeiss, is to provide an easily made cheap arrangement for obtaining uniform illumination from the spectrum itself. It is therefore independent of light-filters.

Figs. 135, 136 give the section and ground plan. D E F G is a

FIG. 135.

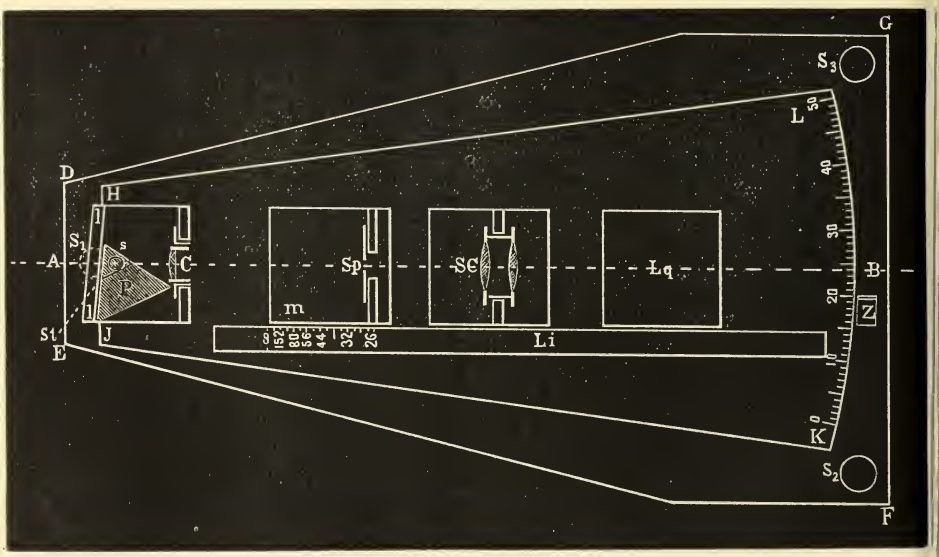


board, about 60 cm. long, on which the apparatus is placed. It is about 2 cm. thick, and is made of three thin boards glued together cross-grained to prevent warping. The side D E is 12 cm. long, and has a levelling screw S_1; at the end F G, 40 cm. long, are two other levelling screws. These screws, which are 6 to 7 cm. high, allow not only levelling but considerable adjustment in height. On this base-board is placed the sector H J K L, consisting also of three thin boards glued together cross-grained. K L is an arc, capable of being rotated about the pivot *s* in H J. In order to separate the planes of the sector and base-board, the pin *s* is passed through a little disc, and two similar discs are placed at

* Proc. Amer. Soc. Micr., xiii. (1892) pp. 54–8 (1 pl.).
† Tom. cit., p. 30 (1 pl.); Journal R.M.S., 1892, pp. 862–3 (fig. 94).
‡ Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 1–29 (5 figs.).

L and K. At the front end of the sector, rather close to the axis of rotation, is erected the carrier of the collector lens C, consisting of a slab 20 by 9 cm., perpendicularly fastened to the sector, and pierced at a convenient height by a circular opening in which the collector lens is set; the centre of this opening must be brought by means of the levelling screws to coincide with the optical axis of the Microscope used. The author employs for his collector the objective of a small opera-glass, of 12 cm. focus and about 2·5 cm. diameter. In front of the lens a small bracket, 7 by 9 cm., is applied to the carrier, and on it is placed the carbon disulphide prism P, of 60° angle and side-planes 9 by 6 cm. The prism is set close up to the collector, so that it is in the position of minimum aberration for blue, and is exactly over the rotation axis *s*. A fillet *l l* is screwed on to the bracket, against which the side-plane of the prism

Fig. 136.



must lie, in order to avoid the neccssity of determining the adjustment on every occasion.

The other carriers must be capable of a sliding adjustment in the axis of the apparatus, and for this purpose they are secured, not on the sector, but on square foot-blocks of about 9 cm. square. Each of these blocks is fitted with three small knobs, so that they may stand steady without vibration; their edges must always be in contact with the graduated bar L *i*. On the first slider is a perpendicular board with an adjustable slit, or a revolver frame with several slits, of breadth varying between 0·1 and 3 mm. The second slider is similar, but, instead of the slit arrangement, carries a non-achromatic two-lensed system S C, the "slit collector," of about 3·5 cm. aperture and proportionately greater focus. The last slider L *q* is for the light-source, usually a small

acetylene burner on a heavy lens-stand for convenient up-and-down adjustment; but other light-sources can of course be used.

The arrangements for adjusting and focussing the apparatus are of the usual character, and are described in full by the author.

Light of any required refrangibility can finally be received on the objective of the Microscope. The author claims that the advantage of being able to work with any part of the spectrum outweighs the laboriousness of fitting up the apparatus, which however need occur but once, as the positions of the parts could be registered on the scale.

Schroeder, Dr. Hugo—**Ueber Beleuchtungsprobleme.** (On illumination problems.)

[A series of discursive articles.]

Central-Ztg. f. Optik u. Mechanik, 1899, Nos. 2–7, Jan. 15 to April 1.

(4) Photomicrography.

Marktanner-Turneretscher, Gottlieb, F.R.M.S.—**Fortschritte aus dem Gebiete der Mikrophotographie.** (Progress in the department of photomicrography.)

[This is the publication in pamphlet form of a section of Dr. J. M. Eder's 'Jahrbuch für Photographie und Reproductionstechnik für 1899.' The author has compiled an illustrative descriptive list of the various instruments, books, &c., on the subject issued during the last two years. The list is cosmopolitan, and most of the items have been noticed in our Journal.]

Sobotta, Dr. J., of Würzburg—**Ueber die Verwertung von Mikrophotographien für die Untersuchung und Reproduktion mikroskopischer und embryologischer Präparate.** (On the value of photomicrographs for the examination and reproduction of microscopical and embryological preparations.)

[In two chapters: (i.) The photomicrography of preparations of the central nervous system with Weigert's boundary colours; (ii.) The photomicrography of opaque objects.] Munich, 1899, 34 pp. and 1 pl.

(6) Miscellaneous.

Babes, V.—**Bemerkungen über demonstrative Vorträge und über Projectionstechnik.** (Observations on proposed methods of demonstration and on projection technique.)

Centralb. f. allgem. Pathol. und pathol. Anat., Bd. X. (1899) No. 6, p. 233.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Preparing Agar.†—Mr. W. W. Alleger gives the following method for preparing agar. Rub up 10 grm. of powdered agar and Witte's powdered pepton and 5 grm. of sodium chloride in a porcelain saucepan with water sufficient to form a thin paste. Add gradually, while stirring the mixture, 500 ccm. of water, and then heat until the agar is dissolved. To the juice from 500 grm. of lean meat add 500 ccm. of water, and then mix with the agar solution, which, while hot enough to remain fluid, should have cooled sufficiently not to coagulate the albumen in the meat-water. Neutralise with 4 per cent. of caustic soda; boil the mixture until all the albumen has coagulated, and then, if necessary, correct the reaction and fill up with boiling water, after which filter

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. † Trans. Amer. Micr. Soc., xx. (1899) pp. 91–5.

through paper. By deferring filtration to the next day the filtrate will be clearer.

The chief feature in this method is the preliminary step of moistening the powdered agar and pepton with a small quantity of water or bouillon, and rubbing to a smooth paste free from lumps.

Magnesia-Gypsum Plates for Cultivating Nitrifying Organisms.* —Herr V. Omeliansky states that he has obtained excellent results from cultivating nitrite-forming organisms on gypsum blocks saturated with Winogradsky's solution (*vide infra*). A perfectly uniform mixture of gypsum and carbonate of magnesia is prepared of the consistence of sour cream. This is then poured out on to a glass plate, and when it has become of a doughy consistence, is cut up into circles for Petri's capsules, and into strips for test-tubes. The circles and strips, properly smoothed off are placed in capsules or tubes along with mineral solution, and, after being properly sterilised, are inoculated with nitrite-forming organisms. Growth is first visible in four or five days, the colonies being of a yellowish hue, ultimately becoming brownish.

Cultivation Medium for Spirillum volutans.† — Dr. Vogt obtains copious development of *Spirillum volutans* on the following medium. Peas are boiled in water (1–5) for about 5 minutes, and the fluid strained through a linen cloth. To the pea-water are added 1 per cent. each of pepton, sodium chloride, and carbonate of ammonia. Even without the pepton *S. volutans* thrives on the medium, but sodium chloride and carbonate of ammonia are indispensable. The mixture must now be allowed to stand for some days—in fact, until it begins to decompose—before it is sterilised. If it be sterilised as soon as it is made, the spirillum does not find the medium suitable to its needs.

Cultivating Leprosy Bacilli.‡—Dr. J. Barannikow, in a preliminary communication, states that he has successfully cultivated typical leprosy bacilli from two cases. The material used was nasal secretion, sweat, and blood. Rapidity of growth was found to depend chiefly on suitability of medium. Skin, brain, and ascitic fluid were favourable starting media. On suitable media rodlets were found in 36–48 hours. Agar and gelatin containing substances suitable for the bacilli produced colonies at 17°–18° C. by the fourth day. If the medium was unfavourable, no growth took place even at body heat.

(2) Preparing Objects.

Methods used for Chilopoda.§—O. Duboscq devotes a special chapter in his paper to technique. He usually killed his specimens with chloroform, cut them in fragments, and fixed with Flemming's solution or Perenyi's liquid. For the latter he used the following formula :— Equal parts of 1 per cent. chromic acid, 10 per cent. nitric acid, and 95 per cent. alcohol. He also used acetic alcohol made as follows :— 10 parts of glacial acetic acid and 100 parts of absolute alcohol; this kills animals instantly in an expanded condition. For staining after Flemming's solution, he recommends safranin in a saturated solution in

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1899) pp. 652–5.
† Op. cit., 1te Abt., xxv. (1899) pp. 801–4.
‡ Op. cit., 1te Abt., xxvi. (1899) pp. 113–4.
§ Arch. Zool. Expér., vi. (1899) pp. 481–650 (7 pls. and 21 figs.).

water containing anilin, differentiation being effected by alcohol and essence of cloves, or picric acid dissolved in absolute alcohol, or Benda's light green. After Perenyi's liquid or sublimate, he used the following method :—Overstain with Delafield's hæmatoxylin, decolorise with nitric acid of 0·5 per cent. strength, or with very dilute Perenyi's fluid, wash with water, stain with alcoholic eosin.

For the study of the blood, the following liquid was used :—Acetic acid, copper acetate, copper chloride, osmic acid, thionine, 1 grm. each ; distilled water, 400 grm. This is added to the blood on a slide, and both fixes and stains after about two minutes.

For the study of the nervous system, he used the following method instead of that of Golgi. The preparations were placed for 48 hours in the following :—5 per cent. solution potassium bichromate, 3 parts ; 20 per cent. formol, 1 part ; and then for 24 hours in 1 per cent. nitrate of silver solution, both solutions being kept at 40° C.

Isolation of Nitrification Microbes from the Soil.*—According to Herr V. Omelianski, the media suggested by Winogradsky are the most suitable substrata for isolating nitrification microbes, silicon jelly for nitrite-formers, and nitrite-agar for nitrate-formers. For making silicon jelly it is necessary to use soluble water-glass (sp. gr. 1·05–1·06) and hydrochloric acid (sp. gr. 1·10). A mixture of equal parts is made and dialysed until the chlorine reaction is no longer given with silver nitrate. Besides the foregoing, the following solutions are required :—

Solution i. Potass. phosph. 1 grm. ; ammon. sulph. 3 grm. ; mag. sulph. 0·5 grm. ; aq. dest. 1000 ccm.

Solution ii. Ferri sulph. 2 per cent.

Solution iii. Saturated solution of sodium chloride.

Solution iv. Magnesia-milk, i.e. a suspension of carbonate of magnesia.

To 50 ccm. of the silicic acid solution, 2·5 ccm. of the first and 1 ccm. of the second solution are added. A loopful of salt is required for each plate, and as much magnesia-milk as will impart a milky appearance to the jelly. The plates are best inoculated by rubbing a drop of the inoculation fluid on the surface by means of a glass rod.

The nitric acid reaction appears about the fifth or sixth day. To render the colonies apparent on the milky surface of the plate, a solution of ammonia is used. A couple of drops of a 10 per cent. solution are placed in two small excavations cut in each plate.

For isolating nitrate-formers, the following media are used in the Imperial Institute at St. Petersburg. A liquid medium is composed of natr. nitros. (Merck) 1 grm. ; natr. carbon. ustum 1 grm. ; kal. phosphor. 0·5 grm. ; natr. chlorat. 0·5 grm. ; ferrum sulph. 0·4 grm. ; magn. sulph. 0·3 grm. ; aq. destil. 1000 grm.

A solid medium has the following composition :—Natr. nitros. (Merck) 2 grm. ; natr. carbon. ustum 1 grm. ; kal. phosph. a trace ; agar 15 grm. ; water 1000 grm.

Demonstrating the Spirilla of Geese.†—Dr. J. Cantacuzène states that he obtained good results from the following method :—(1) Small

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 537–49 (1 pl.).

† Ann. Inst. Pasteur, xiii. (1899) pp. 534–5 (2 pls.).

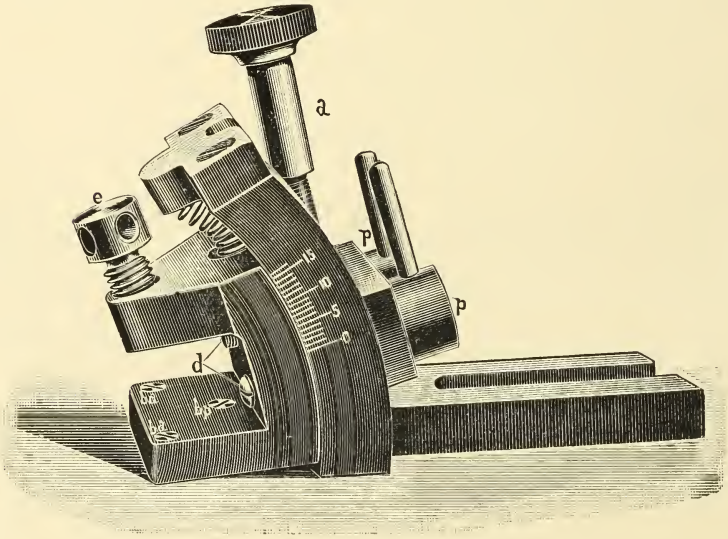
pieces of the organs were immersed in weak Flemming for 24 hours. (2) Wash in water for 24 hours. (3) Series of alcohols, xylol, paraffin imbedding. (4) The sections fixed to the slide were stained with the following fluid :—Ziehl's fuchsin 2 parts ; neutral glycerin 1 part. The sections should not be thicker than 3–4 μ, and must be left in the stain for 24 hours. Instead of fuchsin, magenta-red may be used. (5) Wash quickly in water ; remove excess of water with blotting-paper, then immerse the preparation in a series of ether baths to prevent dehydration by the alcohol. The immersion should last 4–6 hours. (6) Mount the sections in balsam dissolved in ether.

