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.

Minimis partibus, per totum Naturæ campum, certitudo omnis innititur quas qui fugit pariter Naturam fugit.—*Linnæus.*

FOR THE YEAR

1900.

LONDON:

TO BE OBTAINED AT THE SOCIETY'S ROOMS,
20 HANOVER SQUARE, W.;
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MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Chamot's Microscope for Microchemical Analysis.†—This instrument, which is made by Messrs. Bausch and Lomb, has been designed by the inventor to meet the growing demands of microchemistry. The Microscope is intended to be efficient, cheap, and suitable for class work, and its general nature is that of a simplified petrographic instrument.

The stand (fig. 1) is of the Continental type, and, since its use would always be vertical, it was not thought necessary to provide it with a jointed pillar. The coarse adjustment is by rack-and-pinion, and the fine by micrometer-screw. The stage is circular, rotating, provided with centering-screw; its circumference is graduated into degrees for measuring crystal angles. The stage is faced with rubber, and the substage is adjustable by means of a quick-acting screw. Into the substage is fitted the polarising apparatus, consisting of a Nicol prism of large size, and so mounted that, by means of a pin fitting into a slot in the substage-ring, the prism can always be replaced in exactly the same position. The polariser can be swung aside when polarised light is not desired. The prism is so arranged that it can be rotated, and is provided with a circle graduated in degrees. The analysing nicol is also provided with a graduated circle, and it is so mounted that it fits over and above any eye-piece. The draw-tube of the Microscope is furnished with a small projecting pin, which fits into a slot cut in the bottom of the tube-mounting of the analyser. This slot lies in the same vertical plane as the zero points of the analyser, the polariser, and the stage. The zero points of polariser and of analyser are arranged as usual, i.e. for the position of crossed nicols. It follows, therefore, that when the polariser is at zero, and is swung in position below the stage, and the analyser is also at zero, and is in position with its slot on the pin, the nicols are crossed without further adjustment. It is therefore possible to quickly change eye-pieces, drop the analyser in place, and not be obliged to spend time in adjusting it, as is so often the case. Magnifying power is obtained by low objectives and high eye-pieces, so as to diminish risk to the objectives from corrosive fluids. Each eye-piece is provided with cross-hairs at right angles, and a projecting stud fitting into a nick in the upper edge of the draw-tube for lining them. It is found that 1-in., 1/2-in., and 1/4-in. objectives form a convenient set, with 2-in., 1½-in., 1-in., and 1/2-in. eye-pieces. This gives a range of magnification between 20 and 500 diameters, which is amply sufficient for all ordinary analytical work.

The draw-tube of the Microscope is graduated as usual; the mirrors, plane and concave, are on a swinging bar.

* 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. App. Micr., 1899, pp. 502–5 (1 fig.).

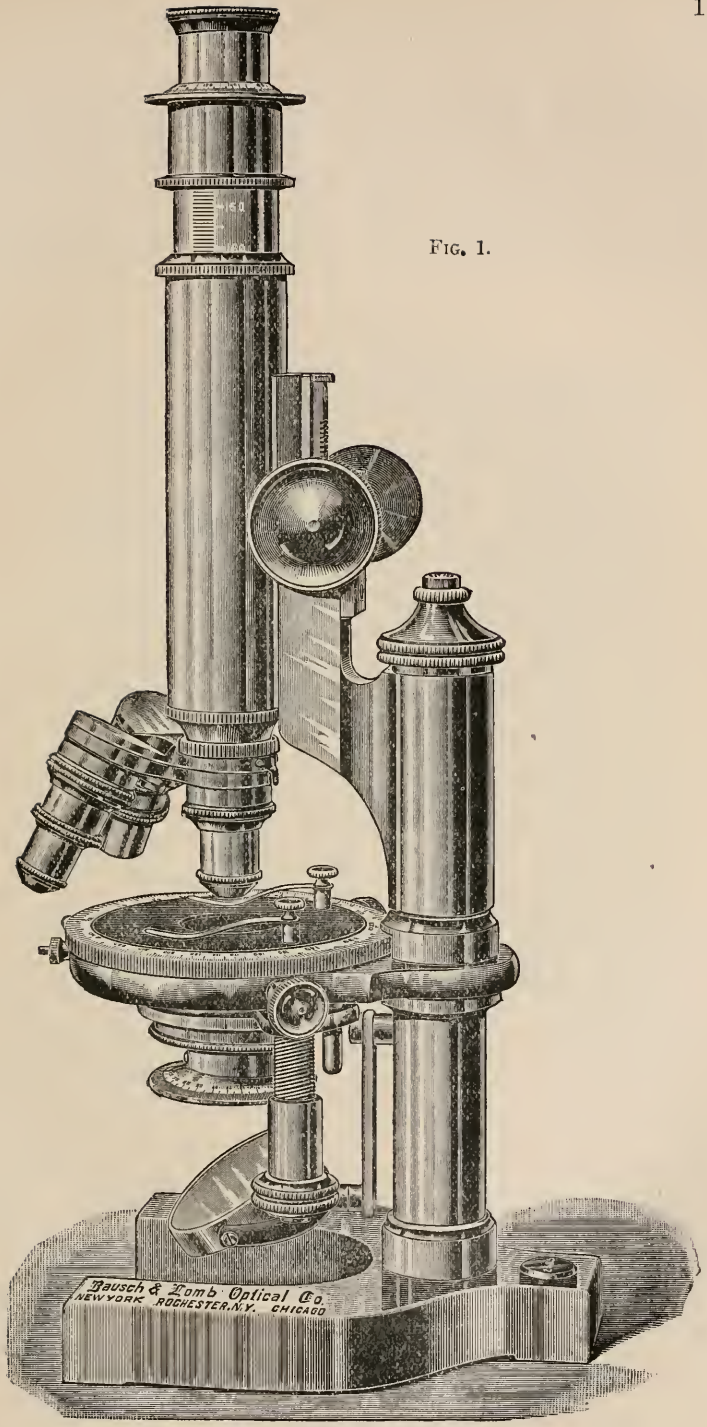


FIG. 1.

Three Small Hand-Microscopes.—With regard to these, which were exhibited by Mr. E. Swan at the Meeting in last November,* it is interesting to note that a figure and description of the original instrument has been found by Mr. Parsons in the first edition of *Carpenter on the Microscope* (1856), p. 73, fig. 15. It was designed by Mr. Gairdner and made by Bryson of Edinburgh.

Berger's New Microscope.—The accompanying cut (fig. 2) illustrates the description of the mechanical stage of Berger's new Microscope,

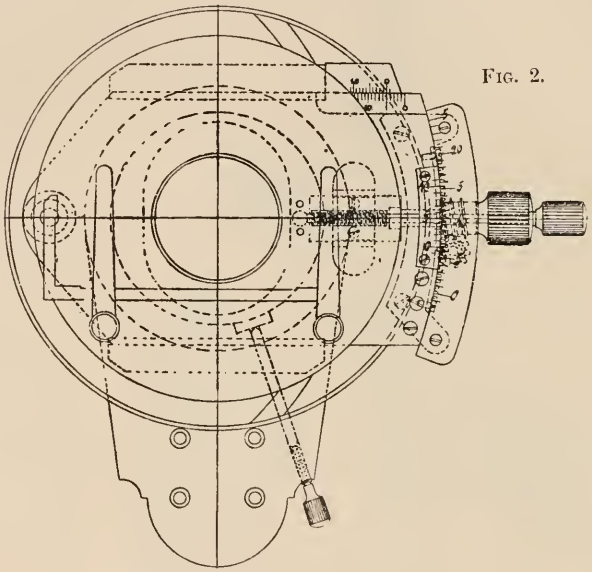


Fig. 2.

which appears on p. 649 of the Journal for 1899; see also figs. 98, 99, and 100 on pp. 584, 585, in the Journal for 1898.

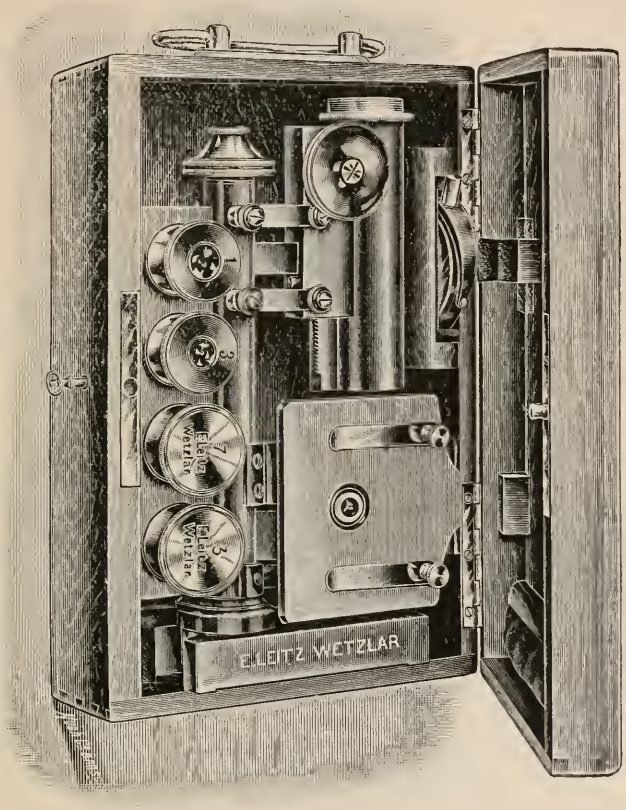
Leitz Travelling Microscope.—This instrument (fig. 3) packs into case 21 by 14 by 7 cm., and weighs only 4 lb. It will be seen from the figure that to set up the instrument for use, the mirror and stage have to be attached, and the tube which carries the ocular must be unscrewed and reversed. It will also be seen that it has rack-and-pinion coarse, and micrometer-screw fine adjustment; the only point not quite clear in the illustration being the method of folding the foot. This foot is a very ingenious one, consisting of two solid rectangular bars of brass lying against each other when the instrument is packed, but which can be opened out so as to make an angle of some 40°, in which position they are firmly held by a spring-catch, and as there is no inclination, this gives ample stability.

Leitz Horizontal Microscope or Cathetometer.—This instrument appeals rather to the physicist than the microscopist; it consists essen-

* Cf. this Journal, 1899, p. 643.

tially of a Microscope mounted on an adjustable pillar (fig. 4), the Microscope being of the compound type, with ocular and combination objective, giving focal distances of 5, 9, and 48 cm. It has rack-and-pinion adjustment for focus, also for vertical adjustment, in addition to a sliding adjustment for the same purpose, both the latter being graduated. The pillar is mounted on a base with levelling screws, both base and Microscope being provided with spirit-levels.

Fig. 3.



Leitz Nebelthau's Sliding Microscope.— This instrument (fig. 5), although originally designed for looking over large brain sections, will perhaps find its chief use in the bacteriological laboratory for the examination of culture plates. For this purpose its unique stage-plate would be particularly serviceable ; it measures 16 by 20 cm., practically every part of which can be brought under examination by the mechanical movement of either Microscope or stage, the necessary illumination being obtained by means of a long rectangular mirror.

The compound Microscope figured can be detached, and a simple lens,

shown lying in front of the instrument in the illustration, can be substituted.

It is only necessary to add that the movements of both Microscope and stage are graduated, so that any desired field may be recorded.

Leitz Dolken's Stand. — This instrument (fig. 6) was designed to overcome the difficulty experienced when examining large bacteriological culture-plates on the ordinary Continental model stand, owing to the

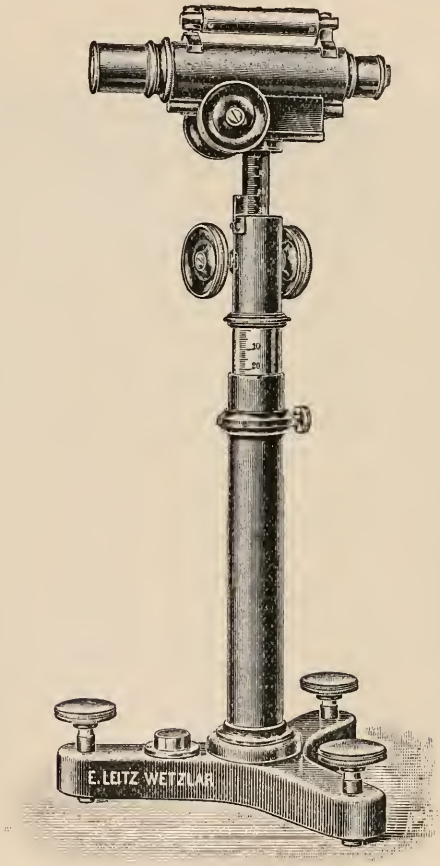


Fig. 4.

short distance from optic axis to limb. The stand is of the same size as the Leitz No. 1, the substage arrangements and focussing adjustments being similar in every respect. The method by which increased space is obtained is so clearly shown in the illustration as to make further description superfluous.

New Hot Stage.*—Dr. A. Macfadyen describes a hot stage, in the

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 246-8 (2 figs.)

construction of which a new principle for regulating the temperature has been applied. The general design is shown in fig. 7.

A is a metal box, with inlet and outlet tubes *a* and *d*. A regulating valve is attached to *a*, and at *b* and *c* are openings, provided with screw-caps. The water in the flask B is heated up to 60°–70° C., and, after flowing through the hot stage, escapes at G. The means of regulating the temperature are shown in fig. 8. The water passes from *a* through

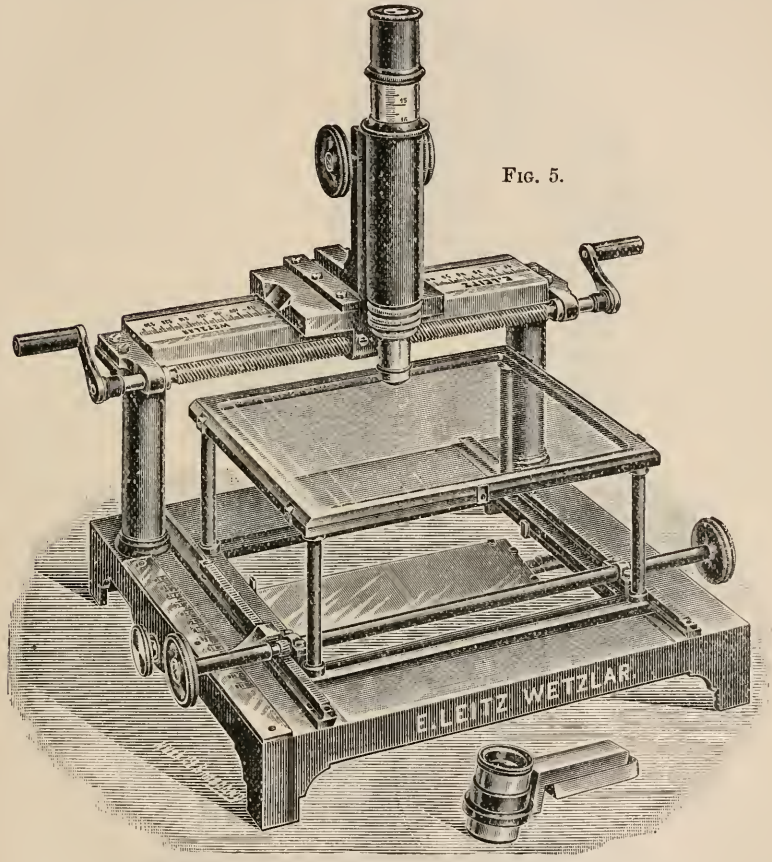


Fig. 5.

the closed cylinder *l*, which projects into air-chamber *g*. The volume of air in *g* varies with the temperature of the water, while the pressure of air in *g* and *l* is kept constant by the piston *k*, which slides freely in the tube *m*. Hence the temperature of the water corresponds to some position of the piston *k*. This carries at one end a flat plate *p*, by which the exit tube *d* is closed. The exit tube *d* not only slides through *i*, but can be adjusted by means of a screw-collar on *i*. To set the apparatus, water of a higher temperature than that required is allowed to flow through, and

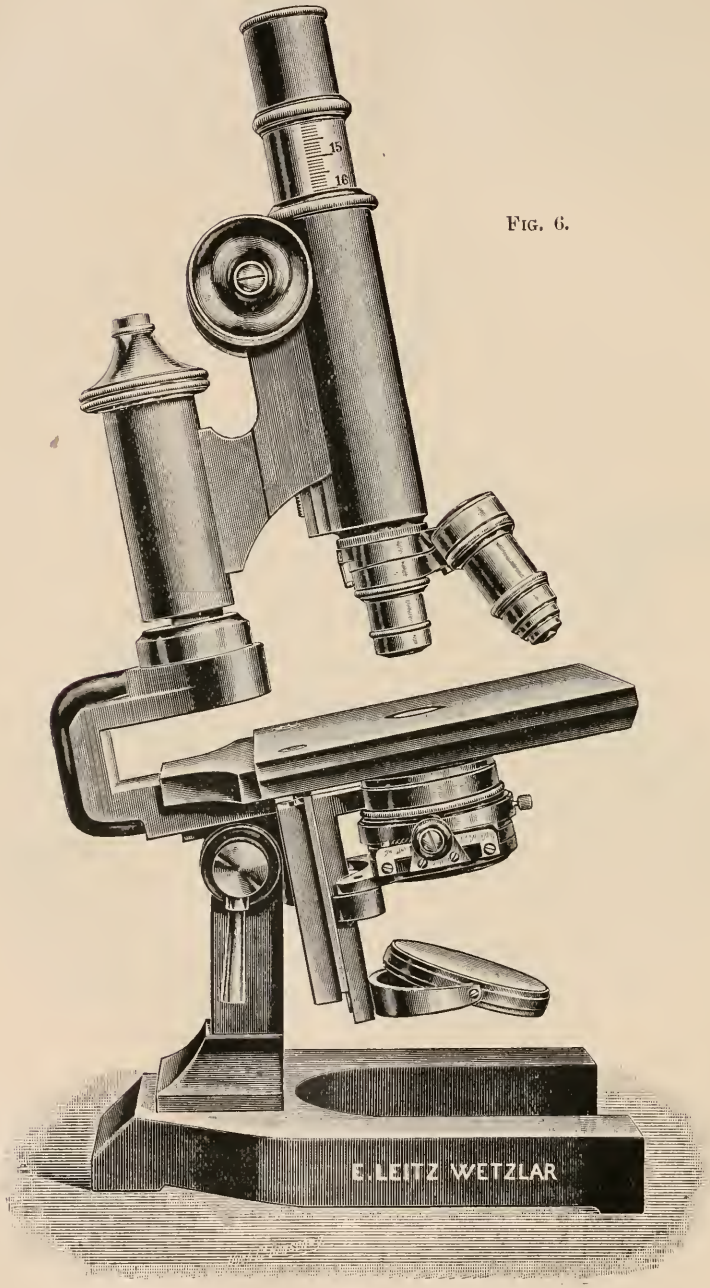


Fig. 6.

when the requisite temperature has been attained, d is then pushed in to arrest the flow. As the temperature falls, the volume of air in g and l

Fig. 7.

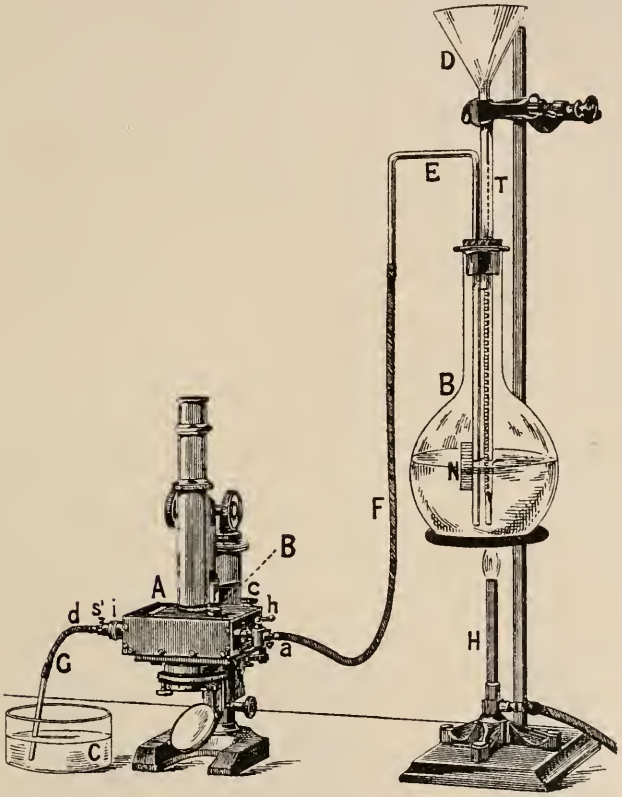
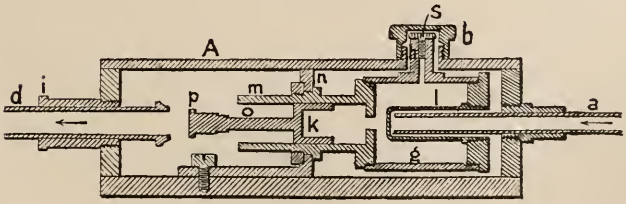


Fig. 8.



will diminish, and the piston k will travel in the direction of a, and so open d by removing the plate p. Fresh hot water then flows through, and the temperature rises, and so on. In this way any temperature

between 20° and 60° is obtainable. The variations are not greater than 1/5 to 1/10 of a degree. The temperature of the object under examination is about 2° lower than that indicated by the thermometer in the stage.

U-shaped Foot.*—Under the title "The U-shaped Foot is clumsy," Mr. W. J. Beall, of Michigan Agricultural College, expresses his opinion of the horse-shoe or Continental form of Microscope foot. Nineteen years ago he selected one or more instruments of some fifteen kinds of stands in order that visitors, his students, and himself, might have a variety for comparison. Since that time he has added other styles to the number. Fig. 9 represents the shape of the horseshoe foot; fig. 10, the same in section as made of solid metal. Fig. 11 represents on the same scale the shape of the foot of another instrument used for nearly

Fig. 9.

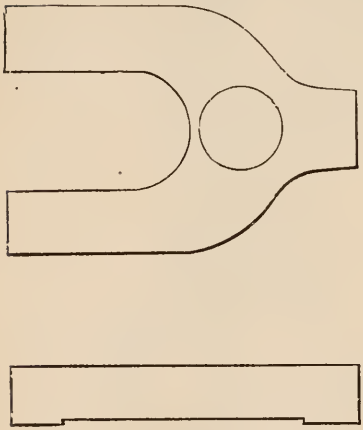


Fig. 10.

Fig. 11.

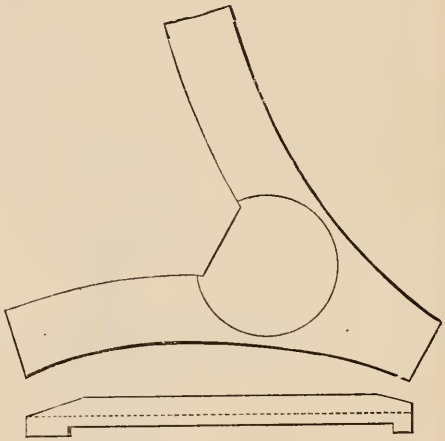


Fig. 12.

twenty years past; and fig. 12 gives a section of the same, the dotted lines indicating the depth of the hollow from the lower side. The first instrument mentioned is 30 cm. high, and weighs six pounds; the second one is 28½ cm. high and weighs a trifle over four pounds. If the first be placed on a table the least bit curved or uneven, the foot stands on three out of four points and rocks easily; while number two stands firmly on the table no matter what may be the condition of its surface. When placed side by side near each other, erect or inclined 20° to 30°, and a string is tied to the top, joining the two, and the feet are placed apart, the heavier instrument tips over before stirring the other one from its position. The author's opinion, which is strongly opposed to the Continental pattern, is best given *verbatim ac litteratim*. "True, the narrow base can be pressed into a smaller box than the other, but on the table there is room enough for a broader base. For utility and for beauty, it seems to me the horseshoe foot has scarcely a thing to com-

* Journ. App. Micr., 1899, pp. 623-4 (4 figs.).

mend it, when compared with the other here illustrated. A considerable portion of the extra two pounds weight seems to be for the purpose of making the stand firm on its feet, which it fails to do. In the use of Microscopes it has been my need to frequently lift them from one place to another, sometimes with considerable speed. Perhaps the extra two pounds may have been added partially with the view of strengthening the muscles of the arm of the one who handles the instrument; if so, the extra weight has accomplished something."

Ahrens' Erecting Microscope.—A point of considerable interest has been found in connection with Ahrens' new erecting Microscope, figured in this Journal for 1888, p. 1020, fig. 161. The erection is performed by means of "Porro" prisms. In the description it is said that "the erection of the image is obtained by two right-angled prisms crossed in the way used in some of the binocular field-glasses." This is probably the first application of "Porro" prisms to the Microscope; and the passage quoted shows that the new field-glasses are not so new as some of us believed.

(2) Eye-pieces and Objectives.

Modern Apochromatic Objectives.* — Dr. H. van Heurck, after some historical and theoretical introduction, summarises the chief forms of modern apochromats.

(1) *Objective* 16 *mm.*, *N.A.* 0·30 (fig. 13).—The system consists of three lenses: the frontal plano-convex of low curvature; the median double; and the superior slightly convex, and in reality formed of a highly curved biconvex lens between two menisci. The low numerical aperture of this objective permits its employment only for histological studies, for which it gives very beautiful and delicate images.

Fig. 13.

Fig. 14.

Fig. 15.

(2) *Objective* 8 *mm.*, *N.A.* 0·65 (fig. 14).—This is a quadruple combination of seven simple lenses of different kinds of glass, and of different curves. It is a very successful objective, and if a microscopist possesses only one apochromat he ought to select this. With different compensating oculars the magnification varies from 62 to 562 diameters. It shows Nobert's sixth group well with axial illumination, and resolves the striæ of *Pleurosigma angulatum*.

(3) *Objective* 6 *mm.*, *N.A.* 0·95 (fig. 15).—The construction of this objective resembles that of the last, but the curves are sharper, especially

* Ann. Soc. Belge de Micr., xxiii. (1899) pp. 43–73 (1 pl. and 6 figs.).

that of the frontal lens. It will resolve, with axial light, Nobert's twelfth group (2830 lines to the mil).

(4) *Objective* 4 *mm.*, *N.A.* 0·95 ; *and* 3 *mm.*, *N.A.* 0·95 (fig. 16).—These resemble the last in design. Dr. van Heurck finds that the 3-mm. will resolve Nobert's thirteenth group, and considers it somewhat superior to the 4 mm.

(5) *Objective* 2·5 *mm.*, *N.A.* 1·25, *water-immersion* (fig. 17).—Construction like last ; a very beautiful objective. A slight alteration of

Fig. 16.

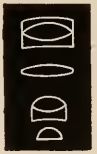


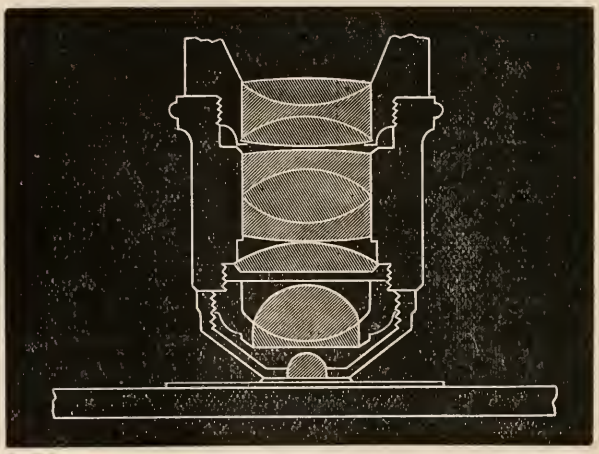
Fig. 17.

Fig. 18.

diaphragm produces a marked effect on the image, and with axial light the resolution lies between Nobert's 13th and 14th groups. With electric oblique light Nobert's 18th group is distinctly resolved.

(6) *Objective* 3 *mm.*, *N.A.* 1·40, *homogeneous* (fig. 18).—This contains ten lenses. The simple frontal lens slightly exceeds a hemisphere,

Fig. 19.



and the object of such a lens is to produce a notable amplification of the object without introducing at the same time great chromatic and spherical aberrations. It reduces the pencil aperture from 1·40 to 0·65. The first doublet discharges similar functions; at first it diminishes the pencil divergence, and afterwards intentionally introduces a certain

amount of chromatic and spherical aberration for more complete correction by the upper lenses. The first triplet destroys spherical and chromatic aberration, and the second triplet the secondary spectrum.

Dr. van Heurck finally tabulates and compares the merits of 3 mm. and 2 mm. apochromats of the most modern makes.*

Fig. 19 is reproduced from Czapski's *Theorie der optischen Instrumente*.† It shows the older form of apochromat, and will be interesting for comparison. It represents an objective of 2 mm. equivalent focus and of N.A. 1·40, on a scale three times the natural size.

CHARLIER, VON C. V. L.—**Über akromatische Linsensysteme.** (On Achromatic Lens-Systems.)
[A very succinct article, with more particular reference, however, to telescopes.] *Öfver. K. Vetensk.-Akad. Förhandl.*, 1899, pp. 657–669.

Objectives of Telescopes. A series of articles in the *Zeitschr. f. Instrumentenkunde*:—

HARTING, H.—**Zur Theorie der zweitheiligen verkitteten Fernrohrobjektive.** (On the Theory of Cemented Doublet Telescope-Objectives.)
[An elaborate mathematical article with tables of constants for different kinds of glass.] Dec. 1898, pp. 357–80.

WOLF, M. — **Über ein Fernrohrobjektiv mit verbesserter Farbenkorrektion.** (On a Telescope-Objective with improved Achromatic Correction.)
Jan. 1899, pp. 1–4 and 1 fig.

HÖEGH, E. VON—**Zur Theorie der zweitheiligen verkitteten Fernrohrobjektive.** (On the Theory of Cemented Doublet Telescope-Objectives.)
Feb. 1899, pp. 37–9.

HARTING, H.—**Zur Berechnung astronomischer Fernrohrobjektive.** (On the Calculation of Astronomical Telescope-Objectives.) April 1899, pp. 104–11.

HARTING, H. — **Über Astigmatismus und Bildfeldwölbung bei astronomischen Fernrohrobjektiven.** (On Astigmatism and Circular Image Distortion in Astronomical Telescope-Objectives.)
May 1899, pp. 138–143, with several tables of constants.

STEINHEIL, R. — **Farbenkorrektion und sphärische Aberration bei Fernrohrobjektiven.** (Achromatic Correction and Spherical Aberration in Telescope-Objectives.) June 1899, pp. 177–183 and 3 diagrams.

HARTING, H. — **Über ein astrophotographisches Objektiv mit beträchtlich vermindertem sekundärem Spektrum.** (On an Astrophotographic Objective with considerably reduced Secondary Spectrum.) Sept. 1899, pp. 269–72.

LEMAN, A.—**Zur Berechnung von Fernrohr- und schwach vergrössernden Mikroskop-Objektiven.** (On the Calculation of Objectives of Telescopes and of Low-power Microscopes.) Sept. 1899, pp. 272–3.

HARTING, H.—**Bemerkung zu dem vorstehenden Aufsatze.** (Note on the foregoing Treatise.) *Ibid.*, pp. 274–5.

* We much regret that in this Journal (1899, p. 337) it was erroneously stated that "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."—EDITOR.

† Edition 1893, p. 245.

(3) Illuminating and other Apparatus.

Electric Microscope Lamp.*—Mr. J. E. Barnard has surmounted the difficulty of adapting the incandescent lamp to Microscopical purposes by strongly illuminating a white surface. The lamp (fig. 20) is

Fig. 20.

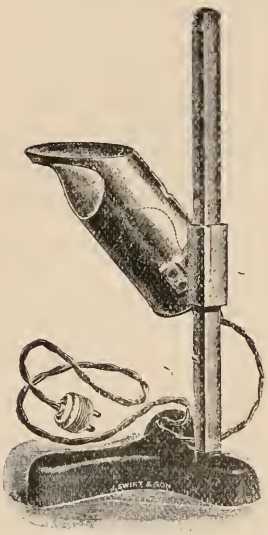
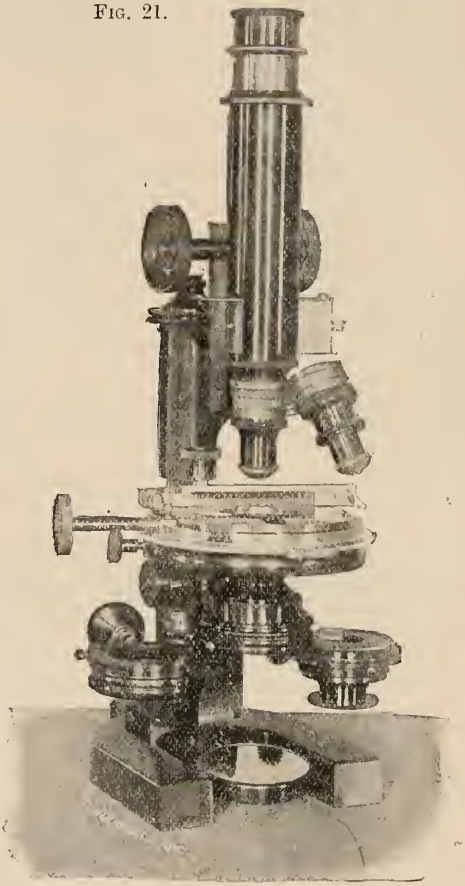


Fig. 21.



enclosed in a brass tube, cut off obliquely at the end and with an aperture opposite the oblique surface. The inner surface of the tube is coated with a thick layer of zinc oxide which, when illuminated, reflects a perfect white light of sufficient intensity for most microscopical purposes.

Winton's Micro-Polariscope for Food Examination.†—Mr. A. L. Winton has found polarised light of great value in the examination of foods, particularly in the detection of starches as adulterants. He thinks the method quicker and surer than the iodine test. For this purpose he uses an arrangement which he has adapted to a Bausch and Lomb's Continental Microscope.‡

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 252–3 (1 fig.).

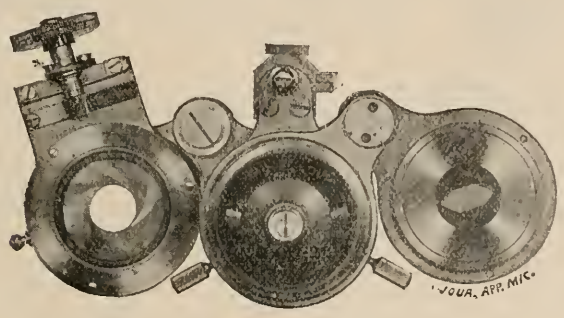
† Journ. App. Micr., 1899, pp. 550–1 (2 figs.).

‡ The device is, however, not new. In the volume of this Journal for 1881 (fig. 48, p. 302) will be found the description of an adapter, and also (fig. 210,

Usually in Microscopes the polariser is fitted to the substage ring which carries the Abbe condenser, and cannot be attached until the substage is lowered and the condenser is removed. For attaching the analyser the Microscope-tube must be raised, the objective or nose-piece removed, and the analyser screwed at the upper end to the tube, and at the lower end to the objective or nose-piece. Both the substage and the tube must be readjusted before the object can be viewed. The change back again to plain illumination is equally laborious. These operations not only consume several minutes each time the polariscope is brought into service, but also, if often repeated, are ruinous to the screw-thread and other parts of the apparatus.

Fig. 21 shows Bausch and Lomb's Continental Microscope fitted with this arrangement. The polariser (fig. 22) is carried on an arm below the substage, and swings into position from the right, at the same time forcing the iris diaphragm out of position to the left. The analyser is mounted in the same manner as in petrographical instruments, the prism being contained in a box which slides in the main tube, so that

Fig. 22.



when pushed to the right, the light passes through the prism, but when pushed to the left, a round opening permits unobstructed vision. When polarised light is desired, the polariser is pushed to the left and the analyser box to the right, and the change to plain illumination is accomplished by the reverse operations. Either change can be made in less than a second, without disturbing the adjustment either of the tube or of the substage, and without damage to the instrument. Another advantage is that the condenser may be used in conjunction with the polariser, thus rendering the crosses on wheat, rye, barley, and some other feebly active starches more distinct. Selenite plates are mounted in a metal slip and are used on the stage.

Watson & Sons' New Substage Condensers. — Fig. 23 represents the dry parachromatic condenser lately introduced by Watson & Sons. It has a total aperture of 1·0 and an aplanatic aperture in excess of 0·90. Its power, 2/7 in., renders it suitable for critical and photographic work

p. 938) of a Microscope with analyser in box above the objective. In the volume for 1888 (fig. 40, p. 279) Messrs. Bausch and Lomb's "Petrographical Microscope," with this device, has already been described. Messrs. Swift also mount the analyser in a slide above the objective.—Editor.

with high-power objectives, and it possesses the convenience of a large field-lens, viz. 5/8 in. diam. The mounting, as shown in illustration, is convenient in form; the iris diaphragm has immediately above it the Society's objective thread into which the optical portion of the condenser screws. The tube surrounding the iris diaphragm is divided to enable the aperture at which the condenser may be working to be known; a carrier is also provided for coloured glasses, dark ground stops, &c. The top lens of the condenser can be removed for work with low-power objectives.

Fig. 23.

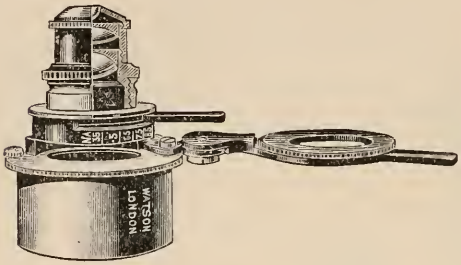


Fig. 24.

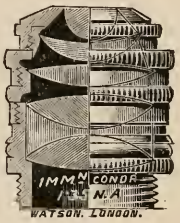


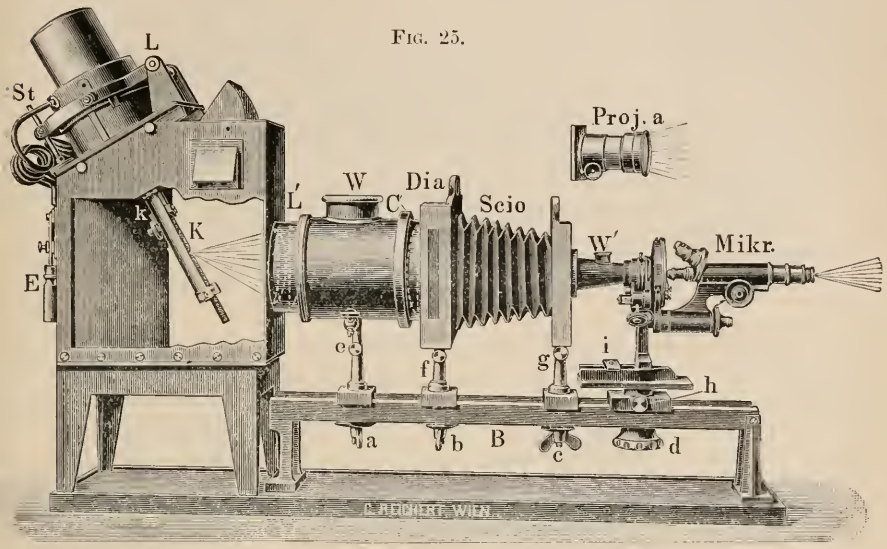
Fig. 24 represents an oil-immersion condenser by the same firm, having a total aperture exceeding 1·3 and an aplanatic aperture of 1·27. It will be noticed that it attains a very high degree of aplanatism, and this is brought about by the use of a triple back correcting lens which is 6/10 in. diam.; its power is 1/4 in. It also can be used dry for medium and low-power objectives by removing the top lens, when its power becomes 2/7 in. and the aperture 0·60 N.A. This optical part is also fitted with the Society's screw, and is supplied in a mount similar to the condenser above described, the iris diaphragm, however, being divided to suit the different optical system.