The author found that all fixatives, except those containing osmic acid, gave very imperfect staining results.

(3) Cutting, including Imbedding and Microtomes.

Jung's New Knife-holder.*—Messrs. Mayer and Schoebel describe some improvements in Jung's microtome knife-holder. These improvements consist in the addition of (1) a pair of screws *d* ; (2) a triplet of screws *b p*, *b a*, *b d* (fig. 137). The first set can be drawn out some

Fig. 137.



5 mm., so that a blade narrower than the usual 34 mm. can be used. A second set can be raised so as to permit the insertion of a thinner knife-blade ; moreover, by unequal arrangement in height they can be made to influence the inclination of the knife, and the front ones allow an adjustment for attaining a more perfectly horizontal section.

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 29–32 (2 figs.).

(4) Staining and Injecting.

New Group of Anilin Pigments, and their Applicability to Tissue Staining.*—Herr H. Rosin has discovered that if saturated aqueous solutions of an acid and an alkaline anilin pigment be mixed so that the mixture have a neutral or approximately neutral reaction, a precipitate occurs. This precipitate is extremely bulky if the correct proportions have been observed, and may be partially or wholly dissolved if either the alkaline or acid pigment be again added in excess. These precipitates are obtained by mixing aqueous solutions of eosin or erythrosin and methylen-blue, of methyl-orange and methyl-green, of rubin and malachite-green, of picric acid and methylen-blue or magenta-red, &c.

All these precipitates are of a crystalline nature, and, while almost insoluble in water, are quite soluble in alcohol. From these solutions they can be re-obtained in crystalline form by concentration of the solutions or by the addition of water. Of all the foregoing the most useful is the eosin-methylen-blue mixture which makes with alcohol a blue-violet solution. When tissue-sections are stained with this, the nucleus is blue and the plasma red. Nerve-cells, however, form an exception; for while the plasma stains red, the nucleus does not stain blue, the blue being picked up by the Nissl bodies. The neutrophile granules of leukhæmia stain violet. As a rule, with this pigment, acid substances become blue, alkaline red, neutral violet.

New Vegetable Pigments for Microscopical Technique.†—Dr. M. Claudius recommends for microscopical technique stains made from flowers and fruits. The most suitable flowers will be found in certain dahlias, while the blackberry and elderberry are the most convenient fruits. The flowers and fruit must not be crushed, and must be quite fresh. The pigment is extracted by boiling in spirit and filtering when cold. The filtrate is inspissated by evaporating off the spirit, and then the strong pigment solution is diluted with water. The most suitable strength is found to be when 100 ccm. of pigment is prepared from 100 grm. of fruit. The solution must now be acidulated by adding 1 ccm. of 25 per cent. sulphuric acid to every 100 ccm. of the staining solution. The acid reaction is absolutely necessary, as this kind of vegetable stain does not work when alkaline or neutral. Ten drops of carbolic acid are added, and then the solution is shaken up and filtered. The sections are immersed in the solution for a couple of minutes, washed in absolute alcohol, cleared in oil of cloves, and, having been treated with xylol, are mounted in balsam. These vegetable stains may also be combined with picric acid or methyl-violet, and thus a double and triple staining may be imparted. To 100 ccm. of the elderberry stain, 5 ccm. of cold aqueous solution of picric acid are added.

When methyl-violet is to be used in conjunction with the picric-acid-elderberry solution, the following procedure is advised:—(1) Stain with a 2 per thousand aqueous methyl-violet solution for 1–2 minutes, and then remove superfluous staining solution. (2) Stain for 2 minutes in the picric-elderberry solution, and again remove any superfluous fluid.

* Berliner klin. Wochenschr., 1899, No. 12. See Centralbl. Bakt. u. Par. 1te Abt., xxvi. (1899) pp. 101–2.

† Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 579–82.

(3) Dehydrate in absolute alcohol. (4) Decolorise in clove oil until the red nuclear stain shows pretty well. (5) Xylol. (6) Balsam.

By this method the nuclei are stained red, the plasma yellow, and bacteria, stainable by Gram's method, indigo-blue. If not stainable by Gram's method then the bacteria are red.

For very thin sections, dehydration in alcohol is hardly necessary, and merely mopping with blotting-paper may be sufficient. For cover-glass preparations the use of alcohol is to be avoided.

New Staining for Nervous Tissue.* — Herr P. Kronthal stains sections of brain and cord by immersing them in a mixture of equal parts of 10 per cent. formalin and saturated formate of lead solution for five days, and then for a similar period in sulphuretted hydrogen and formalin solution. The sections are then washed, treated with alcohol and xylol, and imbedded in balsam. Not only the ganglia and nerve-cells, but the finest branches of the nerves, show a deep brown impregnation, which is fast and lasting.

Staining Cell-walls.†—M. J. Chalon communicates the results of the third series of experiments on staining cell-walls. The staining solutions used were magenta-red, anilin-blue, crocein, tropæolin, neutral red, alkaline blue, naphthylene-blue, congo-red, erythrosin, fuchsin, cyanin, and ruthenium-red. The double stains tried were alkaline blue and fuchsin, alkaline blue and eosin dissolved in oil of cloves, logwood and safranin, cyanin and congo-red, alkaline blue and safranin, solid green and delta purpurin, chrysoidin and azurin, cyanin and eosin, naphthylene-blue and acid-green, alum-methylen-blue and ruthenium-red, acid-green and neutral red. The results from alum-methylen-blue and ruthenium-red are described as superb. Methyl-green may be substituted for methylen-blue. The preparations are immersed for 5–10 minutes in aqueous alum-methylen-blue solution, washed in water, and then transferred to aqueous solution of ruthenium-red. Later on the author recommends alum-carmine and iodine-green, as giving the best differentiation and most lasting results. Other combinations recommended are alum-carmine and methylen-blue, prussian blue and safranin.

Fixation, Staining, and Structure of Protoplasm.‡ — Prof. A. Fischer's work on the fixation, staining, and structure of protoplasm is an exhaustive critical examination of the technique which has been adopted and pursued in modern cell research, and of the theories and speculations which have arisen in consequence of these researches.

The first part deals with fixation generally, that is to say, with the material to be fixed, fixing agents, the appearances produced by fixatives acting on albuminous bodies, and fixation of cell-contents.

The second part is devoted to staining, and the subject is discussed on lines similar to those of fixation. That is to say, there is consideration of the substances to be stained, and of the various pigments and staining fluids used in the process.

* Neurol. Centralbl., March 1899. See Zeitschr. f. angew. Mikr., v. (1899) p. 145.

† C.R. Bull. Soc. Roy. Bot. Belgique, 1898, xxxvii. (1899) pp. 59–90. Cf. this Journal, 1898, p. 685.

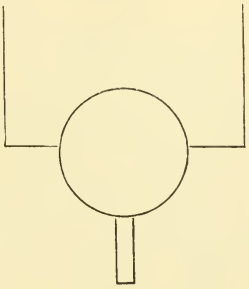
‡ Jena, Gustav Fischer, 1899, x. and 362 pp., 1 pl. and 21 figs.

In the third part the structure of protoplasm is treated of. Therein are discussed striation and artificial striation, the central body, the polymorphism and monomorphism of protoplasm.

(6) Miscellaneous.

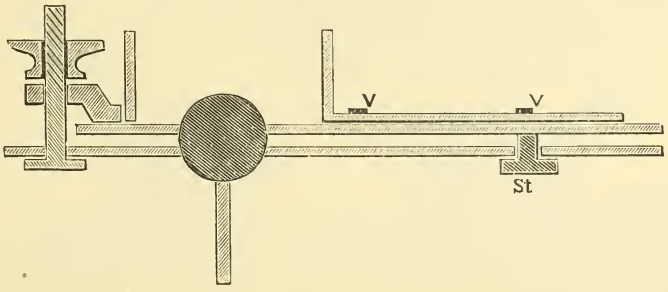
Jordan's New Apparatus for Orienting Small Microscopic Objects.*—Dr. Jordan's embryological researches at the Naples Zoological Station impressed upon him the desirability of endeavouring to find a means of solving the following problem :—"How to get objects

Fig. 138.



to orientate themselves and assume such a position that they can, without risk of displacement, be imbedded in paraffin." His apparatus, invented for this purpose, consists in principle of an orienting table within a trough, which finally, after the hardening of the imbedding material, allows the removal of the paraffin block with the object. A

Fig. 139.



small rectangular box, whose base is some 20 mm. in perimeter, is perforated with a circular aperture, in which a sphere so fits that slightly more than half of it projects into the box. The embryo or other object is placed upon this sphere, secured as described later, and oriented by means of the handle as desired (fig. 138). In a more complete form,

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 33–7 (2 figs.).

shown in section in fig. 139, the sphere works between two plates, of which the lower is in position for Zeiss' preparation Microscope, and the upper can be so pressed by a screw against the lower that the sphere becomes firmly fixed. A rectangular frame, whose walls are perpendicular to one another and to the horizon, is then applied.

The sphere is first smeared with a thin resinous layer and allowed to dry; the object, soaked in cedar-wood oil, is then applied, and secured with collodion. The orientation is now accomplished by aid of the Microscope, the sphere secured, the frame applied, and the paraffin poured in. If the sudden warming is objectionable, pieces of solid paraffin are inserted, and the whole is placed in the thermostat. After cooling, the block with the object is easily lifted off. In cases where it would be disadvantageous for the object to lie so close to the outside of the paraffin block, it is well to lay between the sphere and the object a bit of a larger embryo or some similar material saturated with paraffin and easy to cut.

Dr. Jordan states that he has obtained good results both in orientation and in sections (serial or single). He worked with embryos of 1 to 3 mm.

Fig. 140.

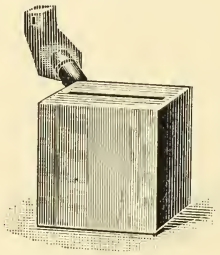


Fig. 141.

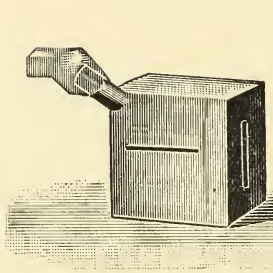
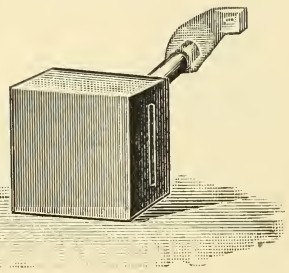


Fig. 142.



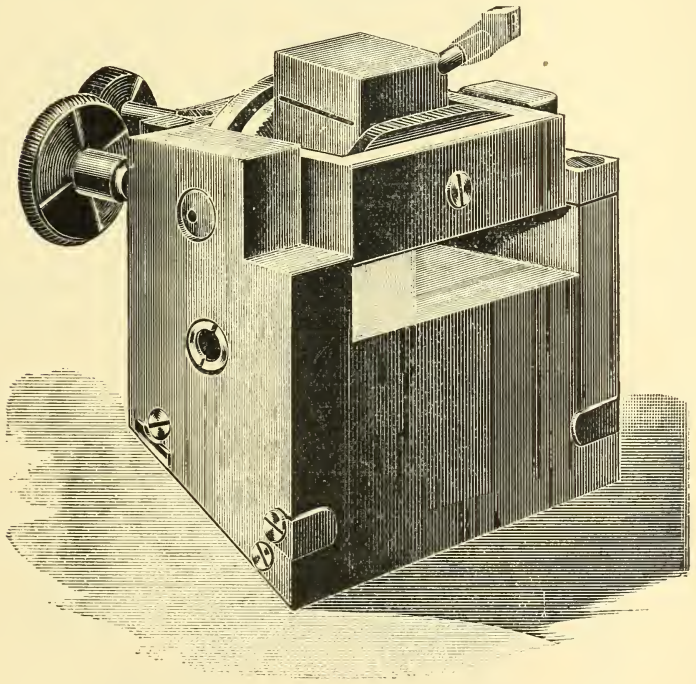
Method for Orienting Small Objects.*—Herr W. Noack describes the method used by him for orienting small objects in sectioning. A metal cube, the faces of which are 16 mm. long, is provided with an arm projecting from one angle in the direction of the diagonal of

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 438–43 (6 figs.).

the cube. Upon the end of this arm is fixed the celloidin block, in which the object is located so as to lie parallel to one of the faces of the cube. A few slices are removed from the block, and then the latter is examined to ascertain the exact position of the object. This done, a mark is scratched on the cube face in the direction of the central line of the object.

Owing to the direction of the arm, the object can be cut in any of three planes, transverse, sagittal, or frontal, or even in a combination of two, e. g. half in one direction, the remaining half in another.

Fig. 143.



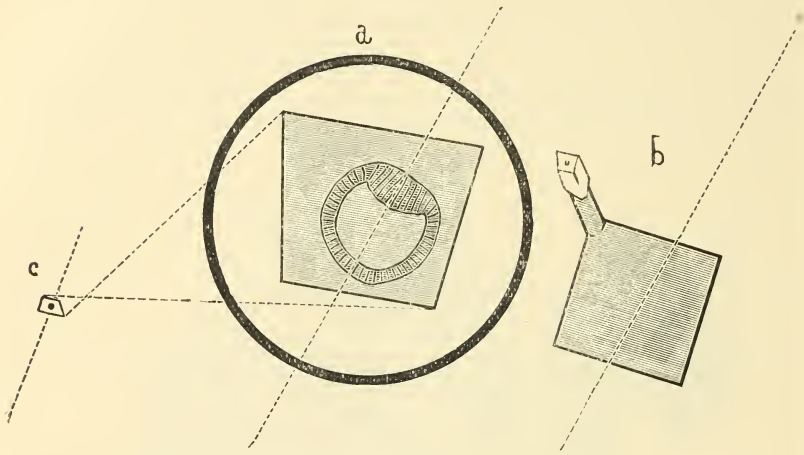
The idea of the apparatus is easily understood from the illustrations (figs. 140–145).

Lignin Reaction of Wood.*—Herr F. Czapek has succeeded in finding a suitable method for obtaining lignin, the isolation of which has long been a desideratum. Wood sawdust is boiled for some minutes in chloride of tin solution, and the chromogenic substance extracted with benzol or ether. A cold saturated solution of sodium bisulphite acts in a similar way to the tin chloride. The amount obtained from 1 kilo. of wood is extremely small. The new body is called *hadromal*, and, accord-

* Zeitschr. f. phys. Chemie, xxvii. (1899) pp. 141–66. See Bot. Centralbl., lxxix. (1899) pp. 126–8.

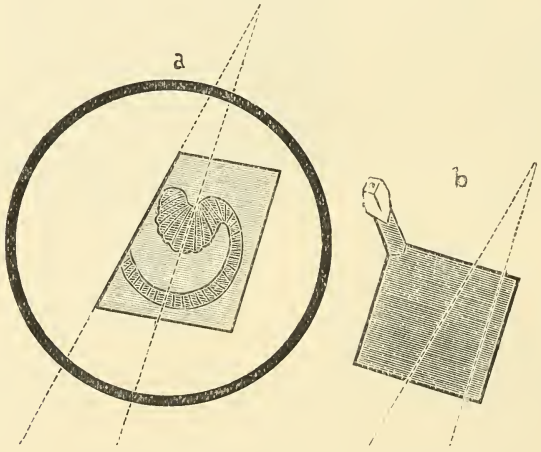
ing to the experience of the author, is constantly present in the most different kinds of wood. It is suggested that the hadromal is a 1, 3, or

Fig. 144.



4 substitution product of benzol, and that the constituent of woody membrane which causes the lignin reaction is a hadromal-cellulose-ether, together with a very small quantity of free hadromal.

Fig. 145.



Microchemical Test for Phosphorus.* — Dr. G. Pollacci had previously shown that the presence of phosphorus in vegetable tissue is microchemically demonstrable by means of a mixture of ammonium molybdate and nitric acid and an aqueous solution of chloride of tin

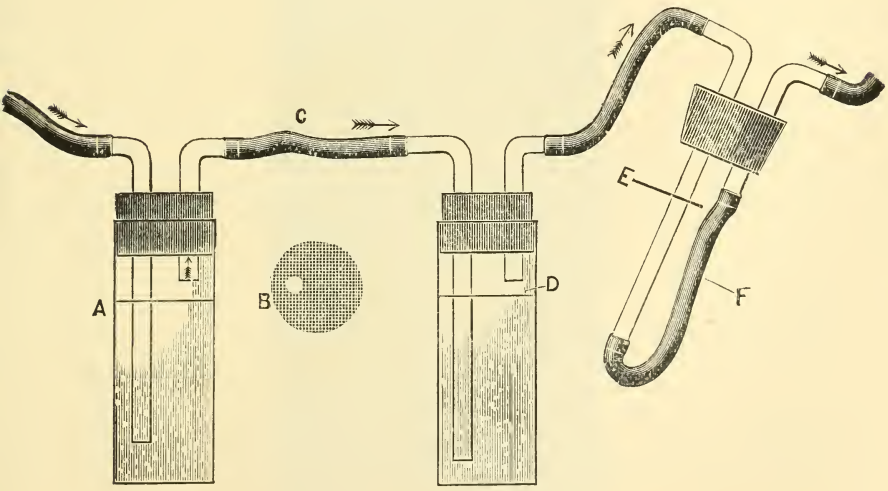
* Atti Ist. Bot. r. Univ. Pavia, vi. (1898) 8 pp., 1 pl. See Bot. Centralbl., lxxix. (1899) pp. 11–12. Cf. this Journal, 1895, p. 249.

($SnCl_2$). If the tissue contains the slightest trace of phosphorus, it becomes stained a cœrulean blue colour in consequence of the formation of ammonium phospho-molybdate, and of the reduction of this body with the formation of sesquioxide of molybdenum. Some botanists have raised objections to this test on the ground that the staining is due to xanthoproteic acid, or to an excess of molybdate, while others have expressed doubts as to the value of the method in testing for phosphorus in lecithins, nucleins, glycero-phosphates, &c. To these objections the author replies, and shows that,—(1) Xanthoproteic acid has no influence on the phosphorus reaction. (2) On account of the solubility of ammonium molybdate in water, and the insolubility of phospho-molybdate, the preparations can be perfectly freed from the former by washing. (3) The green or brown staining which often occurs with chloride of tin solution is to be ascribed to excess of the reagent. (4) Ammonium molybdate converts the phosphorus in all compounds into ammonium phospho-molybdate.

The above described method is therefore perfectly trustworthy for the microscopical demonstration of phosphorus in all organic tissues.

Ethereal Oils in Microscopical Technique.*—Mr. H. Jordan has found that some examples of oleum cajuputi viride and oleum cajuputi album dissolve celloidin. He has remarked that the solvent action is unusually frequent after Calleja's method for staining connective tissue. Oleum linaloes stands the test well.

Fig. 146.

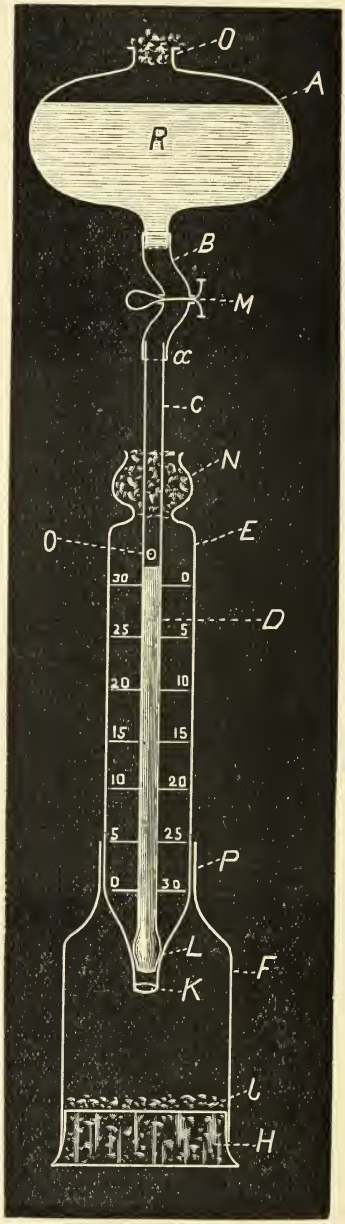


Convenient Washing Apparatus.†—Mr. E. M. Wilcox describes a washing apparatus which is especially adapted for laboratory use (fig. 146). It consists of a jar or a series of jars, each of which is closed with

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 46–7.

† Journ. Applied Microscopy, ii. (1899) p. 396 (1 fig.).

Fig. 147.



a rubber stopper perforated for an inlet and outlet tube. The former reaches nearly to the bottom, and the latter projects a short distance below the stopper. A piece of wire gauze or a perforated plate is inserted in the long tube just below the level of the outlet tube, to prevent escape of the material. As indicated in the illustration, any particular bottle can be removed from the series without interfering with the general arrangement.

Apparatus for Drawing off Sterile Fluids.*—Dr. Stanilaus Epstein has devised an apparatus (figs. 147, 148) for drawing off measured quantities of sterile fluid. The apparatus consists of a vessel R, which contains the sterile fluid, a graduated burette E, and a bell-jar F closed with a cork stopper H, upon which is placed a thin layer of cotton-wool. In the vessel R are two openings, the upper one being plugged with cotton-wool, while to the lower one is attached a rubber tube B to connect with the burette. The burette E is closed below at K, by means of the conical end L of the glass rod D. The glass rod consists of two parts,

Fig. 148.

the upper part C being really a hollow tube having a perforation at O; the lower part D is solid. The upper part of the burette is plugged with cotton-wool N; the lower part fits into the bell-jar at P. The second figure shows a cap for covering the upper opening O of the vessel R.

The apparatus is best sterilised in two parts. The vessel R and the tube are one piece; the rest of the apparatus is another. A pinchcock is put on the tube at M. To use the apparatus, the stopcock M is opened and the burette filled up to any mark. By raising the tube C, the conical end L is also raised and the burette emptied.

Removal of Air Bubbles and other Gases.†—Mr. E. W. Berger states that air-bubbles may be easily removed by immersing the objects for a few hours (2–24) in water which has been boiled.

Cement for Fastening Metal to Glass.‡—200 grm. of finely powdered litharge of silver and 100 grm. of dry white lead are well mixed and worked up to a pasty mass with boiled linseed oil and copal lac.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1899) pp. 34–5 (2 figs.).
† Journ. Applied Microscopy, ii. (1899) p. 388.
‡ Zeitschr. f. angew. Mikr., iv. (1899) p. 333.

The metal surface is smeared with the cement and then pressed on the glass, the superfluous cement being removed with some suitable instrument. The cement dries very quickly and becomes very hard.

Blackening Finely Polished Brass.* — (1) Dip in copper-vitriol solution, allow to dry, and then immerse in solution of sodium sulphide: bright blue-black film of copper sulphide.

(2) Smear with thin solution of mercuric nitrate, then (after drying) with sodium sulphide solution, causing a bright black deposition of mercury sulphide.

(3) Gold chloride and metastannic acid dissolved hot, then applied to the metal.

Photographic Developer.†—Herr E. Merck states that pyrocatechin sublimatum is increasing in popularity as a developer, as it keeps well in solution, is simple and easily manipulated, and quickly produces pictures of great clearness and distinctness. The following solution is recommended as a developer:—water 1000 ccm.; crystallised sulphite of soda 25 ccm.; crystallised carbonate of soda 50 ccm.; pyrocatechin 10 ccm.

Tauxe's Photographic Paper.‡—Prof. J. Amann calls attention to a new paper made by Tauxe of Lausanne, which he has found to possess great advantages for scientific and especially for photomicrographic photography. The finest details of the negative are faithfully and vigorously reproduced. No special treatment is required for copying, toning, or fixing. The copies may be retouched, written on, or painted with ink, Indian ink, water- and oil-colours, without any trouble.

* Cent. Zeit. f. Opt. u. Mech., No. 6, 1899, p. 55.
† Zeitschr. f. angew. Mikr., v. (1899) p. 24.
‡ Zeitschr. f. wiss. Mikr., xv. (1899) p. 445.

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

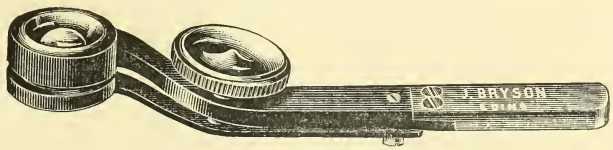
A. Instruments, Accessories, &c.*

(1) Stands.

Three Small Hand-Microscopes.—A case containing three Microscopes was exhibited at the meeting of the Society on Nov. 15th, by Mr. Edward Swan, one of which is represented in fig. 149. The following account of them was given by the President.

"They are interesting from several points of view. First, it will be noticed that although they are of archaic type, they are of comparatively modern manufacture. This kind of Microscope was first designed by Leeuwenhoek about 1673, but his screw focussing arrangement was of a very crude construction. In 1702 we find a considerable improvement

Fig. 149.



effected by Musschenbroek and Wilson. The highest pitch to which these instruments arrived can be well seen in the extract from Ledermüller's work.† This last instrument was called a 'Compass' Microscope, because the lens was mounted on one leg of a 'spring divider' compass, the object being placed on the other leg, and focussing adjustment being performed by means of the screw which worked the spring divider; this, in short, was the principle underlying all the above-mentioned instruments, as well as those now on the table.

"As some of Lieberkühn's improvements are incorporated in the 'Compass' Microscope, its date could not be earlier than 1745, nor later than the publication of Ledermüller's book in 1763. Now, to return to the three Microscopes on the table, as they are fitted with Coddington lenses, they cannot have been made earlier than 1830, but from the appearance of their workmanship they may be dated as late as 1860.

"The history of the Coddington lens is also of interest; for Cod-

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous. † Cf. this Journal, *ante*, p. 529.

dington neither claimed nor had anything to do with its introduction; it was Dr. Goring who attached Coddington's name to it.* Wollaston suggested the use of two plano-convex lenses, placed with their plane sides in apposition, with a diaphragm between them. Brewster subsequently pointed out that a great improvement would be effected by making each lens a hemisphere; for then the incident and emergent pencils would meet the surfaces normally. Brewster's next step was to simplify its construction by substituting a grooved sphere for the two hemispherical lenses. The sphere has been quite given up, and for long the construction has been that of a grooved cylinder.

"There is yet a further point of interest connected with the achromatism of this form of lens. All are aware that an achromatic effect is obtained in an eye-piece by regulating the distance between the two converging lenses, made of the same kind of glass, so that the coloured images of varying size, formed by the excentrical pencils which fall on the first lens, may be unequally magnified by the second lens, in such a manner as finally to make uniformly magnified images. These final images, being superimposed, and all of one size, form a single image that is achromatic for the purposes intended. Now a similar effect can be secured in a single lens by separating its refracting surfaces from each other; in other words, by making the lens of a certain thickness. The partial achromatism which is obtained in the Coddington lens is therefore due to its thickness.

"Notwithstanding the theoretical advantages just enumerated, viz. first, the normal incidence of the rays, and secondly, the achromatic compensation by thickness, it cannot be said that the Coddington is altogether a successful form of lens. Its defects, three in number, are, smallness of working distance, curvature of image, and want of light. There can be no doubt that its performance is incomparably inferior to that of the Wollaston doublet. For example, a Wollaston doublet in my possession shows tubercle bacilli with considerable clearness.

"Returning now, after this long digression, we must admire the admirable workmanship of these three little Microscopes. They appear to be a part of a doctor's outfit, and may have been used for the examination of blood. The highest power is the smallest Coddington lens I have yet seen."

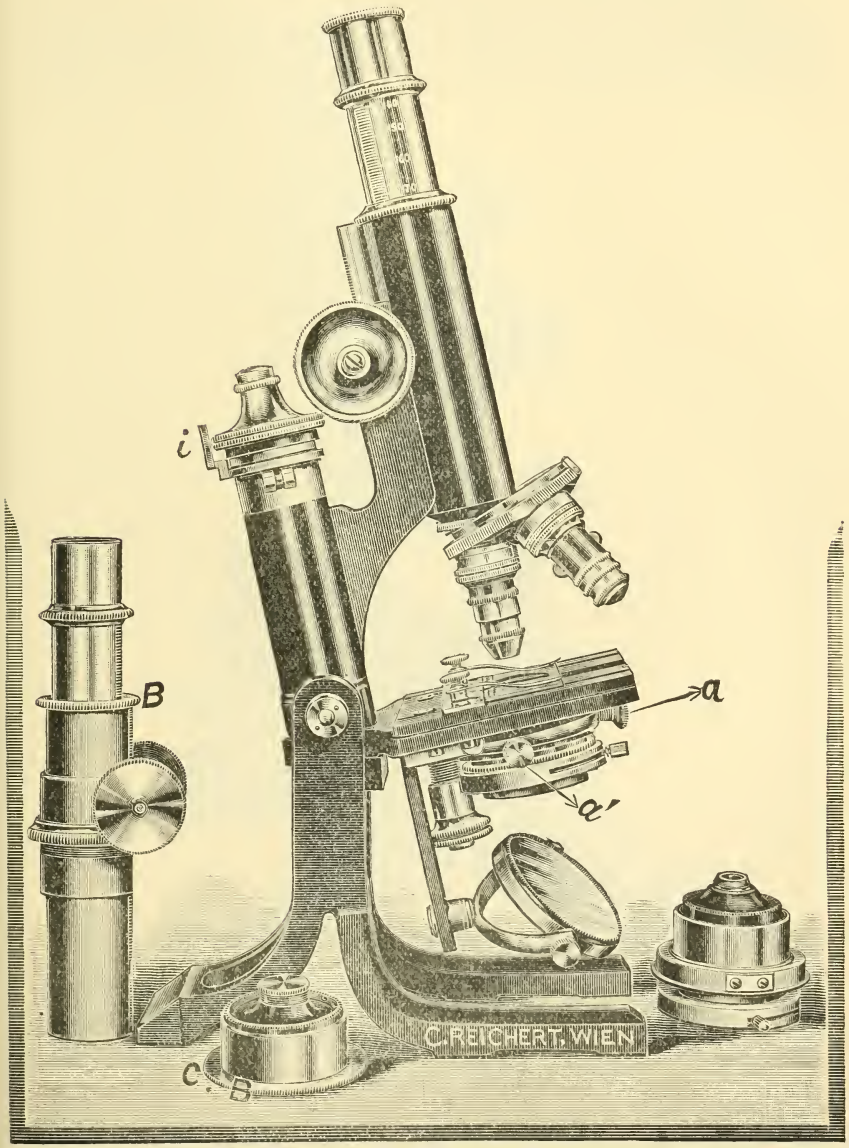
Reichert's New Microscope.—Fig. 150 is an illustration of Reichert's "Baugh" Microscope, which was exhibited by Mr. C. Baker at the October meeting. It is fitted with the new lever fine adjustment which was figured and described on page 374 *ante*. It should be noted that the index, *i*, for reading the divisions on the head of the micrometer screw, is capable of being rotated, so that it can be placed to the zero point wherever that may happen to be.