Reichert's New Projection Apparatus.—This apparatus (fig. 25) is fitted with an optical bench mounted on a solid board, and can be used with the ordinary type of adjustable Continental Microscope. The light-source is either a hand-feed arc lamp, or a Schuckert's automatic self-regulating projection lamp, in metal box lined with asbestos. The 3-lensed 150 mm. diameter condenser system contains a water-chamber affording a sufficient protection to the preparations against prolonged heating. The frame for the reception of the slides is 9 by 12 cm., and the projection-objective, adjustable by rack-and-pinion, is of about 12 cm. focus. There is an adjustable foot-plate to which is fastened the Microscope stand.

The apparatus may also be equipped with a special projection-Microscope stand which very much facilitates the working. The coarse adjustment is then by rack-and-pinion, permitting an especially long movement for the long-focussed objective; the fine adjustment is by micrometer screw. The tube is chosen of such a width that the light-cone of the weakest projection-objective is fully utilised. For the projection-ocular an adjustable draw-out tube is employed. The object-

stage is movable, rotatory, and is fixed by means of screws. The Abbe condenser with iris diaphragm is central, and is adapted for raising and lowering, and can be changed revolver-fashion for a cylinder diaphragm. In order to protect the preparation from excessive heating in the event of long-continued projection, a second water-chamber for alum solution is inserted directly behind the Abbe condenser. For convenience of change from microscopic to diapositive projection, the whole Microscope

Fig. 25.



can be easily drawn off the bench and just as easily replaced. A diaphragm arrangement is provided for stopping off interfering side light.

(4) Photomicrography.

New Photomicrographic Apparatus.*—Mr. J. E. Barnard has devised a photomicrographic apparatus with the following novel modifications.

(1) Rigidity. The apparatus is supported on a cast-iron girder base, thus combining the maximum of strength with the minimum of weight.

(2) Focussing is accomplished in a novel manner. Running along the base is a steel rod, provided with movable brass heads, at the end of which is a grooved pulley carrying a silken cord kept uniformly tense by weights. The cord passes up through the pivot supporting the tail-piece, and is led over guide-pulleys to the fine adjustment. This arrangement allows the Microscope and illuminating apparatus to be swung aside without interfering with the fine adjustment arrangements.

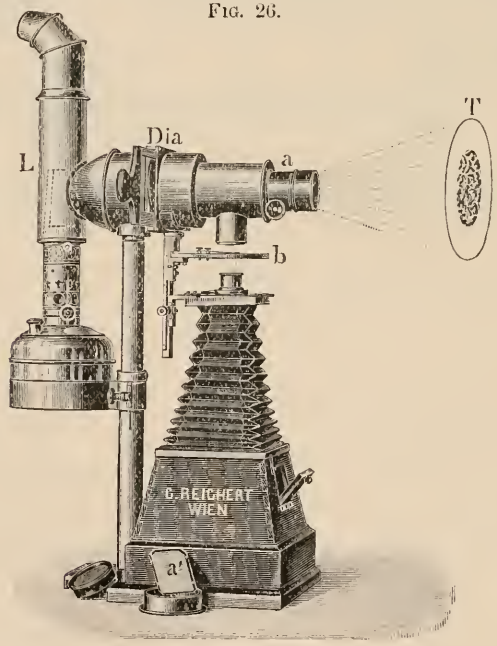
(3) The bellows are in segments, so that the whole or any part may be used. The supporting frames rest on brass tubes, running one on each side of the entire length of the girder base. The contact with the

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 248–50 (1 pl.).

tubes is alternately V-shaped and flat, and the clamping arrangements are entirely independent. The illuminating apparatus is an arc lamp and parallelising system mounted on a brass tube fixed to the swinging tail-piece. The arc lamp is described in this Journal, 1898, p. 170. The entire instrument rests on three levelling-screws supported by thick lead disks on the surface of a stone table which is carried on brick supports above the concrete foundation.

Reichert's New Combined Apparatus for Drawing, Projection, and Photomicrography.—This apparatus (fig. 26) is principally adapted for low powers (6 to 30 diameters) and can be worked with various forms of the incandescent light (petroleum, spirit, gas). It answers the purposes of drawing with magnifiers, photomicrography, and the projection of lantern slides. It is supplied in three combinations:—(1) As a drawing apparatus consisting of a stand fitted with stage capable of moving up and down, condensing lenses in front of the light, mirror inclined at 45°, condensing lens above the stage, Welsbach spirit-lamp fitted with reflector, lens-carrier adjustable by rack-and-pinion, two

Fig. 26.

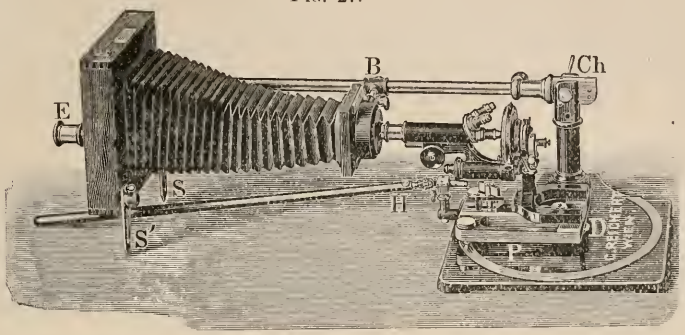


lenses magnifying 6 and 12 diameters; (2) as a photographic camera, double dark slide, and focussing screen; (3) as a projection apparatus, with frames for lantern-slides and projection-lens adjustable by rack-and-pinion.

Reichert's Small Photomicrographic Apparatus.—This apparatus (fig. 27) is made with the guide-rods hinged, so as to be used vertically

or inclined. The base-plate is fitted with three levelling screws, and any of his Microscopes can be adapted. Dark slide for quarter and half plates, focussing screen, and Hooke's key, are supplied with the apparatus.

Fig. 27.



Guide to Photomicrographic Apparatus.* — Herr C. Reichert has issued a guide for the use of photomicrographic apparatus constructed by the firm. Most of the apparatus has been described before, but a modification suggested by von Martenson for low-power photography appears to be new. This consists in placing the principal and accessory parts on separate base-boards. This arrangement is found to be more convenient for examining the specimen, and prevents jarring when the Microscope is bent at an angle.

The photograms, which include objects as various as micro-organisms, the tarsal joint, and metals, are excellent.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Cultivation Medium for Thermophilous Bacteria.‡— Dr. A. Macfadyen and Dr. F. R. Blaxall have found in potato-agar a good medium for cultivating thermophilous organisms. Hereon they grew as isolated colonies, remained discrete, and it was possible to obtain readily pure subcultures. Potato-agar is prepared as follows: Potatoes are steamed, peeled, and pounded. To 100 grm. of potato one litre of water is added, the mass steamed for half an hour, and then filtered. To the filtrate 2 per cent. of agar is added, and the whole autoclaved for 15 minutes. It was found an advantage to add 1 per cent. of salt. After neutralisation with soda and further steaming, the potato-agar is filtered into test-tubes and sterilised once more. This medium, which is practically a carbohydrate soil, is referred to as salt-potato-agar.

* Vienna, 1899, 13 pp., 6 figs., and 18 photograms.

† 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. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 164–5.

Cultivation and Staining of Amœbæ.*—Dr. Feinberg finds that the best medium for the cultivation of amœbæ is a mixture of several organic substances (not specifically mentioned) and common salt solution. In this development is rapid and copious, though the cultures are never pure. A drop of the fluid and a drop of serum are placed on a slide and fixed with sublimate-alcohol. The preparations are then treated with iodine-alcohol and stained with a dilute solution of hæmatoxylin. When the amœbæ become encysted, portions of the nutrient medium mass are fixed and hardened in absolute alcohol, imbedded in paraffin, and sectioned. The sections are best stained with methylen-blue and eosin.

Medium for Isolating Microbe of Scarlet Fever.†—Mr. W. J. Class has succeeded in isolating from scarlet fever cases a large diplococcus, which he believes to be the specific germ of the disease. The successful culture medium is glycerin-agar to which is added 5 per cent. by weight of black garden earth, previously sterilised by discontinuous heating. Epidermis scales are placed on the medium, and the tubes incubated from 2–7 days at about 35°. In about two days whitish-grey semitransparent colonies appear.

New Coloured Nutrient Medium and Appearances produced therein by certain Micro-organisms.‡—Prof. A. Caesaris-Demel, by pursuing the method of cultivating in liver-broth coloured with litmus, has obtained some interesting results with regard to the reaction produced in the medium by the following micro-organisms:—*Bacillus coli communis*, *B. typhi*, *B. pneumoniæ*, *B. anthracis*, *B. icteroides*, *B. prodigiosus*, *Proteus vulgaris*, *Staphylococcus pyogenes aureus*, *Vibrio choleræ*, fowl-bacillus, and *Sarcina lutea*. These results are pictorially summarised in two coloured plates, and the importance of the method for diagnostic purposes in regard to some microbes is thereby rendered obvious. For example, in the case of *B. coli*, the diagram indicates gas-formation and is coloured pink for the first period; the next stages are neutral (yellow), and the final blue-violet. In the case of *B. typhi* the first stage is neutral and all the rest pink. Cholera shows a red-violet hue on the first, and afterwards pink throughout. *B. icteroides* is pink from the start, with gas-formation on the first day.

Cultivations of *B. coli*, *B. typhi*, and *Proteus* under anaerobic conditions showed that after the first day the colour-reaction was neutral, but directly air was restored aerobic appearances presented themselves. The medium is composed of calf's liver infused for 24 hours in 1 litre of water. After expression and filtration the fluid is boiled for one hour, filtered again, and 10 grm. pepton and 5 grm. salt added. The fluid is boiled and filtered again and then neutralised with normal soda solution (about 3 ccm.). The broth is then autoclaved for half an hour at 115°, and after filtration 20 ccm. of neutral litmus tincture are added. 10 ccm. of the broth are poured into test-tubes, and these are sterilised for half an hour in an autoclave.

* Fortschr. d. Med., xvii. (1899) pp. 121–7 (2 pls.).

† Med. Record, lvi. (1899) pp. 330–2, 513–4 (4 figs.). See Brit. Med. Journ., 1899, ii. Epit. 420.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 529–40 (2 pls.).

Apparatus for the Cultivation of Anaerobic Bacteria without the use of Inert Gases.*—The development of anaerobes in fermentation tubes suggested to Dr. Th. Smith their cultivation in flasks. The apparatus depicted in fig. 28 was employed for the cultivation of the tetanus-bacillus. There are two bulbs, A and B, connected by a heavy rubber tube C, and with a clamp D to regulate the communication between them. The bouillon ordinarily fills A and the space below the dotted line in B; but during sterilisation it is forced over into B. It is inoculated through the opening at E. The growth will extend around to A within 24 hours. F is a tin rack for supporting the apparatus. Fig. 29 shows a variation in which a litre flask A and a bent 100 ccm.

Fig. 28.

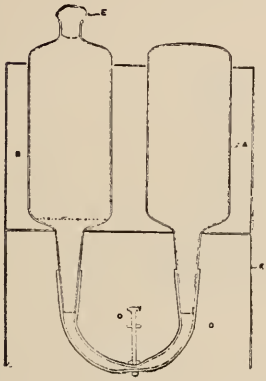
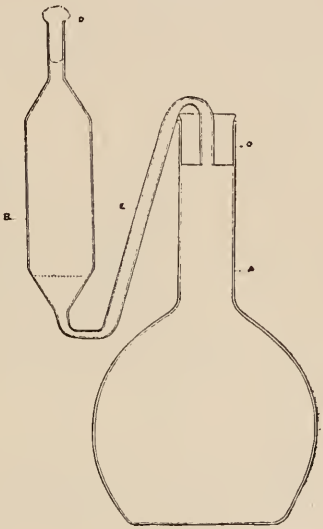


Fig. 29.



pipette B are used. The upper part of the pipette is shortened and plugged with cotton, while the lower part is bent and fitted to the flask with a rubber stopper. The bouillon is inoculated through D, and the growth reaches the flask in 24–36 hours. This form is only partly filled when sterilised, the extra bouillon being autoclaved separately.

Urine-Gelatin for the Diagnosis of Typhoid.†—Dr. H. Wittich records some observations made on typhoid material with Piorkowski's medium,‡ the results of which indicate that the inventor took a too florid view of the value of urine-gelatin for diagnostic purposes. The author has found that, while the appearances of typhoid are as described by Piorkowski, other forms present the same appearances. As a cultivation medium for typhoid its value is highly appreciated.

* Journ. Bost. Soc. Med. Sci., iii. (1899) pp. 340–3. See Journ. App. Micr., ii. (1899) p. 572 (2 figs.).

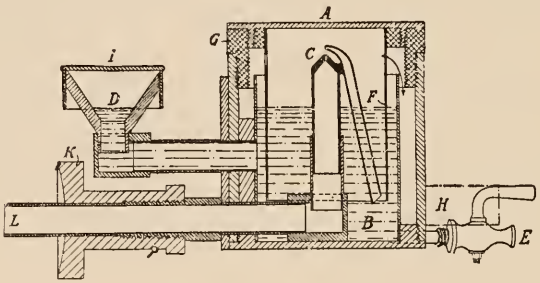
† Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 390–6.

‡ Cf. this Journal, 1899, p. 348.

(2) Preparing Objects.

Delépine Ether Freezing Box. — This is an auxiliary of the Delépine microtome described on p. 128, and is also brought out by Messrs. R. and J. Beck. Although it has been in use for over sixteen years, it has not previously been described. The arrangement of the parts is so designed that the specimen to be cut will remain frozen for a much longer time after ceasing to work the bellows than is usually the case. Scarcely any ether is wasted, as the unevaporated and recondensed ether drops back into the reservoir, the only waste being that which passes out with the air; moreover, an object as large as 2 in. in diameter can be successfully frozen, thus enabling such a specimen as a whole eye to be cut into sections without any difficulty. The ether is introduced into the main chamber by unscrewing the funnel cap D (fig. 30), and the box B may be replenished, if required, during use. The bellows are attached to the end of the tube L, which communicates directly with the nozzle C; the distance of C below the freezing plate A is adjustable, so

Fig. 30.



that the ether may be sprayed over a large or small surface, according to the size of a section under the knife. After a few minutes' working the whole of the ether in B will become almost as cold as the freezing-plate; and to utilise this cold as much as possible, a tube F fixed to the freezing-plate passes down into the ether as in B, and thus equalises the low temperature over the whole of the large plate A much more efficiently than could be the case if only a single point were the source of the cold. The freezing-plate A and the tube F are insulated effectually from the rest of the metal-work by the solid vulcanite carrier G. The various parts are detachable for convenience of cleaning. The air from the bellows, after issuing from C, passes with its ether vapour through holes in the top of the tube F, and thence out of the box by the tube K. Any superfluous ether, as well as the water separated from the ether, may be drawn off by means of the tap E.

Microtechnique for the Study of Sponges.*—Dr. E. Rousseau communicates a summary of the procedures employed by him in the study of sponges. The first two steps are the same for the three kinds, Calcareous, Horny, and Siliceous:—(1) Thin little bits are removed

* Ann. Soc. Belge Micr., xxiv. (1899) pp. 49–56.

from the deeper parts. (2) These are placed in absolute alcohol, which is renewed several times for two days.

Calcareous sponges. (3) Overstain with aqueous 1 per cent. solution of nigrosin (2 days or more). (4) Frequent washing in 90° alcohol (1–2 days). (5) Absolute alcohol, 1 day. (6) Absolute alcohol and ether in equal bulks for 1/2–1 day. (7) Immersion in celloidin for several days. (8) Imbed in celloidin, hardening with chloroform vapour. (9) Place the blocks in 80° alcohol. (10) Decalcify (1–2 days) in the following mixture: alcohol (90°) 100 parts, nitric acid 20–50 parts. When the blocks cut easily, decalcification is complete. (11) Remove the excess of acid by means of powdered chalk. When the chalk no longer dissolves, the acid has been neutralised. (12) Wash in 85° alcohol. (13) Section. (14) Treat the sections successively in 90° alcohol and absolute alcohol, clear in origanum oil, and mount in balsam.

Horny sponges. (3) Absolute alcohol and ether in equal parts (1/2–1 day). (4) Saturate with celloidin (several days). (5) Imbed in celloidin, hardening with chloroform vapour. (6) Cut into blocks and keep in 80° alcohol. (7) Section. (8) Stain with Mayer's picro-magnesia-carmine, picronigrosin, indulin, or Mayer's carmalum. (9) Wash the sections successively in distilled water, 90° alcohol, and absolute alcohol, clear in origanum oil, and mount in balsam.

Siliceous sponges. (3) Absolute alcohol and ether in equal parts (1/2–1 day). (4) Saturate with celloidin (several days). (5) Imbed in celloidin, hardening with chloroform vapour. (6) Cut into blocks and preserve in 80° alcohol. (7) Desilicify for one or more days in the following mixture: 90° alcohol 100 parts, hydrofluoric acid 20–40 parts. The vessels in which this stage is carried out must be made of gutta-percha, or if of glass must be coated with paraffin. (8) When the blocks cut easily, remove the excess of acid by repeated washings in 85° alcohol renewed frequently during several days. (9) Section. (10) Stain with Mayer's picro-magnesia carmine, picronigrosin, indulin, or with Mayer's carmalum; the sections must be kept in 90° alcohol, frequently renewed, before they are stained. (11) Wash successively in distilled water, 90° alcohol, and absolute alcohol, clear in origanum oil, and mount in balsam.

The procedure of other observers is noticed by the author, but only the remarks relative to impregnation with gold and silver need be quoted here. By means of chloride of gold, nervous formations are easily demonstrable in many sponges. Impregnation with silver nitrate shows up the limits of the endothelial cells, and the remains of the formative tissue on the sheath of the spicules. In order to effect this impregnation, the fragments must be previously immersed in a 5 per cent. solution of nitrate of potash for half an hour to remove the chlorides. It is possible to stain the silver preparations afterwards with picrocarmine.

Whey-Gelatin with High Melting-point.*—Dr. O. Appel prepares a whey-gelatin which does not melt easily in the following way. 1 litre of separated milk is heated in a water-bath to 40°, some rennet added and left till it clots. It is again heated, the water-bath being kept on the boil for 1/4 hour, after which it is sieved to separate the whey from

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 76-24.

the curd. The whey is then mixed with 1000 grm. water, 100 grm. gelatin, 10 grm. pepton, and 5 grm. salt, and the solution sterilised for half an hour at 105°. After removal from the autoclave, the solution is filtered through paper into previously sterilised vessels.

If separated milk is not obtainable, skim milk may be used, but then greater care is required for sterilising.

Improved Method for Detecting Bacillus typhi abdominalis in Water and other Substances.*—The extensive experience in India of Mr. E. H. Hankin has enabled him to develope a method for isolating typhoid microbes from water and other substances, which appears to be successful in many difficult cases. The procedure is not altogether new, but is rather a modification of methods which have been long in vogue. To give the method in full detail as narrated by the author would require too much space, and it will be sufficient to indicate the essential feature of the modification. The author's experience is that "if tubes containing smaller quantities of Parietti's solution than the maximum permitting growth are chosen, there is a far better chance of isolating the microbe" than if the tube containing the greatest number of drops, and which has become turbid after 24 hours, be selected. It is possible that the method would give better results if the Pasteur-Chamberland filter were used to concentrate the water.

Formalin as a Reagent in Blood Studies.†—Mr. E. J. Kizer has found formalin a useful reagent for demonstrating the structure of blood-corpuscles, as it produces no appreciable distortion, does not interfere with staining, and is an excellent preservative. One volume of fresh blood is mixed with three volumes of 2 per cent. formalin, and, after standing for an hour, a drop is pipetted from the sediment to a cover-slip, and, having been spread evenly, the film is allowed to dry by evaporation. The slips are next fixed on the flame, and then dipped once or twice into a 5 per cent. solution of acetic acid. The acid is removed by water, and the film stained in 2 per cent. gentian-violet solution; methyl-blue and gentian-violet; hæmatoxylin and eosin; methyl-green and safranin, or Ehrlich's triple stain. Excess of stain is removed by water or alcohol as the stain requires. Lastly, clove oil or xylol and balsam.

(3) Cutting, including Imbedding and Microtomes.

New Delépine Microtome.—This instrument, brought out by Messrs. R. and J. Beck, was invented by Prof. Delépine some eighteen years ago, and its details have been from time to time perfected and improved by him. It may be used for cutting tissues imbedded in paraffin or in celloidin, and is specially intended for cutting sections of frozen tissues (see p. 126) previously imbedded or not imbedded in celloidin. It claims certain marked advantages over other microtomes, including:—(1) The extreme rigidity both of the razor and of the object; (2) the unusual strength of its construction, and its durability; (3) the simplicity and delicacy of the raising motion of the object-holder; (4) the automatic arrangement for regulating the thickness of

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 554–60.

† Proc. Indiana Acad. Sci., 1898, pp. 222–3.

sections; (5) the rapidity of use in cutting large numbers of sections of uniform thickness for class purposes; (6) the new and greatly improved ether-box; (7) the large size of the section that can be cut;

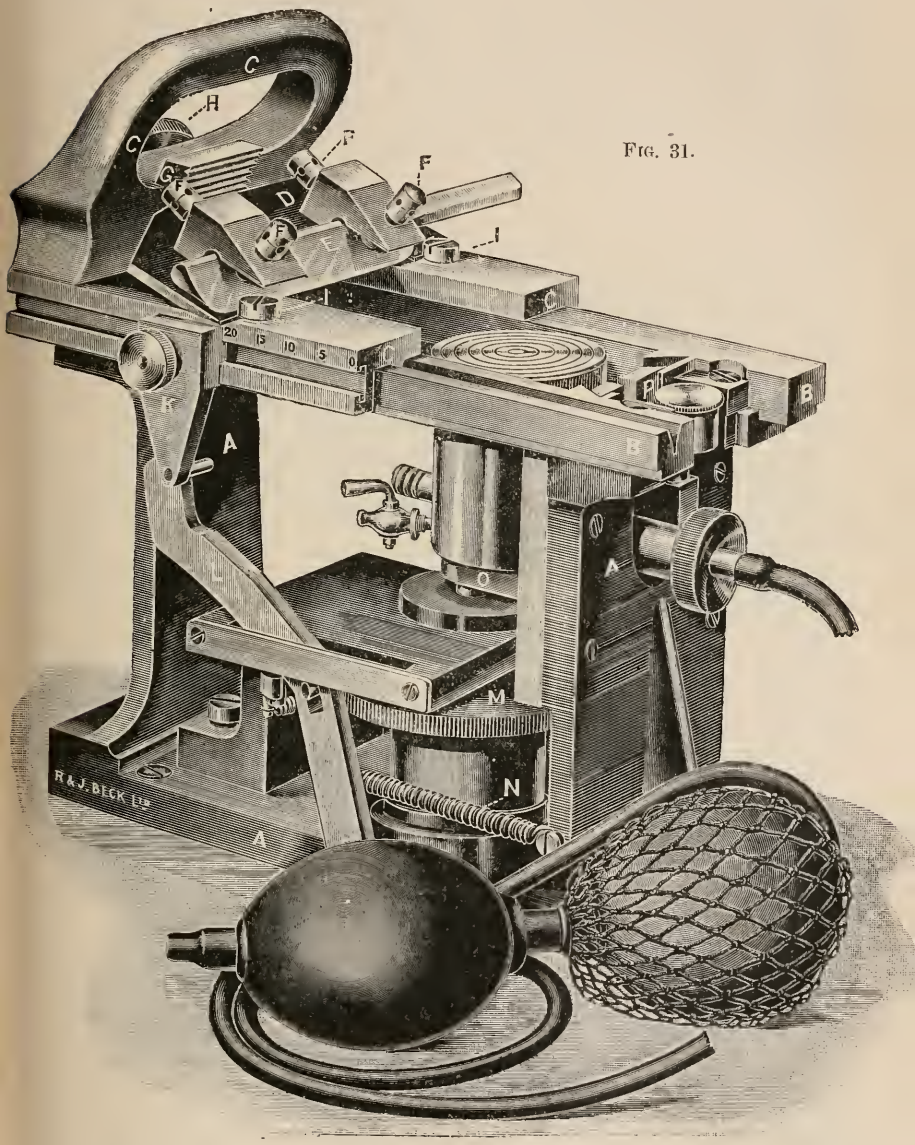


FIG. 31.

(8) its adaptability to various microtomic processes. The stability of the instrument is indicated by the fact that it weighs 24 lb. complete.

Feb. 21st, 1900 K

The frame A (fig. 31) is made of cast iron, and is screwed down to the bench by four screws; but it may, if preferred, be merely fastened by clamps. On the upper portion of A, at a height of $6\frac{1}{2}$ in. above the table, two parallel rails B are fixed, and upon these, which are $9\frac{1}{2}$ in. long, the razor-carriage C travels. The process of fitting the razor-carriage has been adopted by Prof. Delépine after many trials, and is that employed for the saddle of the best American lathes. On one side the rail has a V-shaped depression, the razor carriage being provided with a similar projection along its entire length to fit into it. The bottom of this groove is cut away so that, even when the sides have been somewhat worn with constant use, the V-shaped projection still rests evenly on its two sides and does not touch the groove with its point. On the opposite side the carriage has a perfectly flat surface which slides on a similarly flat rail; thus the only points at which the carriage touches the rails are the two edges of the V on one side and the flat surface of the rail on the other. The carriage overhangs the rails by both side and under pieces; the latter prevent it from being lifted off the stand at any point of stroke; but as these are not made to fit they do not interfere with the perfect sliding of the carriage. The carriage is made of one solid piece of gun-metal, and is pushed backwards and drawn forwards by means of the upper portion, which is in the form of a handle; its heavy weight and the pressure of the operator's hand hold it firmly on the rails.

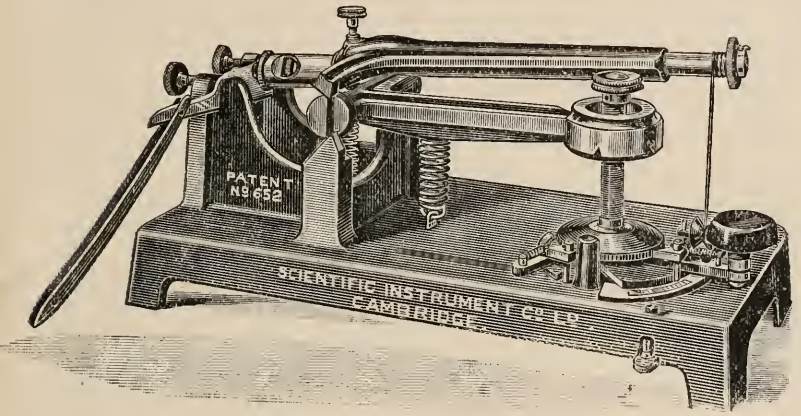
The razor-holder D, with its two jaws, is really an adjustable portion of the razor-carriage, and is made of one solid gun-metal casting; this is necessary to ensure the rigid holding of the razor E by the four set-screws F, two of which clamp the razor down on its carrier, and the other two clamp it from behind. The razor can be adjusted at various angles by means of the serrated movable piece G, which is pressed against the carrier D by means of the thumb-screw H. Thus, if it is necessary for the razor to be at a steep angle to the object, the carrier D is tilted upwards and clamped with its edge in the top groove of the piece G against the two screws I on the carriage. The razor-carrier D can be made in such a manner that the knife may be set at an oblique angle if specially ordered. These valuable adjustments in no way decrease the rigidity of the razor.

In the right-hand side of the knife-carriage is a dovetailed slot in which there slides a projecting piece K terminating in a pin, which at the return of each stroke impinges against a lever L, and this, in its turn, transmits the motion to the ratchet wheel M. The scale on the side of the carriage indicates the number of ratchet teeth moved at each stroke of the lever, and the projecting piece is clamped against the desired number. The scale extends to twenty; there are 250 teeth on the circumference of the ratchet wheel, and one complete revolution raises a micrometer screw through half a millimetre; thus one tooth represents a raising of the object to the extent of 2 μ. This screw presses against the projection O of the dovetailed rising slide P, and by this means the raising and lowering motion of the object is attained. The lever L is brought back after each movement by the spring N. It will be noted that the object is only raised after the section has been cut and the knife withdrawn. The dovetailed rising slide P, with its projection O,

takes either a clamp for imbedded objects or the special Delépine freezing box; these are clamped on to it by the aid of a strong milled head, and can be withdrawn through a slot in the top of the fitting P, when they pass out through the rails.

Cambridge Rocking Microtome, 1900 Pattern.*—The Cambridge Scientific Instrument Company have recently introduced some new features and modifications in their well-known rocking microtome, and for the new pattern (fig. 32) the following advantages are claimed:—increased rigidity, impossibility of tearing sections on the upward movement of the object, impossibility of cutting thick and thin sections,

Fig. 32.



graduated arc for showing the thickness of the sections, catch for holding object above the razor edge, improved method of fixing the cord. The tearing of the sections is obviated by a simple device, by means of which the object is drawn backward before the upward movement begins. The older instrument not infrequently cut sections of variable thickness, but the new pattern is free from this defect. The new instrument is fitted with an orienting object-holder of an improved design; it is simpler than the old pattern and certain in its action.

(4) Staining and Injecting.

Flagella and Capsule Staining.—Mr. N. Morton † gives the following modification of McCrorie's night-blue method. Slides are used in preference to cover-slips. They are washed, bathed in 25 per cent. nitric acid, and kept in methylated spirit. A 24 hours surface-agar culture is used. A small portion is suspended in a few drops of tap water. The suspension is best made by agitating the watch-glass until the germs spread out through the water. A drop or two of the suspension

* Descriptive pamphlet from Cambridge Scientific Instrument Company, 1900. See also Nature, Nov. 30, 1899.

† Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 242–3.

is placed on the slide, and made to spread over the surface by turning the slide about—not by using the needle. Excess is removed with blotting-paper, and the films are allowed to dry at room temperature. The film is not fixed. The stain is made by dissolving 1 grm. of tannic acid, 1 grm. of potash-alum in 40 ccm. distilled water, and adding 0·5 grm. of night-blue dissolved in 20 ccm. of absolute alcohol. The precipitate is removed by filtration, and the filtrate is the stain. The slides are stained for 2 minutes and then washed in running water. Only the flagella are stained, and in order to show up the body of the cell a contrast stain is used. Anilin-water-gentian-violet gives a good contrast.

As the night-blue staining is caused by precipitation, it is advised to filter the solution on to the slide; or the preparation may be over-stained and decolorised in dilute alcohol. The results obtained by this process are better and more certain than those of any other method yet described.

Mr. A. Moore* states that night-blue is very effective for staining capsules, e.g. *Diplococcus pneumoniæ*, *Pneumobacillus*, and *M. tetragenus*. A thin film of liquid serum culture is spread on a slide, dried, fixed with dilute acetic acid, and washed with distilled water. The preparation is then stained with carbol-fuchsin for about a minute, washed again, and dried. The night-blue stain is then applied for one or two minutes, aided if necessary by gentle heat, then washed and dried.

New Method of Flagella Staining.†—Dr. E. Welcke adopts the following procedure for staining flagella. The agar culture should be less than 24 hours old; the bacteria should be killed with 4 per cent. formalin or 1 per cent. osmic acid solution. The film is fixed by heat, and when cold mordanted with Loeffler's or Bunge's fluid, diluted to from 1 to 4 or 1 to 20. After washing and removing the water, the preparation is treated with silver oxide-ammonia solution and heated until it begins to brown. After having been washed, it is immersed in 1 per cent. $HgCl_2$ solution for 1/4 minute. It is again washed, and the treatment with silver-oxide-ammonia solution repeated for 1, 2, or 3 minutes. It is washed again and treated with rodinal- or menthol-developer for 1/4 minute. It is then washed and dried.

Demonstrating the Structure of Bacteria.‡—Mr. S. Rowland, for his observations on the structure of bacteria, selected rosein, as this stain is extremely soluble, innocuous to the organisms examined, and possesses a distinctive and constant differential staining power for certain parts of the bacterial cell. A drop of the culture is placed on a slide and surrounded with droplets of stain, and then mixed together with a needle. A cover-glass is then superposed. With a little practice the amount of fluid between the glasses was so graduated that, while movement was prevented, crushing was avoided. Plasmolysis did not occur if the precautions were properly adhered to.

In order, as far as possible, to avoid errors of interpretation, the violet

* Tom. cit., p. 244.

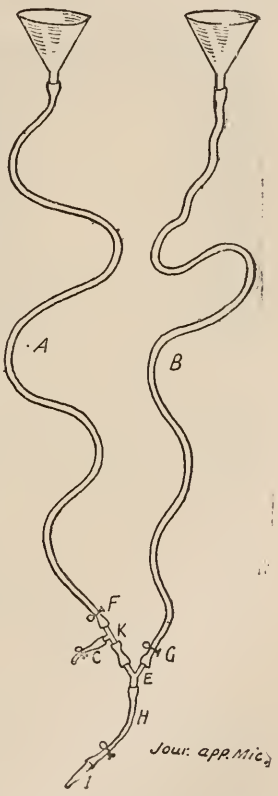
† Arch. f. Klin. Chirurgie, lix. (1899) pp. 129–40 (4 figs.).

‡ Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 143–60 (1 pl.).

end of a wide cone of light was used. The light, before entering the condenser system, was passed through a Gifford's screen, and in this way the image was much improved. This screen is made by dissolving methyl-green in hot glycerin, placing the solution in a glass tank, and immersing in the liquid a piece of Chance's signal-green glass. If constructed with care the red end of the spectrum may be cut off to the line F. Another use of this screen is that even unstained organisms may be examined, and with comparatively wide illuminating cones.

Neisser's Stain for the Diphtheria Bacillus.*—Dr. R. T. Hewlett describes Neisser's diagnostic stain for the diphtheria bacillus. (1) One gram of methylen-blue (Grübler) is dissolved in 20 ccm. of alcohol (96 per cent.), and mixed with 950 ccm. of distilled water and 50 ccm. of glacial acetic acid. (2) Two grams of vesuvin are dissolved in 1000 ccm. of boiling distilled water, and the solution cooled and filtered. Cover-glass preparations are stained in (1) for 1–3 seconds, rinsed in water, counter-stained in (2) for 3–5 seconds, washed in water, dried, and mounted in balsam. The bacillus appears as a slender longish rod stained brown, and generally containing granules of a deep blue or inky tint. There are usually two granules, one at each pole, and occasionally a third in the middle.

Fig. 33.



Histological Fixation by Injection.†—Mr. F. M. McFarland describes a simple apparatus for injecting small animals with a fixative solution. The apparatus (fig. 33) consists of two glass funnels connected with the arms of a Y-tube by rubber tubing. The leg of the Y-tube connects, also by means of rubber tubing, with a cannula which, of course, may be of any size. The main tube A has a lateral tube C for removal of air-bubbles. All the rubber tubes are supplied with pinch-cocks. The tube B is filled with normal saline solution warmed to body temperature, and to it are added a few drops of lactic acid or amyl nitrite to ensure dilatation of the blood-vessels. The tube A is filled with warm fixative solution, e.g. Zenker's. The cannula having been introduced into the aorta, say, of a kitten, the vascular system is first flushed with the saline solution, and when the blood has been removed the fixative in A is run through. The pressure, of course, will vary according to the height the funnels are raised.

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 201–6.
† Journ. App. Micr., ii. (1899) pp. 541–2 (1 fig.).

Staining and Fixing Spore-mother-cells of Anthoceros.* — Mr. Bradley M. Davis makes the following notes on various processes in the case of this representative of the Hepaticæ.

Chromacetic acid fixes filarplasm, but the safranin stains diffusely after it, and gentian-violet does not hold well in the spindle-fibres. If sections fastened to the slide are left several days in weak Flemming, the staining qualities with safranin and gentian-violet are much improved. Merkel's fluid (1 per cent. chromic acid 12 ccm., 1 per cent. platinum

Fig. 34.

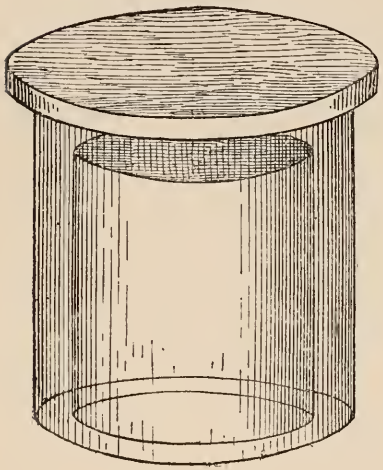
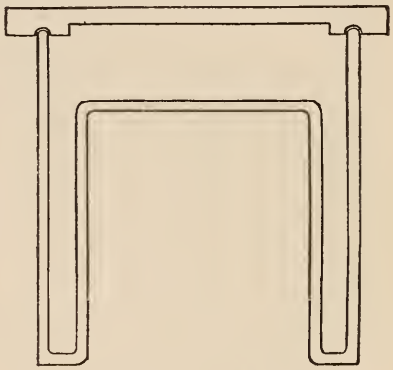


Fig. 35.



chloride 12 ccm., water 72 ccm.), even when used for long periods (36 hours), is thoroughly unsatisfactory; the spindles are badly fixed. Boveri's picro-acetic acid gives beautifully bleached tissue, but achromatic regions are not clearly differentiated, although chromatic elements stain well. Sublimate-acetic (5 per cent. glacial acetic acid in saturated solution of corrosive sublimate) is not good; nuclear membranes and filarplasm are very poorly preserved. Hermann's fluid is very much like Flemming's in its effects, and is thoroughly satisfactory. The osmic acid of the Flemming's and Hermann's mixtures appears to give them certain advantages over all other fluids.

Photochemical Methods of Staining Mucilaginous Plants.†—Mr. A. Lundie stains mucilaginous plants by the chromatype method, using a saturated solution of potassium bichromate mixed with one-twentieth of its volume of saturated cobalt nitrate solution. A piece of an alga, *Batrachospermum* for example, is suspended in this mixture in a glass tube, and exposed to diffuse daylight for 30 minutes. It is then transferred to a slide, treated with silver nitrate solution, and again exposed to light for five minutes. The nitrate is now removed, and an

* Bot. Gazette, xxviii. (1899) pp. 105–6. Cf. *supra*, p. 88.
† Trans. and Proc. Bot Soc. Edin., xxi. (1899) pp. 159–62.

ammonium chloride solution added and allowed to remain until all the chromate has become converted to chloride. The completion of this reaction is marked by the disappearance of the characteristic red coloration of silver chromate. The surplus liquid is now dried off with cigarette paper, and the excess of silver chloride removed by sodium thiosulphate solution. After thorough washing, the preparation is either mounted in glycerin, or, after dehydration by absolute alcohol, in Canada balsam. The staining is uniform throughout, the colour is yellow, and the outline of the mucilage is quite sharply marked off.

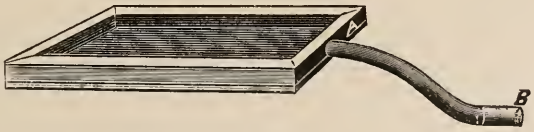
Mucilaginous plants, *Batrachospermum*, *Rivularia*, &c., may be coloured by first impregnating with bichromate and then treating successively with silver nitrate and sodium chloride solutions. The application of this process to seaweeds indicates a method of determining the distribution and the chemical nature of salts present in the tissues of these plants.

Convenient Staining Dish.*—Mr. J. H. Schaffner has designed a staining vessel (figs. 34, 35) which combines the advantages of the Stender dish and the staining dish made by placing a number of crystallising dishes inside each other. It is made of white glass 2 mm. thick. The inside height is 80 mm., of the central part 60 mm.; the internal diameter 80 mm.; diameter of central column, 68 mm. The cover should be 6 mm. thick around the edge, which is grooved so as to fit accurately to the top. The dish will hold eight or ten slides at a time.

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

Apparatus for Removing Air-bubbles from Mounts.†—Mr. J. H. Cooke describes an exhaust apparatus for removing bubbles from mounts (fig. 36). It consists of a slip of plate glass 4 in. by $1\frac{1}{2}$ in., to which is cemented a wooden frame of such a size as to allow ordinary slides to be placed in it. In one side of the frame is bored a hole, and into this is cemented one end of a rubber tube, 6 in. long and 3/16 in. in diameter. A piece of glass tubing B, 1 in. long, closed at one end, and having a small hole at about a quarter of an inch from the closed end, is inserted

Fig. 36.



in the free end of the rubber tube, and so arranged that the hole shall just be covered by the rubber, and the closed end outwards. To use the apparatus, the mount is placed in the cell and covered with a second piece of glass of the same size as the first, and the edges of which have been greased with tallow. If the frame have been properly made the cell will now be air-tight. Exhaust the cell by drawing air through the tube. The valve formed by the hole will prevent the re-entrance of air, and any air-bubbles in the mount will quickly disappear.

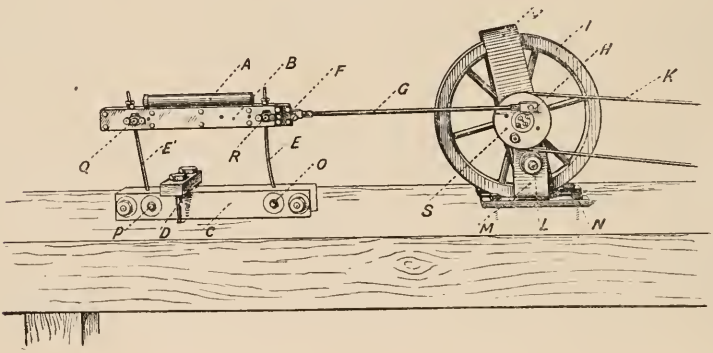
* Journ. App. Micr., ii. (1899) p. 559 (2 figs.). † Tom. cit., pp. 621–2 (1 fig.).

(6) Miscellaneous.

Method for Ascertaining Frequency of Pathogenic Microbes in Air.*—Dr. E. Concornotti exposed glycerin-agar surfaces in Petri's capsules for different lengths of time to the air in various places and spaces. The capsules were then incubated for 24 hours at 37°. Sterilised water was then run over the plate, so as to obtain an emulsion of microbes. Some of this emulsion was examined microscopically in order to obtain a rough estimate of the kinds of organism present. With other portions rabbits were intravenously and intraperitoneally infected. The intravenous method was very successful in discovering pathogenic germs, and seems especially suitable when their virulence has been lowered. Pathogenic bacteria were most frequent in, or in the vicinity of dirty places, and their order of frequency was found to be *Staphylococcus pyogenes aureus*, *St. pyogenes albus*, *Bacillus coli communis*, *Diplococcus pneumoniæ*.

Apparatus for rapidly Disintegrating Micro-organisms.†—Mr. S. Rowland describes an apparatus for obtaining the cell-contents of micro-organisms. A mass of the organisms together with quartz sand and steel

Fig. 37.



balls are placed inside the steel tube A (fig. 37), which is closed at both ends and rigidly fixed to the aluminium frame B. The frame is caused to oscillate horizontally by means of the rod G and the crank-pin H. Two steel rods E, E′ support B, and parallel motion is allowed by means of the joints Q, R, P, O. C is a steel frame clamped to the table by D. Motion is given to the crank-wheel S by the cord K, driven by an electro-motor. The axle of S runs in bearings supported in the frame J, and carries a fly-wheel I. The frame J swings about the stud L, carried in a pair of angle-pieces M, and bolted to the table by N. This arrangement allows easy adjustment of the cord K for tension. At 3500 revolutions a minute, tubercle bacilli are disintegrated in 10 minutes.

Contact Negatives for the Comparative Study of Woods.‡—Mr. R. A. Robertson describes how he gets large sections of woods on a

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 492-501 (2 figs.).
† Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 250-1 (1 fig.).
‡ Trans. and Proc. Bot. Soc. Edin., xxi. (1899) pp. 162-5 (1 pl.).

single sensitive plate which can be used directly as a lantern slide, or as a negative for ordinary prints. The materials used were typical blocks which had been seasoned ten, fifteen, or more years. From these thin hand-plane sections were prepared. The sections, about 6 in. long by 2 or 3 in. broad, were immersed for 24 hours or more in a mixture of absolute alcohol and glycerin, and were kept flattened out under a glass plate. They were then stained with aqueous solution of Bismarck-brown or orange G. The sections were toned in weak spirit, dehydrated in absolute alcohol, and cleared in oil of cloves; eventually mounted in balsam. If mounted in glycerin jelly, the sections were passed from alcohol to a mixture of absolute alcohol and glycerin, and then to pure glycerin.

Thus prepared, the sections are used as negatives for direct contact printing with lantern slides. A plate of glass is fitted into an ordinary printing frame, and on this the series of wood-sections is

Fig. 38.

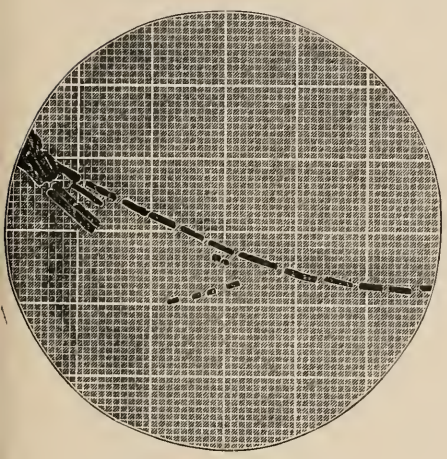


Fig. 39.

arranged in a thin layer of oil of cloves or of glycerin. In the dark room an ordinary lantern slide is placed in contact with these, and clamped down firmly so as to expel air-bubbles and keep the surfaces uniformly in contact. The plates were exposed to gas-light, the time varying with the intensity. After exposure the plate was washed in alcohol followed by water, or in water only in the case of glycerin preparations. The plates were Ilford and the developer hydroquinon; better results were obtained with weak or used developer than with a strong solution.

Antibacterial Action of Acrolein.*—Dr. E. Koch and Dr. G. Fuchs record some experiments with acrolein, which chemically belongs to the class of aldehydes and is therefore related to formaldehyde. The microbes tested were *B. pyocyaneus*, *B. coli*, *Staph. pyog. aureus*, and

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 560-3.

Staph. pyog. albus. The results of the experiments are regarded as satisfactory in respect to the antibacterial and disinfecting properties.

Measuring Bacteria.* — Dr. E. H. Wilson and Mr. R. B. F. Randolph describe a simple and accurate method for measuring bacteria by means of photography. The photographic apparatus is adjusted for an amplification of 1000 diameters, by measuring the magnified image of a stage micrometer on the ground-glass screen (figs. 38, 39). "A drawing is made of a convenient size by ruling with ink two sets of equidistant lines at right angles to each other, each tenth line being somewhat heavier than the others; this drawing should be at least four times the size of the negative to be prepared from it, in order to secure the requisite fineness of the lines. The drawing is then reduced by photography to such a size that the rulings are exactly one millimetre apart. The negative so obtained is the scale used. The image of this scale is superposed on the image of the photomicrographic negative by a process of double printing, the photomicrographic negative being printed first, and the scale afterwards on the same paper, or *vice versa*. The amplification being 1000 diameters and the scale being in millimetres, the reading is directly in micromillimetres."

* Journ. Applied Microscopy, 1899, pp. 598–9 (2 figs.).

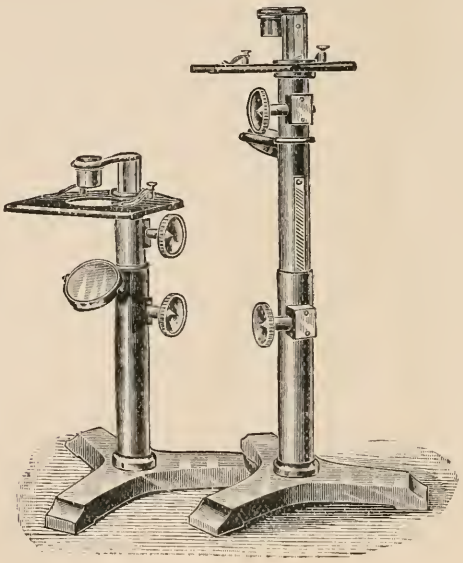
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Bogue's Adjustable Dissecting Microscope.† — Fig. 45 shows the form of dissecting Microscope invented by Mr. E. E. Bogue, of Oklahoma Agricultural College, U.S.A. The intention is to provide an instrument at which the dissector can work more comfortably than at dissecting Microscopes of the ordinary low form. The instruments are of two heights, to accommodate observers of different stature. Each Microscope is provided with two racks and pinions; one for adjusting the

Fig. 45.



lens, the other for raising and lowering the mirror stage and lens. In the left-hand instrument the lens, when in focus, is 260 mm. from the table, about the average height of compound Microscopes. In the right hand one the lens is 360 mm. from the table. The lower rack-and-pinion permits of all intermediate heights according to the needs of the operator. The instrument weighs 69 oz., which is sufficient to give it stability even when racked up to the highest point.

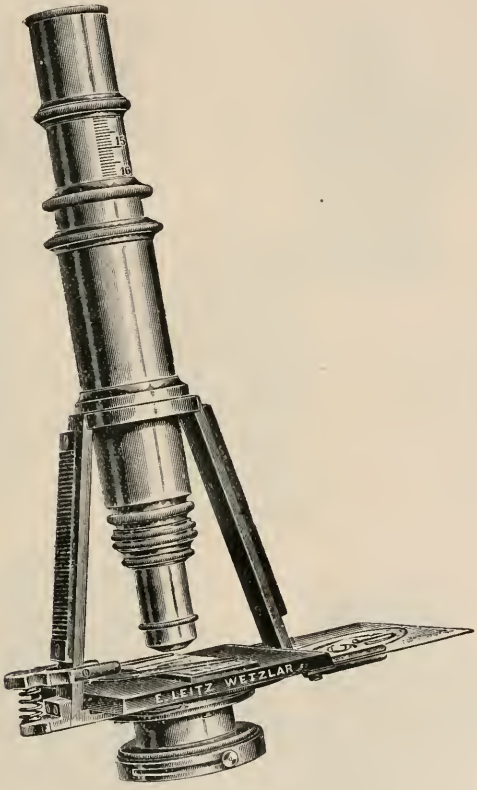
Leitz' Demonstration Microscope.—This is seen in fig. 46. It is adapted for low and medium power, and the square stage is fitted with

* 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. Appl. Micr., 1899. pp. 558-9 (1 fig.).

a wheel-diaphragm. The adjustment is by sliding tube, and, after adjustment, the tube may be fixed by a ring-clamp. A clip is attached to one side of the stage to receive a sketch or label. The instrument can also be fitted with an adjusting screw for focussing high-power objectives; a condenser and iris-diaphragm are provided, if desired.

Fig. 46.



(2) Eye-pieces and Objectives.

Leitz' Revolving Eye-pieces. — This class of fitting has only recently been manufactured by the Wetzlar firm, who consider that their design corrects many of the defects usually found in this accessory. The lower lens (figs. 47 and 48) is so placed that it is permanently fixed, the eye-lens of each combination alone moving in the revolver. So accurate is the construction of the revolver, and so carefully are the lenses adjusted, that the eye-pieces may be changed whilst a specimen is in focus on the Microscope stage without a readjustment of the focus.

The revolving eye-piece is also particularly well adapted to use as a micrometer ocular; for when the eye-lens is turned aside a micrometer scale may be inserted, resting upon the diaphragm of the eye-piece. Once adjusted in this way, the micrometer values are the same for all the eye-lenses of the combination.

Fig. 47.

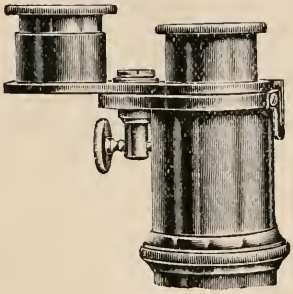
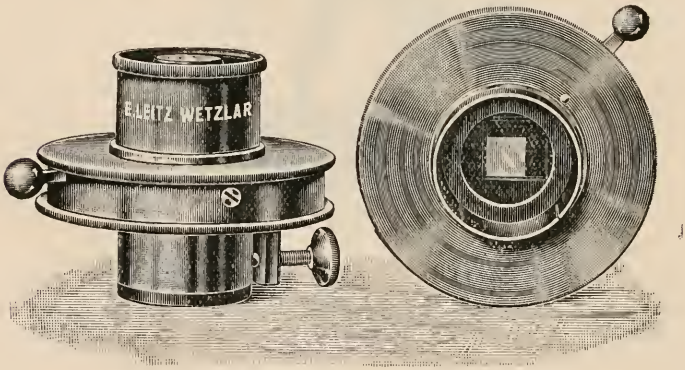


Fig. 48.

Ehrlich's Eye-piece.—This ocular (fig. 49), made by Herr Leitz, is intended to facilitate the estimation of the relative numbers of red and white blood-corpuscles in dry preparations. It is provided with a diaphragm having a square opening, the size of which is regulated by a small lever.

Fig. 49.



Leitz' Achromatic and Apochromatic Objectives.—Leitz' objectives, both achromats and apochromats, are manufactured out of Jena glass. The difficulty at one time experienced from the deterioration of this kind of glass, thereby prejudicing microscopists against it, is overcome by using only glass whose durability has been thoroughly well tested.

The makers have full confidence in their objectives and guarantee them. Figs. 50–52 show three of their achromats. Fig. 50 represents a power about 2/3; it consists of a triplet front and a doublet back, each carefully corrected. Fig. 51 is a dry 1/6 power. A hemispherical front lens is combined with a doublet middle and triplet back, the front lens being the chief magnifier of the combination, and the other lenses correcting the various aberrations. Fig. 52 is an oil-immersion; it consists of a hemispherical front lens, behind which is a meniscus, in its turn followed by a doublet and a triplet; these latter act as correcting lenses.

The apochromats are made of a different kind of glass, and of course give a more perfect correction of chromatic aberration. This advantage is not gained without a certain sacrifice of simplicity in construction,

Fig. 50.

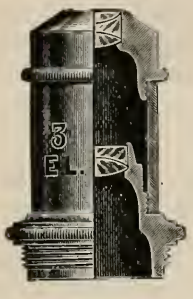


Fig. 51.

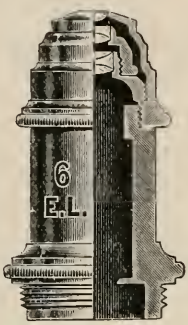
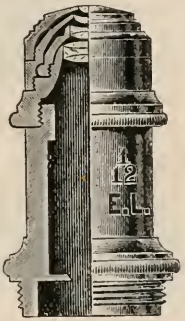


Fig. 52.



as a result of which the apochromat is more likely to suffer from careless handling and from atmospheric changes than the more simple achromat.

As regards sharpness of definition and brightness of field, there is little choice between the two classes of objectives of the same magnification. The apochromats do, as a matter of fact, resolve the fine markings of test objects somewhat more clearly than achromats, but the difference is slight, and in ordinary stained microscopic preparations is hardly detectable.

The correction of both classes of objectives is complete. The ordinary Huyghenian eye-pieces are consequently well adapted for use with either.

The achromats and Huyghenian eye-pieces are also well adapted to the requirements of photomicrography.

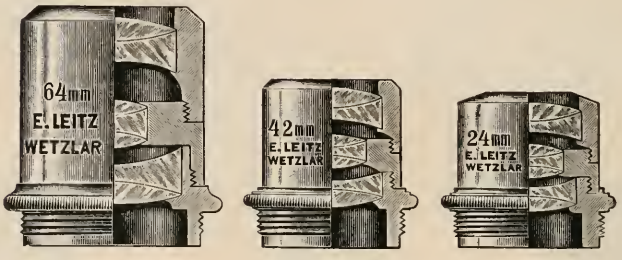
One very important recommendation of the achromats is their remarkably low cost.

Leitz' Objectives for the Edinger Apparatus.—Figs. 53–55 show the objectives of respectively 64, 42, and 24 mm. focal distance designed for the Edinger projection apparatus. In manufacturing these objectives,

use has been made of the principles involved in the makers' new photographic objectives, thereby gaining much in the size of the picture.

HOVESTADT, PROF. — **Jenenser Glas und seine Verwendung in Wissenschaft und Technik.** (Jena Glass and its application in Science and Technique.)
[The author discusses the construction and experience of telescope objectives made of Jena glass.]
Laboratorium et Museum, No. 1, 1900, pp. 5–9 (2 figs.).

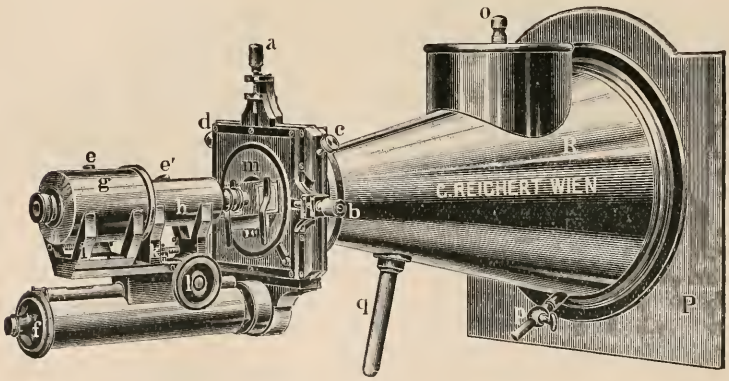
FIG. 53. FIG. 54. FIG. 55.



(3) Illuminating and other Apparatus.

Reichert's Large Projection Apparatus.—This apparatus (fig. 56) is adapted for the strongest currents up to 60 and more ampères, and is suitable for use in an Institute for experimental pathology. The case is of strong oak lined with asbestos, and is fitted with ventilation and diaphragm arrangements. The arc lamp is for hand regulation, and is

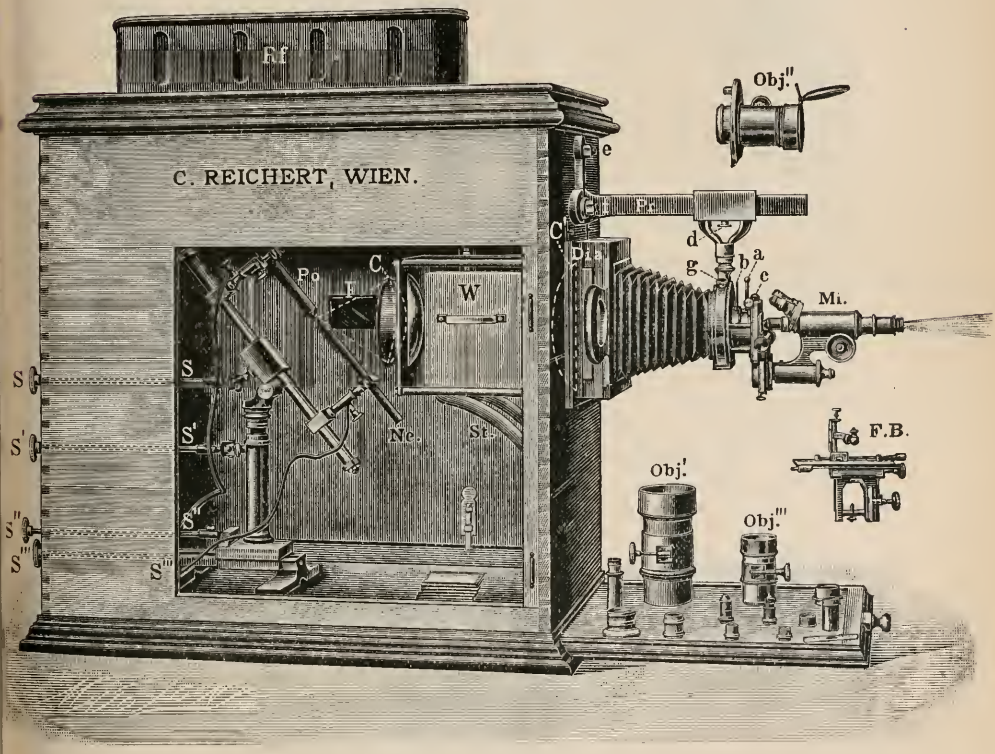
FIG. 56.



easily controlled from the outside in all its movements. The three-lensed condenser system has an aperture of 200 mm. The water-chamber carries the Microscope with the iris diaphragm. The Microscope is so constructed that objective and ocular, each of which has its own tube, can be easily exchanged for others, whilst the position of the

tubes is retained by means of the V-shaped carrier, thus giving absolute security of centering. A specimen of such a microscopic arrangement has been in use at the Vienna Pathological Institute since 1893, and has given great satisfaction. The coarse adjustment of the objective is by rack-and-pinion of sufficient path with long focus, and the fine adjustment is by micrometer screw. The object-stage is easily removable, and is adjustable in two directions by screws; the upper plate is rotatory. Abbe's illuminator is centred by two screws. The Microscope with water-chamber is fastened by two bolts to the condenser system, and is easily detached. In its place a shorter water-chamber, a bellows, or a frame for diapositives can be inserted.

Fig. 57.



Reichert's Medium Projection Apparatus.—This apparatus (fig. 57) consists of an oak case lined with asbestos, a three-lensed condenser system of 160 mm. aperture with a large easily slided out water-chamber between the two front lenses, and an arc lamp for rather strong currents up to 40 ampères. The carbon adjustments are done by hand by means of the screw S; the lamp is regulated by movements vertically and horizontally as well as forwards and backwards, so as to be able

from outside to get the most favourable light-point in this way for any description of projection, whether microscopic or for demonstration of blood circulation in the living frog. The optical bench is placed above the light condenser, so that the space between the condenser and the draw-out shelf remains free and can be made use of. The frame is for slides of 12 by 16 cm. There are a number of accessories, such as an episcope for projection of opaque objects with oblique light, a frog-table, &c.

Beck's New Wide-Angle Oil-Immersion Condenser. — Messrs. R. and J. Beck, encouraged by the success of their dry achromatic condenser, have brought out the above (fig. 58), which, although manufactured on a different formula, has equal advantages as to correction. The aperture is 1·4 N.A., which is the full maximum obtainable without the use of special slides and media. It possesses an aplanatic cone, that is to say, the whole of the light in that cone is brought accurately to one point. The optical combination consists, as will be seen from fig. 58, of four systems of lenses, and is constructed on a new principle. The front lens may be removed when the condenser is to be used for low-power work. The working distance is sufficient for so large an

Fig. 58.

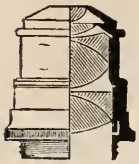
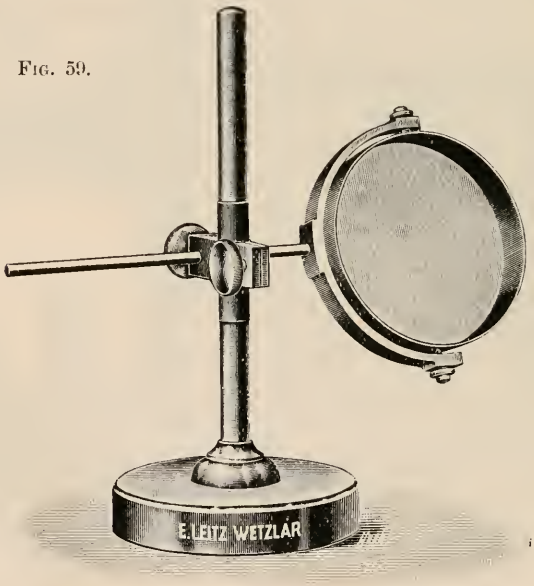


Fig. 59.



angular aperture, being about 0·06 of an inch. Messrs. Beck strongly recommend this condenser, in conjunction with their latest 1/12 1·4 N.A. objective, for work requiring critical resolution, and for all branches of photomicrography.

Leitz' Bull's-Eye Condenser.—This illuminating lens on a new form of stand is shown in fig. 59, and will be clearly understood therefrom.

Gillett Achromatic Condenser.—Fig. 60 represents the Gillett achromatic Condenser, with fine adjustment, presented to the Society by the President at its Meeting in December 1899 (see this Journal, 1899, p. 679).

Fig. 60.

Leitz' Apparatus for drawing Macroscopic Objects.
[This is, in fact, Dr. Wollaston's camera lucida, which was invented before 1807, and which has been in use ever since.]
Centralbl. Bakt. u. Par., 1899, pp. 765–6 (1 fig.).

(4) Photomicrography.

Cobalt Blue Glass in Photomicrography.* —Dr. James Wallace, of Philadelphia, points out that by the use of blue glass in photomicrography the advantage of increased contrast is often obtained. Sometimes, even, contrast is obtained where none seemed to exist. Thus, for example, in the case of a transparent body, such as a mosquito sting, the yellow light of an ordinary lamp is very little affected by transmission through the already yellow object. The yellow tint could in the first place be increased by staining; and then, by the use of the blue colour screen, it will be found to give a strong contrast in the photographic plate. Dr. Wallace has found the following method useful for dealing with specimens mounted in balsam and improperly stained. After removing the cover-glass he soaks the slide for a few minutes in chloroform, then dips it into a solution of picric acid in chloroform, then places it in pure chloroform for five minutes, then in turpentine long enough to get rid of the volatile chloroform, and finally remounts in balsam. The strong contrast afforded by the picric acid staining and the blue glass will give great satisfaction, and is highly recommended for transparent objects. Potassium bichromate stains a good yellow in aqueous solution, and brings out red corpuscles in a very marked manner. The advantage of picric acid is that it is soluble in chloroform, and can be used for objects that have been already mounted in balsam.

Brinckerhoff, W. R.—**A Non-vibratory Bench for Photomicrography.**
Journ. Boston Soc. Med. Sci., III. (1899) p. 257.

Gebhardt, W.—**Die mikrophotographische Aufnahme gefärbter Präparate.** (The Photomicrographic Reception of Coloured Preparations.)
Internat. Photogr. Monatsschr. f. Med., 1899.

Mathet, L.—**Traité pratique de photomicrographie. Le microscope et son application à la photographie des infiniment petits.** Paris, 1899, 8vo, 267 pp.

Walmsley, W. H.—**Photomicrography of Opaque Objects.**
[The author recommends the cultivation of this somewhat neglected subject.]
Micr. Bull, XVI. (1899) pp. 45–6

(5) Microscopical Optics and Manipulation.

Brown, Theodore—**Teaching the Laws of Binocular Vision.**
[The author describes an ingenious little apparatus for demonstrating to a class the changes in the eye when an object is viewed.]
Eng. Mech., LXX. No. 1814, pp. 439–40 (3 figs.).

* Micr. Bull., xvi. (1899) pp. 33–4.

(6) Miscellaneous.

Strehl's Theory of the Microscope: the Pleurosigma Image.*—Herr Karl Strehl produces an article on the pleurosigma as a further contribution to his writings on the theory of the Microscope.† He desires to show that a knowledge of the diffraction theory is necessary to the proper comprehension of microscopic perception, and also that the theory may lead to the detection of some of the most delicate features of the image. Although the article does not readily lend itself to abstraction, an idea of it may be gathered from the following account. He considers the question under the influence of (1) direct light; (2) oblique light. With direct light the normal image is given by an equation:

$$M^2 = \left(\frac{d\,F}{\lambda\,p}\right)^2 \left\{ i + 2\,h \left[\cos Y + 2 \cos \frac{Y}{2} \cos \frac{X\sqrt{3}}{2} \right] \right\}^2.$$

This equation takes slightly different forms when applied to oblique light and to some of the points specially considered. His object, of course, is to show that theory and observation agree. In the course of the article he discusses,—normal image, hexagonal formation, ideal image, depth of image, quarter-phase image, lozenge-formation, chequer-formation, photomicrography. He also gives details of some experimental ratifications.

Behrens, H.—**Anleitung zur mikrochemischen Analyse.** (Introduction to Microchemical Analysis.)
[Second edition of this important work.]
Hamburg (L. Voss), 8vo, 242 pp., 96 figs.

Laboratorium et Museum.
[A new monthly scientific journal, with articles in English, German, and French.] English agents, Sampson Low, Marston & Co.

B. Technique.‡

(1) Collecting Objects, including Culture Processes.

Apparatus for Spore-sowing.§—Herr F. Noll describes the following apparatus (fig. 61), which he found suitable for the regular distribution of spores over a culture-surface. It consists of a wire gauze tube *z*, which is fitted at its lower end into a hole in a circular piece of cork R. Round the rim of the cork is fastened a roll of paraffined paper *p*, the same height as the wire gauze. The interspace is filled with calcium chloride. The upper end of the apparatus is closed with a cork K, having a hook N and a wire to which a piece of the plant with sporanges *s* is attached.

The culture medium is composed of a level layer of sterilised garden earth, which is damped and placed in a plate. The apparatus is suspended within a bell-jar, and the latter inverted over the culture layer.

* Zeitschr. f. Instrumentenk., 1899, pp. 325–35.

† Cf. op. cit., 1898, pp. 301–17; also this Journal, 1899, p. 94.

‡ 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.

§ Flora, lxxxvi. (1899) pp. 386–7 (1 fig.).

As the calcium chloride mantle dries the air, the sporanges open quickly, and it is only necessary to alter the position of *s* from time to time to

Fig. 61.

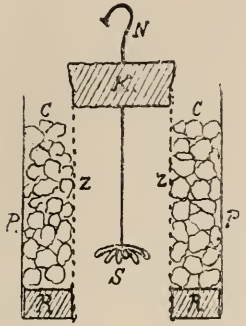
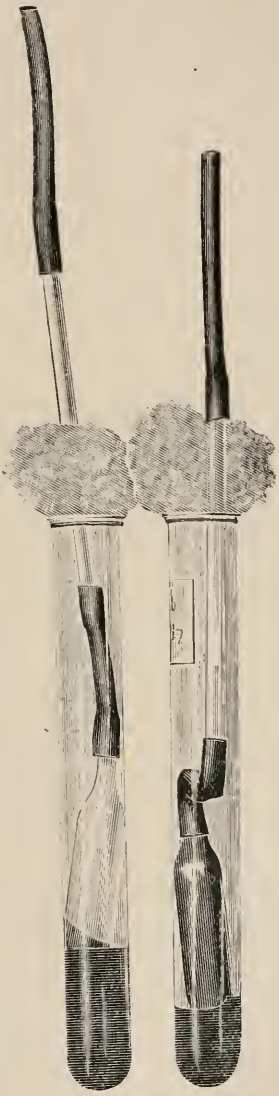


Fig. 62.



disseminate spores over all the surface of the culture medium. When the sowing of the spores is finished, the culture layer may be moistened without removing the bell-jar.

Warm Cupboard for Germination Purposes. * — Herr F. Noll describes a warm cupboard, the object of which is partly to act as a protective screen against the heat of stoves, and partly to make use of the surplus heat for germination and other similar purposes. The cupboard is made of sheet iron, has six shelves, and is divided into upper and lower compartments, each of which is closed by doors. At the end of each shelf is an aperture which may be closed by a sliding-panel. The cupboard is 118 cm. high, 60 cm. broad, and 18·5 cm. deep. The cupboard, when in the vicinity of a stove burning throughout the night, is found to keep at a temperature of 20°–25°, and is therefore very suitable for the cultivation of roots, fungi, and bacteria.

Simple Method for Anaerobic Cultivation in Fluid Media.†—Dr. C. H. Wright describes a method which depends on the fact that a flexible rubber tube closes itself air-tight when it is bent beyond a certain

* Flora, lxxxvi. (1899) pp. 382-3 (1 fig.).

† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 74–5 (1 fig.).

angle. As is seen in the illustration (fig. 62), the apparatus consists of glass and rubber tubing, which are placed inside a test-tube together with a suitable amount of culture fluid. The apparatus and contents are sterilised in the usual way; but just before using, the culture fluid should be boiled to drive off the absorbed oxygen. When a culture is to be made, the medium is infected in the usual way; the lips are applied to the projecting piece of rubber tubing, and the culture fluid sucked up into the inner tube somewhere above the top of the lower rubber tubing. This done, the upper tubing is compressed by the fingers (or pinch-cock), and the tubes are then pushed down so as to bend the lower rubber tubing in the way shown in the illustration. The upper ends of the glass tubes should be plugged with cotton wool. The excess of culture fluid left outside the inner tube affords opportunity of ascertaining whether an organism is an essential anaerobe or aerobe, and also whether it is potentially anaerobic or aerobic. If it be desired to make a cover-glass preparation, the bends of the rubber tubes are straightened out by lifting the glass tube; the culture fluid then flows out into the outer tube.

The apparatus has given good results with the tetanus bacillus.

Procedure for Easily and Rapidly Distinguishing Cultures of Bacillus Typhosus from Bacillus Coli.*—Dr. A. Mankowski employs the following coloured nutrient medium for distinguishing between the bacillus of typhoid fever and *Bacillus coli communis*. The staining mixture is made in two solutions, A and B. Solution A is a 1 per cent. solution of caustic potash saturated with acid fuchsin (the pigment is added until the solution assumes a blackish-brown colour). Solution B is a saturated solution of indigo-carmin in water. Two ccm. of solution A, 1 ccm. of solution B, and 22 ccm. of distilled water, are mixed together, and the mixture should be dark blue in colour and of slightly alkaline reaction. To the nutrient medium the solution is added, drop by drop, until the substratum is of a blue or violet hue. The reaction must be neutral. It is sometimes advisable to add a drop of the indigo-carmin solution to the already coloured medium, in order to intensify the blue, and render the reaction of the typhoid bacilli more evident. The typhoid colonies change the blue to a raspberry or carmin-red colour, and the coli colonies to green or greenish-blue at first, and later on discharge the colour. The medium used was agar, with the addition of 1/2–1/3 per cent. glucose.

New Substratum for Isolating Typhoid Bacilli and Bacillus Coli Communis.†— Dr. A. Mankowski recommends a medium, the chief constituent of which is decoction of "mushrooms," for the differential diagnosis of *Bacillus coli communis* and the typhoid bacillus. To the mushroom decoction 1·5 per cent. agar, 1 per cent. pepton, and 0 5 per cent. NaCl are added. When the mushroom-agar has been boiled, and clarified by means of white of egg, it forms a firm transparent dark brown mass, with neutral reaction and a distinct odour of mushrooms. *B. coli* grows quickly, and forms a silvery-white firm deposit. The typhoid colonies develope less rapidly, and form a transparent shiny moist streak. In six hours gas-bubbles are visible in the *B. coli*

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 21-3. † Tom. cit. pp. 23–4.

colonies. If the medium be stained with the author's indigo-fuchsin solution, the typhoid bacilli change the blue to red, while the coli bacilli decolorise the substratum.

For making the decoction poisonous or edible mushrooms may be used.

New Method for Cultivating Tubercle Bacillus.*—Dr. W. Hesse describes a nutrient medium which is made by dissolving 5 grm. Heyden's nutriment, 5 grm. salt, 30 grm. glycerin, and 10 grm. agar, in 1000 ccm. water, and alkalised by the addition of 5 ccm. mineral soda solution. Plates are made in Petri's capsules, and tubercle bacilli grown thereon from direct inoculation with sputum. On this medium tubercle bacilli almost invariably grow, and in the exceptional cases where the culture is overgrown by other bacteria, impression preparations invariably disclose their presence. The author believes that this method will supersede the animal test in many doubtful cases.

Cultivating Water Bacteria in an Atmosphere Saturated with Moisture.†—Mr. G. C. Whipple has shown, by a series of experiments, that in order to obtain the greatest possible development of water bacteria on the gelatin-plate, a ventilated dish should be used, and the cultures should be incubated in an atmosphere saturated with moisture. The observations were made on cultures placed in (1) moist chamber, (2) ice-chest, (3) incubator, (4) closed chamber, and (5) desiccator. The largest number of bacteria were always obtained from plates developed in the moist chamber, and the least from those in the desiccator. It was also found that there was a direct relation between the humidity and the number of bacteria developed, and that the supply of oxygen had a marked effect on the growth of the water bacteria on the gelatin plate. The practical outcome of these observations was that satisfactory results were obtained by making small notches on the lower edge of the Petri plate, or by extending the sides of the lower plate upwards at four points so as to allow of free circulation of air. These ventilated dishes, placed in an atmosphere saturated with moisture, were not only successful, but were perfectly free from danger of contamination. Cultivation in a moist atmosphere has the further advantage of bringing the bacterial growth to maturity in a shorter time. The incubators should be well ventilated, and their atmosphere kept at or near saturation point. They should be provided with dry and wet bulb thermometers, and the relative humidity should not be allowed to fall below 95 per cent.

Cultivating and Demonstrating the Micro-organisms from Tumours.‡—Dr. Nils Sjöbring has cultivated the microbes of cancer in a medium composed of ordinary pepton-gelatin (8 per cent.) and strong aqueous solution of potash-soap made with human fat (1·5 per cent.). To this 1 per cent. cane or grape-sugar is added, and then the mixture is sterilised. Usually 50 per cent. sterile ascitic fluid was added, but this is not an absolute necessity. The amount of free alkali should be much greater than in bacterial substrata; even 2 per mil. is not unfavourable. Pieces of tumour freshly excised were placed in the tubes and

* Zeitschr f. Hygiene, xxxi. p. 502. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 119. † Technology Quarterly, xii. (1899) pp. 276–82.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 129–40 (4 figs.).

incubated at 37°, and in about a week the microbes developed freely, though not on the surface. Pure cultures were also obtained occasionally from the dead body. Microbes were obtained from thirty different kinds of tumour, and each tumour appears to have a single species. Microscopical examination of the cultures must be made from fresh material, as the bodies do not stand fixation or hardening; though with weak chromic and acetic acids appearances similar to those depicted by Soudakewitsch were obtained. The preparation may, however, be stained with methylen-blue, safranin, or in anilin-blue (weak aqueous solution, with at most 1–5 per cent. alcohol).

The appearances found on examination were extremely variable as to shape, but may be roughly divided into three classes, with, however, numerous transition forms—amœboid forms, typical rhizopoda, and involution or resting forms. The organism of cancer is without doubt a rhizopod, according to the author, and four successful inoculations on mice with pure cultures are recorded.

Growth of Tubercle Bacilli on Potato Substrata.*—Herr E. Tomaszewski tested four different samples of tubercle bacilli on neutral and acid gelatin-potato, glycerin-bouillon, glycerin-agar, neutral and acid glycerin-potato-broth, glycerin-potato-agar, and glycerin-potato-bouillon. The most favourable growth took place on glycerin-bouillon and glycerin-agar. The author therefore concluded that there was no advantage in potato media as against the two last-mentioned substrata.

Cultures of Micrococcus melitensis and its Serum Reaction.†—Dr. T. Zammit reports that:—(1) the micrococcus of Bruce can be grown successfully from a culture seven months old; (2) two-year old cultures give a clear serum reaction; (3) the micrococcus does not grow on sea-water-agar even when brown from sewage contamination; (4) but grows on an agared solution of normal human fæces.

Preparation of Culture Media.‡—Mr. R. B. F. Randolph has, for the last three years, been in the habit of boiling all culture media in an agate-ware double boiler, the outside chamber of which contains a 50 per cent. filtered solution of commercial calcium chloride. This solution has a boiling point of 112° C., and consequently, when boiling, is hot enough to keep the contents of the inner chamber in rapid ebullition. The advantages of this plan are that nothing ever burns, the boiling takes place quietly and without bumping, and the rate of ebullition is easily controlled by adjusting the size of the flame.