The foot is lighter, and yet more stable, than those of the usual pattern. The stage is of Nelson's horseshoe form, and the substage is of the ordinary Continental side-screw focussing pattern; but it is also fitted with centering screws, *a a'*. The rackwork draw-tube, B, which can be screwed into the body, in place of that of the ordinary form, is a feature quite novel to modern Continental Microscopes, though it was

* See Micrographia, p. 182.

employed for a short time by Oberhäuser, *circa* 1840*; but rackwork was first applied to the draw-tube by Benj. Martin, *circa* 1780. The rack-

Fig. 150.

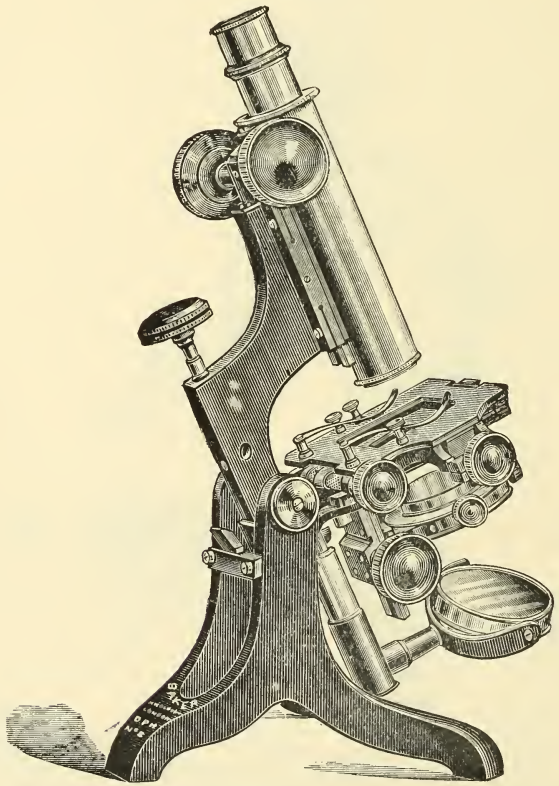


* See Quekett on the Microscope, 1st ed., 1848, p. 326.

work draw-tube in those early days was intended solely for the purpose of obtaining large variations in power apart from changing the objective; now, however, it is only used for the purpose of correcting the objective, i.e. as a substitute for collar correction.

Baker's D.P.H. Microscope No. 1.—This instrument (fig. 151) has diagonal rack-and-pinion coarse movement, micrometer screw, and lever fine adjustment, giving a movement of 1/225 of an inch for each revolution of the milled head; draw-tube, every 10 mm. of which is engraved

Fig. 151.



with a ring, extending from 150 mm. to 250 mm., thus allowing the use of either English or Continental objectives; mechanical stage giving a movement of 25 mm. in either direction, graduated to 1/2 mm., the milled heads being below the level of the top plate, so that large culture plates can be used; the distance from optic axis to limb ($2\frac{1}{2}$ in.) allowing of their easy manipulation. The stage has stops to enable either a 3 in. by 1 in. or a 3 in. by $1\frac{1}{2}$ in. slip to be brought always to the same place for the purpose of recording any given field; but these, together with the stage clips, are removable.

It has a centering substage of universal size (1½ in.) with diagonal rack-and-pinion focussing adjustment; plane and concave mirrors on the movable arm.

The whole is mounted on a solid tripod foot as figured.

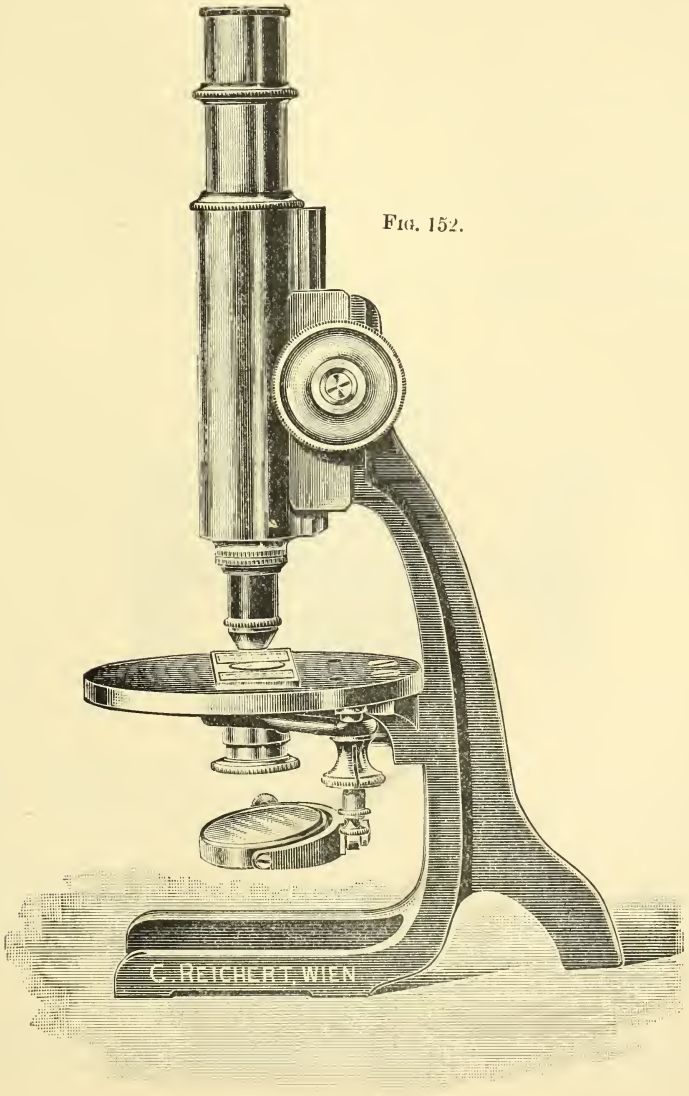


FIG. 152.

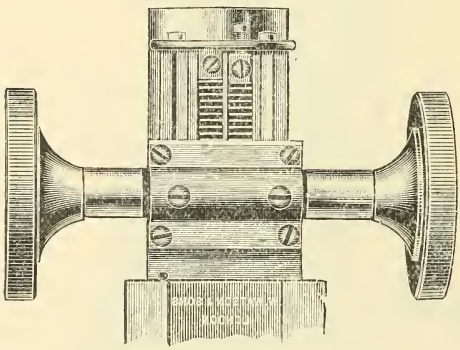
Reichert's Cheap Non-inclinable Stand. — Fig. 152 represents Reichert's cheap non-inclinable stand, fitted with a spiral rack-and-

pinion coarse adjustment, but without a fine adjustment. The substage, which consists merely of an arm capable of being thrown to one side, is of the push focussing type; it carries an achromatic dissecting loup, which makes, as Mr. Nelson has pointed out,* an admirable condenser.

A Microscope of this kind is a very serviceable instrument for serious work, as a 1/4-in. objective can be easily worked without a fine adjustment. It is a capital plan, when using a high power on a first-class stand, to have one of these elementary Microscopes on the table as well, for it will be found in practice more convenient to move the specimen from the larger instrument to the smaller one, when it is required to observe the object under a lower power, than to employ a rotating nose-piece, for the reason that a change in power necessitates also a change in the illumination, and in altering the illumination much time will be lost.

Nelson's Stepped Rackwork (Coarse Adjustment).—Fig. 153 shows Mr. Nelson's new stepped rackwork and pinion as fitted to his Micro-

Fig. 153.



scope by Messrs. Watson and Sons.† The little screw above the right-hand rack is for the purpose of regulating the amount of "step," while the two screws in the centre of the pinion regulate the pressure by which the pinion is forced into the rack.

In ordinary rack-and-pinion work, if there is to be no "loss of time," considerable pressure is needed; but with this kind of stepped rackwork only slight pressure is necessary, "loss of time" being impossible if the right-hand rack has been properly adjusted by means of the upper screw, and then fixed by its clamping screws.

Method of Enlarging and Deepening the Field of a Compound Microscope.‡—Mr. R. Forgan exhibited a practical method of enlarging and deepening the field of a compound Microscope. The essence of the

* Journ. Quekett Micr. Club, iv. (1889) p. 77. † Cf. this Journal, *ante*, p. 261.
‡ Proc. Roy. Soc. Edinburgh, May 16th, 1899.

method consists in shortening the distance between the object-glass and eye-piece, thereby obtaining a diminution of magnification with a corresponding increase of field; the Microscope being made to act somewhat after the fashion of a telescope. A very great depth of focus is thus obtained. It is possible that this form of Microscope might be very serviceable in the study of circulating systems when high magnification is not desired.

It should, however, be pointed out that the great shortening of the tube-length will put the objective out of correction; but this would not make any important difference with the very low powers which only would be used in this manner.

Berger's New Microscope.—In the account of Messrs. Zeiss' new Microscope (Berger's model) * a description of the mechanical stage was unfortunately omitted. On referring to fig. 98, p. 584, it will be seen that the heads of the pinions are on Turrell's plan, but the outer head gives transverse movement to the stage-plate instead of vertical movement. The pitch of the screw on this pinion is fine, so that the motion is slow. The vertical movement, which is actuated by the inner pinion head, is on altogether a novel plan. The motion is one in arc; this stage-plate being pivoted on the left-hand side, has rack teeth cut in it, into which a pinion is geared. This pinion has a toothed wheel fixed to it, in which engages an endless screw attached to the pinion that carries the inner pinion head. The speed of the object at the centre of the stage is about half that of the rack, because the object is placed about half-way between the rack on the right and the pivot on the left-hand side of the stage.

The stage is concentric with simple non-mechanical rotation; it can be clamped in any desired position by a small screw at the side of the stage (not shown in the figure).

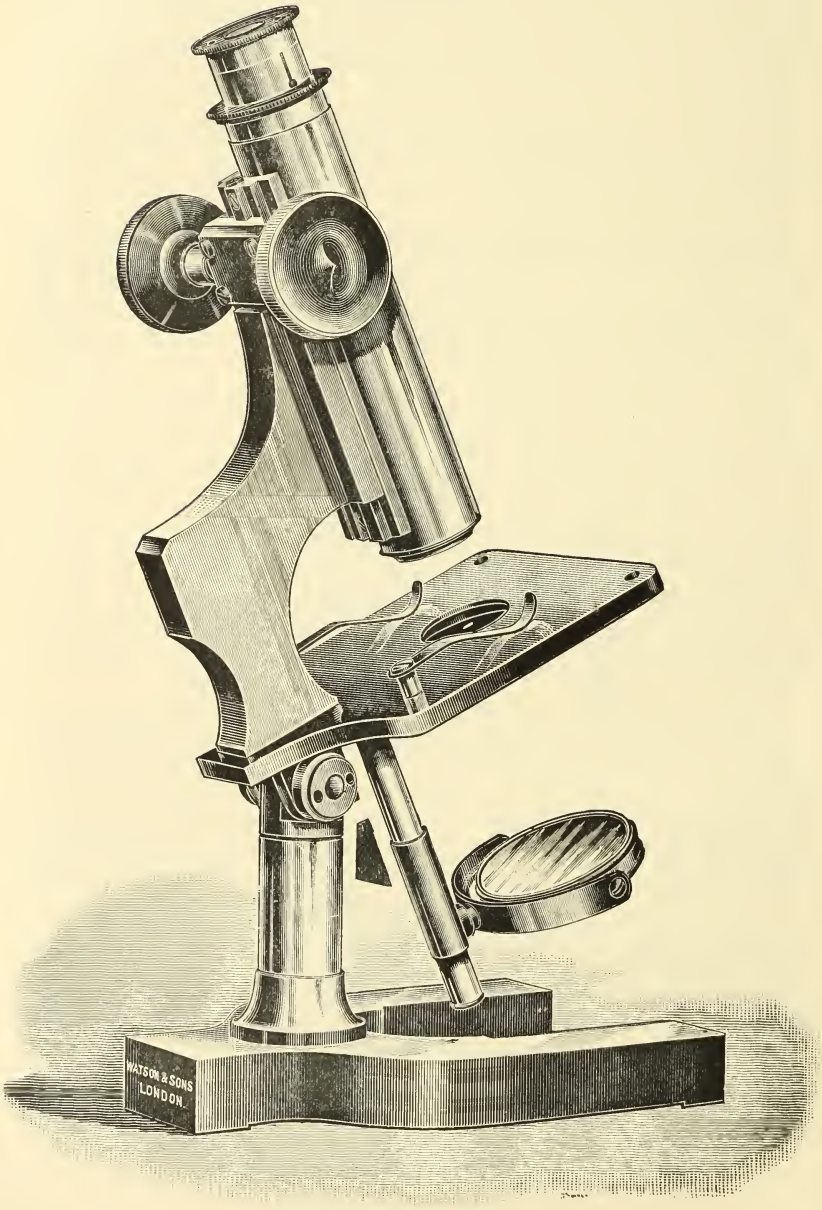
Watson and Sons' "School" Microscope.—This Microscope (fig. 154) is of plain but substantial construction, and has been designed specially for the use of schools, and for the teaching of animal and vegetable histology. The makers have adopted a suggestion that has been made on many occasions, viz. that a Microscope possessing a thoroughly good coarse adjustment without any fine adjustment should be supplied in place of the ordinary cheap student's Microscope, which is provided with an indifferent fine adjustment and plain sliding body.