Apparatus for obtaining Plate Cultures or Surface Growths of Essential Anaerobes.§—The apparatus (fig. 63) described by Dr. W. Bulloch consists of a bell-jar placed on a ground-glass slab. At the top are two openings fitted with tubes and stop-cocks, from one of which a tube leads to the bottom of the bell-jar. The lower edge of the bell-glass is smeared with unguentum resinæ. On the slab is placed a Petri's dish, and in this a beaker containing the inoculated tubes. In the Petri's dish and on the side farthest from the long tube are placed

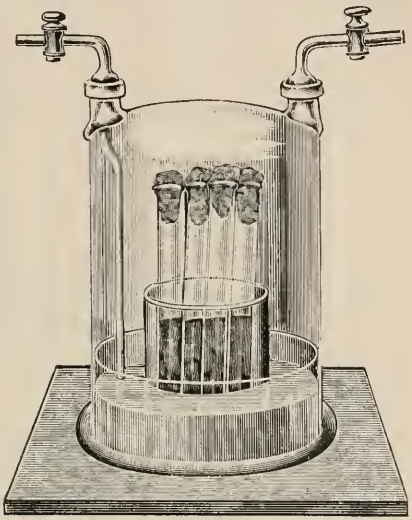
* Zeitschr. f. Hygiene u. Infekts., xxxii. (1899) p. 247. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 166. † Brit. Med. Journ., 1900, i. p. 315.

‡ Journ. App. Micr., ii. (1899) pp. 632–3.

§ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 140–2 (1 fig.).

2–4 grm. dry pyrogallic acid. The bell-jar is then applied so that the end of the long tube dips into the Petri dish. Both stop-cocks are now opened, and hydrogen or coal-gas introduced through the short upper tube. When the apparatus is full both taps are turned and an air pump applied to the short tube. After opening the stop-cock, one or two strokes of the piston produce a sufficient vacuum, and then the tap is closed again. By means of a piece of rubber tubing applied to the long tube, strong potash solution is introduced (109 grm. solid KHO in 145 ccm. water) into the Petri's dish. It is necessary to make the potash solution some time before using. The whole operation of putting the apparatus into complete working order does not occupy five minutes. The apparatus has been used with great success for tetanus, malignant œdema, rauschbrand, and *B. aerogenes capsulatus*.

Fig. 63.



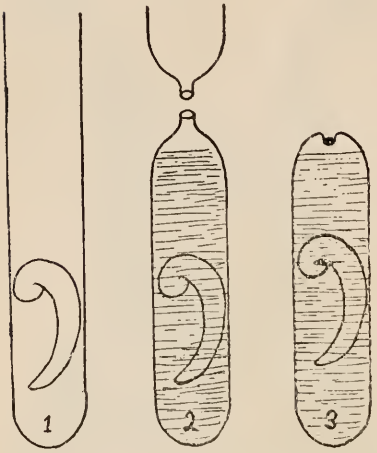
(2) Preparing Objects.

Preparation of Plague Vaccine. * — Prof. A. Lustig and Prof. G. Galeotti have extracted from plague bacilli a poisonous nucleo-proteid, which is capable of conferring immunity even in small doses, by the following method :—"We cultivate the plague bacilli in large glass dishes containing a stratum of common agar-agar. After some days' development we scrape with a bone spatula the colonies which have formed, and dissolve the mass in a 1 per cent. solution of caustic potash. We then add a very dilute solution of either hydrochloric or acetic acid until a slight acid reaction is introduced, and we collect in a filter the precipitate formed. After careful washing, the precipitate itself is dried *in vacuo*, and in the presence of sulphuric acid, or else immediately redissolved in a 0·5 per cent. solution of carbonate of soda. The dried substance, which has lost none of its chemical and biological properties, is easily redissolved in a solution of carbonate of soda when required. The solution of this substance may also be passed through a Chamberland filter for greater guarantee of sterility. The precipitate is composed solely of a nucleo-proteid in a state of relative purity. It possesses all the general reactions of nucleo-proteids, is soluble in alkalies, insoluble in dilute acids, gives on digestion an insoluble product and a peptone, and on dissociation by sulphuric acid gives nucleinic bases. It is extremely toxic for several animals, and is able to produce the intravascular coagulation of the blood."

* Brit. Med. Journ., 1900, i. p. 311.

Permanent Preparations in Hermetically Sealed Tubes.*—Mr. H. F. Nachtrier describes a method for keeping animals and botanical specimens in tubes hermetically sealed. Glass tubing of a size just admitting the specimen and considerably longer than the final sealed tube is to be is employed. One end is closed, the tube filled with 80–70 per cent. alcohol, and the specimen carefully introduced. Nearly all the alcohol is then poured off (fig. 64). The tube is then drawn to a point at some distance from the object and broken off at the neck (fig. 65). It is then filled by means of a tube-funnel with a long small end. When filled, the end is sealed in a Bunsen flame (fig. 66). Care is required in sealing, but the secret of success consists in making as small a neck as is practicable. Flemming's mixture of alcohol, glycerin, and water usually answers better than pure alcohol. The introduction of a slip of milky or black glass is an improvement in some cases, as it shows up the objects better.

Fig. 64. Fig. 65. Fig. 66.



Permanent Preparations of Urinary Casts.†—Dr. L. N. Boston has found the following medium suitable for preserving all kinds of casts. Liquor acidi arseniosi (U.S.P.), one fluid ounce; salicylic acid, half a grain; glycerin, two fluid drachms. Warm slightly until the ingredients are dissolved, then add acacia (whole tears) and warm again until the solution is saturated. After subsidence decant the clear supernatant fluid. A drop of formalin may be added to this mixture if desired.

The casts are obtained from urine by sedimentation, the supernatant fluid being decanted off. A drop of the deposit is pipetted on to a slide, and if casts be present, the fluid is evaporated nearly to dryness. A drop of the medium is then placed in the centre of the urine-patch and the two mixed by carefully stirring them together with a needle. A cover-glass is then put on. The slightest pressure or the application of heat is usually destructive of casts. The slide is now put in a cool place for a few hours in order that hardening may be complete, and the preparation ringed round with zinc-white.

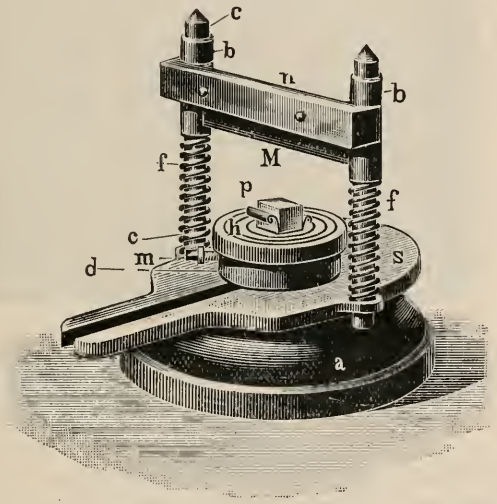
(3) Cutting, including Imbedding and Microtomes.

Schaffer's Paraffin-block Quick Cutter.‡—Prof. Jos. Schaffer's apparatus, which he has now used for three-and-a-half years, is represented in figs. 67 and 68. A circular domed iron base plate *a*, planed flat at the top, bears firmly screwed in its centre, but projecting above it by means

* Science, x. (1899) pp. 771-2 (3 figs.). † Micr. Bull., xvi. (1899) p. 34.
‡ Zeit. f. wiss. Mikr., xvi. (1900) pp. 417–21 (2 figs.).

of a neck (fig. 68, *o*), a metal disc *d*, which is hollowed out (fig. 68, *t*) for the reception of the imbedding plate (fig. 67, *h*). This plate consists of a hard wood disc with shallow brass dowel, which fits pretty accurately in the hollow of *d* (fig. 68, *t*), and can be firmly fastened thereon by the screw *m*. On the imbedding plate the paraffin-block (fig. 67, *p*), which has already received a parallelopipedal form from the adjustable imbedding frame, is erected with plane faces and firmly melted on. In the iron base plate two steel pins (fig. 68, *o'* and *o''*), equidistant from the circumference and in two radii at right angles to one another, are inserted, their height exactly corresponding to the thickness of the neck bearing the disc *d*. A conspicuous part of the apparatus is the guillotine over the imbedding plate, worked by a vertical up-and-down push motion. The hard brass plate *s*, by means of a long slit, grips the neck of the disc *d* clamp-fashion, as well as one of the steel pins (*o'* or *o''*).

Fig. 67.



As the perpendicular distance between the flat top of the dome and the underside of the neck *o* exactly corresponds to the thickness of the plate *s*, the latter can be worked to and fro as if in a slide-groove. This movement is confined to the range between one of the steel pivots, *o'* or *o''*, and the central neck *o*. If the plate with the slit is drawn out, it can then be lifted over the pivot and rotated round *o*, and placed over the other pivot. This rotation is exactly 90°.

The plate *s* carries, on two lateral projections, two vertical steel columns *c*, whose bases are screwed into the plate. These columns support a crossbar *n*, the knife-carrier, by means of two collars so accurately fitted that they only allow a clean vertical push of the knife-carrier. The knife (fig. 67, M) is fastened on one face of the crossbar, and moves with it. The down motion is by finger pressure; the up by the resilience of the two spiral springs *f*.

When one face of the block has been cut, the knife-carrier is lifted

off the columns, turned through 180°, and replaced; the second face is then cut, and is parallel to the first. Then the plate *s* is rotated through 90°, and the other two faces are similarly cut.

When the paraffin-block has been so "defined," the imbedding plate

Fig. 68.

with the block is removed and placed in the clamp of the microtome. The apparatus is made by A. Fromme, Hainburgerstrasse 21, Vienna iii.

(4) Staining and Injecting.

Staining Malaria Blood.*—Prof. A. Celli stains malaria blood by first fixing the films 15–20 minutes in absolute alcohol. The films are made by allowing the blood to spread itself out between two cover-glasses. The staining is done by the Tiemann-Remanowsky method:—(*a*) A saturated aqueous solution of medicinal methylen-blue at 25°–30° for three days; (*b*) an aqueous 1 per cent. solution of eosin, A, G. or B (Lucius). One to 3 parts of (*a*) are mixed with 3–5 parts (*b*). The time required for staining the films is 20–30 minutes. The red corpuscle is stained pink, the hæmosporidium blue, and its chromatic substance purple.

Method for Staining the Nuclei of Endoglobular Parasites of Birds.†—M. A. Laveran uses a solution of methylen-blue prepared by Dr. Borrel in the following way. A solution of silver nitrate is treated with soda solution, and the precipitated silver oxide carefully washed. To the silver oxide is added a saturated solution of methylen-blue, and

* Brit. Med. Journ., 1900, i. p. 304. † C.R. Soc. Biol, vi. (1899) pp. 249–52.

the mixture having been well shaken is left for several days before it is decanted. This blue is termed Borrel's blue.

Films of bird's blood infected with Laverania are fixed in absolute alcohol for one hour, and then immersed in the following freshly prepared staining solution:—Borrel's blue, 1 ccm. in a 1 per mil. aqueous solution; soluble eosin, 5 ccm.; distilled water, 4 ccm. The blue and eosin solutions are filtered at the time of mixture and not afterwards.

After 12–24 hours, the cover-glasses are washed in distilled water, and then immersed for one or two minutes in a 1 per cent. aqueous solution of tannin. The slip is then washed, dried, and mounted in balsam.

The nuclei of the Hæmatozoa are stained violet, the rest of the protoplasm is uncoloured or faintly blue; the red corpuscles are pink and their nuclei violet.

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

New and more Permanent Method of Mounting Amyloid Sections Stained with Iodine.*—Dr. A. B. Green recommends the following procedure for mounting amyloid sections. Three solutions are required:—(1) Weigert's iodine; (2) liquid paraffin (30 ccm.) and iodine crystals (1 grm.); (3) xylol (30 ccm.), iodine crystals (1 grm). First place on a cover-slip white vaselin to be ready for mounting. Float the section on to a slide, and remove as much water as possible. Drop on some of solution (1) until the section is sufficiently stained. Drain off excess, and pour over some of solution (2). Drain away excess, and pour on solution (3). Drain away excess, blot quickly, and put on vaselined cover-slip at once.

(6) Miscellaneous.

Methods for Distinguishing between Bacillus Tuberculosis and Bacillus Smegmæ.†—Mr. W. C. C. Pakes points out that *Bacillus smegmæ* may be easily mistaken for *Bacillus tuberculosis*, and that it has been found in sputum, wine, and milk. It differs from the tubercle bacillus in not being pathogenic to guinea-pigs, in its cultural reactions, and its inability to resist the decolorising action of absolute alcohol after having been stained with warm phenol-fuchsin. The following modified Ziehl-Neelson method is advised:—The film, which should not be too thin, is dried in the air, and then passed thrice through the flame. The preparation is stained with hot phenol fuchsin (60°) for five minutes, and then washed with water. Every visible trace of stain is removed in absolute alcohol, and, after having been washed in water, the preparation is immersed in 25 per cent. H_2SO_4 for five or six seconds, and then washed in water again. Having been contrast-stained for about three seconds in phenol-methylen-blue, the preparation is washed, dried, and mounted.

If there be any doubt, Hansell's method may now be adopted. The film is prepared and stained as before, but after washing in water, it is dried and then immersed in acid-alcohol (absolute alcohol 97 per cent., HCl 3 per cent.) for ten minutes, after which it is washed in water. The preparation is contrast-stained for several seconds in equal parts of a saturated alcoholic solution of methylen and water, washed, dried, and mounted.

* Lancet, 1899, i. p. 581. † Brit. Med. Journ., 1900, i. p. 186.

New Method for Detection of Bacillus Coli Communis and Bacillus Typhi Abdominalis in Water.*—Mr. W. C. C. Pakes describes a method for detecting *B. coli* and *B. typhosus* in water, which has the advantage of being more delicate than those usually employed. The medium is glucose formate broth, which is composed of ordinary meat infusion, 1 per cent. pepton, 0·5 per cent. NaCl, 2 per cent. glucose, and 0·4 per cent. sodium formate. After solution of the ingredients, the medium is neutralised, and then 2 ccm. of $\frac{N}{1}$ NaHO added. The broth is then boiled in the steam steriliser for 20 minutes, filtered, poured into test-tubes, and sterilised for 20 minutes on the day it is made and the two succeeding days. After inoculation, the tubes are placed in Buchner's tubes with alkaline pyrogallol (anaerobic cultivation) and incubated at 42° for from 18–24 hours. An examination is then made, and those tubes which show signs of growth are removed. Incubation of the remainder is continued, and examinations made at the end of 48 and 72 hours, when, if there be no signs of the growth, the tubes are rejected. Ordinary gelatin and agar-plates are then made.

Fig. 69.

In testing a sample of water for *B. coli*, large and small quantities must be examined, and the water is concentrated by passing it through a special filter, an illustration of which is appended (fig. 69). After all the water has run through, 10 ccm. of sterilised water or bouillon are poured into the bougie, and the bacteria brushed into the fluid. The emulsion represents a concentration of 200 times; and 0·1 ccm. will represent 20 cm., and so on. A series of glucose formate broth tubes is then inoculated with variable quantities both of the original water and of the emulsion.

Testing for Ergot in Flour.†—Fr. Musset demonstrates the presence of ergot in flour by using 70 ccm. of a mixture of chloroform and alcohol (about 10–1), the specific gravity of which, at the time of examination, is to be brought up to 1·435 by the addition of absolute alcohol. In this mixture 5 grm. of the suspected flour are shaken up, and after having been allowed to settle, some of the floating scum is removed to a cover-glass and allowed to dry. A little xylol is then added, and the preparation examined microscopically.

Bibliography.

Carazzi, D.—**Manuale di tecnica microscopica.** xii. and 311 pp. Milano, 1899.

Duclaux, E.—**Traité de Microbiologie.** T. i. Microbiologie générale, 3 and 632 pp. T. ii. Diastases, Toxines et Venins, 3 and 768 pp. Paris, 1899.

Migula, W.—**System der Bacterien: Handbuch der Morphologie, Entwicklungsgeschichte und Systematik der Bacterien.** Bd. i., 1897; Bd. ii., 1900. Jena.

Lehmann, K. B., und R. Neumann.—**Atlas und Grundriss der Bacteriologie und Lehrbuch der speciellen bacteriologischen Diagnostik.** 2. Auflage. München, 1899.

* Brit. Med. Journ., 1900, i. pp. 188-9 (1 fig.).

† Ph. Centr. Halle, 1899, p. 617. See Zeitschr. Angew. Mikr., v. (1899) pp. 230–1.

NOTES.

The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

I.—HUGH POWELL'S MICROSCOPES.

Hugh Powell, born in 1799, was, like Andrew Ross, a philosophical instrument maker. He resided at 24 Clarendon Street, Somers Town, and probably worked for the trade, but the first notice we have of him is in connection with the first of three Microscopes made by him for Cornelius Varley.* These Microscopes are figured and described in the *Transactions* of the Society of Arts, the account of the first being in vol. xlviii. p. 332, pl. 4 (1831).

Figs. 70, 71 show that this is a non-achromatic simple Microscope; five lenses are mounted in a calotte rotating wheel, the coarse adjustment is by moving the stage up and down the pillar, and by clamping it with a pinching screw. The rod carrying the lenses, which slides into the top of the pillar, is moved by a fine adjustment screw, the milled head of which is seen at the bottom of the pillar.

The plan of this fine adjustment is very important, because it is the first instance we have of a sprung fine adjustment movement; a nut is placed on the screw at a short distance from its entry into the lower end of the rod which carries the lenses (fig. 72), and by it a spring is compressed (fig. 72); another spring is also placed at the lower end of the screw to keep the milled head in close contact with its seat (fig. 73). By these means all slack between the movable rod and the screw is taken up, thus ensuring that a movement of the rod will immediately follow that of the screw, and this quite independently of the direction in which it is turned; in other words, loss of time when the motion of the screw is reversed is wholly prevented. We shall see that this device was copied in Valentine's Microscope, made by Andrew Ross. The stage has a lever mechanical movement; this, after having been twice modified by Varley, was further altered by White in 1843, and in that form was used by several makers for about thirty years. Below the stage there was a cylinder diaphragm (fig. 74). This is the first time we meet with a true cylinder diaphragm; the appliance which most nearly approaches it being the "cannon" of Joblot in 1719. The base of this Microscope is peculiar, as it has no proper foot, but instead it is fitted with a screw-clamp for

* Cornelius Varley was an artist; he was born in 1781 and died in 1873, his last picture having been painted in his ninetieth year. He was much interested in scientific matters; he ground and polished Microscope lenses, and in 1826 he ground and polished a plano-convex diamond lens for Dr. Goring. He was one of the seventeen founders of this Society who met at Edwin Quekett's house in 1839.

attachment to the edge of a table; curiously, at an exhibition some little time ago, there was a Microscope in use that had precisely this same kind of clamp.

Fig. 70.

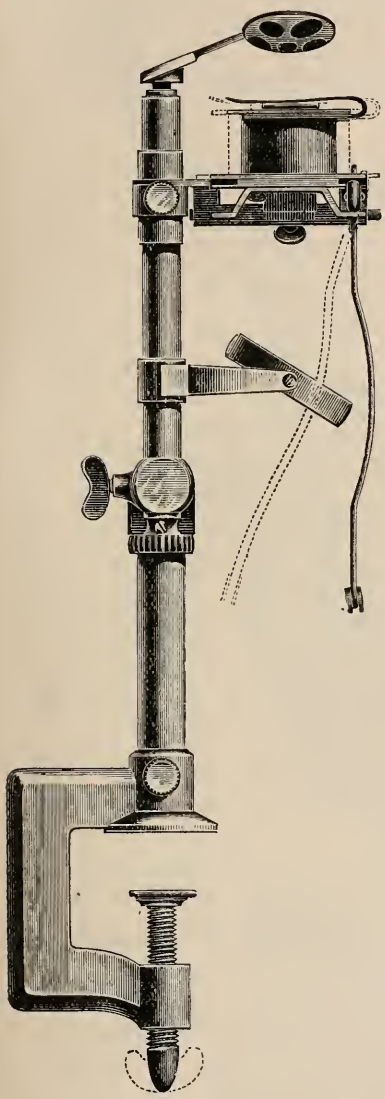
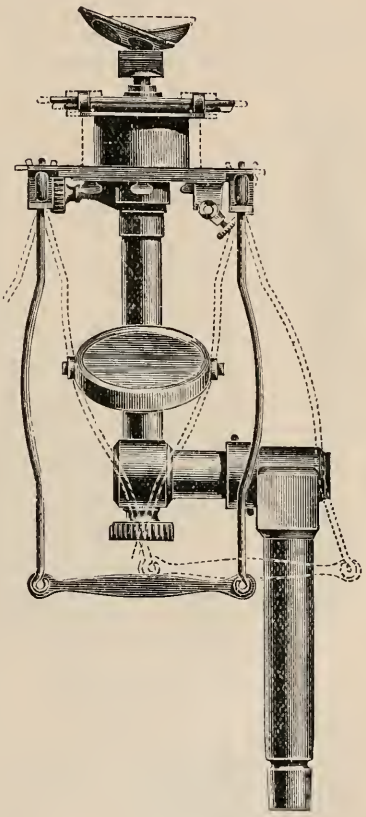


Fig. 71.



Amongst the apparatus figured with this Microscope, there is one little piece that deserves special notice, viz. the stage forceps; this is

sprung in a manner still used by Powell, not only for apparatus of this kind, but also for his jointed mirror arm. This method, shown in fig. 75, is very simple and most efficacious; the pivot, which is carried through the plate holding it, is grooved, and a flat spring with a U-shaped nick in it slips into this groove. I have an old Microscope by Powell, dated about 1840, in which the mirror, stage forceps, stage bull's-eye, &c., are all sprung in this manner; and although it is some sixty years old, its moving parts act in the smoothest way possible.

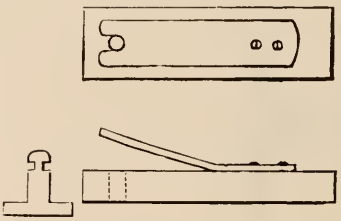
Fig. 72.

On examining the plates in the *Transactions* of the Society of Arts, published both before and after this time, we find that a number of them were drawn by C. Varley and engraved by E. Turrell. Varley lived at 1 Charles Street, Clarendon Square, Somers Town, and Edmund Turrell was, we learn, an engineer and engraver at 46 Clarendon Street. On February 14th, 1832, Turrell published in the *Transactions* of the Society of Arts,* an account of his well-known Microscope-stage, which was at first, and for a long time subsequently, made only by Powell. This is still the best ever designed, and is largely used at the present time; so we see that these two men not only lived in the same neighbourhood as Powell, but also gave their attention to Microscope construction. The question naturally arises, who was the author of all this springing in the Microscope? It is impossible to say what influence Turrell had in the matter, because he probably died shortly after his invention of the mechanical stage, as his name disappears from the plates in the Society of Arts' *Transactions*, and in 1838 we learn that he was dead. Varley certainly was the first microscopist to appreciate and record the great value of springing every movement in a Microscope; he was himself a good mechanic, and had just previously designed a special lathe

Fig. 73.

Fig. 74.

Fig. 75.

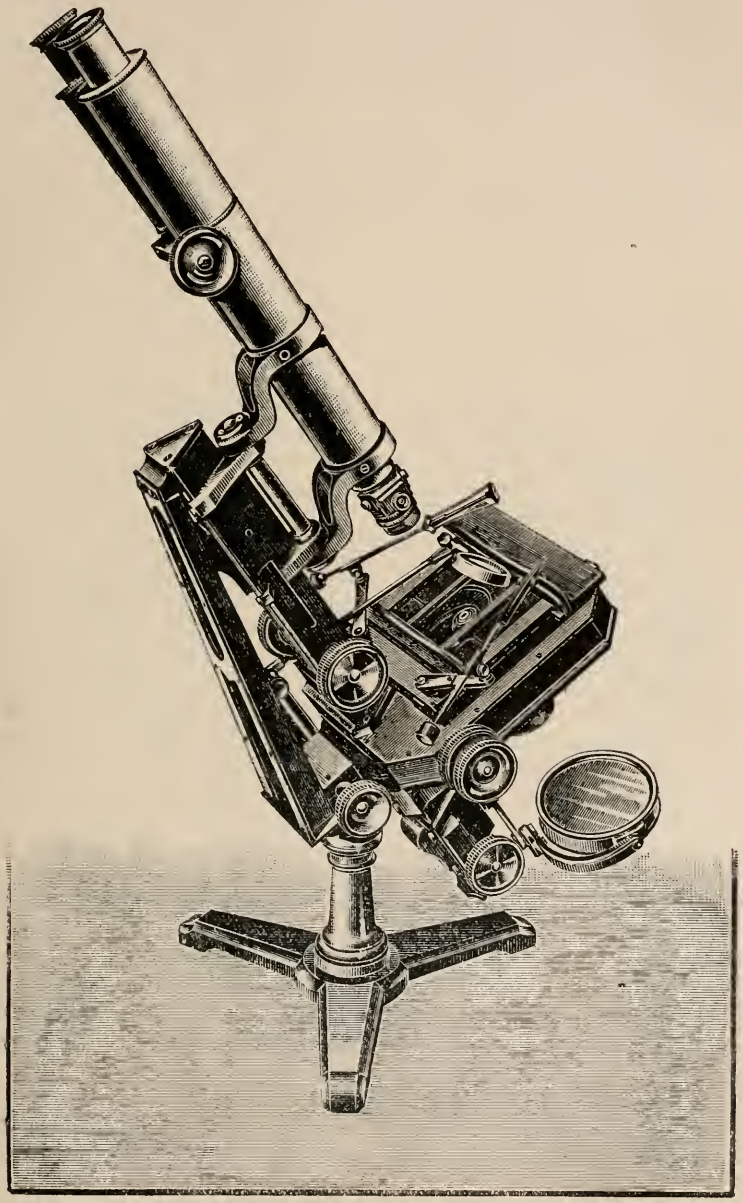


for lens work; moreover he must have acquired a large experience of mechanical appliances from the great number of plates he had drawn

* Vol. xlix. p. 113, pl. 4 (1833).

of all sorts of machines, so that it is probable that, in designing the general plan of his Microscopes, he had indicated details with regard to the springing of the various movements ; but a careful perusal of

Fig. 76.



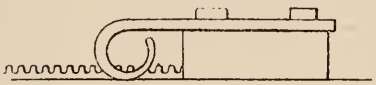
the descriptions of these Microscopes will show that Powell's share in this matter was far from inconsiderable.

Next we have, in the *Transactions* of the Society of Arts, the first description of Powell's work issued under his own name, viz. his stage fine adjustment.* Here there is a Turrell stage raised by wedges, which are advanced beneath it by means of a micrometer screw.

The head of the screw is divided into twenty divisions, and the value of each division is one six-thousandth of an inch. The Microscope made by Powell for this Society in 1841 has a stage of this kind (fig. 76).

The next in order is Varley's second Microscope, which he calls a "Vial Microscope."† This Microscope, simple and non-achromatic, was a modification of his previous model; both the calotte lens-holder and the fine adjustment were suppressed, and a rackwork coarse adjustment with a square bar having 40 teeth to the inch and a sprung pinion was supplied; this is the first instance we have of a sprung pinion, and a better plan of mounting a pinion has not yet been devised; but although it was subsequently adopted by the principal makers, all, with the exception of Powell, have at the present time discarded it (fig. 77). (A sprung pinion can also be very well seen in fig. 80.)

Fig. 77.



There was a special kind of stage for holding a cylindrical bottle or phial, through the side of which algæ or other objects were examined; for viewing slides or similar objects, the phial was removed, and a stage with lever mechanical motion fitted into its place. The screw-clamp foot was replaced by a circular ring and post, not unlike a modern Microscope lamp support. In this Microscope we first have the mirror-arm joints sprung in the manner indicated above (fig. 75). These Microscopes became popular, and in a modified form were made by Powell for Andrew Pritchard, who published an account of them in the second edition of his *Microscopic Illustrations* (1838).

Now we come to the year 1841, which is an important date in Microscope construction, because about this time the recently constituted Microscopical Society of London "requested Messrs. Hugh Powell, Andrew Ross, and James Smith ‡ each to furnish a standard instrument, made according to their own peculiar views." Powell's Microscope was delivered on December 22nd of that year, and although an account with a figure of it was promised, it has, so far as I am aware, never been published. The Microscope (fig. 76) is still in our cabinet, and, with the exception of the addition of a binocular body in

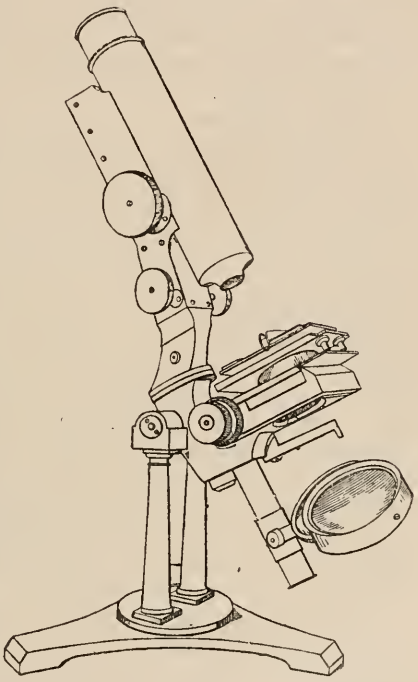
* Vol. I. part 2, p. 108, plate 3 being in vol. xlix. (1833).

† Trans. Soc. Arts, I. p. 158, pls. 5 and 6 (1834).

‡ The order was given to Smith on August 19th, 1840, and to Powell and Ross on May 26th, 1841.

1862, is in its original condition. The mounting of the body upon a carriage which traverses an upright triangular post is evidently derived from the Ross model of 1839. The flat tripod foot, single pillar, and compass joint, were a survival from preceding non-achromatic Microscopes. It is important to note that this instrument has an achromatic condenser, and is therefore a very early example of one so fitted; because the achromatic condenser was, as we learn from the *Penny Cyclopædia*, introduced into this country from France in 1839. The stage, which has Turrell's mechanical movements, is raised by means of a 50-thread screw pushing under it three inclined planes, placed at the periphery of a rotating plate (slope 1 in 6); the speed is therefore 1/300 in. for each revolution. All the motions throughout the entire Microscope are thoroughly sprung.

Fig. 78.



At this time Powell took into partnership his brother-in-law, Mr. P. H. Lealand; and under their joint names a Microscope (fig. 78), upon an entirely different plan, was brought out; it is figured in the frontispiece of Cooper's *Microscopic Journal* for 1841, and described at page 177, but the working parts are better shown in the plate in the *Transactions* of the Society of Arts.* In the general design of this Microscope, both as regards the mounting of the body on the grooved limb and the double pillar support, the influence of Mr. George Jackson will be at once recognised, and this is the first instrument, so far as is known, in which these two ideas of his were carried out. It should be remembered in this connection that Jackson introduced three things in Microscope construction: first, the grooving of the Lister limb; secondly, the double pillar †; and thirdly, the ploughing of the body and substage slides in one cut. It is interesting to note

* Vol. liii. p. 78 (April 1841).

† According to Quekett, the double pillar was introduced by George Jackson in 1838, but I have been unable to find any example or notice of it prior to this Microscope of Powell's in 1841.

that this Microscope had the weight of the body and the coarse adjustment placed upon its fine adjustment, which was actuated by a cone on a micrometer screw. (The advancing cone, for stage focussing, was first described by Andrew Pritchard in his *Micrographia.**

The limb of this Microscope could be rotated at the flanges, seen just above the level of the stage; this limb, with its coarse and fine adjustment, proved unsatisfactory, and quickly passed away; but the most important part of the model, viz. the trunnion on the limb, which quite displaced the compass joint, constitutes a real advance in Microscope construction, and is now almost the only method in use, both here and on the Continent. This plan, as we have seen above, was due to George Jackson; the double pillar was of course only a matter of detail. The Microscope had a Turrell's stage with non-concentric rotation.

The next Microscope made by Messrs. Powell and Lealand (fig. 79) is a very important one; it is figured and described in the November number of the *London Physiological Journal* for 1843 (only five numbers of this very rare work were published). We notice that both the Lister limb with the Jackson groove and the flat tripod with the two pillars have been discarded, and in their place we have a bar movement and a true tripod to carry the Microscope. Inside the bar or transverse arm is a lever of the first order, which moves only the nose-piece carrying the objective, the other end of the lever being actuated by an advancing cone on the end of a micrometer screw; the stage is similar to that of the preceding Microscope, viz. a Turrell's with non-concentric rotation. The instrument is still supported on trunnions, so the advantage of Jackson's plan is retained, although his form of foot is altered. There can be no doubt that Microscopes built on the bar movement model had far superior fine adjustments to those made with a Lister limb, which at that time, and for forty years afterwards, were fitted only with short lever fine adjustments attached to the end of their body-tubes.

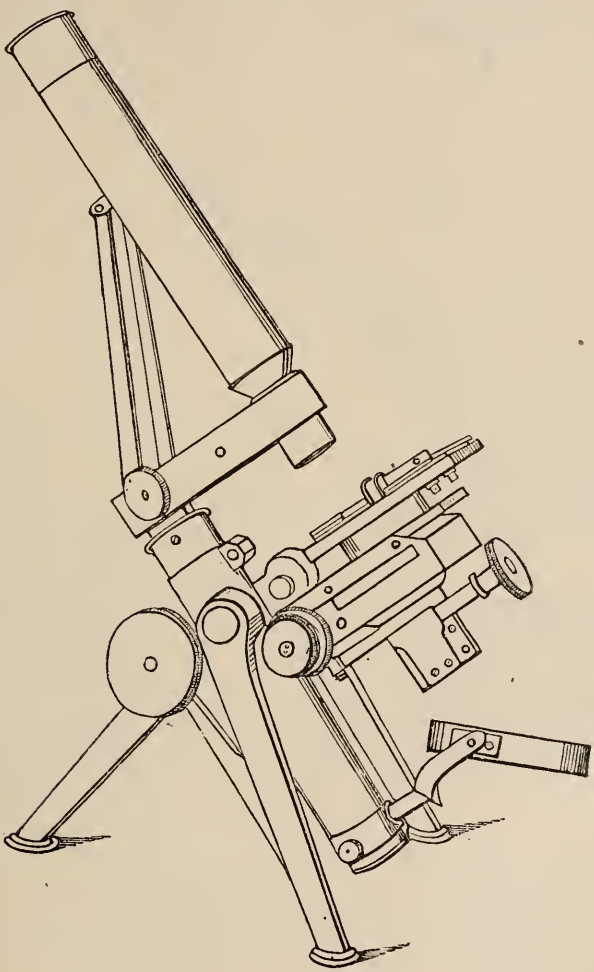
As the publication of this Microscope pre-dated that of Andrew Ross by one month, it follows that the credit of the invention must be given to Powell. In the article "Microscope" in the *Penny Cyclopædia*, 1839, Andrew Ross utterly condemns the bar movement; nevertheless in 1843 he adopted it, and it was exclusively used by that firm for about thirty years.

In 1847 Messrs. Powell and Lealand greatly improved this fine adjustment by suppressing the advancing cone, and by placing a direct acting micrometer screw in a vertical position on the top of the bar, immediately behind its pivot (fig. 80); and from that day to the present time the fine adjustments made by this firm have remained unchanged. This plan of fine adjustment is first figured and described in connection with a portable Microscope in the first edition of Quekett, p. 80, fig. 45 (1848). Quekett, in his second edition (1852), p. 77,

* Page 217, fig. 23, 1837.

falls into an error in stating that the Microscope he represents in plate 2, which is similar to fig. 80 above, is described in the *London Physiological Journal* (1843). He has failed to note the alteration in the fine adjustment.

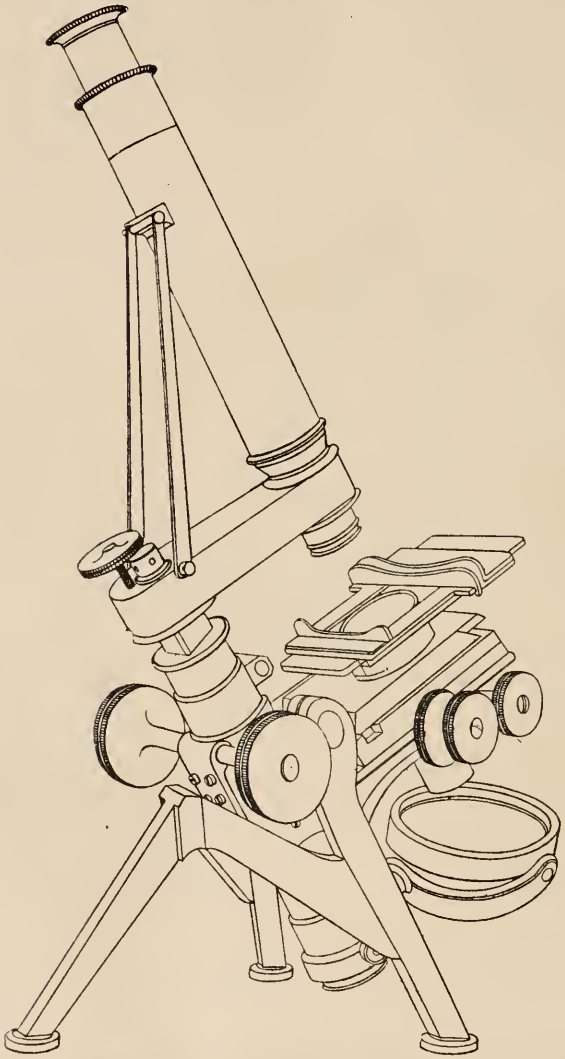
Fig. 79.



We are, however, slightly anticipating the next Microscope Powell made for C. Varley, which is figured and described in the December number of the *London Physiological Journal* for 1843. It will be unnecessary to fully describe this instrument; I may merely state that it had a lever motion to its stage, a rackwork coarse adjustment

with a sprung pinion, and a short lever nose-piece fine adjustment. It is here mentioned particularly on account of the peculiar manner in

Fig. 80.



which it is attached to its pillar, and also for the shape of its flat tripod foot. The limb of this Microscope, instead of being supported by a compass joint at the top of a single pillar, was attached to the

side of the pillar by means of a stout conical * pin, which passed through both the pillar and the limb, and which was capable of being tightened up by a screw. The flat tripod foot was known as the bird's-claw. This excellent form of mount, which from its construction leaves plenty of room on the right-hand side of the Microscope for the manipulation of the substage and the mirror, was afterwards adopted by Powell for his iron Microscope, which I described in the *Journal* for 1899, p. 209, and from which figs. 81 and 82 are reproduced.

Fig. 81.

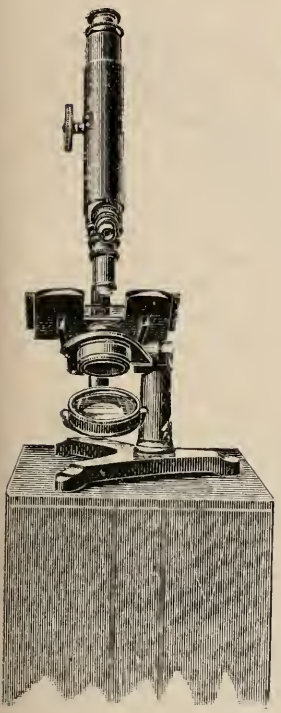
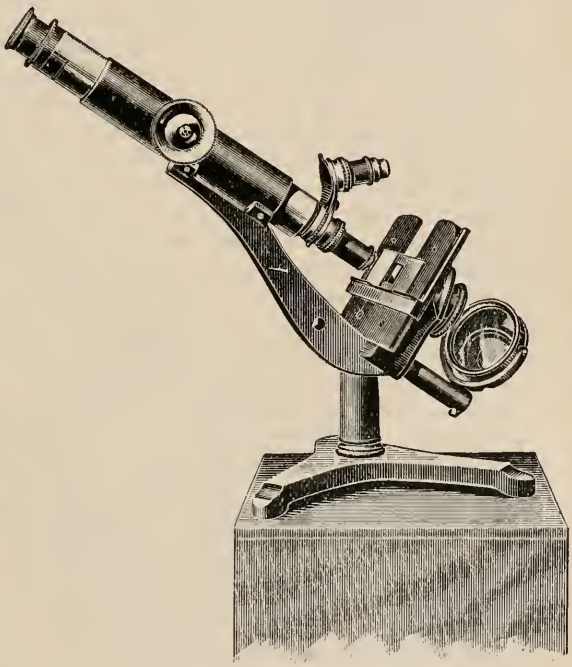


Fig. 82.