The power needed for ordinary student's work can be quite well and precisely focussed by means of this rackwork and pinion. The Microscope takes the Continental size of eye-piece, and has a draw-tube. The universal fitting for substage apparatus screws into the under side of the stage; an inclining joint and adjustable double mirror are also fitted. The total height of the instrument is 10 in.

BAUSCH, E.—**Manipulation of the Microscope. A Manual for the work-table, and a Text-book for the Beginners in the use of the Microscope.**
Rochester, N.Y., 1899, 8vo, 200 pp.

* See this Journal, 1898, p. 583.

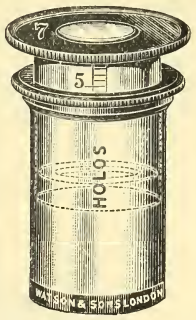
Fig. 154.



(2) Eye-pieces and Objectives.

Watson and Sons' "Holoscopic" Eye-pieces. — These eye-pieces (fig. 155) are on the Huyghenian principle; the eye-lens is attached to a draw-tube, to the lower end of which the diaphragm is fixed. When the tube is pushed in as far as it will go, the eye-piece is under-corrected; but, as it is extended, it becomes increasingly over-corrected. The latter condition enables it to be used with apochromatic objectives, and the former with the ordinary achromatic lenses. They have been specially designed to obviate the necessity for two sets of eye-pieces if a worker has both apochromats and achromats in his outfit.

Fig. 155.



Spitta, E. J.—"Achromatics *versus* Apochromatics." *Amer. Mon. Micr. Journ.*, Oct. 1899, pp. 296–309.
The author gives a clear popular article on the subject.

(3) Illuminating and other Apparatus.

Notes on Optical Projection.*—After some introductory remarks upon the unfamiliarity with the principles of lantern projection frequently displayed by lecturers, Prof. Behrens describes two contrivances he has invented for the improvement of his projection apparatus.†

I. *Electric Hand Regulator for Microscopic Projection.*—He has made inquiries at various Institutes using his apparatus, and has found, with regard to the relative merits of lime-light and electric light, that the former, if used with his burner, is perfectly sufficient even for very large audiences when glass pictures are projected; and that it is even preferred to the violet arc light on account of its warm pleasant tone. But in the case of the projection of microscopic slides, a light stronger than the ordinary lime-light was desirable. On testing the following light sources with Weber's photometer, it was found that their brightness measured in meter candles was,—Schmidt and Haensch's zirconium burner, 12; Behrens' lime-light burner, 26; Schuckert's differential lamp with 20-ampère current, 125.

The superiority of Schuckert when high illumination is required is manifest, and the author has therefore adapted his apparatus for its reception, and in so doing has made use of the lamp alone without its heavy brass and iron fittings. He has moreover mounted the lamp in a light aluminium camera. In his hand regulator he has endeavoured to remedy the usual defects of arc lights, viz. their uncertainty, costliness, want of adaptability to other than their assigned current intensity, and want of interchangeability with a lime-light burner.

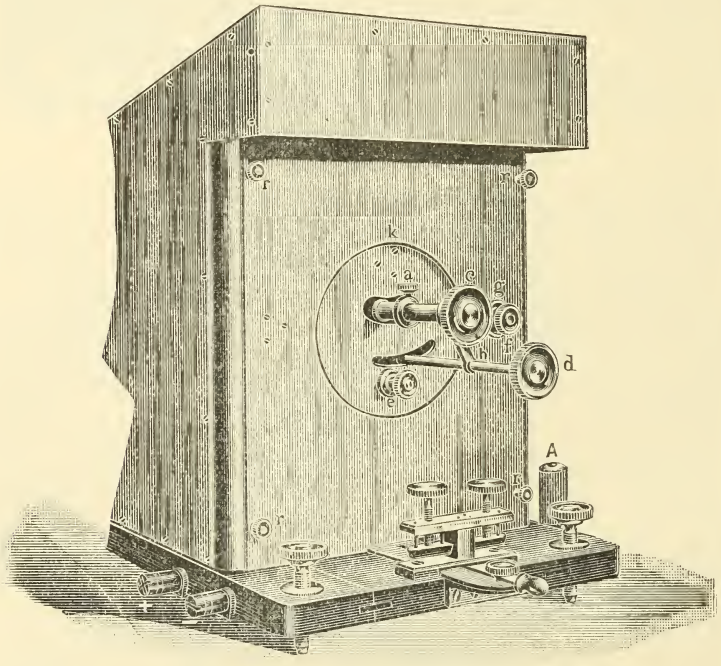
He has every reason to believe that his hand regulator thoroughly satisfies the following eight conditions:—(1) It is exchangeable for a lime-light burner; (2) it is applicable both for a constant and a variable current; (3) it is applicable for currents of the most varying intensities; (4) the current flows only through the carbon and not through the

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 183–95 (3 figs.).
† Cf. this Journal, *ante*, p. 89.

regulator; (5) the arc-light can be centered both horizontally and vertically; (6) the size of the arc is regulated by one handle only; (7) the whole regulator can be pushed about 14 cm. horizontally; (8) the entire apparatus is outside the camera.

The regulator is mounted on an aluminium plate, which forms the back wall of the camera: it is fastened thereto by the milled heads *rrrr* (fig. 156) after the removal of another similarly fastened back wall carrying the lime-light. Each back wall has a circular sinking *k*, near which is the screw *f* for centering the arc vertically; the clamp *g* fixes the regulator when centered; the screw *e* controls the horizontal center-

Fig. 156.

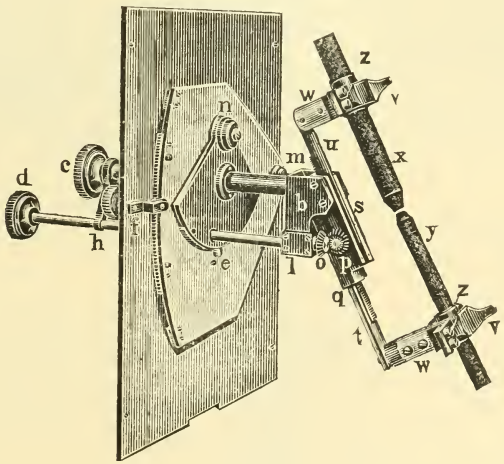


ing of the arc. On loosening *a*, the whole regulator, including *c*, *h*, *d*, is moved backwards or forwards by gripping *c*. This last movement therefore serves to bring the image of the arc into the rear principal plane of the objective. Rotation of the screw *d* regulates the size of the arc light from time to time. Fig. 157, showing the inner side of the back plate, will give a clear idea of the action of the various parts. The horizontal and vertical adjustments by rotation of *e* and *f* are really circular movements about centres *n* and *m*. For controlling the size of the light the rotation of *d* is transmitted through the conically toothed wheels *o*, *p*, to two sliders *q* and *s*, which mutually approach or recede. The carbons are inclined at 45° to the vertical, so as to get the best

effect. The brass carbon-holders *z z*, with their clamps *v v*, are insulated by porcelain brackets *w w*. The current enters and leaves by binding screws, not visible in the figure, at the side of *z z*. Carbons of various diameters corresponding to the various current intensities can be used. Current intensity should lie between 5 and 20 ampères, the highest value being suitable for the greatest possible requirements. If an installation current is too powerful, a resistance apparatus should be introduced into the circuit. The author recommends that of Schuckert & Co.

II. *The Projection of Search-Slides.*—It is frequently desirable to search systematically a section of a large organ. Such a section may be 8 or 10 cm. in diameter. Professor Behrens projects it by an ordinary photographic objective, and obtains a magnification of 25 diameters; thus the image may be some 2 metres in diameter; an iris diaphragm stops off any parts not wanted.

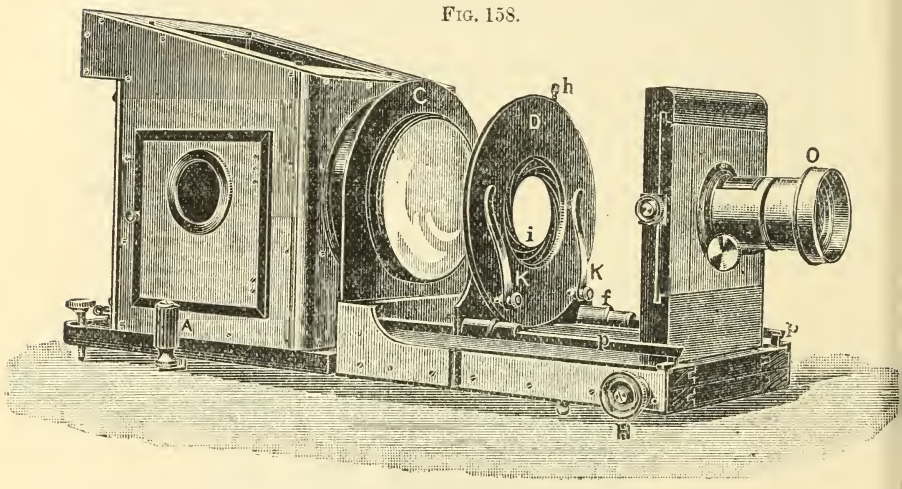
Fig. 157.



The arrangement is seen in fig. 158. The prismatic guides *p p*, with the diapositive bearer and the objective board O, can be removed *en masse*. D is a thick, circular, blackened, perpendicular brass plate of 22 ccm. diameter, perforated for a 10 cm. iris diaphragm operated by a lever *h*. The metal clips K K are secured by screws, which not only prevent falling out, but permit adaptation to slides of different thicknesses. If a slide is smaller than the opening, a piece of plate glass must be placed as a backing. The opening is protected on the reverse side by a plate of mica to prevent injury to the slides from overheating, and Professor Hermann (to whose suggestion the entire apparatus is due) found this mica plate so satisfactory that an exposure of 10 minutes to a 20-ampère current through a Schuckert lamp produced no melting of the Canada balsam. The diaphragm should be placed at such a distance from the condenser that the converging light-cone is but slightly larger than the iris. If a higher than 25 diameters magnification of any part be desired,

that part can be projected by an ordinary microprojection objective. The diaphragm plate C D is secured to the prismatic guides by a pair of double telescoping tubes, of which the inner one is steady, and the outer,

Fig. 158.



by means of an Archimedean screw arrangement, slides on the inner; this also answers for the fine adjustment, the coarse being worked by the milled head H.

(4) Photomicrography.

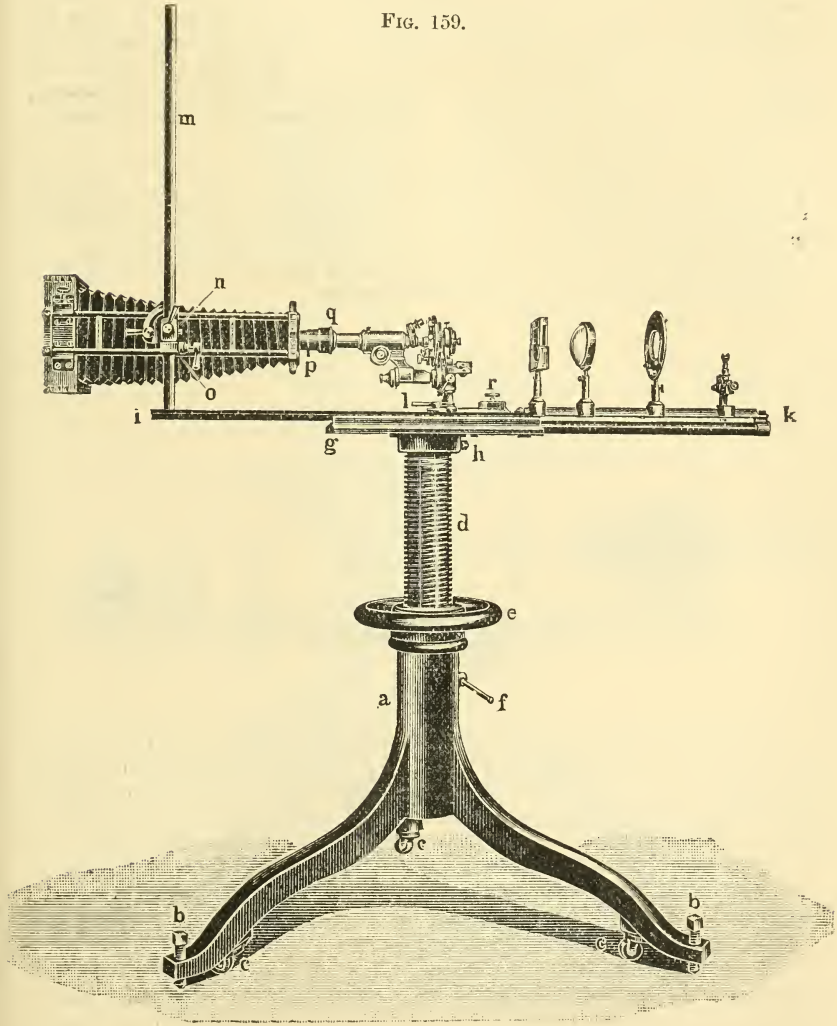
Gaylord's Complete Photomicrographic Apparatus.* — Under the above title Prof. Gaylord describes the most recent and most developed form of an apparatus originally invented by himself, and afterwards improved by C. Winkel.† The principal feature of the construction is the placing of the entire apparatus upon one support, at the same time connecting the camera and Microscope indirectly.

The support upon which the apparatus rests is a solid cast-iron tripod *a* (fig. 159) through the feet of which are levelling screws *b*, *b*, *b*. Directly at the back of the levelling screws are rollers *c*, *c*, *c*, by means of which the entire apparatus may be moved. Rising from the centre of the tripod is a shaft *d*, upon the surface of which is a coarse screw. Engaged in this screw, and supporting the shaft upon the neck of the tripod, is a large collar *e* in the form of a wheel. On the shaft *d* is cut a longitudinal slot in which a key is placed, and upon which the screw *f* impinges. By this arrangement, when *f* is loosened and *e* turned, the shaft *d* rises or falls according to the direction of rotation. The table *g* rests upon *d*, and is attached to it by a large pin fitting into its upper portion. The table is clamped fast by the screw *l*, and may be rotated in the short axis of *d* by loosening *l*. Attached to *g* are the camera support slide *i* and the illuminating bench *k*. The camera sup-

* Zeitschr. f wiss. Mikr., xvi. (1899) pp. 289–94 (3 figs.).
† Op. cit., xiv. (1897) p. 313. Cf. this Journal, 1898, p. 354.

port consists of a plate which slides in a dove-tail slot in the table *g*, and is clamped by the screw *l*. Rising from *i* is the carrier *m*, to which are clamped the camera rails swinging upon a pivot supported by a block *n* which is adjustable vertically on the carrier *m*. The position of

FIG. 159.