The next Microscope made by Messrs. Powell and Lealand is not, I believe, figured or described anywhere; neither can we now assign a precise date for its introduction. I have asked Mr. Thomas Powell about it, and he tells me that his own instrument is dated 1855, and that, as it was only worked at in odd times, it took a long time to make. It is not improbable therefore that this model was brought out after the Exhibition of 1851. It will be unnecessary to illustrate this

* This and similar important details of Microscope construction mentioned in these papers are not mere copies from books, but have been learnt by the examination of existing Microscopes.

instrument, as it is very similar to the No. 1 stand as at present made (see fig. 84). The differences between them are as follows:—the tripod foot is smaller, but similar in every other respect; the stage has non-concentric rotation; in the substage the pinion for rotary motion is placed in a vertical instead of a horizontal position as at present, and the substage apparatus screws into the substage. The back-stay fitted to the bodies of the previous models is omitted. This was the first Microscope made by this firm that had a complete substage; in this point it was probably a copy of the Microscope Andrew Ross prepared for the Exhibition of 1851, at which Messrs. Powell and Lealand were not exhibitors.

The next Microscope was brought out in 1861, and was figured and described by Mr. Lobb in the *Quarterly Journal of Microscopical Science*.* The instrument (fig. 83) is about the same size and is very similar to the present model, the principal difference being in the arrangement of the concentric rotation of the stage. A large and massive ring is firmly attached to the limb of the Microscope; inside this ring there is a second ring capable of being rotated by rack-and-pinion; to this second ring is attached a short and stout limb carrying both the stage and substage. When therefore the stage is rotated, the substage rotates with it. This stage, like that of all Powell's Microscopes, had Turrell's rectangular mechanical movements, and the substage had rectangular and an independent rotary movement as well. The pinions for rotating both the stages, as well as for the independent rotation of the substage, are placed in a vertical position; but in an example I have seen, dated 1866, they are placed horizontally. The Turrell stage of this Microscope was made much thinner than those of the previous models; this permitted a very oblique beam of illumination to be thrown upon the object from below the stage—a point which in those days was thought to be of much importance. This Microscope is fitted with a Wenham binocular, in such a manner that the binocular tubes can be removed and a monocular tube substituted for them; this method of mounting the binocular body is still retained in the No. 1 Microscope as at present made. Wenham described this excellent form of binocular in the *Transactions* of the Microscopical Society†; and as this Microscope was finished about May 1861, it follows that it must have been one of the first Microscopes to be fitted with a Wenham binocular. Powell was the first to adapt rackwork to the tubes to adjust the instrument for different widths between the eyes. In my opinion, the Wenham binocular is the best and most generally useful binocular that has as yet been invented.

The next and last Microscope is the present No. 1, which was brought out in 1869, and which, strange to say, has never been figured or described in our *Journal*. It will be seen from fig. 84 that it does

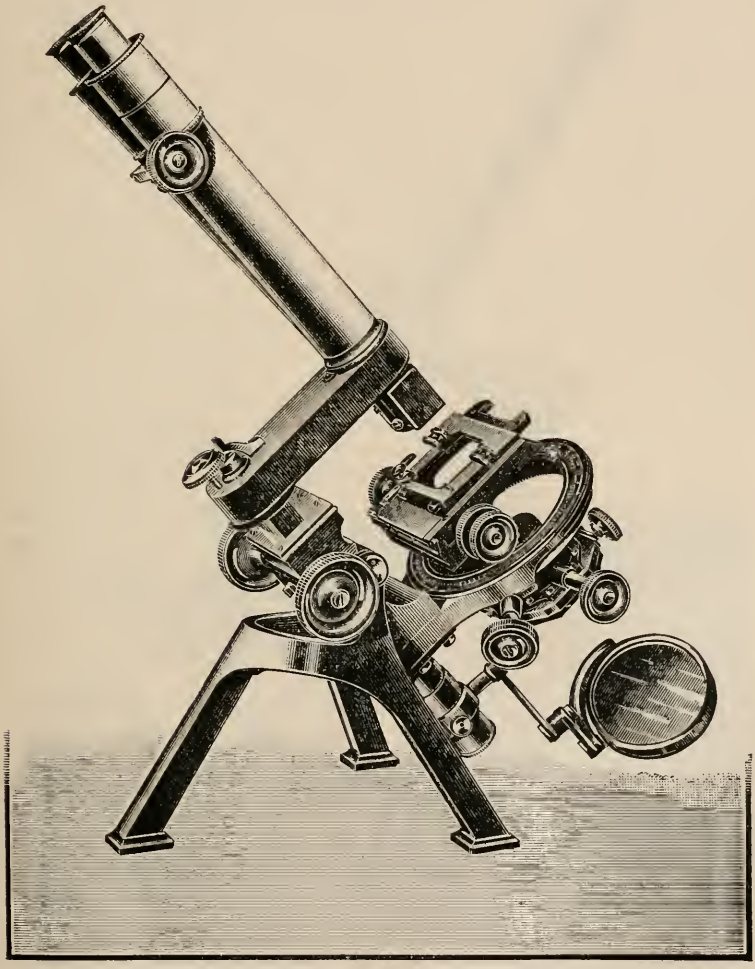
* Vol. i. n.s. (1861) p. 175.

† Vol. ix. p. 15 (1861), paper read December 12th, 1860.

not differ greatly from the preceding model; the ring was made thinner, and the rotating stage mounted in the same plane as the ring; as the substage is entirely detached from the stage, it does not rotate with it. The difference between Powell's concentric rotating stages and those of Ross, is that Powell's are capable of complete rotation through the entire circle, while those of Ross can only be rotated through about 3/4 of the circle, as the limb fouls the heads of the pinions of the rectangular movements of the stage.

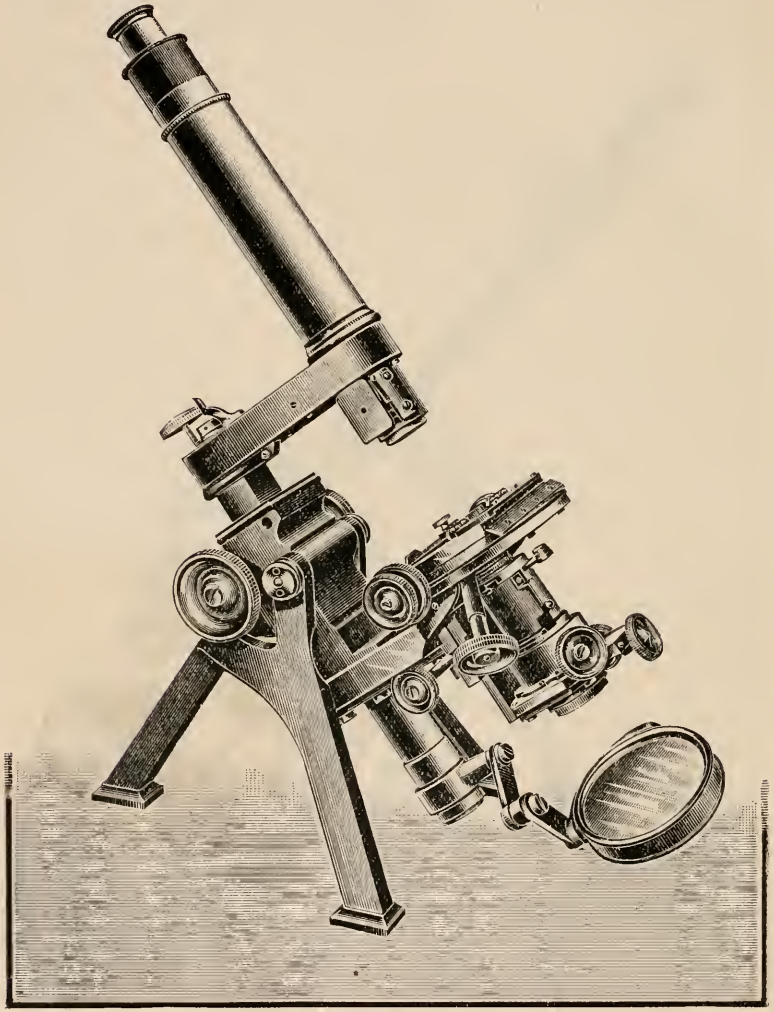
This rotary stage is beautifully finished; it is a conical movement

Fig. 83.



which bears upon six steel points let into the fixed brass ring. The pinion for the rotation of the stage cannot, as in some other Microscopes, be thrown in and out of gear, but the movement is so perfectly adjusted that the stage can be rotated easily and smoothly without handling the pinion. The only alterations that have been made in this stand were at the author's suggestion, viz. 1st, a fine adjustment was added to the substage in 1882, this being the first Microscope to be

Fig. 84.



so fitted; 2nd, rackwork to the draw-tube in 1887; and 3rd, diagonal rackwork was fitted to the coarse adjustments in 1897. The figure is taken from the instrument recently presented to this Society by the late Dr. Whittle.

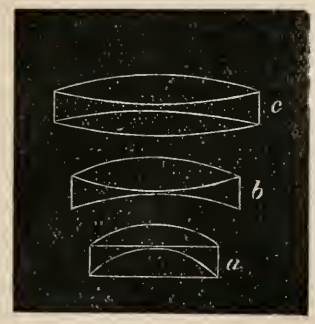
OBJECT-GLASSES.

With regard to Powell's early object-glasses nothing has been published; and as most of them have been put together so that they cannot be unscrewed, I have only been able to examine a few. The following is a list of some glasses in my cabinet, with their apertures and optical indices, and with a record of such observations as I have been able to make.

Date.	Focus.	N.A.	O.I.	Remarks.
1838	2	·10	20	A fine lens.
„	1	·25	25	Very good lens.
„	1/2	·225	11·2	Well corrected.
„	1/4	·34	9	Well corrected.
„	1/8	·5	6	Double fronts. Three graduated diaphragms at the back.
1840	1/16	·6	3·5	
	1/2	·34	15·6	
1848	1/4	·5	10·5	Triple front and back, double middle, marked covered and uncovered (fig. 85).
Ante 1857	1/4	·7	14	Single front, double middle, triple back, collar graduated.
„	1/12	·93	6·6	Triple front and back, double middle, collar graduated (fig. 85).

In 1846 we find a 1/4 with a triple front and double middle and back.

Fig. 85.



With regard to the single front for medium powers, such as the 1/4 of 0·7 N.A., Powell did not seem to find it satisfactory, because he afterwards went back to the triple front and back and double middle (fig. 85).

Powell was the pioneer of very high powers; as early as 1840 he made a 1/16, in 1860 a 1/25, and in 1864 a 1/50. In 1857 he claims an aperture as great as 175° for his 1/16, in which year our President, Mr. Shadbolt, says "its performance is deserving of the highest praise." In the Paris Exhibition of 1855 a water-immersion lens by Prof. Amici was exhibited, and in the London Exhibition of 1862 water-immersion lenses were exhibited by Messrs. Hartnack and others, those of Messrs. Hartnack being better than those of other foreign exhibitors, but his 1 mm. focus immersion was stated to be

inferior to Messrs. Powell and Lealand's dry 1/25. Now, the true principles underlying water-immersion were not understood at that time; it was thought that the only advantage to be gained in adopting it would be a reduction in the quantity of light reflected at the plane surface of the front lens, and therefore the new construction was held to be not worth further consideration. In America, however, the water-immersion was taken up by Wales and Tolles; but Mr. Stodder, writing upon the resolution of Nobert's bands in April 1868, thinks it necessary to explain the term water-immersion, which shows that there it was quite a new thing at that time.

Later in the same year Col. Woodward claims to have been the first to obtain a true resolution of the 15 band (90,078 lines to the inch), and says that the Powell and Lealand 1/25 gave the best results, though among the lenses he was using there were a No. 11 Hartnack immersion (1866) and a Wales immersion 1/10. It would seem that these immersion lenses were of 0·98 N.A., and Powell and Lealand's 1/25 was close on N.A. 1·0. The immersion objectives by Messrs. Hartnack in the Paris Exhibition of 1867 were much improved. Mr. J. Mayall, jun., writing in October 1868, prefers immersion objectives to dry.

Early in 1869 Messrs. Powell and Lealand brought out their first immersion, a 1/16, and with this Col. Woodward,* in April 1869, succeeded in resolving the 19th band (112,597 lines to the inch), a performance which all the other lenses in his possession failed to accomplish.

In July 1872 we first hear of a water-immersion 1/10 having a duplex front made by Tolles. (Mr. Wenham's proposed duplex front for a dry lens in March 1869 may have suggested the idea to Mr. Tolles.) In October 1872, Col. Woodward stated that, with Tolles' new water-immersion 1/16 (which presumably had a duplex front), he had been able to surpass all his former work, including that done with Powell's 1/16 immersion of 1869.

In December 1874, Messrs. Powell and Lealand brought out their new formula water-immersion lenses: these had duplex fronts, and were remarkably fine lenses. The next step was the introduction of homogeneous immersion by Mr. Stephenson and Prof. Abbe in April 1878; but it is necessary to point out that homogeneous-immersion lenses had been previously made by Tolles, who used soft balsam instead of oil of cedar as the immersion fluid. In April 1879 Messrs. Powell and Lealand exhibited their first oil-immersion, an 1/8; and having now brought the history both of the Microscope objective and of Mr. Powell's connection with it to comparatively recent times, we must stop.

Powell was famous for his achromatic condensers; and for many

* Col. Woodward's claims were disputed at the time, but anyone carefully reading his masterly articles and the letters of his disputants can only come to the conclusion that the colonel's claims were just.

years he alone made condensers suitable for the highest kinds of critical work. The following short account contains the history of the achromatic condenser. In 1838 an achromatic objective was used as a condenser by Dujardin; in 1839 this plan was adopted by Andrew Ross. The achromatic condensers we find in 1840 are merely the achromatic quarters of that period having an aperture not greater than 0·35 N.A.; these had no stops or diaphragms of any kind. In 1849 Gillett's condenser was introduced; its aperture was about 0·65 N.A., and it had a rotating wheel of stops. In 1854 Powell brought out a new achromatic condenser of 0·76 N.A., which, like Gillett's, was provided with a wheel of stops. In 1859 he improved it by increasing its aperture to 0·98 N.A.; but it is stated that in order to utilise its full effect, it is necessary to have the object mounted between two cover-glasses. This defect must have been subsequently remedied, as I possessed one of these condensers and found that it would work through any ordinary slip. The formula of this 1859 condenser was altered somewhere about the end of the seventies, its aplanatic aperture being increased, otherwise it remained the same. This new formula condenser may be distinguished from the older one by the plano front of its second lens, the second lens of the other having a concave front surface. This 1859 condenser remained unapproached for critical microscopical work, until the substage condenser was apochromatised by Powell in 1895. In April 1869, Messrs. Powell and Lealand brought out a side bull's-eye, which, used in conjunction with a super-stage, gave a powerful beam of very oblique illumination. It is probable that it was with this instrument that the so-called "striæ" on *Amphipleura pellucida* were really first resolved.

About the year 1870 Powell brought out a new arrangement of prisms for obtaining non-stereoscopic binocular vision, with high powers. The utility of such appliances is doubtful, because they all more or less impair the sharpness of the image; the only thing that has ever been said in their favour is that they are less fatiguing than the monocular, but it is doubtful if they possess even this one advantage.

Hugh Powell died November 1883. An excellent portrait of him was presented to our readers as a Frontispiece to the volume of this Journal for 1899.

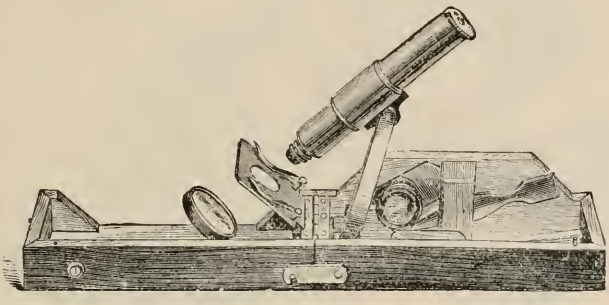
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Portable Field Microscope.—This portable Field Microscope (fig. 86), which was exhibited before the Society at its meeting on March 21st, (see p. 270) by Mr. Ernest Barker, was first made some twenty-five years ago, by Mr. Henry Anderson, who was for many years with the late Mr. Andrew Ross. This Microscope has been in Messrs. Newton's catalogue for many years, they having kindly lent us this illustration.

Fig. 86.



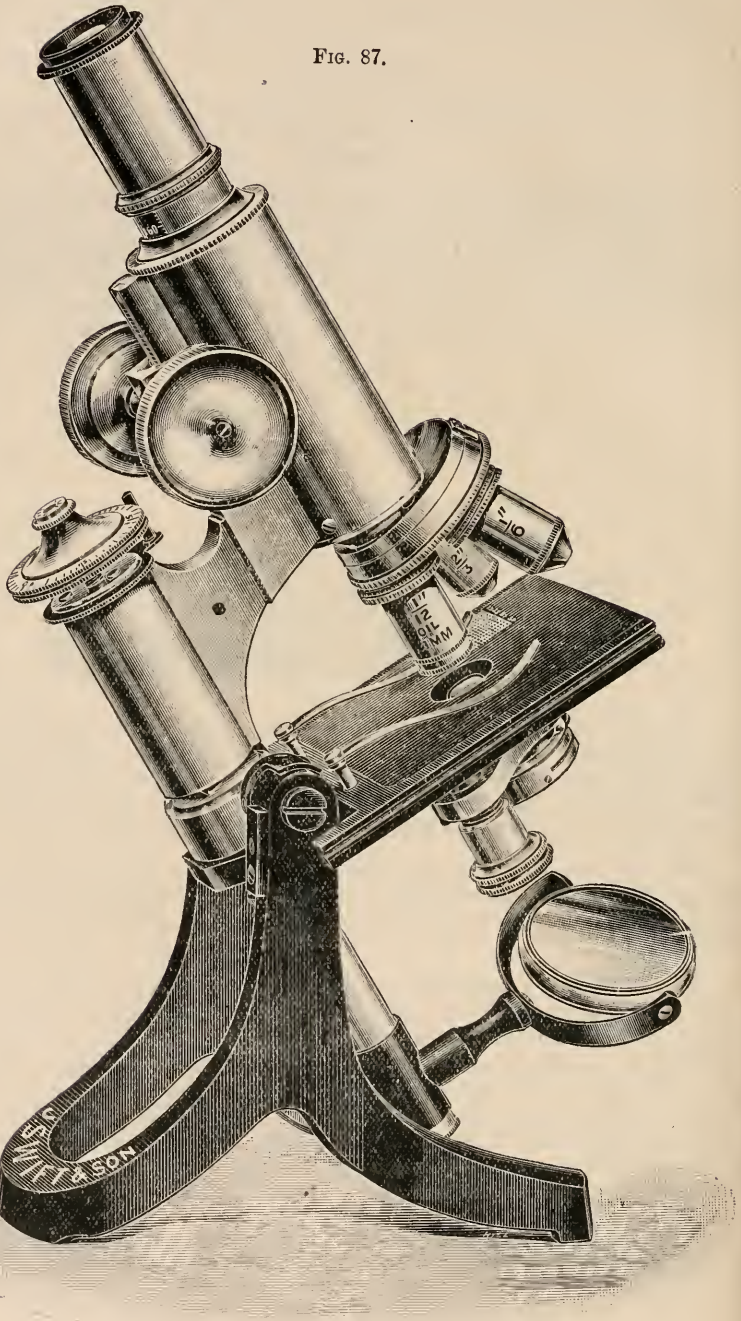
The Portable Field Microscope is specially designed and adapted for botanical and seaside work, as it can be brought into instant operation without any unpacking or screwing together. It is fitted with eye-piece, achromatic dividing object-glass, live cage, tweezers, and glass dipping-tube, and goes into a mahogany case $4\frac{1}{2}$ in. by $1\frac{3}{4}$ in. by 2 in.

Swift's New Student's Microscope.— Fig. 87 represents the new pattern Microscope exhibited by Mr. Swift at the Meeting of the Society on March 21st, fitted with the Campbell differential-screw fine adjustment (see p. 271).

Swift's New Portable Microscope.—This is seen set up in fig. 88. It will be noticed that a very low power can be used, owing to the great range of focus allowed by the rack-and-pinion and draw-tube. It is fitted with a substage condenser having an iris diaphragm and a push-tube focussing adjustment. The back leg is looped, so that when it is folded up to pack in its case, as in fig. 89, the limb with the head of the fine adjustment screw passes into this loop. This forms not only an efficient portable sea- or pond-side Microscope, but also one well adapted for bed-side diagnosis. (See p. 406.)

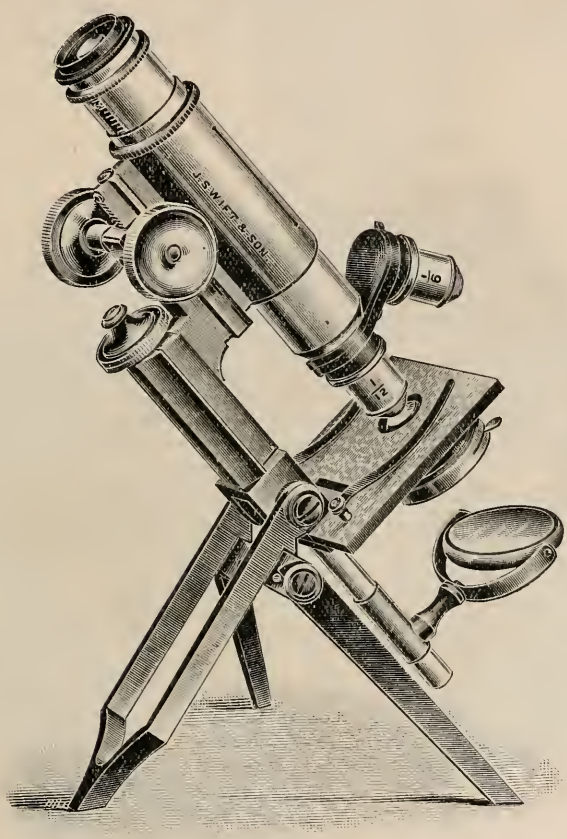
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Fig. 87.



Zeiss' Photomicrographic Stand. — In reference to Berger's New Microscope, already described in this Journal,* fig. 90 shows the way in which the "planar" projection lenses are adapted to this stand, and the manner of placing it on the bed of the projection apparatus.

Fig. 88.



(2) Eye-pieces and Objectives.

Spitta, E. J.—**Achromatics versus Apochromatics.**
Amer. Mon. Micr. Journ., 1899, p. 296.

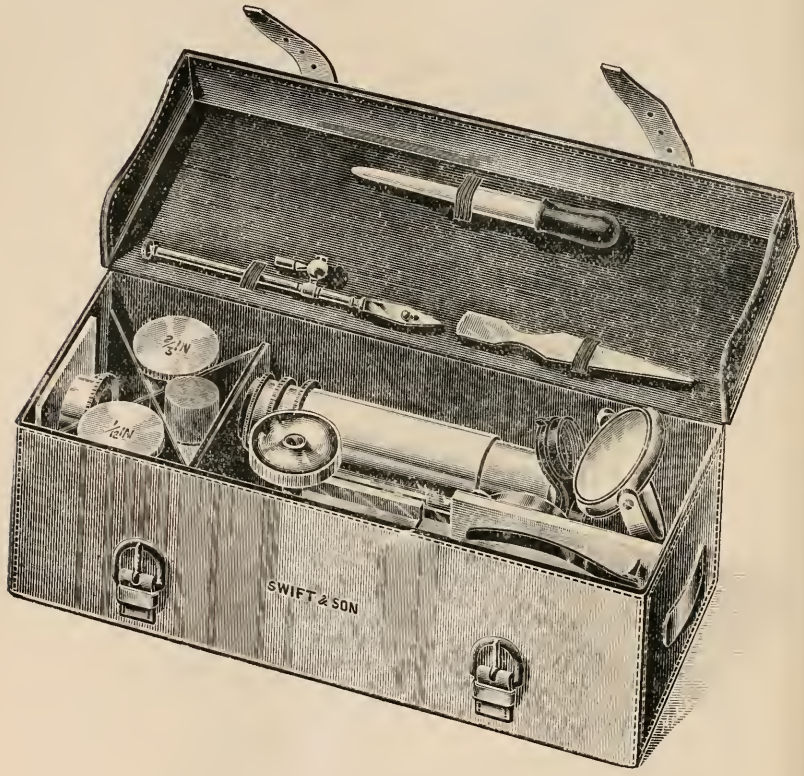
(3) Illuminating and other Apparatus.

Zeiss' Projection Arc-Lamp. — This is shown in Fig. 91, which gives elevation and plan. The carbons are always inclined at about 40° to the vertical, although by loosening the screw K they can be brought

* 1898, p. 583, fig. 98.

into the vertical if desired for spectrum observations. In this latter case, the iron cover, fastened with two milled heads, and carrying the chimney-like protuberance, has to be placed in such a way that the broad opening behind the lamp is covered up. The advantage of setting the carbon obliquely is that the light from the more brilliantly glowing pole (the positive) is thrown out almost horizontally, whereas in a vertical setting the light is thrown downwards. On each side of the box is a door for inserting the carbons; the door contains a dark glass window.

Fig. 89.



The two large screws S t' and S t'' are for centering the light. S t'' regulates the height, and S t', which terminates each end of a horizontal axle, adjusts the light sideways. The lamps require a tension of 45 to 50 volts. The lamps are also fitted with mechanism for automatically approximating the carbons so as to keep the incandescent crater in the same spot. In one form of lamp this is done by hand movement. In the selection of a lamp regard should be paid to the purpose in view. For micro-projection a current of 20 ampères is sufficient; for

diapositive 20–30; and for episcopic projection 20–50 ampères. In the two latter cases the size of the lecture-hall must be considered.

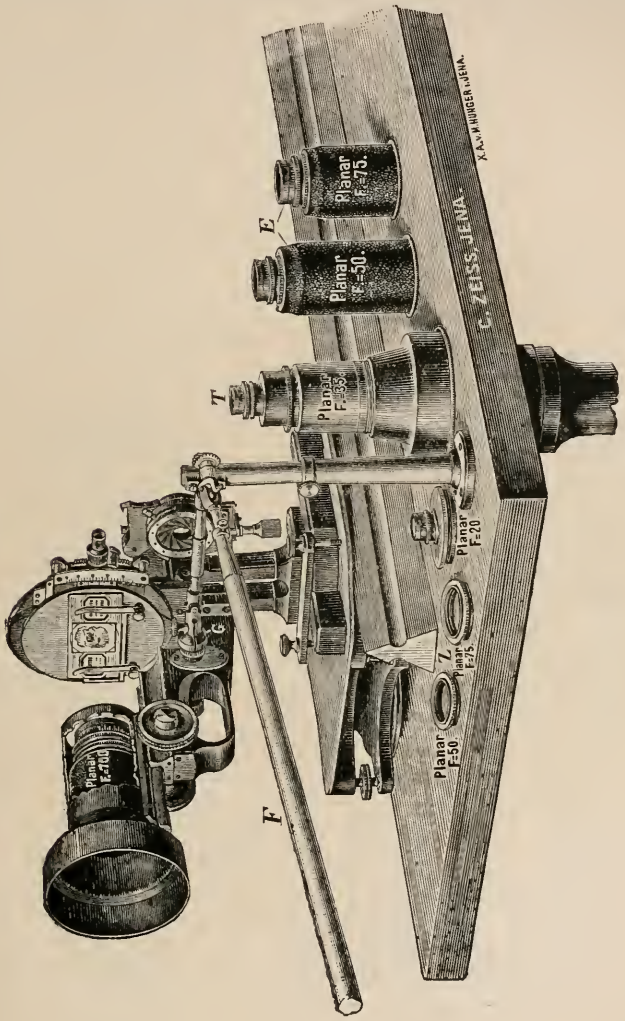


Fig. 90.

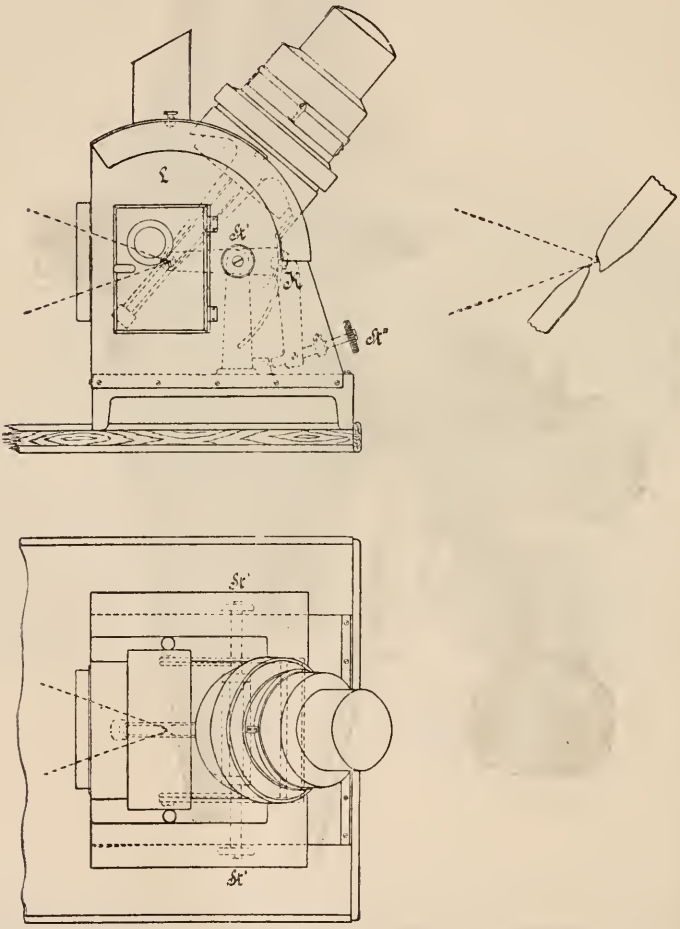
Zeiss' Projection Apparatus. — Figs. 92–95 are some of the diagrams of the complete arrangement; fig. 94 being a sectional elevation, and the others plans. The lettering is the same throughout. A, the water-chamber; B, illuminating mirror; D, lantern-slide carrier; F, horizontal push footplate; K, coupling screw; L, projection lamp; M *k*, Microscope; P, projection-system carrier; *r*, tube-mirror; S′ two-lens portion of collective lens; S, single-lens portion of collective lens;

S p, illuminating mirror for incident light; S t', S t'', milled heads for centering light source.

Fig. 92 shows the setting up of the apparatus for micro-projection with Microscope stand.

Fig. 93 shows the change-over from micro-projection to macro-projec-

Fig. 91.



tion. The Microscope stand is pushed aside; the macro-objective is inserted into the projection-system bearer P; in the lantern-slide carrier P a suitable adaptation is made by sliding out the object-glass carrier.

Fig. 94 shows the arrangement for the micro-projection of fluid and

wet preparations. The Microscope stand is set and adjusted vertically; it is fitted with mirrors B and *r*.

Fig. 95 shows the application of the mirror S *p* with vertical illuminator.

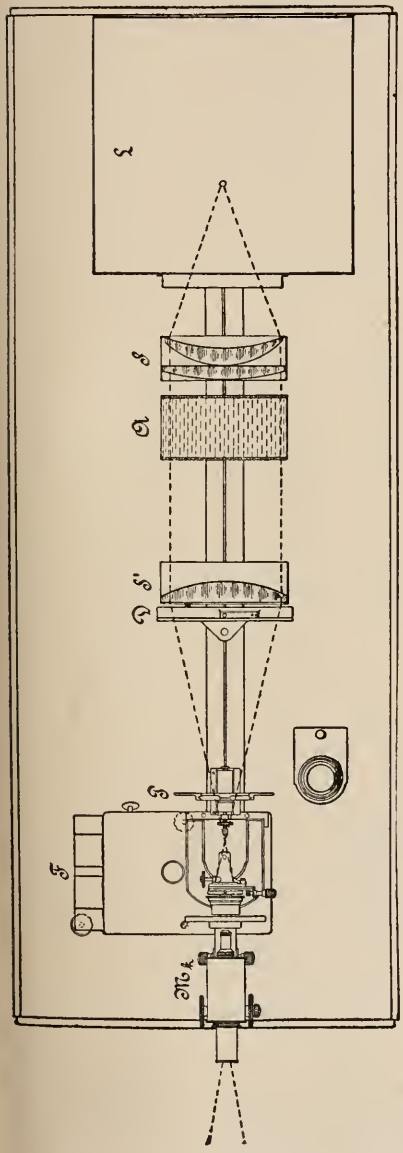


Fig. 92.

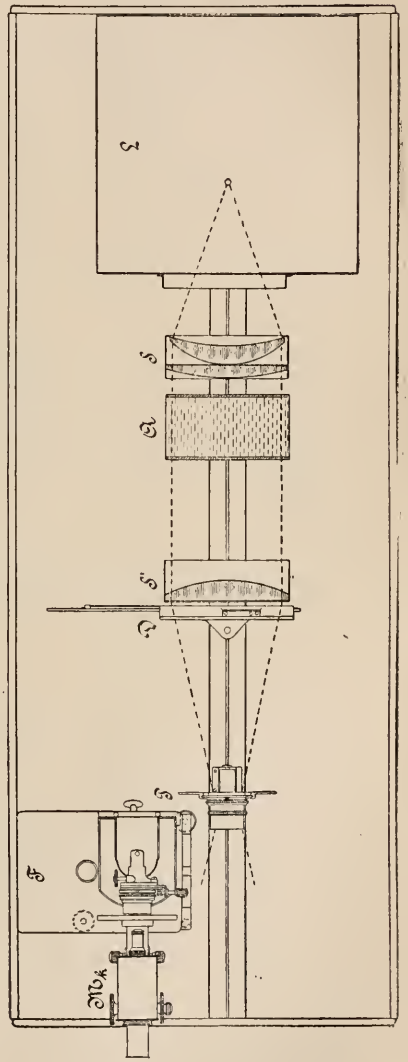


Fig. 93.

Lothian Dissecting Microscope and Table.* — This instrument, designed by Mr. A. Craig-Christie, and made by Baird of Edinburgh, is intended as an inexpensive aid to the student of botany and zoology.

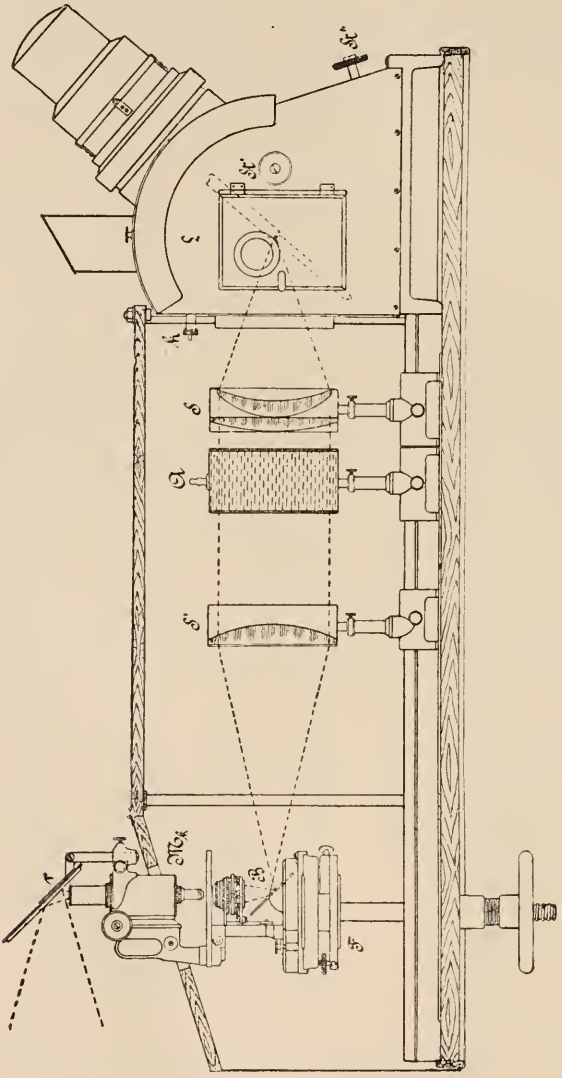


Fig. 94.

Fig. 96 represents a metal base and upright with a double arm, which, for focussing, slides up and down on the upright. One arm terminates in a ring into which is placed a watchmaker's eye-glass; to the other is

* Illust. Ann of Micr., 1900, pp. 123–4 (2 figs.).

attached a three-power pocket lens. The arms are of such a length that each lens is brought, by rotation, over the same spot; thus different

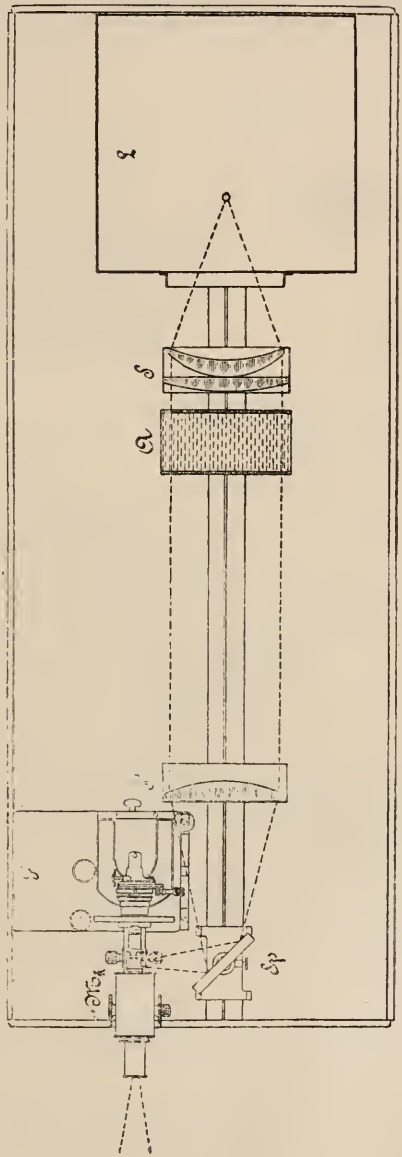


Fig. 95.

powers can be applied to the same object. Fig. 97 shows the dissecting table, which is made of sheet metal and is supplied with a glass top

removable for cleaning. When dissections under water are required, the glass plate is replaced by a glass-bottomed metal tank which fits into a circular opening in the middle of the table. The table is without a bottom, so that a piece of white paper may be placed underneath

Fig. 96.