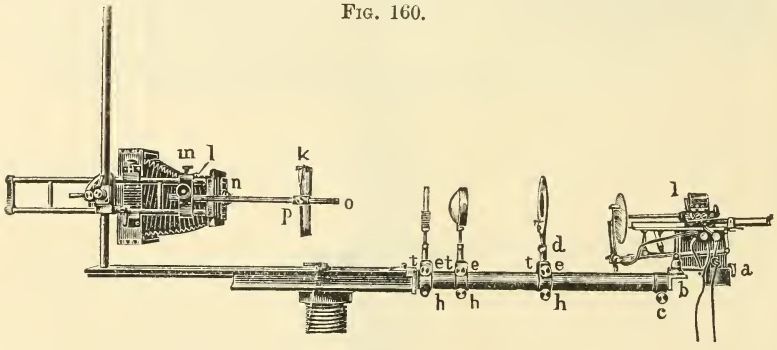


the camera may be changed from vertical to horizontal, or to any desired intermediate angle. The entire camera, in any position, may be adjusted to the height of the Microscope by raising or lowering the supporting block *n n m*. Beneath *n* is a second supporting block *o*,

which is usually clamped fast after the camera has been adjusted; the screw of the block *n* may be loosened, the apparatus swung clear of the Microscope about the axis *m*, a stop adjustment between *m* and *o* indicating the proper position of the camera when swung back. The connection between the Microscope and the camera is accomplished by means of the usual double collar, but in this case the smaller ring is composed of two, the outer sliding over the inner, and having an Archimedean screw arrangement. To the outer ring is attached the pin *p*, and by rotating *p* the outer tube slides forward and enters the cap *q*. When the camera is to be swung away, the tube *p* is withdrawn, and the camera then swings clear. The Microscope is clamped fast to the table by a block and screw *r*.

The support for the illuminating apparatus consists either of a simple prismatic bar, stiffened by a tube as in fig. 159, or of a more complete arrangement as in fig. 160. Fig. 159 shows an attachment for acetylene gas; fig. 160 a Thompson 90° arc-light, which is especially suitable for photomicrography, as the negative carbon is always in the optical axis, so ensuring prolonged centering of the crater.

Fig. 160.

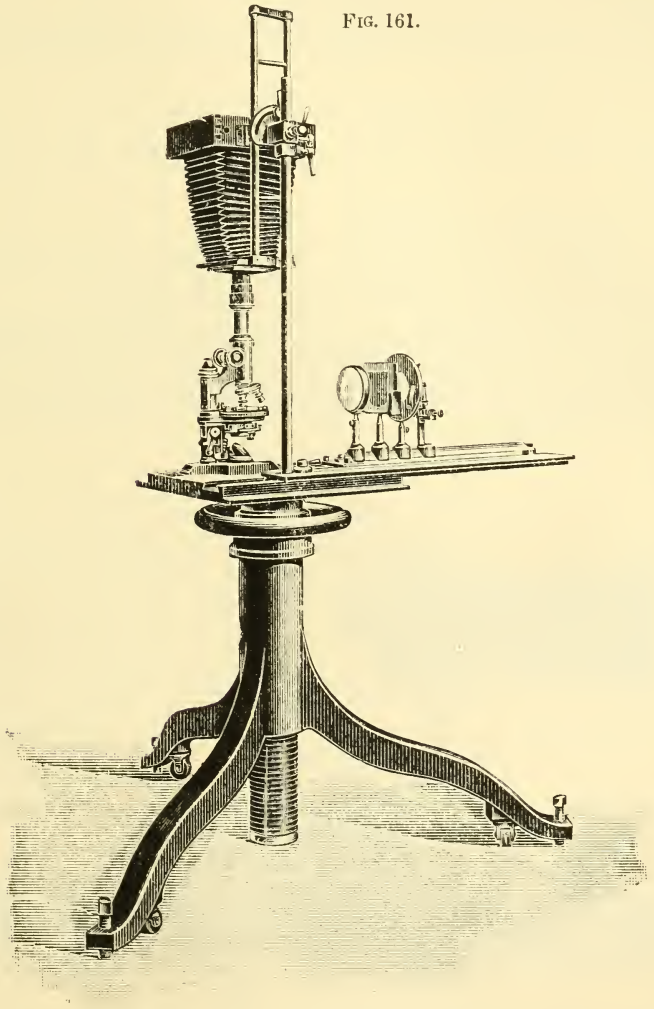


The illuminating support shown in fig. 160 consists of a strong brass tube fastened to the Microscope table by a bracket, and upon this tube are placed the various parts of the illuminating apparatus. The electric arc-light may be adjusted for height by rack-and-pinion; the head of the pinion is seen at *a*. The arc-lamp is supported by a bracket *b*, and may be revolved about a vertical axis at *b*. The bracket *b* is fastened to a tube which is fitted into the tube of the illuminating bench, which is split and reinforced by the clamping ring *c*. The arc-lamp may be swung under the bench by loosening *c*.

The various parts upon the bench (i.e the tube) may be adjusted vertically by a rack-and-pinion *d*, and transversely by a slide and screw *t*, *t*, *t*. On the upper surface of the tube is cut a longitudinal slot, and on each support is a small key *e e e*, which engages this slot and determines the position of the support. The supports are clamped fast by the screws *h*, *h*, *h*, and if it is desirable to dispense with any part of the illuminating apparatus, *h* is loosened, the key *e* raised, and the support swung beneath the bench.

In photography with low powers (microcolinears of Voigtländer and planars of Zeiss) the arrangement of fig. 160 is convenient; the Microscope is removed, the objective *n* attached directly to the camera front board, and a large movable stage *k* attached to the camera. The

FIG. 161.



stage proper is of glass, supported by a metal frame. The coarse adjustment is accomplished by moving the stage in the rod *o*, and is clamped in place by the screw *p*. The fine adjustment is by rack-and-pinion at *l*. The complete stage is detachable, and is fastened by the screw *m*.

For vertical photography the entire apparatus is arranged as in fig. 161 (the illuminating apparatus is not properly arranged), the screw support is lowered to the maximum (40 cm. fall), the camera is rotated to the horizontal position, then raised to the proper height, and the slide is pushed forward until the camera is over the Microscope. The further arrangements can be seen from the figure.

The inventor gives five reasons why the apparatus, in practice, offers certain advantages over those larger forms of apparatus which are divided between two tables.

(1) The apparatus, when once centered, may be moved by means of the rollers to any point desired.

(2) It may be used equally well in the horizontal or vertical position.

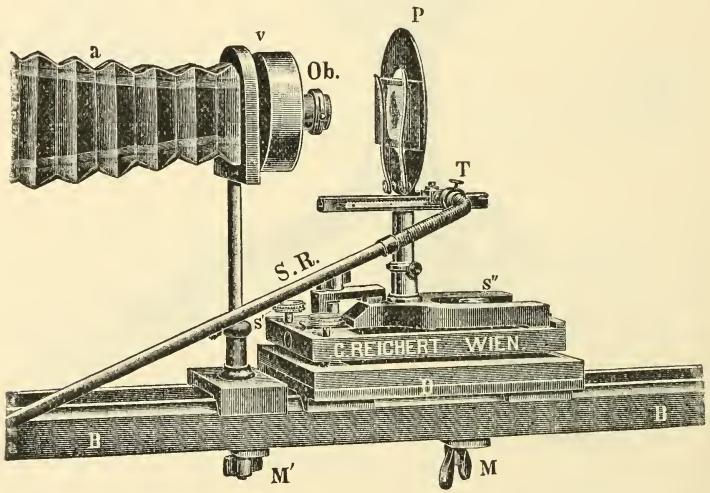
(3) It may be adjusted to any height convenient to the observer without disturbing the alignment.

(4) The entire apparatus may be centered to an independent source of light (sunlight, &c.) without disarranging the alignment.

(5) It takes up less floor space than the larger apparatus.

The inventor finds, after a year's experience, that no bad effects from vibration have been noted. Köhler's method of illumination is in process of adaptation. The idea of mounting on screws and rollers has occurred independently, but later, to the firm of Zeiss, who are applying it to some of their instruments.

Fig. 162.



Reichert's Low-Power Photomicrographic Apparatus.—The apparatus shown in fig. 162 is intended for low-power photomicrography, where a planar or colinear lens *o b* is used instead of an ordinary Microscope objective. The stage P, holding the object, is placed in a vertical position on a horizontal table. The object is brought into focus by moving the stage to and from the lens by rackwork; a pinion head

which actuates this movement is seen at T; to this is attached by means of a flexible joint the rod S R; this enables focussing to be conveniently performed at the screen end of the camera.

Favre et Chauvet—**De la photographie microscopique.**
Lyon Médical, 1899, No. 17, p. 584.

Toison, J.—**Présentation de Microphotographies.**
Comptes Rend. de l'Ass. des Anat. Paris, 1899, p. 19.

Walmsley, W. H.—**Photomicrography with Opaque Objects.**
Trans. Amer. Micr. Soc., XX. (1899) p. 189.

(5) Microscopical Optics and Manipulation.

Kerber, A.—**Beiträge zur Dioptrik.** (Treatise on Dioptrics.) Part 5.
Leipzig (Fock), 1899, 8vo, 16 pp.

(6) Miscellaneous.

Douglas, C. C.—**Chemical and Microscopical Aids to Clinical Diagnosis.**
Glasgow (Maclehose), 1899.

Garbini, A.—**Manuale per la tecnica del microscopio nelle osservazioni istologiche, anatomiche, zoologiche.** 4th ed. Milan (Vallardi), 1899, 8vo, 304 pp.

Goldstein, M. A., M.D.—**The Microscope, its Educational and Practical Value.**
Journ. of App. Micr., Sept. 1899, pp. 490–2.

Morel et Soulié—**Manuel de technique microscopique.**
Paris (Soc. d'édit.), 1899.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Growing Anaerobes in Air.†—Mr. W. W. Alleger states that certain anaerobic bacteria (tetanus, symptomatic anthrax, malignant œdema) grow readily in glucose-agar stick cultures, without any precautions to preclude oxygen, if the tubes be placed in the steam steriliser for ten minutes, and then quickly cooled just before inoculation, although no growth, or only a scanty one, takes place in the same medium under identical circumstances if this precaution is omitted. The explanation given is that the free oxygen is driven out by the heat, and growth takes place before the medium has had time to reabsorb sufficient air to interfere with development.

Cultivation of Typhoid Bacilli from the Rose-coloured Spots.‡—Dr. Neufeld recommends the bacteriological examination of the rose-coloured spots in typhoid on account of its simplicity and rapidity. Out of ten cases he had only one negative result, and in that instance the other methods of diagnosis failed. He ascribes the success of his method to the use of liquid media. It is interesting to note that in one case the method was successful where the Widal reaction failed.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Journ. Applied Microscopy, ii. (1899) p. 511.

‡ Zeitschr. f. Hyg. u. Infektionskr., xxx. No. 3. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 149–50.

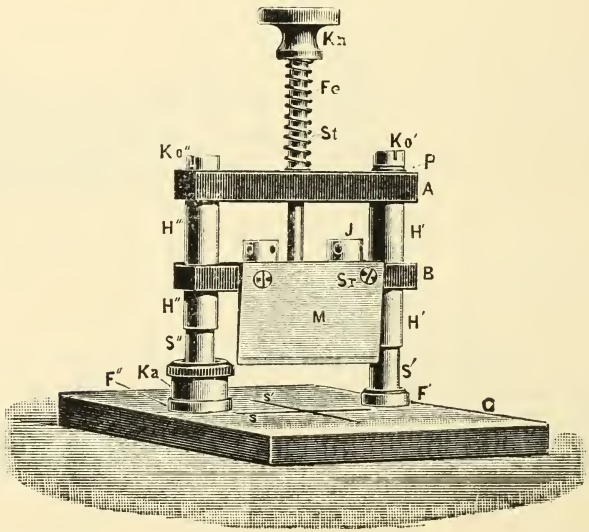
(3) Cutting, including Imbedding and Microtomes.

Virchow's Cutter for Dissection of Membranous Preparations.*—This apparatus of Herr Hans Virchow, of Berlin, is the result of difficulties often experienced by the author in getting truly cut sections with scalpel or scissors through embryo layers and such like objects. In addition to accomplishing the purpose of cutting to any desired orientation (so that serial sections may be afterwards made if desired), it permits the dissection of a preparation into parts without damage.

This apparatus (fig. 163) consists of four parts,—knife, glass plate, knife-holder, and frame.

(1) *Knife.*—The knife M takes the form of a blade 30 mm. in length and 20 mm. high. The lower side bears the edge, and the upper is fastened to the knife-holder by two screws S*r*. The holes for the screws are not circular but slit-shaped, being prolonged perpendicularly, so that in tightening the screws the knife is capable of a slight up and down adjustment. For it is necessary that the knife should be most accurately set, so that in the downstroke the edge should exactly reach the plate; in this way the object will be cut through without damage to the edge. The two screws J, inserted in the crossbar B, serve to complete this adjustment; they press on the knife-back, and are used to depress the knife, if necessary, after the screws S*r* have been tightened.

Fig. 163.



(2) The *Plate* G consists of a rectangular piece of plate-glass, 9 cm. long by 6 cm. broad, and bears three finely scored lines which serve for orientation of the preparation. Two of these lines *s* are parallel,

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 295–9 (1 fig.).

0·25 mm. apart (only one shown in figure), and are under the knife-edge; the third *s'* is at right angles to the first two. The object is set with regard to these lines, and its orientation attained either with the naked eye, or with lens or Microscope.

(3) The *Knife-holder* comprises the lower crossbar B, the two collars H' and H'', and the rod S*t*, which is rigidly attached to B, and passes through an orifice in the upper crossbar A, and at its upper end bears a knob K*n*. When K*n* is depressed, this arrangement sinks, and is brought to rest by the collars H' and H'' meeting the plinths F' and K*a*; at the same moment the knife-edge just reaches the glass plate. The spring F*e* raises the knife-holder again when the pressure is removed.

(4) The *Frame* comprises the two pillars S' and S'' and the upper crossbar A. Of these S' is firmly secured to the glass plate, and to it belong the plinth F' and the screw-head K*o*'. The pillar passes through an orifice in the crossbar A, which can be rotated round the pillar. But in order that A, in spite of this movability, should not be loose (which would render accurate knife-adjustment impossible), a spring is placed between the crossbar and the head K*o*', and finds a support on the head, and presses the bar firmly down against the pillar, which is here broadened out. This spring P is a piece of brass concavely punched out, thus acquiring a twist and acting as a strong spring. It has an orifice through which the upper end of the pillar passes in order to receive the screw-head K*o*'.

The second pillar S'' is rigidly connected with A by means of the screw-head K*o*'', and can be swung out of its place over the glass plate. The means for accomplishing this are not shown in the figure, but will be understood from their description. The plinth F''' is immovable on the glass plate, and bears at its upper end a dove-tailed wedge, and the pillar at its lower end has a corresponding hollow which fits tightly on the wedge.