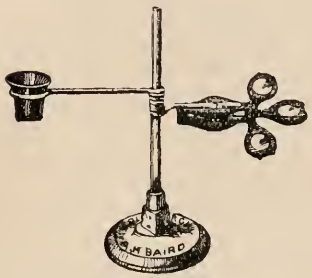
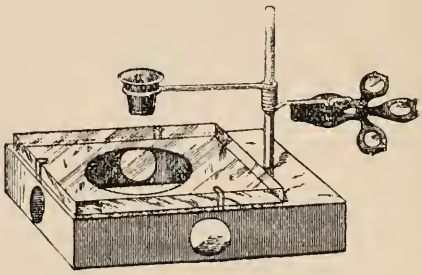


Fig. 97.



for reflecting light up on to the object. The lenses can be taken off and the whole apparatus dismounted and packed within the space of the dissecting table.

Reichert's Accessory Apparatus for Entomologists. — This apparatus (fig. 98) was constructed, on the suggestion of Prof. A. Korlevié of Agram, for the purpose of fixing small insects intended for observation in such a way that they can be moved and turned in all directions, and be observed with low-power objectives and illuminated by the mirror from all sides. The needle carrying the insect is placed in the cork roller K, which is provided with two ball bearings adjustable by means of the screw F in such a way that the roller is movable in all directions and yet can be fixed in every position. Should the needle be too long for the space under the objective, the substage is removed, and the traverse *h* is put into its mounting upside down, so that the roller comes under the stage. Then there is space enough for all ordinary objectives. The plane and concave mirror, which is movable in all directions, serves for illumination. The apparatus is intended for affixing to existing stands.

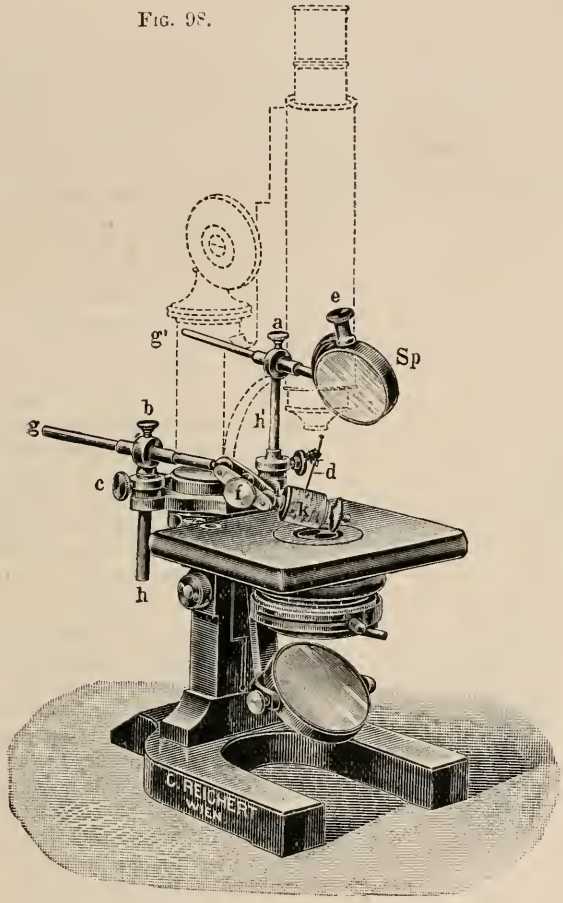
(4) Photomicrography.

Photomicrographic Notes.*—Under this title, Mr. Albert Norman gives some very useful practical hints addressed primarily to beginners. He recommends oil-light as the easiest and most certain luminant; in some cases, such as in photographing very delicate or stained specimens, he even considers it the best. He is of opinion that vibration has been greatly over-estimated, and that bad focussing or careless manipulation is a more frequent cause of blurs. Table legs should be insulated by felt wads. Sometimes blurring is due to a faulty connection between the fine adjustment of the Microscope and the long focussing rod of the camera. Lime-light is exceedingly useful for high-power work, such as the photography of bacteria at one to four thousand diameters; but at one thousand diameters it is not essential, for an oil-lamp with an inch

* Illust. Ann. of Micr., 1900, pp. 110 and 111.

wick used edge-on will fully expose a medium orthochromatic plate in from one to two minutes, using a 1/12th apochromatic objective and Zeiss' No. 4 projection ocular. For fine low-power work, the oil-lamp with a circular wick is indispensable.

Fig. 98.



Hubbard, J. C.—**Colour Screens as applied to Photomicrography.**
Journ. Boston Soc. Med. Sci., III. (1899) No. 11, p. 297.

Martens, Dr. F. F.—**Einige neue photometrische Apparate.** (Some new Photometric Apparatus.)
[The instrument is on the spectroscope principle, but by means of a mirror the absorption band is brought immediately under the fixed band, and so more perfect comparison is obtained.]
Zeit. f. angew. Mikr., March 1900, pp. 338–40 (1 fig.).

Roster, G.—**Le applicazioni della fotographia nella scienza.** (The applications of Photography in Science.)
Congr. Fotogr. Ital. Firenze, Atti ii. (1899) SA., 26 pp.

(6) Miscellaneous.

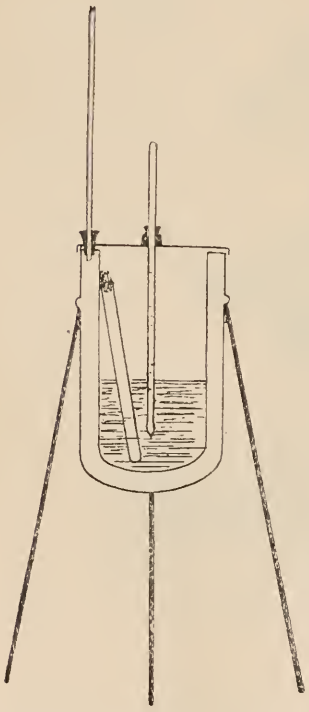
Illustrated Annual of Microscopy for 1900.
[Contains some twenty-four interesting articles on various subjects.]
Percy Lund, Humphries & Co., London.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Incubator.†—Dr. C. Tonzig describes a new incubator for gelatin cultures which is said to be very satisfactory in its action. It consists of a wooden case of which the horizontal measurements are 22 in. by 15 in., and the height 28 in. A tube of sheet zinc 3 in. in diameter passes vertically through the middle of the wooden case, and projects both above and below. At the lower end it is expanded into the shape of a flat-bottomed cone, beneath which a gas-flame is placed. At the upper end there is a thermometer, and a thermo-regulator for the gas supply. The zinc tube is filled with water, which is heated 10° C. above the temperature required in the incubator. Observations made in the bacteriological laboratories of the University of Padua showed that the temperature thus produced in the incubator was constant and uniform, and that when regulated to 20° C., it did not rise above 22°, so that there was no melting of the gelatin, even when the temperature of the room rose to 19° C. (66° F.)

Fig. 99.



Apparatus for Heating Cultures to separate Spore-bearing Micro-organisms.‡—Dr. C. B. Stewart has devised an apparatus which maintains a constant temperature of 80° C. without any attention. It is made of beaten copper, and spun afterwards; the inner chamber is 18 cm. deep and 9 cm. in diameter. The condensation tube (fig. 99) is 1 m. in height. To use the apparatus a small quantity of pure benzol, B.P. 80° C., is poured into the jacket through the hole for the condensation tube. A small flame keeps the benzol boiling, and as the vapour condenses in the condensation tube, and runs back, very little is lost. The chamber is filled to about one-third of its depth with water at 80° C. When the lid is

* 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.

† Lancet, 1900, i. p. 1014.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 366–7 (1 fig.).

removed to introduce test-tubes, the temperature falls 10°–15°, but the loss is rapidly recovered, and in 15–20 minutes after the thermometer has risen to 70°, the tubes will have been exposed to a temperature of 75° or over, most of the time.

Nutritive Medium for detecting Sulphide Formers.* — Prof. W. Beijerinck detects sulphide formers by means of white lead. Carbonate of lead is added to ordinary meat-gelatin or meat-agar in quantity sufficient to make the plates of a snowy white. The substratum is inoculated by pouring over the surface drain-water diluted with distilled water. The plates are incubated at 23° C. In a couple of days the presence of sulphide-forming germs is rendered evident by the appearance of brown colonies, the growths of other bacteria being white. As the lead sulphide in the brown colonies is unaffected by air, the reaction is permanent, and is gradually intensified. In order to render the browning more distinct, part of the surface may be covered with a glass plate when the growth has well developed. This not only hinders diffusion, but prevents oxidation of the sulphuretted hydrogen.

New Covering for Culture-tubes.†—Dr. W. Hesse recommends the following method for covering the mouth of culture vessels for the purpose of preventing evaporation and loss of moisture during prolonged sterilisation and incubation. The cotton-wool plug is covered over with a square piece of coffer dam (sheet rubber used by dentists) the sides of which are about 3 cm. long. Over this is placed another piece of similar size, but having a hole about 2 mm. in diameter punched in the middle. This fastening is so tight that evaporation from the vessel even in the incubator is very slight, and cultures may be kept in the thermostat as long as a month without detriment, provided that the amount of the medium be not too small.

A similar expedient may be applied to Petri's capsules.

Substrata for Cultivating Tubercle Bacilli.‡—MM. F. Bezançon and V. Griffon recommend two media for cultivating tubercle bacilli. One of these is a potato disk covered with a thin film of glycerin-agar. The agar fixes the potato firmly in the culture-tube, so that the surface of the potato may be energetically rubbed with tuberculous material. This medium is extremely favourable to growth. The other substratum is made by passing blood from the artery (carotid of rabbit) into tubes containing agar-bouillon. The tubes are then sloped, and when set, a solid surface is obtained on which colonies of tubercle bacilli become evident in 6 days, and in 15 days the growth is extensive.

New Medium for Cultivating Tubercle Bacillus.§—Herr W. Hesse recommends the following medium for cultivating tubercle bacilli. The pepton is replaced by Heyden's aliment, which is a preparation of soluble albumen with properties intermediate between coagulated albumen and somatose. The medium is composed of Heyden's aliment 5 grm.; salt 5 grm.; glycerin 30 grm.; agar 10 grm.; normal soda

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) p. 196.
† Op. cit., 1te Abt., xxvii. (1900) pp. 258–9.
‡ C.R. Soc. Biol., vi. (1899) pp. 77–9.
§ Zeitschr. f. Hygiene u. Infektionskr., xxxi. (1899) p. 502. See Zeitschr. f. wiss. Mikroskop., xvi. (1900) pp. 492–3.

solution (28·6–100) 5 ccm.; distilled water 1000 grm. The Heyden's aliment is first dissolved in water, and then the agar-mixture containing the rest of the ingredients is added. The medium is filtered while hot, through a special apparatus. On this medium tubercle bacilli are said to be demonstrable from sputum after a few hours' incubation, and it is claimed that the procedure obviates the necessity of testing doubtful secreta in animals.

Effect of Varieties of the Medium on the Growth of the Typhoid Bacillus.*—Prof. E. J. McWeeney states that the experiments made by him on the effect of certain varieties of the nutrient medium on the growth of the typhoid bacillus show that:—(1) the growth improved with increasing addition of decinormal sodium hydrate to the unneutralised gelatin up to the beginning of alkalinity (indicator phenolphthalein); (2) the addition of salt in quantities varying from 0·1 to 1 per cent. to the fully neutralised gelatin made no difference in the amount of growth; (3) the omission of both salt and pepton exercised no appreciably unfavourable influence on the growth in gelatin made with meat decoction; (4) addition of phenol to gelatin in the proportion of 0·05 to 0·5 per cent. exercised an inhibitory influence on all growths when the addition exceeded 0·07 per cent.; between 0·05 and 0·07 the effect was to check the anaerobic growth; and (5) Parietti's solution added to ordinary bouillon suppressed the growth of the typhoid bacillus when the bacillus coli was also present.

Culture and Demonstration of Amœbæ.† — Herr G. Marpmann points out that pathogenic amœbæ are easily cultivable in the animal body, guinea-pigs and rabbits forming suitable hosts. Artificial cultures of earth, water, and intestinal amœbæ are obtainable only when the medium resembles the natural environment and when the temperature is normal. A good medium consists of agar 0·6, hay infusion 100, alkaline bouillon 10 parts. On this medium the mixed colonies of bacteria and amœbæ will be found in about twenty-four hours after inoculation. Without the presence of living bacteria amœbæ do not grow, and if the bacteria be killed off by means of alcohol or strong soda solution, they remain encapsuled and do not develope further.

Other media which may be recommended are:—(1) Hay or straw decoction, 30–40 grm. boiled for half an hour in 1 litre of water, filtered, and alkalised with carbonate of soda. (2) Hay or straw-agar. The foregoing decoction with the addition of 1·5 per cent. agar. (3) *Fucus crispus* substratum. A 5–15 per cent. solution of fucus in water or bouillon is boiled, mixed with 10 per cent. 1/10 normal caustic potash solution, filtered, and analysed. (4) Agar-medium:—agar 0·5, water 90, alkaline bouillon 10; boil, filter, sterilise.

The cultivation of blood amœbæ and of malaria and leukhæmia parasites has not yet been effected on artificial media, probably owing to the fact that as they are cell-parasites, a dead medium is insufficient for their wants. They are, however, cultivable in animals, as has been recently shown by Löwit, who injected rabbits with a mixture of leukhæmic blood, ascitic fluid, and blood drawn from the finger.

* Roy. Acad. Med. Ireland. See Lancet, 1900, i. p. 939.
† Zeitschr. f. angew. Mikr., v. (1900) pp. 325–38 (7 figs.).

The author, after describing various forms of incubators suitable for amœbæ cultures, addresses himself to staining procedures. The first of these is that of Romanowsky and Nocht. A few drops of 1 per cent. alcoholic solution of eosin are mixed with 2 ccm. of water, and this mixed with a solution of 1 per cent. methylen-blue in ½ per cent. soda solution. The latter is dropped in until the colour is a dark-brown violet. The fixed films are floated on this mixture for about ten minutes, and then, having been washed in water, are treated in the usual manner.

Löwit treats his specimens of leukhæmic blood as follows:—The films are dried for 1–1½ hour at 110°–115°, and are then stained in a mixture of 30 parts alkaline methylen-blue (Loeffler) and 15 parts of saturated aqueous solution of thionin. The preparations are stained for 15–20 minutes, washed in water, and differentiated in acid alcohol (0·3 per cent. HCl.) as long as the stain is given off. They are then treated in the usual way. The hæmatozoa are blue to green.

Another method is to stain the fixed film in saturated aqueous solution of thionin for half an hour, and, after washing and drying, immerse for 10–20 seconds in iodopotassic iodide solution; wash again and mount in balsam. The parasites are green.

A similar stain had been previously recommended by Mallory for *Amœba coli*. The film was fixed in alcohol, stained in saturated aqueous solution of thionin for 5–20 minutes, washed, differentiated in 2 per cent. oxalic acid solution for ½–1 minute, dehydrated in 55 per cent. alcohol, and mounted.

For demonstrating the malaria parasite, Korosko's mature solution of methylen-blue and eosin is mentioned. This consists of methylen-blue C or B. G. N. 1; distilled water 100; absolute alcohol 5; 20 per cent. caustic potash 12 drops. After standing for three months, 2 ccm. of the filtered solution are mixed with 4 ccm. of 1 per cent. eosin solution. The films are fixed for one hour at 105°–110°, and then stained in the foregoing mixture for 12–24 hours at 30°.

(2) Preparing Objects.

Value and Action of Fixative Fluids.* — Dr. W. von Wasielewski, after an exhaustive examination of the respective values of fixative solutions, lays it down that on the whole the best results are obtained from Flemming's fluid and its modifications, such as Hermann's and vom Rath's mixture. With these may be included other fluids which contain acetic acid, such as Zenker's, Carnoy's, Telyesniczky's, and also picroacetic acid, chromacetic and sublimate acetic acid, and some others.

With the exception of platinum chloride, fixative solutions containing only one ingredient are of less value than mixtures. The special properties of the chief media may be appreciated thus. Osmic acid and potassium bichromate are the best for retaining the cell-mass. Platinum chloride, as a simple fixative, does well for nuclear division, and the staining with safranin-gentian-violet-orange is excellent. Acetic acid holds the first position for its structure-retaining properties. Picric acid penetrates most rapidly.

Centrosomes are not demonstrable by any fixing or staining method.

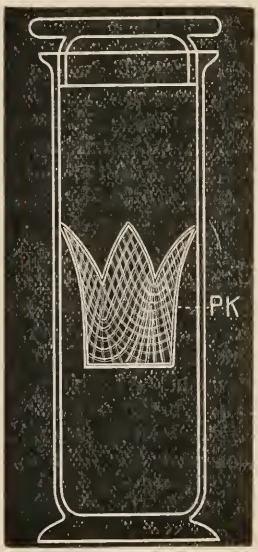
* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 303-48 (2 pl.).

The cell-nucleus is more resistant than the plasma, except in the case of potassium bichromate, which acts thereon injuriously. The size of the nuclear vacuole in which the nucleole lies greatly depends on the fixative; sublimate and mixtures containing nitric acid produce a large vacuole; while with picric acid, chromosmic acid, or Merkel's and Lindsay's fluids, it quite or almost disappears.

The structural appearances of the cell-plasma vary extraordinarily according to the fixative used. Thus the plasma is more or less homogeneous with formalin, potassium bichromate, osmic acid. It is finely or coarsely granular with hot water, sublimate picric acid, Merkel's mixture, sublimate, chromacetic acid, Hermann's and vom Rath's mixture. It may be filamentous or reticular with sublimate, picric acid, platinum chloride. The plasma mass is very variously preserved, sometimes quite filling the cell, as with osmic acid, while with others, as chromic acid, it is quite shrunk up. Some fixatives, such as formalin, produce a large number of vacuoles in the plasma.

Simple Apparatus for Rapid Dehydration. * — Prof. J. Schaffer describes a simple apparatus (fig. 100) which he has used for some time with great success for dehydrating histological objects. A square piece of platinum wire net, the sides of which are about 5 cm. long and the meshes about 1 mm. wide, is bent into the shape depicted in the illustration so as to form a sort of basket. The basket is made to fix itself automatically against the sides of the glass jar into which it is jammed by bending the corners outward. Of course the apparatus may be used for fixing, washing, or staining objects, and the only disadvantage that can be complained of is the dearness of the platinum net.

Fig. 100.



Celloidin Imbedding and Staining Tubercle Bacilli in Celloidin Sections. † — Mdlle. E. Wolff, in some remarks on celloidin imbedding, advises that the celloidin should be treated first with absolute alcohol, and afterwards with ether, as this sequence makes a clearer solution than the reverse procedure. The slow evaporation of the solvent mixture is strongly urged, for celloidin will not remain clear if direct access of air be permitted, and the slower the evaporation the better the mass will cut.

For demonstrating tubercle bacilli in celloidin sections, the following procedure is given. The sections are placed on slides, the superfluous alcohol drained off, and the section pressed down with blotting-paper. While still damp, carbol-fuchsin is filtered over the section, and the slide warmed until the solution begins to vaporise. This hot-staining must

* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 422–5 (1 fig.).
† Tom. cit., pp. 427–31.

be repeated four or five times. The slide is then plunged into distilled water, the section floats off, and then, after a short washing, is differentiated in 60 per cent. alcohol, to which nitric acid in the proportion of 20 drops to 100 ccm. has been added. A second bath in acid-alcohol is required to complete the differentiation. The acid is removed by washing freely in distilled water, and then the preparation may be contrast-stained with very dilute aqueous solution of methylen-blue, thionin, or iodine-green. After washing in water, the section is replaced on a slide, mopped up, rapidly dehydrated with absolute alcohol, cleared up in xylol, and mounted in xylol-balsam. The preparations keep well.

Modification of Nissl's Method.* — Sig. G. Boccardi has modified Nissl's method in the following way. Fixation in absolute alcohol for 24 hours or in 10 per cent. formalin for 12–24 hours, with consecutive gradual transference to absolute alcohol; paraffin imbedding. The sections are stuck on the cover-glass with water. After removing the paraffin with xylol, the preparations are transferred to absolute alcohol, and then stained with the following mixture:—erythrosin 0·1 grm.; toluidin 0·2–0·5 grm.; water 100 grm. Though not absolutely necessary, it is advisable to add 4–5 drops of aceton to the mixture. The staining requires 15–20 minutes at ordinary room temperature, and 5 in the thermostat at 37°, or one minute if heated over the flame. The preparations are then washed in water for a few seconds, and immediately afterwards differentiated in 0·5 per cent. alum solution. This takes a few seconds or at most a minute. After having been washed in distilled water, the preparations are passed through alcohol to xylol and mounted in xylol-balsam.

Point in the Technique of the Cox-Golgi Method.† — Dr. J. B. Nicholls calls attention to the importance of immersing sections of nervous tissue which have been treated by the Cox-Golgi method for a few seconds in 50 per cent. caustic alkali solution. This not only deepens the colour, but brings it out when the sections are apparently unstained.

Preparing Copepoda.‡—Mr. C. D. Marsh collects copepoda in a dredge, the mouth of which is covered with a cone of coarse wire gauze. The animals may be killed in some osmic acid solution; alcohol is, however, the best fixative and preservative. The specimens may be stained in 1–3 days, by pipetting off most of the alcohol, and putting a little picro-carmine in the bottle. The animals are best dissected on a slide and in glycerin. Care must be taken to substitute the glycerin gradually. The needles used should be ground flat so as to make minute scalpels. The best mounting medium is Farrant's.

Preparing Earth-worms for Sectioning.§—Mr. R. Pearl stupefies the worms by placing them in 3 per cent. alcohol for an hour, and during the next hour gradually raising the strength to 6 per cent. Some 6 per cent. alcohol is then injected into the anus by means of a syringe. The intestinal contents are loosened by rolling and pinching the worm

* Monitore Zool. Ital., x. (1899) pp. 141–3. See Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 471–2.
† Journ. App. Microscopy, iii. (1900) p. 674.
‡ Op. cit., ii. (1899) pp. 295–6.
§ Op. cit., iii. (1900) p. 680.

between the fingers. The canula is now inserted in the mouth, and the alimentary canal flushed out. When the stream runs clear, the animal may be killed in some fixative solution.

Fixing Intestine of Cat.*—Herr M. von Lenhossék states that he has obtained brilliant pictures of the mucosa and musculature of the intestine by the following method of fixing. A piece of intestine (small intestine of cat) about 2 sq. cm. was stretched on a cork frame and fastened down with quills, great care being taken to avoid touching the epithelial layer. The preparation was then fixed in the following mixture:—

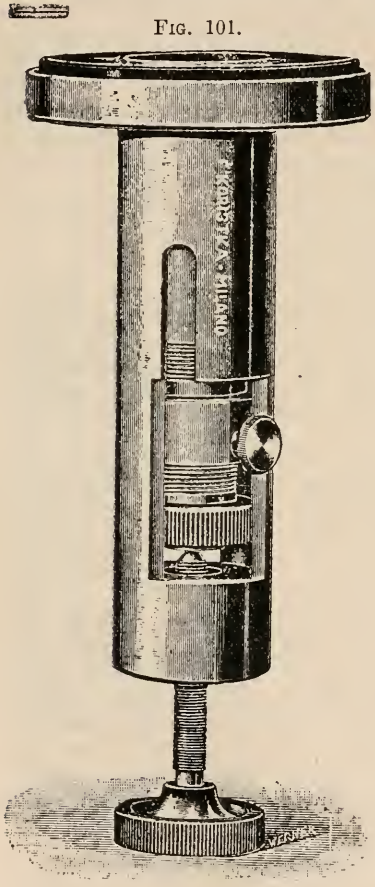


Fig. 101.

Apáthy's sublimate alcohol (alcohol 50 = 100 ccm., NaCl 0·5 grm., sublimate 4 grm.) 75; absolute alcohol 25; acetic acid 5; for 6 hours, and afterwards hardened in 90 per cent., 96 per cent., and absolute alcohol for 24 hours each.

Preparing Specimens of Iron and Steel.†—Mr. W. M. Merrett describes the following procedure for preparing specimens of iron and steel for microscopical observation. Pieces 3/4 of an in. square and 1/4 of an in. thick are taken, and one surface is carefully ground on a series of emery papers, mounted on plate glass, finishing off with a very fine grade. Fine-grade papers are prepared by washing the finest slime from the best flour emery, mixing it with a solution of egg albumen in water, brushing it on paper free from grit, and then allowing it to dry. The specimen is rubbed on the fine emery paper, then on rouge paper, and finally on a wet rouge wheel. At this stage the specimen becomes lightly engraved, the harder constituents appearing in relief. The structure is not shown by polishing only, but must be made evident by physical or chemical processes. The constituents are usually shown up either (1) by rubbing the specimen with liquorice juice on parchment; (2) by attacking it with a very dilute solution of nitric acid in alcohol or in water; or (3) by heating it in air to about a straw colour (240° C.).

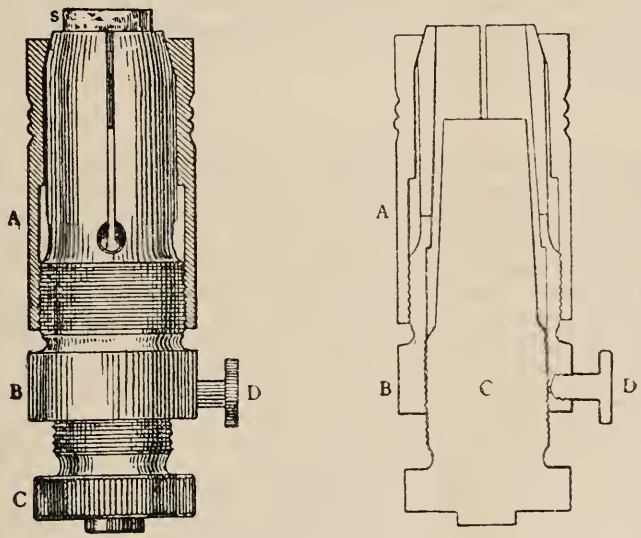
* Anat. Anzeig., xvi. (1899) pp. 334–42.

† Illust. Ann. Microscopy, 1900, pp. 46–51 (12 figs.).

(3) Cutting, including Imbedding and Microtomes.

New Hand Microtome with Tubular Clamp.*—Dr. Adr. Fiori has, with the aid of Koristka, invented a hand microtome which is intended for sectioning vegetable tissues. The apparatus is of the ordinary shape, i.e. it is cylindrical, is surmounted by a circular cutting-plate, and has a micrometer screw at the lower end for raising the object-carrier (fig. 101). The micrometer screw is marked off in ten divisions, each of which corresponds to a rise of five-hundredths of a mm., while a groove at the lower end of the body serves, due regard being observed as to levelling, as a guide for estimating the distance traversed by the screw. The body of the microtome is cut away to allow the piece C of the object-carrier to be screwed up and down. The opening has a narrow

Fig. 102.



prolongation upward for the passage of the screw D. Its edge, when D is not engaged in the prolongation, serves to prevent the clamp from projecting above the level of the cutting-plate. The object-carrier consists of three parts, a hollow tube (fig. 102 A) connected externally with the body and internally choke-bored above to a cone-shape. This tube is screwed below to a second hollow tube (fig. 102 B) terminating above in a tubular clamp. The internal diameter of this clamp is 14 mm., and its upper end is conical. The clamp is split longitudinally in four places, so as to make four jaws, which, when the tube A is screwed up, approximate and diminish the internal diameter of the clamp by 1½ mm. after the manner of a crayon-holder. At the lower end of the second

* Malpighia, xiii. (1899) pp. 193–9 (3 figs.).

tube is a female screw into which is screwed the third piece (fig. 102 C), a conical block with a milled head at its lower end for screwing it up and down. In the piece B the screw D (fig. 102) works and serves as a lever for pushing out the object-carrier, for fixing the piece B, and for preventing the clamp rising above the level of the cutting-plate.

The manipulation of the apparatus is very simple. The object, inserted in elder pith, is placed within the jaws of the clamp after the object-carrier has been pushed up. The clamp is then tightened, and the carrier withdrawn until it comes in contact with the micrometer screw.

Modification of the Rutherford Microtome.*—Dr. D. F. Harris has devised a modification of the Rutherford microtome which differs from the primitive form in the following particulars. (1) The size of the freezing-box is considerably increased. (2) The gum-well is placed centrally in the elliptical ice-box. (3) Less of the well projects above the surface of the ice-box. (4) The upper surface of the platform which raises the frozen tissue is of brass, deeply corrugated. (5) The circular glass plate is replaced by a pair of rails which are covered by strips of glass having a convex surface.

(4) Staining and Injecting.

Staining Sections while Imbedded in Paraffin.†—Mr. S. Smith describes the following method for staining sections which have been imbedded in paraffin and cut with the rocking microtome in the ordinary way. The ribands are placed in the staining solution in a flat covered vessel, which is left in a warm place until the sections became perfectly flat. The vessel is then removed to a cool place for 12–24 hours, and then the staining solution poured off slowly so as to leave the ribands lying flat on the bottom of the dish. Water is then poured in to re-float, and also wash the sections. This done, the sections are placed on slides, allowed to dry, passed through turpentine or xylol, and mounted in balsam.

Fixing and Staining Blood Films.‡—Mr. R. Muir describes two methods for fixing and staining blood films.

(1) Dry method. The film having been dried in air, is fixed in a solution composed of 20 per cent. aqueous tannin solution, 2 parts; saturated aqueous solution of sublimate, 2 parts; saturated aqueous solution of potash alum, 5 parts. The fixative is filtered on to the film, and after 2–4 minutes the preparation is washed successively in water, methylated spirit, and again in water. It is now stained for 2–4 minutes with 2 per cent. aqueous solution of eosin, or for 15 minutes or more if to show the eosinophilous reaction. The film is again washed and then carefully dried over the flame in order to fix the eosin in the cells. When dried, it is dipped in water, and some saturated aqueous solution of methylen-blue filtered on. To this staining solution it is advisable to add saturated caustic potash solution in the proportion of one drop to the ounce. After about 2 minutes, the stain is washed off and the pre-

* Journ. Anat. Physiol., xxxiii. (1899) pp. 609–11.
† Op. cit., xxxiv. (1899) pp. 151–2.
‡ Journ. Pathol. and Bacteriol., vi. (1900) pp. 394–6.

paration dehydrated in absolute alcohol, cleared in xylol, and mounted in balsam.

(2) Wet method. The still wet film is fixed in corrosive sublimate (Muir) or in 2 per cent. formol, and then, having been washed, is treated with the fixative described in the dry method, which is allowed to act for 2 minutes. The preparation is then successively washed in water, alcohol, and water, after which it is stained with eosin and again washed. Some saturated solution of potash-alum is now dropped on and allowed to act for 2 minutes, after which the preparation is washed in water, and then stained with methylen-blue. The film is again washed, then dehydrated, cleared up, and mounted as before. In this method the film must not be allowed to dry at any stage. Carbol-thionin-blue may be used instead of methylen-blue ; the film is then fixed in sublimate. These methods give good results with sections.

Safranin Staining.*—Dr. L. W. Ssobolew has found that sections, especially celloidin sections which have lain long in alcohol and do not stain well with safranin, may be successfully stained by remordanting them with Flemming's fluid. The sections should be immersed in a mixture of 10–15 drops of this fluid and 5 ccm. of distilled water for 5–10 minutes. They are then washed, and stained with saturated aqueous solution of safranin. The after treatment is the same as usual.

Method for Fixing and Staining Nervous Tissue.† — Mr. A. P. Ohlmacher has used the following modification of Carnoy's fluid for a long time on account of its great penetrating and hardening properties :— absolute alcohol, 85 parts; chloroform, 15 parts; acetic acid 5 parts; sublimate to saturation (about 20 grm.). Small pieces of tissue are hardened in a quarter to half an hour; large slices require 18 to 24 hours. After hardening, the pieces are washed, and may be kept in 80 per cent. alcohol. The fluid may be used several times. The staining procedure recommended by the author is to stain for a minute in Ehrlich's anilin-gentian violet, then drain off the superfluous fluid, and wash in water. Treat with picric acid-fuchsin solution (0·5 per cent. acid fuchsin to a saturated solution of picric acid which is diluted with an equal volume of water). Dehydrate with absolute alcohol. Clear up in clove oil, and mount in xylol-balsam.

Modification of Kronthal's Method of Staining Nervous Tissue.‡ —Herr H. K. Corning states that he has obtained better results by fixing and hardening in 10 per cent. formalin previously to immersing in the lead formate mixture. Moreover, instead of the lead formate obtained by dropping formic acid into saturated solution of acetate of lead, he uses Merck's plumbum formicum. Though Kronthal's method § possesses some advantages over that of Golgi, the penetrating power of the fluids (the original and the modified) is not great, and does not reach deeper into the piece of tissue than 3–4 mm.

Method of Staining Medullated Nerve-fibres en bloc, and a Modification of Marchi's Method.‖ — Dr. D. Orr states that he has

* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 425–6.

† Bull. Ohio Hosp. Epilept., 1898. See Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 435–6.

‡ Anat. Anzeig., xvii. (1900) pp. 108–11.

§ Cf. this Journal, 1899, p. 548.

‖ Journ. Pathol. and Bacteriol., vi. (1900) pp. 387–93 (1 pl.).

obtained excellent results by the following method, which renders the fine medullated nerve-fibres coursing in the grey matter very distinct and conspicuous. A piece of fresh tissue from cortex or cord, not exceeding 1/8 in. in thickness, is placed in a mixture of 2 per cent. osmic acid 8 ccm. and 1 per cent. acetic acid 2 ccm. If the mixture be darkened within 24 hours, it should be renewed. After 48 hours the piece is immersed in 10 per cent. formalin for three days, and is then imbedded in paraffin or celloidin. The sections are passed through 1·5 per cent. permanganate of potash solution and 1 per cent. oxalic acid solution until differentiation is complete. They are then treated in the usual manner.

The modification of Marchi's method consists in immersing pieces of central nervous tissue which have been hardened in bichromate, in the aceto-osmic acid solution just described for ten days. This addition so increases the penetrating power of osmic acid, that the central portions of the block are found to give the Marchi reaction quite as well as the peripheral.

The author has found that the initial stages of fixation and hardening may be hastened by using a mixture of 2 per cent. bichromate and 5 per cent. formalin for 24 hours, and then removing to 2 per cent. bichromate.

Modification of Marchi's Method of Staining Degenerated Nerve-fibres.*—Mr. J. N. Langley and Mr. H. K. Anderson adopt the following procedure for preventing nervous tissue from becoming brittle, and for enabling adjoining sections to be stained by other methods. After hardening in 2 per cent. potassium bichromate or in Müller's fluid, the pieces are placed for a day in a solution of gum in 2 per cent. potassium bichromate. Sections made with a freezing microtome are removed to a 2 per cent. potassium bichromate solution to wash out the gum. Successive sections may then be placed in:—(1) a mixture of potassium bichromate and osmic acid to stain the medulla of the degenerated fibres, and may be left therein for 1–3 weeks; (2) in water, then in alcohols up to 70 per cent. to remove the fixative and to harden somewhat; then back through alcohols to picrocarmine or other stains; (3) chrome-alum mixture, and stained by the Weigert-Pal method as modified by Heller and by Ford Robertson.

The writers find that spinal cord may be kept for more than a year in potassium bichromate, and still give the Marchi reaction by the foregoing method.

Staining Gonococci in Living Leucocytes.†—Herr Plato mixed a droplet of pus with a loopful of neutral red solution (1 ccm. of cold saturated aqueous neutralised solution and 100 ccm. of physiological salt solution), and on examining as a hanging drop found that the intracellular gonococci were stained deep red. Warming the stage excited amœboid movements, and during this phase the cocci lost their colour, regaining it when the movements ceased and the granular condition of the leucocyte was resumed. It is stated that intracellular gonococci have a greater receptivity for the pigment than other organisms, while

* Proc. Physiol. Soc., p. xxxi. See Journ. of Physiol., xxiv. (1899).

† Berlin Klin. Wochenschr., 1899, No. 49. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 286–7.

those free in the plasma (extracellular) behave in a way similar to other organisms.

In fixed preparations a mixture of 20 ccm. of cold saturated aqueous neutralised solution and 100 ccm. of water stain the cocci deep red in a few seconds, while the nuclei of the cells are but faintly coloured, so that the nuclei do not obscure the cocci.

New Method of Staining Gonococcus.*—Dr. Dreyer gives the following method for staining gonococcus. The preparation is stained with Loeffler's methylen-blue in the usual way, and then, having been washed with water, is treated for 4 minutes with 1 per cent. protargol solution. After differentiation the preparation is washed repeatedly, and then contrast-stained by immersing it for half a minute in dilute carbol-fuchsin (10 drops Ziehl-Neelsen to a watch-glassful of water). The bacteria are blue, the tissue cells and nuclei red.

Differences in the Staining Reaction of Friedlaender's Bacillus.‡—Dr. P. Clairmont found—from histological examination of the liver and kidney of a case wherein Friedlaender's bacillus had been discovered intra vitam in the pus of an abscess—that the bacteria were not decolorised in sections which had been stained by Gram's method and afterwards treated with alcohol and oil of cloves, while the colour was discharged from culture preparations of the same origin.

PETIT, L. C.—**Refraction versus Stain in Microscopy.**
New York Med. Record, LV. (1899), No. 16, p. 851.

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

Preparing Glycerin-Jelly.‡ — Glycerin-jelly for mounting microscopical objects and also for museum specimens is easily prepared by placing photographic gelatin in a washing apparatus and leaving under a gentle stream until clean. It is then melted by a gentle heat in an equal quantity of glycerin. After this it should be hot-filtered thrice. A thymol crystal will keep it from becoming mouldy.

(6) Miscellaneous.

Method for Demonstrating Actinomycotic Appearances in Tubercle.§—Prof. P. L. Friedrich and Dr. H. Nösske describe actinomycosis-like appearances which they have found in tuberculosis produced experimentally by injecting into the arterial circulation suspensions of tubercle bacilli. The appearances depicted in the illustrations are strikingly like those of actinomycosis, and show a central mass of bacilli surrounded by a zone of club-shaped elements arranged radially. These typical appearances were demonstrated by special staining methods, and the sections exhibit a striking contrast to those stained by carbol-fuchsin and the ordinary method. One of these procedures was hæmatoxylin staining, followed by Gram and eosin. These sections show violet staining of the tissues, the bacilli being blue and the clubs red. A still

* Monatsber. üb. d. Gesammtleist. a. d. Gebiete d. Krankh. d. Harn., iii. (1898) No. 3. See Zeitschr. f. wiss. Mikr., xvi. (1899) p. 383.

† Wiener Klin. Wochenschr., 1899, p. 1068. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 272–3. ‡ Journ. App. Microscopy, ii. (1899), p. 641.

§ Beiträge z. Pathol. Anat. u. z. allgem. Pathol., xxvi. (1899) pp. 470–510 (1 pl. and 4 figs.).

better result is exhibited by a more complicated procedure. The sections were hot-stained with 1 per cent. bleu-de-Lyon, then washed, and differentiated with a solution made up of sp. vini 3, aceton 3, distilled water 3, and anilin 1. After washing with sp. vini, the sections were stained with carbol-fuchsin, and then differentiated with 1 per cent. HCl-alcohol. The sections, having been washed in water, were contrast-stained with an aqueous slightly acid solution of Bismarck-brown, then dehydrated in alcohol, cleared in xylol, and mounted in balsam.

Study of Central Nervous System.*—Dr. G. C. van Walsem gives a systematic and critical account of the technical methods employed in investigating the central nervous system, discussing at length macroscopic preparations and drawings, microtome sections, fixing, staining, and so on.

Demonstrating Hæmatozoa of Padda oryzivora.†—M. A. Laveran has been able to demonstrate by a special staining method a hitherto unobserved phase in the development of the endoglobular hæmatozoa of *Padda oryzivora*. Fresh rubbings of spleen pulp are fixed in a saturated aqueous solution of picric acid. After having been washed in water, the films are stained with a mixture of eosin and Borrel's blue.‡ After an immersion of 15–18 hours, the preparations are washed in distilled water, and then treated with 5 per cent. tannin solution for some minutes. They are then dehydrated, and mounted in balsam. The newly observed parasites are spherical or oval bodies, 2–3 μ in diameter, and are found free in the plasma or within cells. They appear to be present in great abundance, while the numbers of the pigmented parasites are not increased. They are not evident in fresh blood nor after ordinary staining methods.