Thus, when desired, the pillar S'', the frame, knife, and knife-holder, can be rotated round the other pillar out of the way, and in this way the orientation of the object by vertical inspection can be attained.

Although the cutting is done by pressure, the author has found no disadvantage even with so difficult a material as yolk.

Starlinger's Apparatus for obtaining Perfectly Parallel Thin Brain Sections.* — This apparatus has been gradually perfected by Dr. Starlinger as an auxiliary to the Marchi method of brain dissection, and is in general use in the asylum laboratories of Lower Austria.

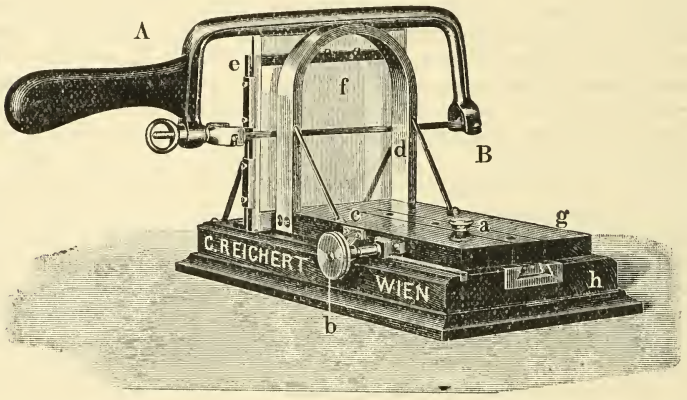
The author points out the importance of obtaining the complete section series in the pathological study of a brain, and how difficult, as well as uncertain, it generally is to obtain such. By his apparatus, a whole hemisphere, or an entire brain, can be easily cut into a complete series of sections. The action of the machine resembles that of a chaff-cutter.

The apparatus (fig. 164) consists of two parts, the knife A, and the framework B. The knife being thin and yielding, is set in a bow-saw frame. This peculiarity of the knife is of main importance, as every kind of stouter blade is unsuitable. The base *h* is a species of slide and carries a perpendicular glass plate *f* secured in a frame *e*. This

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 179-83 (1 fig.).

plate can be drawn out from the frame. The sliding part *g* carries a metal arch *d* (11 by 9 cm. in aperture), and its movement is controlled by a rackwork *b*. The distance of *d* from *f* is regulated by a micrometer *c*, and the screw *a* clamps *g* to *h*. When the slide has been set

Fig. 164.



at the desired thickness, the brain is pushed with the left hand through the arch *d* slightly pressed on the glass plate. The right hand grips the knife-handle and cuts through, leaning against the arch as a guide. The section usually adheres to the glass plate, which is then lifted out and immersed so that the section can be floated off. The author's custom is to make preliminary slices 1·5 to 2 cm. thick, and, after immersion in Marchi solution, to examine them for signs of degeneration; if any should be found, he cuts thin sections forwards or backwards as required. He invariably keeps his sections in strict serial order, and if any be removed for examination a sheet of blotting paper is inserted to mark the gap.

(4) Staining and Injecting.

Hæmatoxylin, Carmine, and allied Substances.*—Herr P. Mayer makes a useful and timely contribution on certain pigments used in microtechnique. Though limited to a consideration of logwood, hæmatoxylin, hæmatein-cochineal, carminic acid, and carmine, the author's compilation is an excellent summary and bibliography of what is known of these pigments. References are given to these stains and to their combinations. Though none of the descriptions contain anything new, the information conveyed in these short articles is extremely useful from historical, technical, and bibliographical points of view, and a perusal will repay those who are interested and occupied with staining sections and tissues.

Flagella Staining.†—Prof. E. Zettnow records some recent improve-

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 196–220.
† Zeitschr. f. Hygiene u. Infekts., xxx. (1899) pp. 95–106 (1 fig.).

ments in the technique of flagella staining. Three mordants are described,—iron, alum, and antimony. Iron mordant is prepared by boiling for 5 minutes 20 grm. of tannic acid and adding iron oxide in slight excess. The solution is filtered, and when cold the mordant is ready for use. Pure iron oxide is prepared by precipitating iron chloride with ammonia.

Better results are obtained with alum-mordant, prepared by heating 10 grm. tannin with 200 ccm. in a water-bath at 55°–60°, and adding aluminium acetate. The mordant should be quite clear, but if cloudy, some more tannin solution should be added with the aid of gentle heat.

Antimony mordant is still stronger, and is prepared by dissolving 1 grm. of tartar emetic in some water, and then, together with 500 ccm. of a freshly prepared 5 per cent. solution of tannin, heating the mixture in a water-bath at 35°–40°. This mordant is opalescent when cold, but becomes clear on heating. Its action is increased (1) if the preparation be allowed to cool in the heated mordant until the latter begins to turn turbid; (2) if caustic soda be carefully added until the reaction becomes amphoteric or faintly alkaline. The cultures, 10–24 hours old agar or bouillon, are killed with 4 per cent. formalin; the latter immediately, while the former are washed off the agar with water and then killed. The solution is allowed to sediment for 24–72 hours, when it is decanted, and replaced by 1 per cent. formalin, and this in turn by pure water. The films are fixed with heat, washed with water, and then hot-mordanted for 5–10 minutes.

The films are stained with gold or silver. For the gold method the preparation is treated with gold chloride and heated until the solution vaporises. The silver solution is made from a solution of 4 grm. silver sulphate left in 500 ccm. of water for an hour. A quantity of this saturated silver solution is mixed with 30 per cent. aqueous solution of ethylamin, until a clear colour solution, which does not contain ethylamin or silver in excess, is obtained. A few (4–5) drops are placed on the mordanted preparation and heated until it steams. The bacteria and flagella are brownish-black. If not sufficiently stained, the process may be repeated or the colour further developed by means of gold chloride or mercury chloride. The latter gives the best results. The preparation is treated with 4–5 drops of 1 per cent. sublimate, and then reduced with a soda-pyrogallol solution. Soda solution (soda 2 grm., water 100 ccm.) 4 drops; pyrogallol solution (1 grm. pyro in 20 ccm. alcohol + 2 drops of acetic acid) 1–2 drops.

Injection-staining of Vascular Systems of Plants.* — Mr. R. A. Robertson has found the following simple method useful for class purposes and for private work. To the end of a large glass funnel a length of india-rubber tubing is securely wired. The funnel is fixed at a convenient height, and the lower end hangs free, eight feet or more in length; at the lower end is fixed a compressor clip. The stem (air-dried, preserved in spirit or fresh) has its end cut smooth and circular, and securely wired into the lower free end of the tube. In the case of delicate stems it is preferable to lute with balsam or asphalt. A beaker is placed beneath to catch the escaping fluid. The funnel and tube are filled with weak aqueous solution of fuchsin, the clip removed,

* Trans. and Proc. Bot. Soc. Edinburgh, xxi. (1897) pp. 54–6.

and the stem left for a few hours. If a living stem be used, the stain is chiefly confined to the conducting elements, and hence a differential staining is afterwards obtainable. The fuchsin is replaced by weak picric acid; this darkens and fixes the tissue, and when it comes through clear the stem is removed and transferred to 90 per cent. alcohol. In a few days it is decolorised and fit for sectioning. The sections may be contrast-stained with hæmatoxylin.

If required for dissection of the vascular system, the preparation may be immersed in, instead of injected with, weak picric acid, and then preserved in alcohol.

Romanowski's Staining for Bacteria.* — Prof. E. Zettnow has recorded his experience of Romanowski's eosin methylen-blue staining. He divides methylen-blues into two categories, those with green and those with violet-red reflex, and expresses his preference for the Höchster medicinal samples. The Höchster methylen-blue is made up to a 1 per cent. solution, and 1 drop of 5 per cent. caustic soda solution is added to 1 ccm. The eosin recommended is brom-eosin B A extra Höchst. in 10 per cent. solution.

The best proportion of the blue to the red solutions is as 2–1, and 2 drops of soda solution are added after mixing 2 ccm. of methylen-blue solution with 1 ccm. of eosin solution.

The cover-glasses are stained for 2–5 minutes, then washed with water, and examined. The preparations do not keep.

For differentiating and decolorising were used:—(*a*) for blood preparations, acetic-acid-methylen-blue (2 grm. methylen-blue in 400 ccm. water + 1 ccm. acetic acid); (*b*) for bacteria, eosin 1–500, or methylen-blue 1–10,000, or solution *a*.

Blood preparations were usually differentiated with one washing of the acetic-acid-methylen-blue. Bacteria were often treated two to six times with eosin solution, with a short washing afterwards with 1–10,000 methylen-blue. The specimens prepared by this method, as shown in the coloured plate, are extremely elegant.

Modification of the Aronson-Phillips Method for Staining Malarial Blood.†—Mr. E. G. Horder recommends the following modification of the Aronson-Phillips method:—

(1) *Preparation of Cover.*—Have ready a cover-glass in a pair of Ehrlich's forceps, and in another a piece of gutta-percha 1/2 in. square. Prick the ear and touch the drop with the edge of the gutta-percha. The latter is then laid flat and drawn across the cover-glass, commencing from the edge held by and parallel to the forceps. In this way 10 or 20 different smears can be made in a few moments.

(2) *The Heating.*—The cover-glass is passed 16–18 times through the flame of a spirit-lamp, the wick of which is 1/2 in. long.

(3) *The Staining.*—The best stain is made from Ehrlich-Biondi powder (Grübler). The solution, as given from Cabot in a note, is made by dissolving 15 grm. of the powder in absolute alcohol 1 ccm. and distilled water 6 ccm. The solnutio is made up as required. The time required for staining is two minutes or less.

* Zeitschr. f. Hygiene u. Infektionskr., xxx. (1899) pp. 1–18 (1 pl. with 9 coloured figs.).

† Lancet, 1899, ii. p. 889.

Differential Stain for Goblet-cells.* — Mr. C. Thom recommends that sections should be stained first in Mayer's hæmatein for 15–30 minutes, washed in 70 per cent. alcohol, and then stained on the slide in a solution of Bismarck brown in 70 per cent. alcohol for a very short time. The mucus-containing cells pick up the brown, all the other cells are stained with hæmatein.

Method of obtaining a Black Reaction in certain Tissue Elements of the Central Nervous System.†—Dr. W. F. Robertson obtains a black reaction with sections of central nervous system, by immersing pieces of tissue in a solution composed of 5 per cent. of formalin to a 1 per cent. solution of platinum bichloride. The bottle should not be too tightly corked, as air must not be excluded. In from 1 to 3 months the piece of tissue begins to blacken. The immersion is continued for some weeks longer, and during this period the bottle should be more tightly corked, and if necessary the solution renewed.

When ready for examination the piece is soaked in dextrin solution for some hours, then sectioned, and mounted in balsam in the usual way.

The chief structural features revealed by this method are:—(1) fibres in the wall of intracerebral and medullary vessels; (2) primitive fibrils of the protoplasm of the nerves; (3) certain granules in the nucleus of the nerve-cell; (4) special cell elements.

(5) Mounting, including Slides, Preservative Fluids, &c.

Method of Mounting Fungi in Glycerin.‡—Mr. A. Lundie meets the difficulty of expelling the air and properly teasing out the filaments when mounting fungi like *Eurotium*, &c., in the following ingenious manner. A piece of *Eurotium* is placed on a slide, wetted with chloroform, strong glycerin added, and a cover-glass imposed. By heating the preparation over a Bunsen flame the chloroform is made to boil and so drive off the last traces of air. The bubbles of chloroform vapour, in passing out, scatter the hyphæ and tease out the preparation, without breaking it up as is done when needles are used.

Fixation after Methyl-blue.§—Prof. A. S. Dogiel finds that in using Bethe's ‖ method of fixation, it is not only unnecessary but distinctly hurtful to add hydrochloric acid to the solution of acid ammonium molybdate, and it is also unnecessary to add peroxide of hydrogen, or to cool the molybdate while the preparations remain in it. His modified formula runs as follows:—Place the sections in a 5–10 per cent. solution of acid ammonium molybdate for 12–18 hours at a temperature of 17° to 19° C.; wash in distilled water for half an hour, dehydrate, clear, and mount.

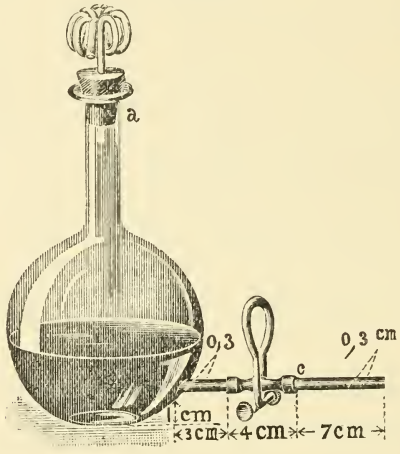
(6) Miscellaneous.

Flask for Preserving Fluid and Semifluid Nutrient Media.¶—Dr. L. Heydenreich has given up cotton-wool as stopping for flasks,

* Journ. Applied Microscopy, ii. (1899) p. 497.
† Scottish Med. and Surg. Journ., iv. (1899) pp. 23–30 (2 pls.).
‡ Trans. and Proc. Bot. Soc. Edinburgh, xxi. (1899) p. 159.
§ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 361–4.
‖ Arch. f. Mikr. Anat., xliv. (1895); Anat. Anzeig., xii. (1896).
¶ Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 149–56 (5 figs.).

and has adopted Hest's method, which consists in using a bunch of tubing with sixteen bends. The tubes are made of brass or copper, are drawn out, and are without join or soldering. The measurements given are,—wall about 0·75 mm., bore 1–3 mm. The length of a single bend is about 1·5 cm. The construction of the bunch is easily gathered from

Fig. 165.



the illustrations (figs. 165–167). It will be seen that one end is long, the other short, and that both point downwards. The long end is inserted in the rubber plug which fits into the neck of the flask (fig. 165). At 1 cm. above the bottom of the flask, projects a tube

Fig. 166.

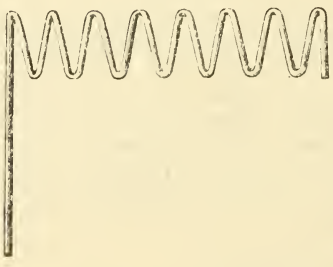
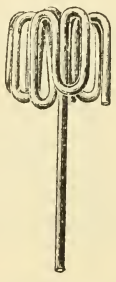


Fig. 167.



3 cm. long, with a lumen of 3–4 mm. The end of this tube is slightly expanded, and to it is connected a rubber tube closed by a pinch-cock. Through this tube fluid is withdrawn as desired.