Demonstrating Canaliculi of Bone.§—Dr. W. Colquhoun arranged glass tubing in lengths of about 12 feet up the wall of the laboratory. To the bottom of each of these tubes a bone (e.g. tibia of sheep) was fastened by means of rubber tubing and a rubber cork, after an end had been sawn off and the medullary cavity cleaned out. The periosteum was also stripped off, and any opening on the outside of the bone plugged with wooden pegs. The tubes were then filled with some staining solution containing a little antiseptic, and the bone left exposed to the warm air of the room, so that, as it lost moisture from the outside, the stain would be sucked in by the natural channels. After about a month the nuclei of the bone and the lining membrane of the canals were found stained. The sections were made by grinding after permeation with balsam.

By the foregoing procedure the canaliculi were but faintly stained, and this defect was remedied by using first a penetrating fixative (such as 3 per cent. bichromate of potassium with or without 0·25 per cent. osmic acid) and following this up with a fluid (such as 1 per cent. nitrate of silver), which would form a precipitate by chemical combination with the first. After the first fluid had been allowed to act for a

* Verh. K. Akad. Wetenschap. Amsterdam, vii. (1899) pp. 1–184 (8 pls. and 30 figs.).

† C.R. Soc. de Biol., lii. (1900) pp. 19–22.

‡ Cf. this Journal, *ante*, p. 264.

§ Journ. Anat. Physiol., xxxiv. (1899) pp. 84–9.

few days, the slice of bone was ground smooth on one side, and then treated with the silver solution for a week or two in the dark. After this it was permeated with balsam, and the other side ground down in the usual manner.

Dental Histology.*—Those interested in dental histology will find an excellent and useful account of the various processes necessary for demonstrating the structure and appearances of normal and diseased teeth in the article by Mr. L. Strangways, which, though covering a great deal of ground, is extremely concise.

New Liquid for Counting Blood-corpuscles.†—M. G. Hayem has found the following fluid very satisfactory as a menstruum for counting blood-corpuscles:—Distilled water 200 grm.; sodium chloride 1 grm.; sodium sulphate 5 grm.; solution of iodo-potassic iodide 3–4 ccm. The iodo-potassic iodide solution is composed of: distilled water 500 grm.; potassium iodide 25 grm.; iodine in excess. The amount of the iodine solution varies for different animals; for man it is 3·5 ccm.

Biological Test for Arsenic.‡—Herren R. Abel and P. Buttenberg, in an article on the action of mould fungi on arsenic and its compounds, deal with the demonstration of the metal by means of cultures. The results of Gosio and Abba § are confirmed, and the authors find that for the qualitative determination of arsenic this method is universally applicable, and is more sensitive than chemical tests. The mould used was *Penicillium brevicaule*, and the medium a sterilised mash of mouldy bread. At 37° and often within 24 hours, and always in from 48–72 hours, the growth was so luxuriant that the characteristic garlicky odour was perceptible. In this way 0·00001 grm. As_2O_3 and often 0·000001 grm. could be detected. Of metallic arsenic less than 0·0001 grm. could not be clearly demonstrated.

The method is applicable to any substance or compound or structure, such as chemical solutions, skins, hides, carpets, paper, woven fabrics, foodstuffs, and beverages of all descriptions. The presence of arsenic in minute quantities in human and animal bodies was easily demonstrated, and in the living subject a dose of 5 drops of liquor arsenicalis was detected.

Method for Sticking Celloidin Series with Water and Albumen.‖—Prof. P. Argutinsky communicates the following simple and satisfactory method for sticking celloidin sections on slides. The slide is carefully cleaned from grease by means of spirit and heat. A small drop of Mayer's glycerin-albumen is placed on each slide, and spread out into a very thin layer. The albumen is then coagulated by warming the slide. The sections, cut under 70 per cent. alcohol, are carefully straightened out and removed with a dipper to the slide, and then covered with alcohol. If the sections be not quite smooth, they must be replaced in alcohol to be straightened out. When the sections are satisfactorily arranged, the alcohol is removed by touching the long side of the slide

* Illust. Ann. Microscopy, 1900, pp. 61–70 (9 figs.).

† C.R. Soc. Biol., vi. (1899) p. 265.

‡ Zeitschr. f. Hygiene u. Infektionskr., xxxiii. pp. 449–90. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 187–9. § Cf. this Journal, 1899, p. 239.

‖ Arch. f. Mikr. Anat. u. Entwicklungs., lv. (1900) pp. 415–19.

with blotting-paper. Strips of filter-paper, 8–12 mm. thick, are now placed on the slide, and pressure applied with the finger. This removes the remains of the alcohol, and presses the section into the albumen. The filter-paper strips are then removed, and the slide is at once immersed in distilled water, where it remains until required for further treatment (staining, &c.). Slides thus treated may remain in the water for a whole day without detriment; but if not required for several days it is better to place them in 70 per cent. alcohol.

The albumen is best coagulated by placing the slides for some minutes in an incubator at about 100° C.

Encain Hydrochloride as a Narcotising Agent.*—Mr. G. T. Harris extols the virtues of encain hydrochloride (Beta-encain) as a narcotising agent. He has found it give far better results than cocain, and has tried it on Vorticellidæ, Rotatoria, and Vermes. Mr. Rousselet also reports favourably as to its action on Floscullariæ. A 1 per cent. solution is recommended. It is stated to be perfectly stable in aqueous media.

Method for obtaining Thin Laminæ of Minerals.†—M. F. Stöber recommends the following procedure for reducing granules of minerals and stones to thin laminæ. Upon a large cover-glass lying on a slide is placed some Canada balsam. This is liquefied by heat, and then some of the powder to be examined dropped in. The balsam is now covered with a piece of paper, and over this is placed a thin piece of rubber, and then another slide. Pressure is now made so that the grains may sink into the soft balsam and settle on the upper side of the cover-glass. When the balsam has become hard, the slides and paper are removed, and the grains ground down flat and even with fine emery. Some balsam is now placed on a slide, and the preparation with the ground surface downwards placed thereon. The balsam is now heated, and pressure applied as before. When the balsam has become hard, the cover-glass is sprung off, paper is placed on the smooth surface, and the preparation again heated and pressed so that the grains with their ground side may firmly adhere to the slide. The other surface is now ground until the granules are sufficiently thin, and then the preparation is provided with a cover-glass. In the same way thin sections may be transferred from one slide to another.

Peculiar Diffusion Movements of Microscopic Objects.‡—Dr. J. Katz calls attention to some peculiar movements observed in a recently mounted specimen of sputum containing tubercle bacilli. Some six hours after having been treated with xylol and then mounted in chloroform-balsam, the bacilli were observed to exhibit active movements. In character the movements were trembling and undulatory, and recalled the appearance of spirilla in motion. The origin of the movements is ascribed to diffusion currents arising out of the use of xylol as a clarifying agent and of chloroform-balsam as a mounting medium.

Slide Labelling.§—Prof. G. J. Peirce mentions a neat device for labelling slides. One end is painted with a very thin solution of balsam.

* Illust. Ann. Microscopy, 1900, pp. 28–9.

† Bull. Soc. Franç. de Minéral., xxii. (1899) pp. 61–6. See Zeitschr. f. wiss. Mikr., xvi. (1900) p. 516.

‡ Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 431–3.

§ Journ. App. Microscopy, ii. (1899) p. 627 (1 fig.).

When dry this is easily written on with ink, and the record may be permanently preserved by means of another coat of balsam.

Writing on Glass.*—Herr F. Noll remarks that for a long time he has used the edge of ground-glass stoppers for writing notes relative to the contents of the bottle. The notices are easily made with a lead pencil, and readily removed with a damp cloth when required. Recently he has had laboratory vessels ground near the top so that notes can be written thereon. This has been found a great convenience, while the increased cost is quite trivial.

FRIEDLAENDER, C.—**Mikroskopische Technik zum Gebrauch bei medicinischen und pathologisch-anatomischen Untersuchungen.** (Microscopical Technique for use in Medical, Pathological, and Anatomical Investigations.) Sixth edition, by C. J. Eberth. Berlin (Fischer), 1900, 8vo, 359 pp. and 86 figs.

SZYMONOWICZ, L.—**Lehrbuch der Histologie und der mikroskopischen Anatomie, mit besonderer Berücksichtigung des menschlichen Körpers, einschliesslich der mikroskopischen Technik.** (Handbook of Histology and of Microscopical Anatomy, with especial reference to the human body, including Microscopical Technique.) Parts 1 and 2. Würzburg (Stuber), 1899.

* Flora, lxxxvi. (1899) p. 384.

VI.—*A New Form of Fine Adjustment.*

By E. B. Stringer, B.A.

(*Read 16th May*, 1900.)

In the accompanying fine adjustment I have endeavoured to overcome those imperfections which proved troublesome in photomicrographic and also in visual work. The main points of its construction will be seen in fig. 103, and are as follows.

The limb, which is of the Jackson type, is prolonged into a vertical pillar P, of triangular section, placed close behind the coarse adjustment and body, so that any shake, should it exist, is not magnified by an intervening arm. The lever is of the second order, having its fulcrum F at the bottom and just in front of the pillar, and bearing on the moving part at a point exactly underneath it; this point being so near the fulcrum as to render the movement extremely slow.

The moving part, which carries the coarse adjustment and body in front of it, has a back plate attached to it by eight screws, with which, if necessary, its fit may be adjusted. It has two prolongations which pass downwards on each side of the limb, and receive a transverse steel pin in their extremities. This pin carries a small roller R, of hard steel, upon which the lever bears, downwards.

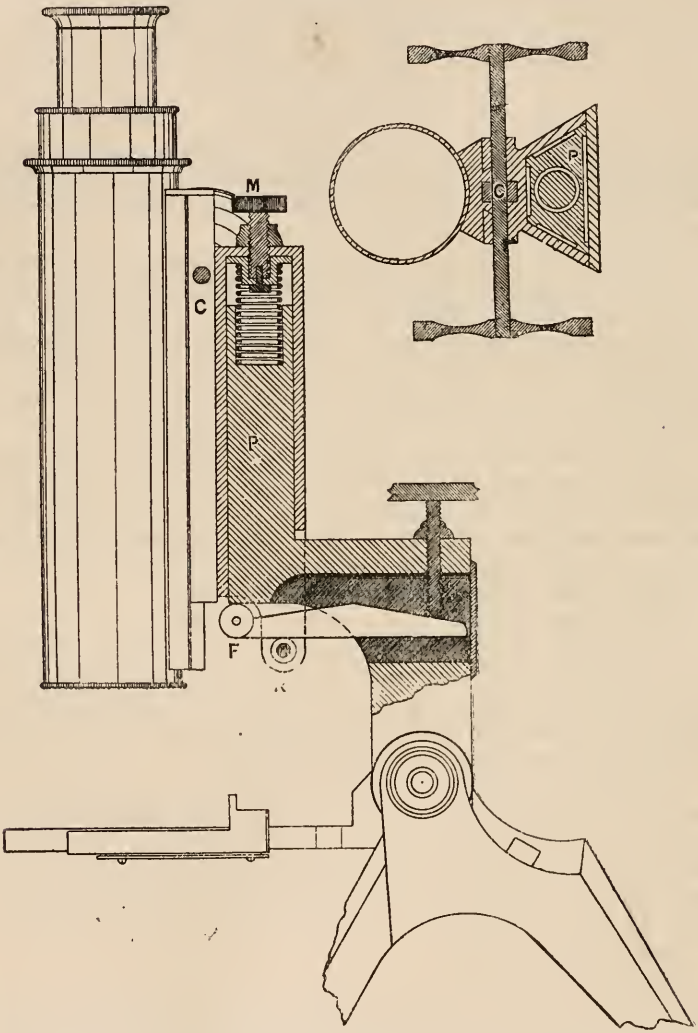
The opposing spring is in a recess at the top of the pillar, and draws the roller upwards against the lever. The action of the roller is to abolish friction at this point, and to convert the movement of the lever, which is of course the arc of a circle, into the straight movement of the sliding part, without the least tendency to the production of a shake in a backward or forward direction.

It will be noticed that in virtue of the position of the spring the weight of the body is supported by it; so that, though this weight is, as it must be, considerable, it is in practice reduced to a small minus quantity; and the pressure of the lever on the micrometer screw is thus very slight, being in fact only just enough to take up its backlash. The finest screw may in consequence be used without danger of its suffering from wear.

Further it will be seen that the weight of the body bears most upon the spring when the Microscope is in a vertical position, whilst in the horizontal position it is quite inoperative; so that for the latter position the same spring is much too strong, and by exerting an undue strain might cause lateral movement. It is in consequence of this that much of the trouble occurs in photomicrography; fine adjustments which are perfectly satisfactory in the vertical or inclined positions, sometimes working badly when set horizontally.

To meet this difficulty I have added a means by which the tension of the spring may within considerable limits be controlled. A milled

Fig. 103.



P, Pillar. F, Fulcrum of lever. R, Steel roller on which the lever bears. M, Milled head controlling tension of the spring. C, Coarse adjustment pinion.

screw M, seen just behind the coarse adjustment, passes into the hollow pillar and terminates in a plug which bears upon the spring. When

the Microscope is set horizontally this screw is run out to its full limit, leaving just sufficient tension in the spring to work the movement in this position. Also should a binocular body or unusually heavy nose-piece be in use in ordinary work, the tension of the spring may with advantage be increased in proportion, by slightly screwing it up.

It would seem that only by such means can a high degree of sensitiveness be maintained under all conditions, in movements which actuate the entire body.

Another point of importance is that the body, as will be seen, is drawn downwards by the lever, and drawn upwards by the spring; the force in each case being applied exactly in the line of motion; so that, even should the pillar fit loosely and side shake be possible, it does not for the most part occur. Arrangements (and there are several) in which the body is *pushed* against an opposing spring, tend much to increase the liability to every kind of side shake and jamming.

Also, seeing that the moving part is firmly held between the lever below and the spring above, any alteration of focus when the milled head is at rest is quite impossible; a point of great importance in photomicrography.

The movement is well protected from dust, and is of sufficient strength to withstand the roughest treatment. It may be taken apart with great ease, it being only necessary to unscrew the transverse steel pin, and remove it and the roller, when the whole may at once be lifted off the pillar.

I should add that Mr. Nelson, who saw my drawings before Messrs. Watson made the instrument, suggested that the pillar should be slightly hollowed out at the sides, so as to bear only at its edges, thus guarding against the possibility of any lateral rocking movement. He subsequently suggested that the back plate should be slightly sprung by cutting away the underlying metal in four places; also that the pillar should be made wider and considerably truncated in front, so as to form a bar similar to that in the coarse adjustment of Powell's large stand. All these three improvements have been carried out in the present instrument.

Careful trials since made have shown that with this form of pillar the strongest spring works perfectly well, without the least tendency to the production of side shake, either in the vertical, inclined, or horizontal position. The adjustment controlling the tension of the spring, therefore, loses much of its importance. Very critical workers might still, however, find it advantageous.

NOTES.

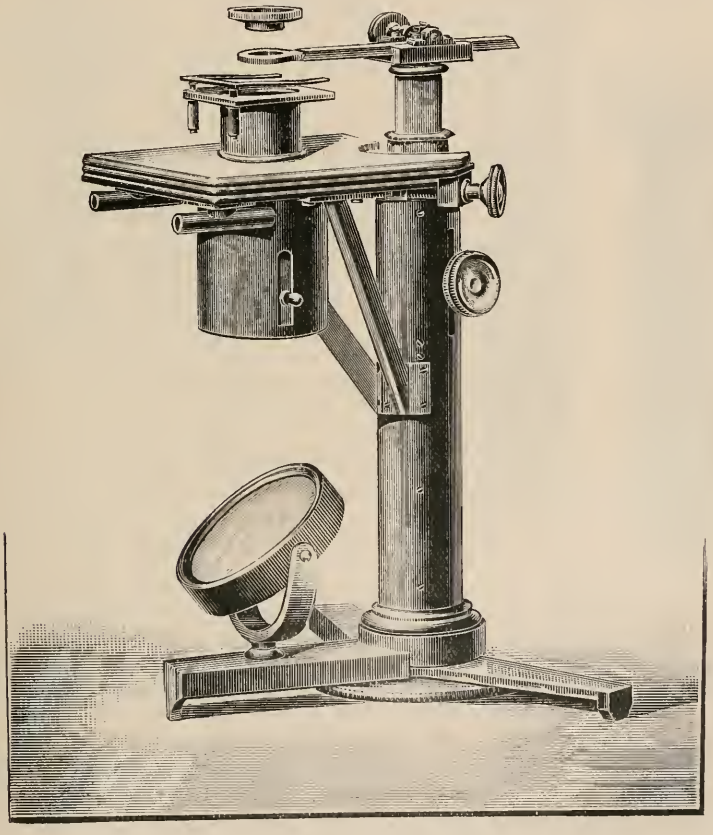
The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

II.—ANDREW ROSS'S MICROSCOPES.

The name of Andrew Ross first appears in the *Transactions* of the Society of Arts,* in connection with a Microscope he made in March 1831, for Mr. W. Valentine of Nottingham. At this time Mr. Ross's address was 5 Albemarle Street, St. John's Square, Clerkenwell; and it is probable that he was a philosophical instrument maker to the

Fig. 104.



* Vol. xlviii. p. 413 (1832).

trade, and that Mr. Valentine, in getting him to carry out his ideas, preferred to deal direct with the actual maker rather than through any of the retail opticians, who merely engraved their names on the instruments made by Messrs. Ross, Powell, and others.

Mr. Valentine's Microscope was a very good one in its day. It has been repeatedly figured, but important details in its construction, which have had much influence on the evolution of the Microscope, have been passed over without notice.

Description of this Microscope. — The foot was a flat folding tripod, fig. 104—a common form at that time; it was subsequently altered to a solid flat tripod. Stage—mechanical with slow rectangular movements, actuated by direct-acting screws.

This movement was a sort of fine adjustment stage movement, the coarse adjustment being the movement of the lens over the object; it should be remembered that for about three-quarters of a century it had been the custom to fix the object and move the lens over it.

Fig. 105.

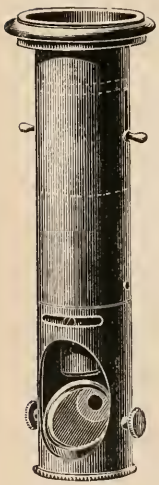


Fig. 106.

Illumination.—Wollaston's illuminating apparatus, fig. 105, or a modification of it, as shown attached to the Microscope in fig. 104.

Focussing.—These movements were three in number:—1st, by drawing out the inner triangular bar; 2nd, by rack-and-pinion work, which moved the middle triangular bar; 3rd, by fine adjustment screw, which moved the outer triangular bar. So in principle the movement is not unlike that of the modern Continental Microscope, where the body and coarse adjustment are carried by the fine adjustment screw.

This Microscope was, like many of that date, both single and compound. The lens-holder, for either a single lens or a Wollaston doublet, is shown in fig. 106. These lenses, although non-achromatic, were excellent; their fields and apertures were small; nevertheless they gave very good images. I have in my cabinet a Wollaston doublet which shows tubercle bacilli. The lens-holder was attached to the top of the inner triangular bar by means of a conical pin; the lens was therefore capable of a motion in arc over the preparation as well as that given to it by means of the extension rackwork. This movement—a very convenient one for a simple dissecting Microscope — owes its origin to Ellis's Aquatic Microscope, made by J. Cuff in 1755; afterwards Benj. Martin was the first to add rack-and-pinion to the extension and a worm-wheel to the tangential movement.

The compound body was attached to the inner triangular bar by a conical pin, in the same manner as the lens-holder (fig. 107).* The important part of the Microscope lies in its fine adjustment; the screw with 50 threads to the inch had its head divided into 100 parts, and placed below the foot. This Microscope resembled, in three points, Adams's Universal Microscope of 1746, for both had upright pillars, both flat folding tripod feet, and both had the heads of their fine

Fig. 107.

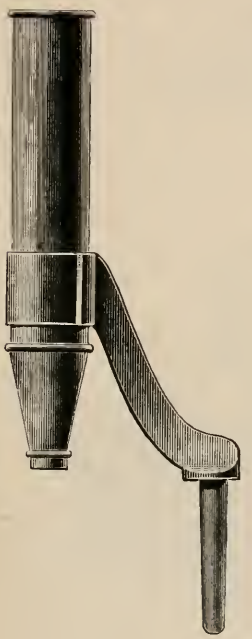
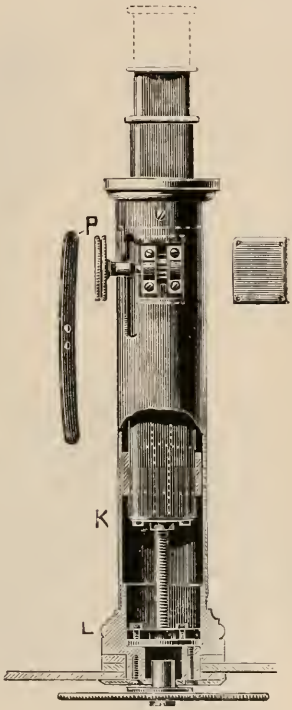


Fig. 108.

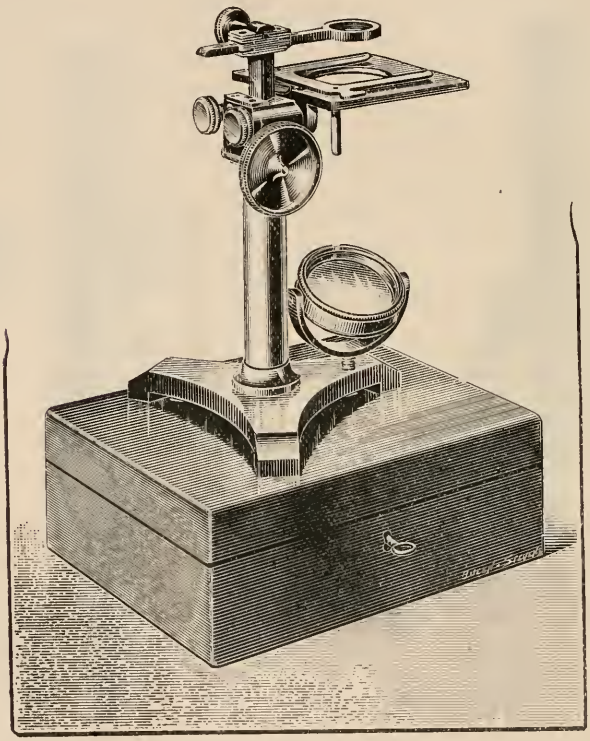


adjustment screws below the bases of their pillars; Adams's, however, was a stage focusser. This is the first instance we meet with of the head of a fine adjustment screw divided for micrometrical purposes; and it was the suggestion of Mr. R. H. Solly, whose liberality in defraying the cost of the plates illustrating these early Microscopes enables us to

* Mr. J. Mayall, junr., figures this Microscope, with the compound body and Wollaston condenser attached, in the Cantor Lectures of the Society of Arts for 1888, p. 14, fig. 20, but he has failed to note its identity with Valentine's Microscope. Had he known that an important feature in this Microscope was copied from a Microscope designed by C. Varley, he would probably have modified his adverse criticism on the latter's work.

ascertain many important facts with regard to their construction. But to return to the fine adjustment:—it had a sprung nut K, fig. 108, and also a sprung bearing for its lower portion at L, to prevent loss of time in its action. The spring in the rack-slide of the lens-holder, fig. 106, and also the spring P, fig. 108, which fits inside the round pillar, and presses the triangular bar into one of the angles of its slide, will be noticed. From the text we learn that this springing of the fine adjustment was copied from a Microscope designed by C. Varley,

Fig. 109.



which is figured and described in the same volume of the *Transactions* of the Society of Arts.* From the above account it will be seen that this first Microscope of Andrew Ross, or at least the first issued under his own name, was an excellent and thoroughly practical construction.

In 1832 we find Andrew Ross at 15 St. John's Square, Clerkenwell, and achromatic objectives bearing his name with this address upon them are still extant. In 1838 his address is 33 Regent Street.

* See figs. 72, 73, *ante*, p. 284.

Piccadilly, and in 1839 the article "Microscope" in the *Penny Cyclopædia*, written by him, was published. In this article is figured a simplified form of Valentine's Dissecting Microscope, fig. 109. It has no fine adjustment, but as there is a thoroughly well sprung rackwork coarse adjustment acting upon a triangular bar, its focussing

Fig. 110.

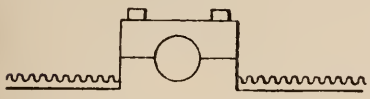
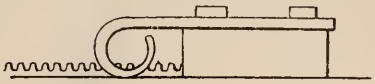
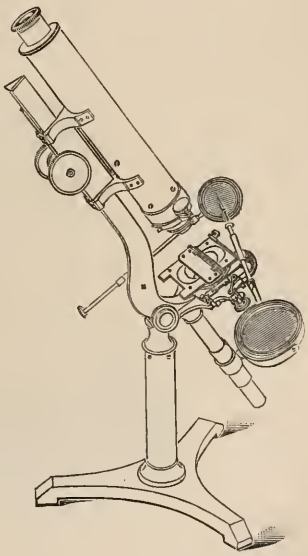


Fig. 111.



capabilities are quite equal to the work it is intended to perform. The springing of the coarse adjustment pinion of this Microscope was an advance upon that of Valentine; for while Valentine's was like fig. 110, this Microscope had one like fig. 111. This kind of sprung coarse adjustment was first used in C. Varley's Vial Microscope, made by Hugh Powell in 1833, and it is even now by far the best method of mounting the pinion; but it has been given up by all manufacturers except Powell. This instrument is very portable, for the pillar unscrews from the foot, the mirror unships, and the two screws seen at the back liberate the stage, which can be packed flat in the case. This Microscope is also figured in vol. iii. p. 220 of the *Quarterly Journal of Microscopical Science* (1855).

Fig. 112.



The next Microscope, a compound, fig. 112, is also figured in the *Penny Cyclopædia*. The foot and pillar are similar to those of the dissecting stand, but the feature that at once attracts attention is the Lister limb supporting a cradle which carries the body. It has been thought that this form of mount was suggested by Mr. G. Jackson; but we learn, from a note in the *Quarterly Journal of Microscopical Science*,* that the editors have Mr. Jackson's authority for saying that it was originally made by Mr. Ross. The fine adjustment is of the short lever nose-piece type. Although the name of the inventor of this kind of fine adjustment is not stated, it is pretty certain that it was Andrew Ross. James Smith fitted a somewhat similar arrangement to one of his early Microscopes in 1839. The stage is mecha-

* Vol. i. p. 219 (1853).

nical, with rectangular motions performed by two racks and two pinions, both pinions being at right angles to the stage, in which respect Smith's Microscope was also similar. An achromatic condenser could be fitted beneath the stage instead of the rotating diaphragm. The compass joint was supplied with a screw clamp to fix the instrument at any inclination.

Fig. 113.

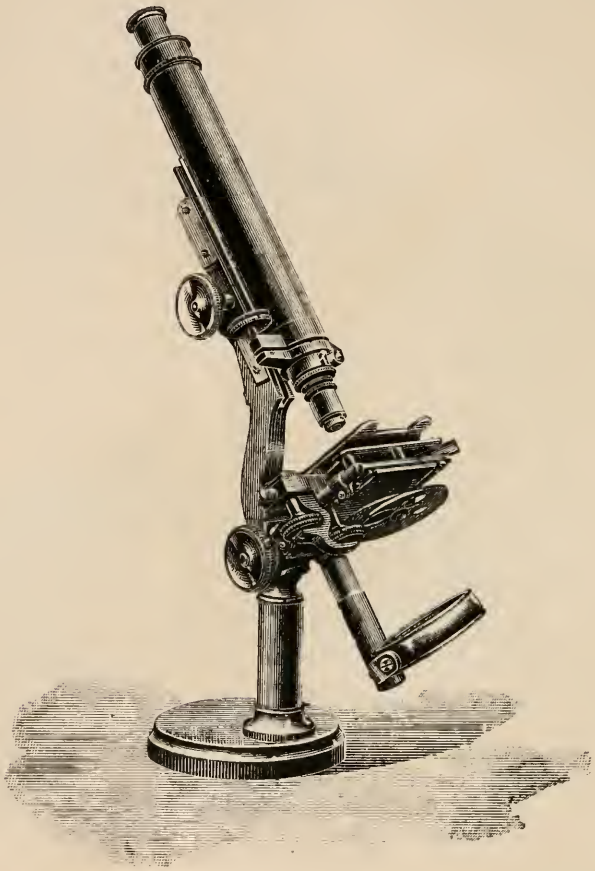
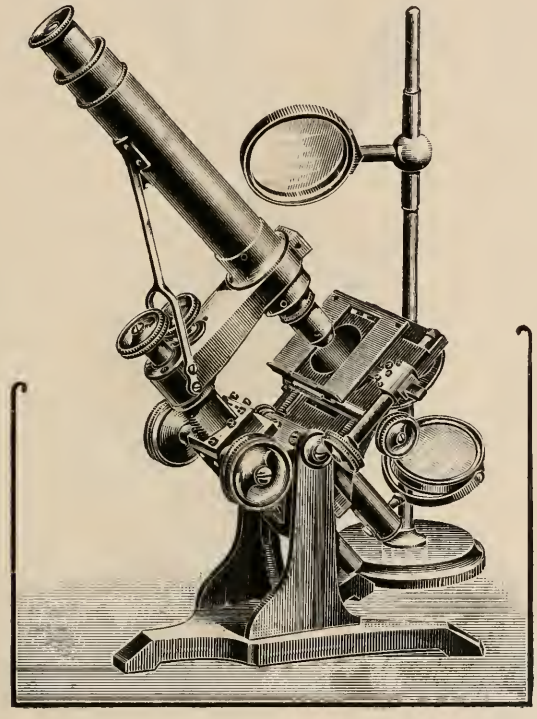


Fig. 113 shows the next stage in the evolution of Ross's Microscopes. Here the Lister limb is retained, but the cradle is dispensed with, the limb itself being grooved and the rack attached to the body. This capital form of mount was designed by Mr. Jackson, but it is impossible to say who was the first manufacturer to carry it out practically. We know that both Powell and Smith adopted this plan in 1841, and probably Ross made this Microscope in that year. The

fine adjustment and the stage remain as before; the lower part of the stage is better seen in this figure; the rotating diaphragm is attached to a plate, which slides in grooves below the stage; it is removable, and an achromatic condenser can be inserted in its place. The large lower milled head is the clamp of the compass joint. The foot is circular and capable of rotation, so that the greatest amount of stability can be secured when the instrument is used in either an inclined or a vertical position. This excellent idea, which was first introduced by Cuff in 1765, is still carried out.

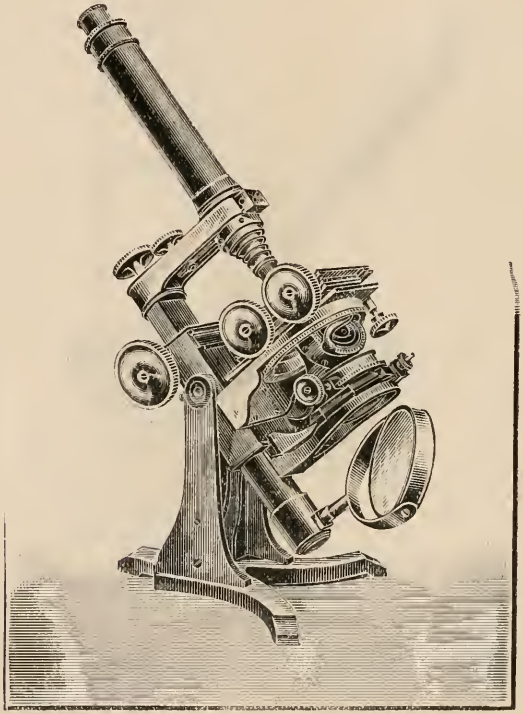
Fig. 114.



Andrew Ross's next model was constructed upon a totally different plan, as we can see from fig. 114, which is copied from a very rare book, the *London Physiological Journal* for Dec. 1843. This figure is so clear, and the model so well known, that a description is superfluous; the following improvements may however be pointed out. The hanging of the instrument between two supports is far preferable to the former method of fixing it upon the top of a compass joint; this, as we have seen, was the invention of George Jackson; its centre of gravity is lowered, and its poise is in every way better.

The pinions of the rectangular movements of the stage, though placed at right angles to one another, are both in the same plane as the stage. By placing the fine adjustment lever inside the transverse arm, a far steadier movement is secured. The coarse adjustment, obtained by racking a well sprung and stout triangular bar out of the limb, is a very sound construction, which yields a smooth and steady movement, and which also possesses the advantage that the milled heads of the pinion are brought down closer to the table. Compare this with figs. 112, 113. The substage arrangements are

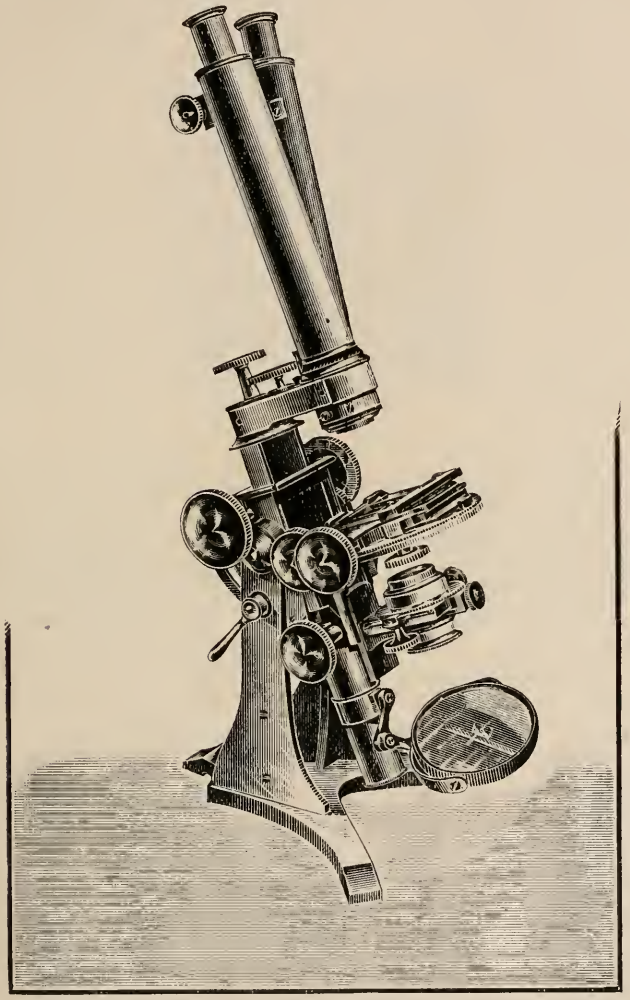
Fig. 115.



the same as in the previous model. There is one feature this Microscope possesses which has been generally overlooked, viz. that the body, together with its transverse arm, can be removed, a plain arm can be substituted for the purpose of carrying a single lens or a Wollaston doublet, so this instrument can be used either as a simple or compound Microscope. About 1847 Andrew Ross moved to 2 Featherstone Buildings, Holborn, and about 1850 a new model was brought out; but fig. 115, taken from the 2nd edition of Quekett (1852), plate 11, dated 1851, shows that the general form of the instrument

remained much the same as it was before. The following alterations may be enumerated :—1st, a rectangular bar was substituted for the triangular bar in fig. 114, and the back-stay to the body was omitted ; 2nd, the pinions controlling the rectangular stage movements were

Fig. 116.



placed parallel instead of at right angles to one another ; 3rd, concentric rotation was added to the stage ; 4th, a complete substage with rectangular and rotary movements was supplied.

It is highly probable that this model was prepared for the Exhi-

bition of 1851; but we are unable to obtain any information on the subject from the Report of the Jurors of the Microscopical section. This was the last Microscope Andrew Ross designed. He died in 1859, and was succeeded by his son, Thomas Ross.

Thomas Ross prepared for the Exhibition of 1862 a new model very similar to the previous one, the chief difference being the addition of a binocular body, fig. 116. This form of binocular, which was invented by Wenham in Dec. 1860, is by far the best of all the contrivances that have as yet been introduced. The stage was made a little thinner, and the diameter of the substage tube was altered from 2 in. to 1·527 in.

On March 15th, 1843, Ross delivered the Microscope which had been ordered by the Microscopical Society of London on May 26th, 1841; but unfortunately we are now unable to determine what that Microscope was like, because it was exchanged in 1863 for the binocular Microscope in our cabinet, which was made by Thomas Ross, fig. 116. The original Andrew Ross model must have been like either fig. 113 or fig. 114. If we assume that it was like the latter figure, which was then an entirely new pattern, some time must have been taken with alterations and adjustments, and so the delay in its delivery would be accounted for.

THE OBJECT-GLASSES OF ANDREW ROSS.

The first achromatic Microscope object-glass constructed in this country was made to the order of Dr. Goring by W. Tulley, the telescope maker, of Islington, in 1824; it was an uncemented triplet, and cost 90*l*. Mr. J. J. Lister, in 1824, began experimenting with achromatic object-glasses; on seeing a 4/10 and a 2/10 which Tulley had made for Dr. Goring, he suggested some improvements, the result of which was the production of the celebrated 9/10 by that firm. Subsequently Mr. Lister ground and polished lenses himself. On January 21st, 1830, he read his paper on the two aplanatic foci before the Royal Society. In 1837 he designed an 1/8 object-glass for Andrew Ross. This had a triple front (Mr. Lister's invention) and two doublets (fig. 117); for the lower powers he suggested a double combination, which was formed by combining a front (one of Andrew Ross's failures) with one of Lister's backs (this is Lister's own account; but, according to Ross, it was a Lister front that was combined with a Ross back). I am rather inclined to think that there is a clerical error in Lister's account, and that Ross is correct. If this is so, then the lens will have a back similar to the middle combination of the lens in fig. 117 and a front of the form shown in fig. 121. In 1840 Lister obtained Ross's consent to instruct James Smith in the construction of object-glasses; he says, "even in 1843 it was with the understanding that he should not go to deeper powers than 1/4 in.,

and 'Smith's quarters' were long in repute. Some variations too have been since made in the construction in which I have had no part; but for all, the principle of the two aplanatic foci has furnished the clue."

Andrew Ross began making Microscope object-glasses in 1832; the following list gives a tabulated history of his work. One of his

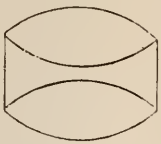
Fig. 117.

most important discoveries was that of the aberration caused by the cover-glass (1837), and its method of correction by lens distancing was suggested to him by Mr. Lister's paper on the two aplanatic foci. In 1849 Ross added a correctional collar to the Gillett's condenser; he was also the inventor of the silver side reflector in 1836.

In 1855 Mr. Wenham made the correcting collar of objectives in such a manner that it moved the back lenses of the combination

Fig. 118.

Fig. 119.



instead of the front; this constituted a real advance, and this plan has now become general; it is mentioned here because Ross made lenses from formulæ supplied by Mr. Wenham. In 1850 Ross made a chromatic condenser consisting of three lenses; the front was a hemispherical meniscus, the middle a plano, and the back a crossed lens; this lens was designed by the Rev. W. Kingsley, professor of mathematics at Cambridge (fig. 118). It was a very good condenser for a non-achromatic one, and its performance was not unlike Abbe's three-lens

condenser; it however did not become popular here, as the achromatised condenser was preferred.