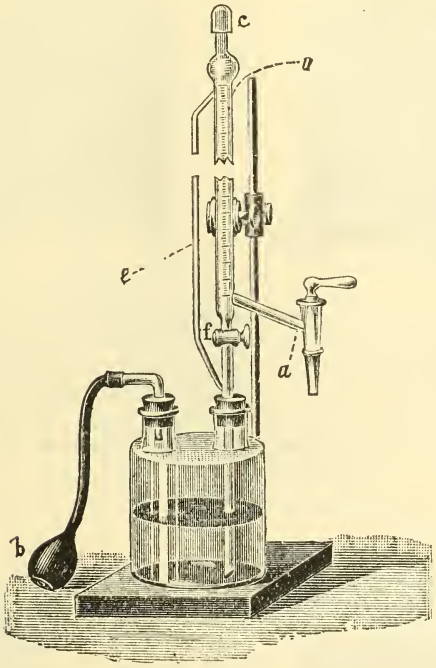
Burette for Bacteriological and other Titrations.*—Dr. L. Heydenreich describes a burette which possesses the advantage of measuring

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 145–9 (2 figs.).

off a definite quantity of fluid automatically, and of allowing any surplus to run back into the flask.

As will be seen from the illustration (fig. 168) the burette proper is quite simple. It is graduated in divisions of cubic centimetres and tenths, the zero 0 being at the top. With the main tube two lateral tubes are connected, *e* and *a*. The latter comes off at an angle of 70°, and is provided with a tap. The upper end of *e* opens into the burette just above the zero mark, while the lower end joins the main tube below the stop-cock *f*. Immediately above the zero mark there is a bulbous expansion of the burette, and the top is covered with a cap *c*.

Fig. 168.



The fluid to be measured is contained in a Woulf's bottle with two openings. Through one of these passes the lower end of the burette; through the other, a glass tube connected with a rubber tube having a ball at the free end. In the ball is a small hole. The fluid is forced from the bottle into the burette by squeezing the ball *b* several times. While this is being done, the tap *f* is open and a finger placed over the hole in the ball. When the fluid has risen up above the zero mark and perhaps into the bulb, the tap *f* is closed. The residue above 0 then runs back into the flask through the side tube *e*. The desired quantities are removed through the side tube *a*.

The apparatus can be made of any desired size, the most convenient being 25–30 ccm.

Apparatus for Carrying Samples of Water for Bacteriological Examination.*—Dr. L. Heydenreich describes an apparatus used in the transport of samples of water. It is cylindrical, stands on short feet, and is provided with a lid and handle. From the lower edge projects a

Fig. 169.

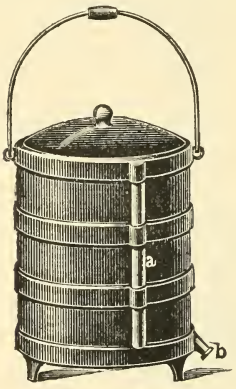
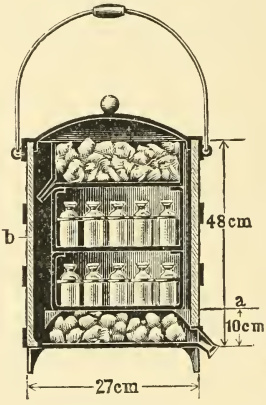


Fig. 170.



short nozzle for the outflow of melted ice-water. The bucket is made of metal, is lined with felt, and covered with oilcloth. Its internal arrangements are three superimposed frames or trays, the uppermost for ice, the lower two for bottles. Each tray will hold ten bottles. At the bottom of the upper tray is a short pipe, through which the melted ice escapes to the bottom. The free end of this pipe projects into the groove *a* (figs. 169, 170).

Fig. 171.

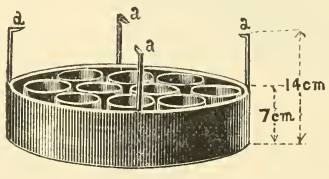
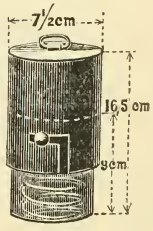


Fig. 172.



In fig. 171 is a pan or tray with details and measurements. The upright rods with pieces turned in at right angles support the tray above, and serve also for the removal of the tray itself.

A description of another metal case for bottles requiring special care is also given (fig. 172). The chief points in this apparatus consist in

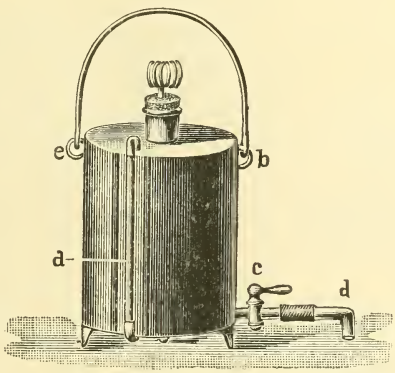
* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 163–7 (4 figs.).

the bayonet-joint by which the lid is fixed on, and the spring at the bottom which prevents the lid from slipping.

Sterilising Apparatus.*—The apparatus described by M. J. Hausser consists of a porcelain funnel with a perforated plate, and fitted into the mouth of a kind of separating funnel, which in its turn fits into the mouth of a flask connected with a filter-pump. All parts of the apparatus are heated to 125°, and boiling water and kieselguhr are run on to a double layer of filter-paper placed on the plate of the funnel. In this way a layer of moist kieselguhr, 0·5–1 mm. thick, is deposited. A layer of kieselguhr which does not allow the passage of air under a pressure of 1 kilo. acts as a perfect steriliser to any liquid filtered through it, whilst it permits the passage of 15–20 times as much liquid as does an equal surface of porous porcelain.

Sterile Water Apparatus.†—Dr. L. Heydenreich describes an apparatus for making and keeping ready for use sterile water (fig. 173). It is

Fig. 173.



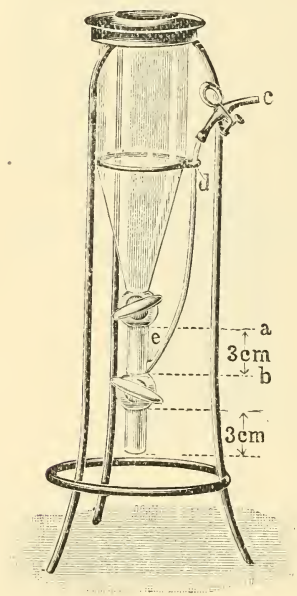
made of metal (copper or brass), its diameter is 18 cm., its height 20 cm., it holds about 5 litres, its inner surface is tinned, and it stands upon three legs. Close to the bottom is an outlet tube, 3·5–4 cm. long and 3–4 mm. wide. This is provided with a tap, and its free end is expanded to grip a rubber tube. At the top is a short neck closed with a Hest's stopper (see figs. 165–167). The apparatus is also provided with a water-gauge tube, and this is protected by a sliding shutter (not shown in figure). The apparatus is filled up to the neck with water, and then sterilised in a Papin's digester for 20–30 minutes at 135° (two atmospheres). This apparatus will be found very convenient for bacteriological and other investigations.

Funnel for Collecting the Sediment of Water intended for Bacteriological Examination.‡—Dr. L. Heydenreich describes a funnel for obtaining the sediment of water for bacteriological examination. The

* Bull. Soc. Chim., xxi. (1899) pp. 250–3. See Journ. Chem. Soc., 1899, Abst., ii. p. 569. † Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 156–7 (2 figs.).
‡ Tom. cit., pp. 178–9 (1 fig.).

hopper holds 2–3 litres, has very sloping sides, and a pipe with two stopcocks (fig. 174). The bore of the pipe is 0·6 cm. wide, and the lumen of the tapways is the same. The space between the taps is connected with a pipe *e d c*, the bore of which is 0·3–0·4 cm. in diameter. This pipe is supported at *d* by an attachment to the stand, and its free end is connected with a piece of rubber tube closed by a Mohr's pinch-cock with Leiss's hook.

Fig. 174.



The taps are all closed when the water is poured in. When the sediment has collected at the lower end of the hopper, the tap *a* is opened. The sediment-water, however, does not pass into the pipe until the pinch-cock is nipped. The tap *a* is then closed, and the contents are allowed to escape into a porcelain dish by opening the tap *b*.

The illustration shows the chief measurements.

Bacteriological Diagnosis of Plague.* —Dr. C. B. Stewart describes the methods adopted at the Bombay Research Laboratory for diagnosing the plague in man or animals, and for testing a plague culture. The remarks apply only to recent cultures on agar or in bouillon at the ordinary room temperature, the optimum being 74° F. The colonies on agar appear in 24 to 48 hours, and, when touched with a wire, slip about on the surface. After one or two days' incubation, agar slants which have been smeared with 0·1–0·2 ccm. of broth culture show the "ground-glass" appearance when inspected from underneath.

In broth the stalactitic growth is held to be characteristic of the plague microbe.† It has been found that the addition of a little cocoanut oil or of glue, before sterilisation, facilitates the formation of stalactites by affording *points d'appui*. Another phenomenon which appears to be characteristic consists in growth along and up the glass rod which has been used for inoculating the flask. When the upward growth reaches the surface, it spreads out, covering the surface with colonies, from which stalactitic downgrowths soon depend. The broth remains quite clear.

The microbe stains readily with anilin dyes, but not by Gram's method. The bipolar staining is not constant, but bipolar spots are easily detected in living and unstained specimens. Suspensions of plague microbes in water dry as a bluish film on a slide. The microbe is polymorphic; sometimes it resembles a coccus or diplococcus; sometimes a short stumpy bacillus, with rounded ends; diplobacilli are frequent, and sometimes there are short chains.

* Brit. Med. Journ., 1899, ii. pp. 807–8. † Cf. this Journal, 1897, p. 327.

Microscopical Diagnosis of Anthrax.*—Herr Olt gives the following method for the microscopical diagnosis of anthrax:—3 grm. of safranin are dissolved in 100 grm. of nearly boiling water. When cold the solution is filtered. The film is made in the usual way, with blood or spleen-juice. The staining solution on the cover-glass is heated to boiling for ½–1 minute. The cover is then washed in water and examined.

In connection with sending samples of anthrax by post, &c., for examination, the author remarks that it is improper to pack anthrax material in glass or metal cases, as it is likely to putrefy. He advises that a little blood or spleen-juice should be dropped on a piece of well-boiled potato. This, packed in a matchbox which is not air-tight and covered with paper, preserves the moisture sufficiently. This may be despatched at once, or retained for 2–24 hours, and thus give an opportunity for vegetating and sporing.

Preparation of Vegetable Casein for Experimental Purposes.†—For studying the extracts, the preventive and bactericidal properties of leucocytes, an effective pyogenic agent is necessary. This was found in 1890 in vegetable casein, which is now prepared in a pure condition by the following method described by M. J. Colard. A stream of water is run through wheat flour enclosed in a bag until the stream comes out quite clear, indicating that all the starch has been removed. In this way 150 grm. of wet gluten are obtained from 1 kgrm. of flour. 100 grm. of gluten are macerated in 4 l. of water containing 4 grm. of caustic potash per litre. When all the gluten is dissolved, the fluid is decanted or filtered through a cloth, and then acetic acid in slight excess is added. The purified gluten is thus reprecipitated; in winter the precipitation may be hastened by gently heating the fluid. The vegetable fibrin is next removed from the gluten by extracting successively with 60 per cent., 80 per cent., and 100 per cent. alcohol. The insoluble residue, which is vegetable casein, is dried carefully. From 1 kgrm. of flour 20 grm. are obtained. As a pyogenic agent it is used in a feebly alkaline solution prepared by digesting the pure product in 0·5 per cent. potash solution at 37°. It is then reprecipitated with dilute HCl, and redissolved in water to which a few drops of caustic soda solution have been added. To excite suppuration, 8–10 ccm. of the alkaline solution at 5 per cent. to 10 per cent. are injected into a pleural sac. In about two days an equal quantity of pus may be withdrawn.

Blood Stains and the Guaiacum Test.‡—Mr. E. Schaer states that blood stains are easily dissolved out in a 70 per cent. aqueous solution of chloral hydrate; if old, the process is facilitated by moistening the stain with dilute acetic acid. And inasmuch as guaiacum (and also guaiaconic acid) is soluble in the chloral solution, the guaiacum blue reaction is much simplified.

Filling Fermentation-Tubes.§—Mr. W. W. Alleger fills fermentation-tubes with hot bouillon, from which the air has been expelled by a

* Deutsche Tierärzt. Wochenschr., 1899, No. 1. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1889) pp. 157–8. † Ann. Inst. Pasteur, xiii. (1899) pp. 735-6.
‡ Amer. Mon. Micr. Journ., xx. (1899) pp. 274–83.
§ Journ. Applied Microscopy, ii. (1899) p. 496.

stay of some minutes in the steriliser immediately before use. This procedure practically diminishes the trouble arising during sterilisation from a large air-bubble in the closed end of the tube.

Modification of Koch's Method for making Gelatin Plates.*— Dr. L. Heydenreich finds that it is more convenient to reverse Koch's method and place the ice-pan above the gelatin to be cooled. The same kind of tripod-leveller is used.

Widal's Reaction with a Measured Quantity of Blood.† — Dr. R. L. Pitfield has found by experiment that a disc of filter-paper (Schleicher and Schüll's 598) 8 mm. in diameter will absorb 1 ccm. of blood from a drop on the finger. If dried, the blood may easily be dissolved out in 10 ccm. of water, bouillon, salt solution, or bouillon culture of typhoid, and thus a dilution of one to ten of the blood obtained.

New Procedure for Inoculating Animals with Rabies Virus.‡— Dr. J. Lebell recommends the following procedure which possesses all the advantages and none of the disadvantages of trepanning and subdural infection. The fixed virus is injected into the spinal canal. An ordinary Pravaz syringe is used, and the needle inserted between the spinous processes of the first and second lumbar vertebræ. Two or three drops of an emulsion of the fixed virus is sufficient. The injection site should be freed from hair, disinfected with a one per thousand sublimate solution, and after inoculation covered with collodion. The rabbit dies on the seventh or eighth day. If the procedure be properly carried out there are no complications.

Black Anilin Ink.§—Dr. L. Heydenreich gives the following formula for preparing anilin black ink which combines chemically with fibres and does not fade. (A) Crystallised copper chloride 4; sodium chloride 5; ammonium chloride 3; distilled water 30. (B) Anilin hydrochlorate 40; gum arabic 15; water 95. The two solutions must be kept apart and in the dark. When required for use equal bulks are mixed together. If one solution only be preferred, then, before mixing with solution A, 100 hydrochloric acid is added to solution B, and the whole boiled for some time. Though intended to dye filter-papers so as to contrast with white or coloured fibres in the filtrate, the ink may be used for other articles, such as linen. Filter-papers are to be soaked in the ink for two days, dried, steamed for 10–15 minutes, washed in soapsuds, and finally in distilled water.

* Zeitschr. f. wiss. Mikr., xvi. (1899) p. 153 (2 figs.).
† New York Medical Record, 1899, i. pp. 659–60 (1 fig.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 221–2.
§ Zeitschr. f. wiss. Mikr., xvi. (1899) p. 177.