Date.	Focus.	Angular Aperture.	N.A.	Character.	Remarks.
1832	1	14°	·12	Two achromatic doublets	Made for Mr. R. H. Solly.
1833	1	18°	·16	Uncemented triple	Tulley's form.
1834	1/4	55°	·46	.. ..	Belonged to Prof. Quekett.
1836	1	15°	·13	Cemented triple	Fig. 119.
1837	1	22°	·19	Designed by Mr. J. J. Lister	Fig. 117.
„	1/8	64°	·53		
1842	1/2	44°	·37		
„	1/4	63°	·52		
„	1/8	74°	·60		
1843	2	10°	·09		*London Physiological Journal.*
„	1/6	66°	·55		
„	1/12	90°	·71		
1844	1/8	85°	·68	Copied from objectives constructed by Prof. Amici	
„	1/12	135°	·92		
1848	2	12½°	·11		From 1st edition of Quekett.
„	1/12	120°	·87		
1851	1	27°	·23		Report of Jurors, Exhibition 1851.
„	1/2	60°	·50		
„	1/5	113°	·83		
„	1/8	107°	·80		
„	1/12	135°	·92		
1852	1/4	75°	·61		2nd edition of Quekett.
„	1/4	105°	·79		
„	1/12	150°	·97		
1855	1/2	65°	·54		3rd edition of Quekett.
„	1/4	120°	·87		
„	1/6	135°	·92		
„	1/8	150°	·97		
„	1/12	170°	·99		

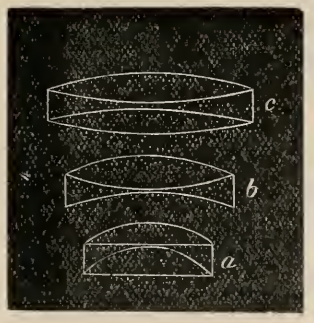
The following (see next page) are in the possession of the author. The numerical apertures and the optical indices are from actual measurement.

It is very difficult at this date to ascertain who was the inventor of the various improvements in objectives; nothing was published about any improvement at the time of its introduction, and much secrecy was observed. I should be disposed to regard Ross's 1832

Date.	Focus.	N.A.	O.I.	Character.	Remarks.
1836	1	·14	12·7	Cemented triple, fig. 119	Address, 15 St. John's Sq., Clerkenwell.
„	1/2	·19	7·9	„ „	
Post 1837	1	·21	16·7	Two doublets and triple fronts, fig. 117	A fine lens.
Ante 1837	1/2	·28	12·7	Three doublets	Well corrected. Address, 33 Regent St., Piccadilly.
„	1/4	·40	9·5	Ditto, ditto. No correction collar	Well corrected.
Ante 1847	1/4	·54	9·8	Correction marked, covered and uncovered. Two doublets and triple front, fig. 117	Well corrected.
1854	1/6	·93	12·9	Three doublets and single front. An early example of single front lens. The mount, which is dated, is very massive, and weighs 4 oz. A fair lens. Correction collar graduated	
Circa 1840	1/12	·81	6·2	Correction marked covered. Triple front, triple back, double middle, fig. 120	Well corrected.
1856	1	·21	19·1	Two doublets, front fig. 121, back same as middle, fig. 117	Not so good as 1-in. above; lens is dated.

objective as a copy of a Continental one, and his 1833 objective as a copy of Tulley's. The triple front, fig. 117, was undoubtedly due to Mr. J. J. Lister.

Fig. 120.

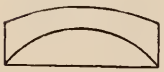


Mr. Wenham, writing * in 1869, claims to have been the inventor, about the year 1850, of the single front; but in an article written by him for the third edition of Quekett in 1855, he does not even mention

* Mon. Micr. Journ., i. (1869) pp. 111, 170.

the single front. The lens figured by Mr. Wenham in his 1869 paper has a single front, a double middle, and a triple back (fig. 122); he states that the triple back was the invention of Mr. Lister in 1850. He alters* this form of lens in 1873 to a single front, a triple middle, and a single back, the whole of the corrections being performed by the single flint in the centre of the triplet. I have an example of this kind of lens, and have seen many others, but cannot say that they are better than the (1854) 1/6 with the single front and the three doublets.

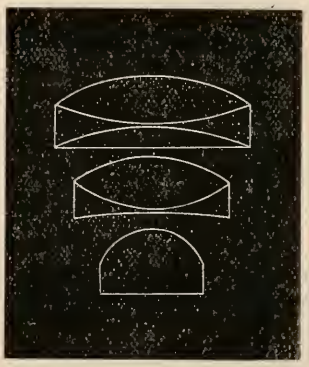
Fig. 121.



Personally I am inclined to believe that the triple back is older than 1850, and it is doubtful if it was the invention of Mr. Lister, as he makes no mention of it. A good many improvements in objectives were undoubtedly due to Prof. Amici.

The optical index which equals $\frac{\text{N.A.} \times 1000}{\text{Initial power}}$ reveals the true character of a lens, and shows the real advance made in object-glass construction. Example :—The 1/4 (before 1837) has an O.I. of 9·5,

Fig. 122.



and that of 1847 one of 9·8, only a slight difference; this is accounted for by the fact that the older lens is a true 1/4, while the later is between a 1/5 and a 1/6 in power, so that the ratio of aperture to focus is about the same in both. In the 1 in. lenses we have an advance from 12·7 to 16·7, and then to 19·1. We may compare these old lenses with the modern apochromatics, 1 in. O.I. 28, 1/2 O.I. 32, 1/4 O.I. 22, 1/6 O.I. 15, this last lens being not so greatly different from the 1/6 of 1854.

Andrew Ross died in 1859.

* Mon. Micr. Journ., ix. (1873) p. 157.

MICROSCOPY.

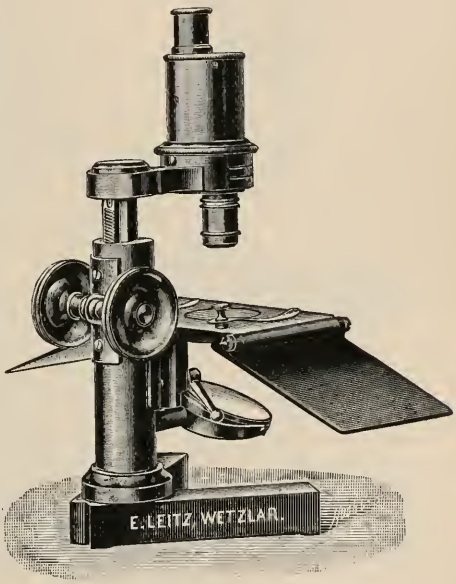
A. Instruments, Accessories, &c.*

(1) Stands.

Pfeiffer's New Preparation Microscope.—This has been designed by Prof. Pfeiffer to meet a want felt by him in his work on malarial parasites. He considered that an instrument of this kind should give an erect image, a maximum object-distance, large field, and sufficient magnification.

Fig. 123 shows the Microscope, which is built on the ordinary principle, but the inverted image produced by the objective is by a suitable prism arrangement presented to the eye as erect. These prisms are contained in a somewhat wide brass tube, which on its under side carries the objective excentrically, and on its upper the ocular. The bending of the light-path shortens the tube length, so that the eye is only 13–15 cm. above the stage on which the hands work. Three objectives are supplied; No. 1 gives 32-fold magnification at 45 mm. object distance; No. 2, 44-fold at 25 mm.; and No. 3, 65-fold at 15 mm. In spite of the passage of the light through the prisms, the image is full of light, sharp, and free from chromatic defects. The optical part is mounted on a firm stand with rack and pinion; the stage is spacious, and has supports for the hands. The stage-opening is provided with iris diaphragm, and the whole instrument can be very conveniently packed into a light box. The maker is Herr Leitz.

Fig. 123.



Erection of the microscopic image by means of prisms was first effected by Ahrens.† The same idea was carried out by Zeiss in 1895.‡

Vernier Microscope.—The Microscope shown in fig. 124 is of the type known as the Vernier or Micrometer Microscope. It was designed in the first instance for Prof. Baily of the Heriot-Watt College, and

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

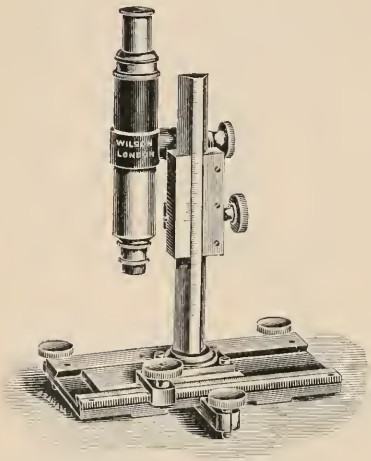
† Cf. this Journal, 1888, p. 1020, fig. 161.

‡ Cf. this Journal, 1895, p. 580, figs. 82–84.

embodies several suggestions made by his assistant, Mr. Cameron Smith. It is intended chiefly for use in a physical laboratory, where minute measurements of distances are very often required—such as the exact amount of bending of a rod, or of the stretching of a wire under a given weight, to determine Young's modulus; minute changes in thermometers and barometers; the comparison of two fiducial marks, or the distance between them; the measurement of refractive indices of plates and liquids; and numerous other purposes.

The instrument consists essentially of a horizontal and a vertical slide, along which scales to any practicable degree of fineness are engraved. The slides are actuated by rack-and-pinion movement where the scales are not read to a finer degree than 0·05 mm.; but for more minute readings a micrometer-screw arrangement is adapted. The Microscope proper is fixed at right angles to a horizontal axis, and thus turns in a vertical plane. At the common focus of the eye-piece (Ramsden) and the objective a finely divided glass micrometer-scale is placed, giving either the same reading as the verniers, or a finer one. As a higher power than 1 in. is seldom used with this class of Microscope, no fine adjustment is required. A divided circle has been added to the horizontal axis in some instruments to enable the Microscope to be placed at any required angle. The instrument is mounted on three levelling screws, and the lower slide is set in a horizontal position by means of a circular level let in at the base. By substituting a telescope object-glass for the objective, the instrument is converted into a very useful reading telescope, by which minute measurements can be taken at a considerable distance from the object.

Fig. 124.

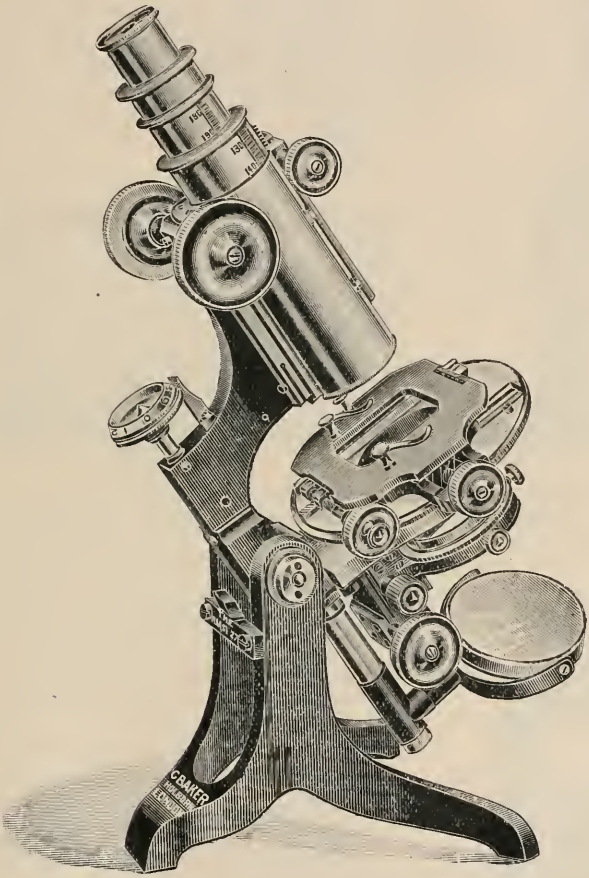


It will be seen from this description that readings can be taken in almost every direction.

C. Baker's R.M.S. 1·27 Gauge Microscope has diagonal rack-and-pinion movements and lever fine adjustments fitted to both the body-tube and the substage (fig. 125). Two draw-tubes are provided, one with rack-and-pinion adjustment; both are graduated in millimetres. The length of body with draw-tubes closed is 120 mm., when extended 250 mm. The diameter of draw-tube is the R.M.S. No. 3 size, viz. 1·27 in., and the body 1½ in.; when the draw-tubes and nose-piece are removed, low-power objectives and photographic lenses can be placed in the body, and a longer working distance obtained. The distance between the nose-piece and the top plate of stage, when the body is racked back to the fullest extent, is 3½ in. The rotating mechanical stage has a movement of 1 in. in either direction, and is graduated to 0·5 mm. The

milled head of the horizontal movement is placed lower than the top plate of the stage, and the other milled head is removable, so that large slides or culture plates can be conveniently examined. The substage is of the R.M.S. standard size (1·527 in.), and is provided with centering screws ; the milled heads of the coarse and fine adjustments are so

Fig. 125.

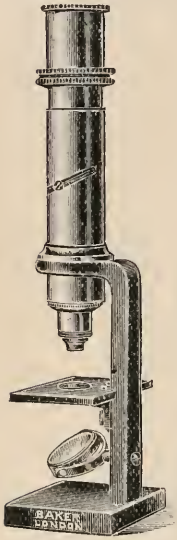


placed that they can be worked without shifting the hand ; the plane and concave mirrors are 2½ in. diameter. All the fittings are sprung, and have adjusting screws to compensate for wear. The foot is of the solid tripod form, and it has a bracket to support the stand when in a horizontal position.

C. Baker's Plantation Microscope (figs. 126, 127) is constructed according to the advice of the London and Liverpool Schools of Tropical Medicine, and is designed to enable missionaries, planters, hospital

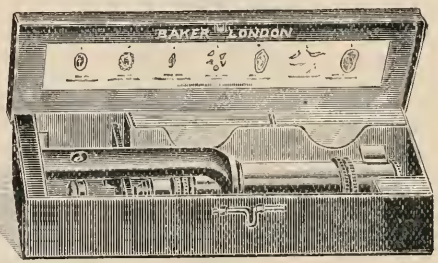
assistants, and others, to detect the presence of parasites, &c., common on man and animals, especially in the tropics. The magnifying power is × 150, and the focussing adjustment is made by rotating the body in its outer jacket-tube; a pin fixed to the body travels in a spiral slot in the jacket-tube, by which means a steadier movement is obtained than with an ordinary push-tube fitting.

Fig. 126.



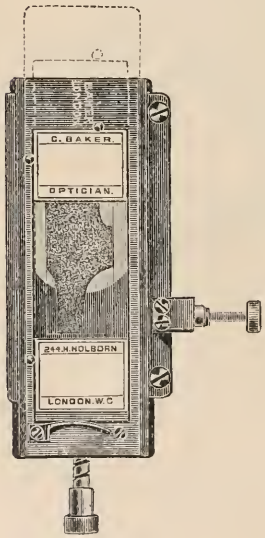
The instrument is packed in a japanned tin case, complete with glass slips and covers, also directions for use and illustrations of the eggs of the principal internal parasites, such as *Anchylostoma*, round and whip worms, *Amœbæ*, *Bilharzia*, *Distoma ringeri*, &c.

Fig. 127.



C. Baker's Attachable Mechanical Stage. — This stage (fig. 128) is specially designed for use with their diagnostic Microscope; it will be found useful in the systematic examination of covers as large as $1\frac{1}{2} \times 3/4$ in. The attachable stage is held in position by a spring runner fitting to the sides of the Microscope stage. A horizontal movement of $1\frac{1}{2}$ in. is obtained by a sliding top plate, which can be worked independently of the screw adjustment. This piece of apparatus, like the Microscope to which it is fitted, is very portable, being $4\frac{3}{4} \times 2\frac{1}{2} \times 1/2$ in.

Fig. 128.

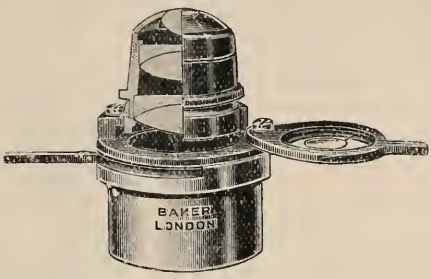


(3) Illuminating and other Apparatus.

C. Baker's New Achromatic Condenser (fig. 129) has a N.A. of 1·0, and is a modified form of the well-known Abbe achromatic condenser; the lenses, however, are smaller, being 7/8 in. diameter instead of $1\frac{1}{16}$, and the aplanatic cone is not less than 0·90. It is supplied with an iris diaphragm, a turn-out stop carrier, and three stops for dark ground illumination. The power of the optical combination is 4/10 in.; working distance 1/10 in. With the front lens removed, this condenser has a power of 8/10

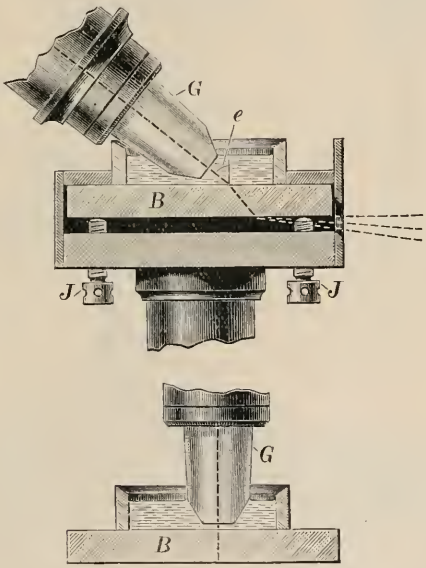
in. and 13/32 in. working distance, and is then suitable for use with the lower powers.

Fig. 129.



New Refractometer with Variable Refractive Angle.*— This instrument, made by Zeiss and designed by Dr. C. Pulfrich, is intended for the examination of a very highly refractive liquid, which is placed between two glass plates as in a kind of hollow prism, but with the difference that the refractive angle of the prism can be varied at pleasure.

Fig. 130.

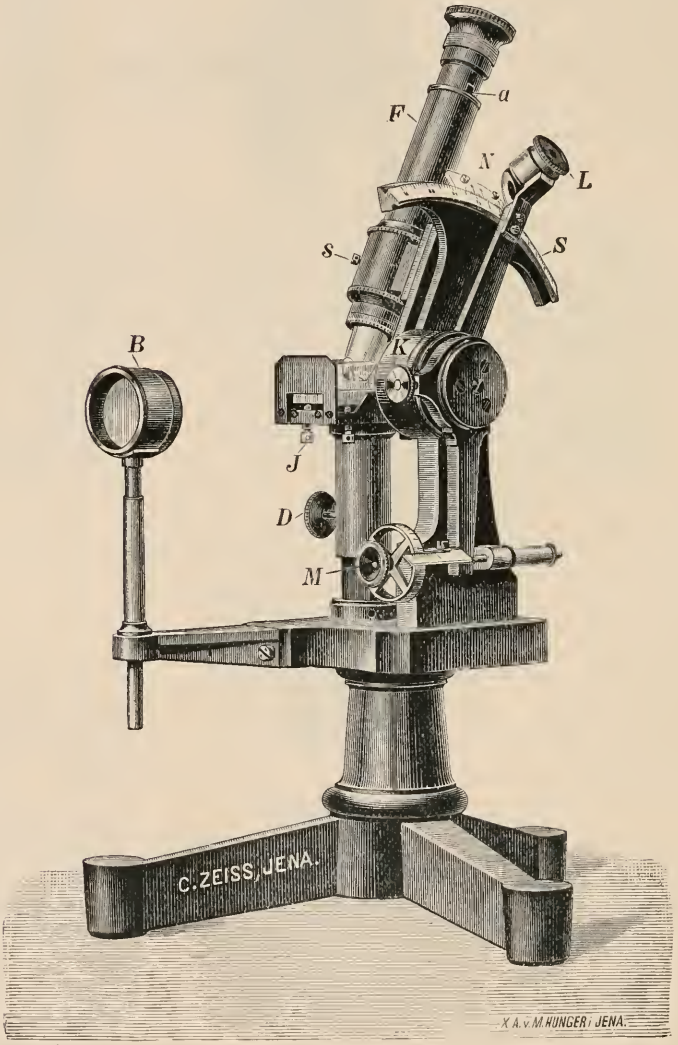


One of the two glass plates (B in fig. 130) forms the horizontal floor of a glass trough intended for the reception of the liquid; the other glass plate G takes the form of a slightly conical cylinder several centimetres long with even end-planes. The lower end of this cylinder dips into

* Zeitsch. f. Instr., 1899, pp. 335–9 (4 figs.).

the liquid, the other is in close connection with the observation-tube. Both telescope and glass cylinder are rotatory round an axis lying in the plane of the front face of the cylinder. The floor-plate of the trough

FIG. 131.



is illuminated with a streak of monochromatic light. If the telescope is so placed that the cross-threads coincide with the limiting line of total reflection, the prism angle is then equal to the angle of total

reflection and we get $n = \frac{1}{\sin e}$, where n = refractive index and e the angle of total reflection. The method is, as it were, a special case of prismatic vision, and can be defined as the method of oblique incidence and normal emergence. As the refractive index of the less refractive medium (air, $\mu = 1$) is known, there is no limit to the applicability of the method. In the case of the very highly refractive liquids, the glass parts are made of a specially hard and dense kind.

If Δn, Δe be small variations in the values of n and e, then the degree of accuracy is given by the equation

$$\Delta n = -\frac{\Delta e}{\sin e \,.\, \tan e}.$$

Volatile liquids and liquids which easily solidify are difficult to deal with.

A view of the instrument is shown in fig. 131. The rigidly attached sector S carries a scale graduated from 0° to 75° into half degrees. The

Fig. 132.

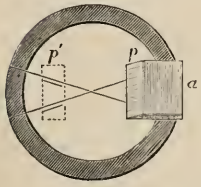
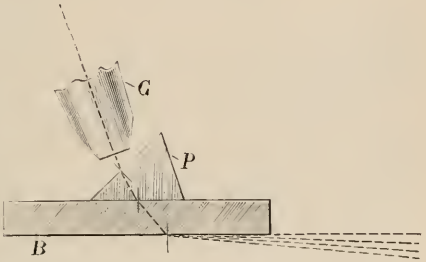


Fig. 133.



telescope F rotates about the horizontal axis, and a vernier N, by means of the lens L, gives readings to 1′. The coarse adjustment of the telescope is by hand motion; and the fine by a drum-headed micrometer screw M graduated to 1′. The latter appliance adapts the instrument for dispersion readings, for which the previous formula suffices.

The glass body at the base of the telescope is tapered off and cone-shaped; its under surface is only a strip 5 mm. broad, which is placed accurately in the axis of rotation of the telescope. Thus the solution-trough can be approximated very closely to the strip, and the distance regulated by the milled screw-head D. The lens B serves for the oblique illumination of the under side of the glass trough. The light source is sufficiently far removed to allow of the formation of a flame-image on the screen before the glass plate. Diaphragms can be placed in the telescope to cut off any reflected images.

A little window a in the eye-piece (fig. 132) allows, by a method of reflections, the normal adjustment of the telescope-axis to the prism-planes; small adjustments are imparted by the screw J (fig. 131).

The method of examining solid bodies is clearly shown in fig. 133. The solid must be in the shape of a prism P, and is placed on a plane piece of glass B with parallel sides, the refracting angle of the prism

being parallel to the rotation axis of the telescope. A drop of oil or water secures optical contact between the prism and glass plate.

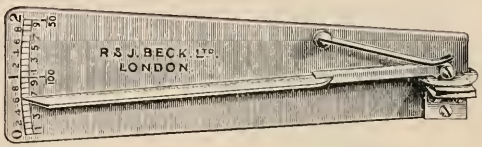
MARPMANN—**Ueber Prismenspektroskope und Mikrospektroskope mit Fernrohr.** (On Prism-spectroscopes and Micro-spectroscopes with Telescope.) *Zeit. f. angew. Mikr.*, V. (1900) pp. 309–13 (2 figs.).

(6) Miscellaneous.

Becks' Cover-glass Gauge.—Since the thickness of the cover-glass slightly alters the correction of a high-power object-glass, the purpose of this gauge (fig. 134, one-third full size) is for observing the thickness of thin glass covers under which objects are to be mounted.

All the object-glasses of these makers which are not provided with

FIG. 134.

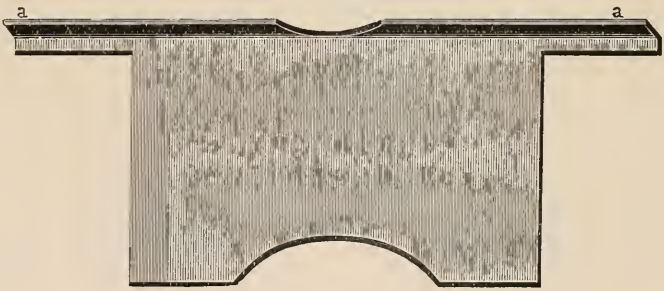


correction collars are corrected for cover-glass of 0·006 in.; this is the mean thickness of their No. 1 cover-glass, and it is advisable that no glass thicker than this should be used for high-power observation.

To ascertain the thickness of a cover-glass or lamina of any kind, first raise the long lever, and then slide in the cover-glass on the steel plate or bracket, and gently lower the lever on to it; the hardened steel point close to the fulcrum of the lever must rest on some portion of the cover-glass.

The thickness can then be read off on the scale in 0·001 in.; thus the scale illustrated above reads 0·006 in.

FIG. 135.

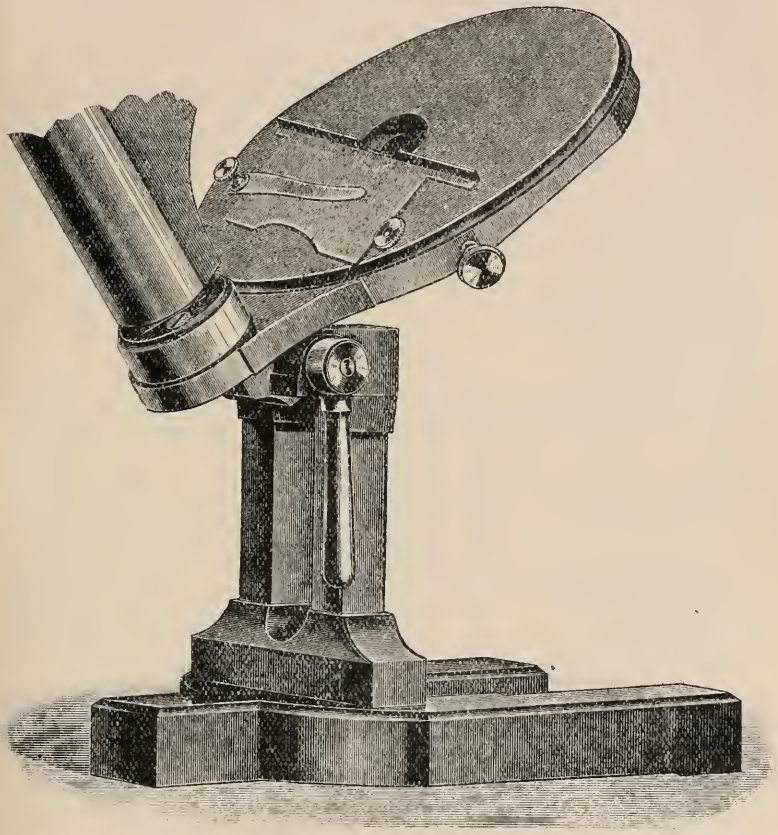


Mayer's Simple Object-pusher.*—Dr. Paul Mayer, of Naples, makes this convenient accessory (fig. 135) out of a thin metal plate, whose edges are cut accurately enough to move freely between the bases of the ordinary object-clamps (fig. 136). One spring is removed, and the other serves to press the plate on the stage with suitable pressure. The upper

* Zeit. f. wiss. Mikr., xvii. (1900) pp. 7–9 (2 figs.).

edge is bent upwards at right-angles, and the middle part is cut away so as not to interfere with high-power objectives. The object-slide rests

Fig. 136.



against the turned-up edge. By resting one's thumbs on the plate and one's forefingers on the object-slide, it is possible, with a little practice, to systematically and easily search every part of the preparation.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Medium containing Brain Substance for Cultivating Tubercle Bacilli.†—Dr. M. Ficker finds, from a series of comparative cultiva-

* 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, xxvii. (1900) pp. 504–11, 591–7.

tion researches on acid, amphoteric, neutral, and alkaline media which were made from sputum, potato, blood-serum, and from numerous human and animal organs, that substrata with acid or amphoteric reaction are far more favourable than those with neutral or alkaline reaction. The best of all was a medium containing brain substance and having an acid reaction. This was prepared in the following way:—Fresh brain was passed through a mincing machine, two or three times, and the mass mixed with an equal bulk of distilled water. This was then heated slowly to boiling, being constantly stirred the while. After having boiled for a quarter of an hour, the decoction was passed through a strainer. The strained broth was then distributed into flasks, and steam-sterilised for two hours. This stock broth was used to mix with serum or agar. For the brain-serum medium equal parts of stock and serum were used and then mixed with 3 per cent. glycerin. Slants in test-tubes were made of this mixture in the usual way. The brain-agar medium was made by mixing equal parts of a 2·5 per cent. solution of agar and the stock-broth and then adding 3 per cent. glycerin. The mixture was distributed into test-tubes, and the tubes steam-sterilised for half an hour.

During sterilisation brain-agar separates into two layers, the upper one being agar, the lower brain substance. It is, therefore, necessary to shake the tubes well and make them set as soon as possible to prevent the brain substance sedimenting. Any kind of brain may be used; the serum recommended is horse-serum. The growth on these brain media is very satisfactory, as regards both amount and rapidity of development. Brain may also be used after the manner of potato. For these cultures a brain is set by steaming it for 1–1½ hours. It is then cut up into slices which are placed in test-tubes or capsules. In the test-tubes about 10 drops of 3 per cent. glycerin are placed; in the plate-cultures 15–20 drops. The tubes and capsules are then steam-sterilised twice for half an hour. The slices should not be too thin.

Cultivating and Staining the Nodule Organism of the Leguminosæ.*—Mr. R. Greig Smith has obtained excellent growths of the nodule organism with a faintly acid medium containing 1 per cent. pepton, 5 per cent. glucose, and 0·5 per cent. potassium chloride. Air-dried films, fixed by floating on 5–10 per cent. formalin, were stained with carbol-violet, washed, air-dried, and mounted in balsam. When prepared in this way, the organisms appeared as more or less oval capsulated yeasts with vacuoles and terminal buds. The diversity of shape depends on the thickness of the capsule, the nature of which is dependent on the cultivation medium. Glucose tends to produce thin delicate capsules, while with sucrose they are tough. By using an undiluted young pepton-glucose culture, fixing in formalin, and staining with Cœrner-Fischer solution, the author succeeded in staining the flagellum. This flagellum is thin, single, terminal, about 2 μ long, with a tuft at the distal end.

Influence of Metals on Broth Cultures of Bacteria.† — Herr B. Isachenko states that experiments with *Bacillus spermophilinus* showed

* Centralbl. Bakt u. Par., 2te Abt., vi. (1900) pp. 371–2.
† Selsk. Khoz. Lyesov., clxxxix. (1898) pp. 35–42.

that when broth cultures are to be kept more than a month, only iron vessels should be used. Tinned iron, nickel-plated or zinc-plated iron vessels are quite unsuited for bacterial purposes. Copper vessels should be used only for a very short time for preserving sterilised broth.

(2) Preparing Objects.

Formaldehyde as a Killing and Fixing Agent. * — Prof. T. P. Carter has found that the following formula yields most satisfactory results when used for killing and fixing:—formaldehyde, 40 per cent. solution, 50 ccm.; distilled water, 50 ccm.; glacial acetic acid, 5 ccm.

By this solution tissues are killed and fixed in from 6–12 hours, but the immersion may be continued for 24 hours without damage. The pieces are then transferred to 50 per cent. alcohol for one hour, and afterwards to 75 per cent. and 95 per cent. alcohol for half an hour each.

Method of Examining Red Blood-corpuscles. † — Sig. A. Negri, in his researches on the nucleus of mammalian red corpuscles, adopted Petrone's method. The best results were obtained by removing the blood (man and rabbit) along with osmic acid 1 : 4000, placing it in picric acid 1 : 4000, and then staining with formic acid carmine. From the appearances observed the author arrives at the conclusion that the forms described by Petrone are not to be regarded as nuclei.

Apparatus for rapidly Dehydrating Pieces of Tissue. ‡ — Herr M. Pokrowsski describes a small apparatus (fig. 137) intended for dehydrating pieces of tissue as rapidly as possible. The essential part of this contrivance, as will be seen from the illustration, resembles a wine-glass in shape, the cup of which is perforated with numerous holes. In lieu of perforated metal the cup may be made of wire sieve. The apparatus is placed within a large glass vessel which is filled with alcohol or some other hardening fluid, and the tissue to be hardened is located in the cup.

Fig. 137.

New Maceration Medium for Vegetable Tissue. § — Herr O. Richter finds that strong ammonia will macerate vegetable tissue without injury to the cell contents such as starch and aleurone-grains, chlorophyll granules, &c. The fluid was used boiling, cold, and at a temperature of about 40° C. The rapidity of the maceration depends on the temperature.

Preparation of Conceptacles of Fucus. ‖ — M. J. Chalon finds that male and female carpomates (conceptacles) of *Fucus vesiculosus* and *serratus* can be preserved indefinitely in strong

* Amer. Mon. Micr. Journ., xxi. (1900) pp. 93–6 (1 pl.).

† Anat. Anzeig., xvi. (1899) pp. 33–8 (9 figs.).

‡ Medizinsskoe Obosrenie, Sept. 1899, 3 pp. and 1 fig. See Zeitschr. f. wiss. Mikroskopie, xvii. (1900) pp. 38–9 (1 fig.).

§ Oesterr. Bot. Zeitschr., lv. (1900) p. 5.

‖ Bull. Soc. Belge de Microscopie, xxv. (1898–9) pp. 107–9.

alcohol, and may be sectioned from this fluid. Some few specimens become brittle; these should be immersed for 24 hours in alcohol to which 20–25 per cent. glycerin has been added. No water is to be used. When the *Fucus* sections are placed in pure glycerin, they slowly assume their original bulk, and may be advantageously mounted in glycerin-jelly. This procedure should be carried out on the slide. The sections should be stained with alcohol solutions of anilin dyes, followed by glycerin and glycerin-jelly. The best results were obtained with acetic gentian violet. Behrens recommends staining *Fucus* with acetic carmin, passing slowly through alcohols up to 100°, oil of cloves, balsam. This acetic carmin is prepared by making a saturated hot solution of carmin in 45 per cent. acetic acid. The author tried this method on male *Fucus*; the sections were stained for one hour, then soaked in alcohol for 12 hours, followed by glycerin and glycerin-jelly. The results were excellent, but not so good as those mounted in balsam.

Demonstrating the Elastic Fibres of the Skin. * — Herr L. Merk obtained excellent results with the following solution :—absolute alcohol 40 ccm., distilled water 20 ccm., nitric acid 20 drops.

Eight to ten drops of this solution are mixed with 10 ccm. of a 3 per cent. solution of hydrochloric and alcohol. The sections (hardening in alcohol or Zenker's fluid) are left in the staining solution for 24 hours and then washed in distilled water, after which they may be examined in glycerin or in balsam, or they may be further stained with methylen-blue, vesuvin, hæmatoxylin.

Rapid Method for Demonstrating Amyloid Degeneration.†—The sections to be examined are placed for 2 or 3 minutes in an iodo-potassic iodide solution of the following composition :—Water 100, potassium iodide 1, iodine in excess. The sections are then immersed in 1 per cent. sulphuric acid. The degenerated parts then become dark green. The sections are further treated with 96 per cent. alcohol, which changes the green to a cœrulean blue. If mounted in glycerin, the degenerated parts are blue and the non-degenerated yellow.

Simple Apparatus for Washing several Preparations simultaneously. ‡ —Dr. R. Kolster describes an apparatus for washing several preparations at the same time, and which is specially adapted for the Marchi method. The essential features are easily understood from a glance at the illustrations (figs. 138 and 139). Above is a glass vessel capable of holding several litres, and having an opening near the bottom. This is plugged with cork perforated for the passage of a glass tube. A piece of rubber tubing connects the tube with another, the extremity of which is drawn out to a very fine point. A clamp is fitted to the rubber tubing, so that the outflow of water can be regulated. The rest of the arrangement consists of a number of large test-tubes, which are connected together by means of glass tubes and rubber tubing. One of these tubes is long, and reaches to near the bottom of the test-tube,

* S.B. k. Akad. Wiss. Wien, cviii. (1899) pp. 335–80 (3 pls.).
† Clinic. vet. Oesterr. Monatschr. See Zeitschr. f. angew. Mikr., v. (1900) p. 214.
‡ Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 9–13 (2 figs.).

while the outflow tube is short, and cut off close to the stopper. Some cotton-wool is placed at the bottom of each tube. The upper end of the

Fig. 138.

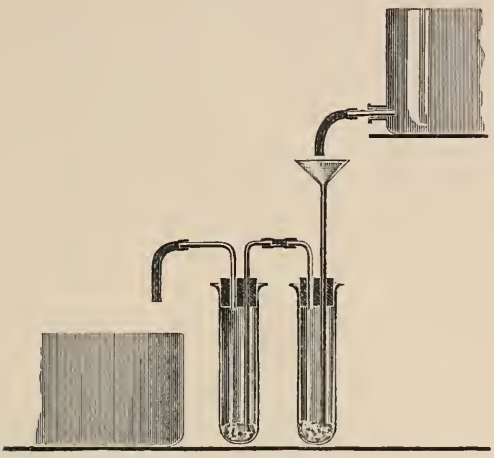
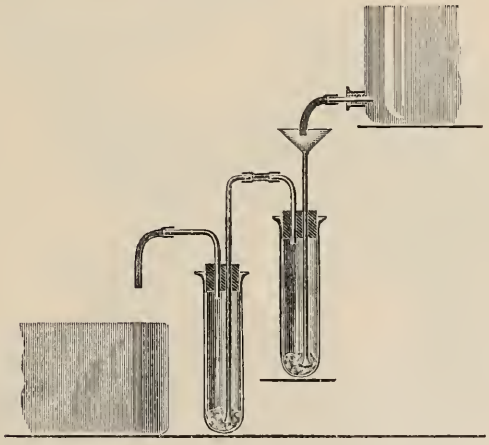


Fig. 139.



first tube is provided with a funnel. The test-tubes may be arranged on the same level or stepwise.

(3) Cutting, including Imbedding and Microtomes.

Neuberger's Simple School Microtome.*—Prof. Neuberger, of Freiburg in Baden, has invented this instrument as an improvement on the small student's microtome of Jung. While Jung's is admirable for cutting

* Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 1–6 (4 figs.).

paraffin series and frozen objects, it is not very successful with fresh or hardened plant specimens. Fig. 140 explains the theory of Neuberger's

Fig. 140.

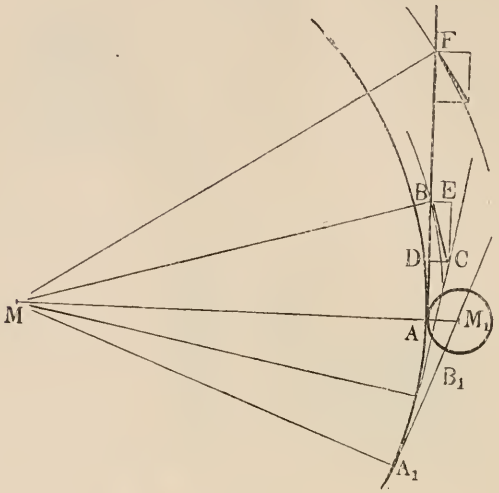
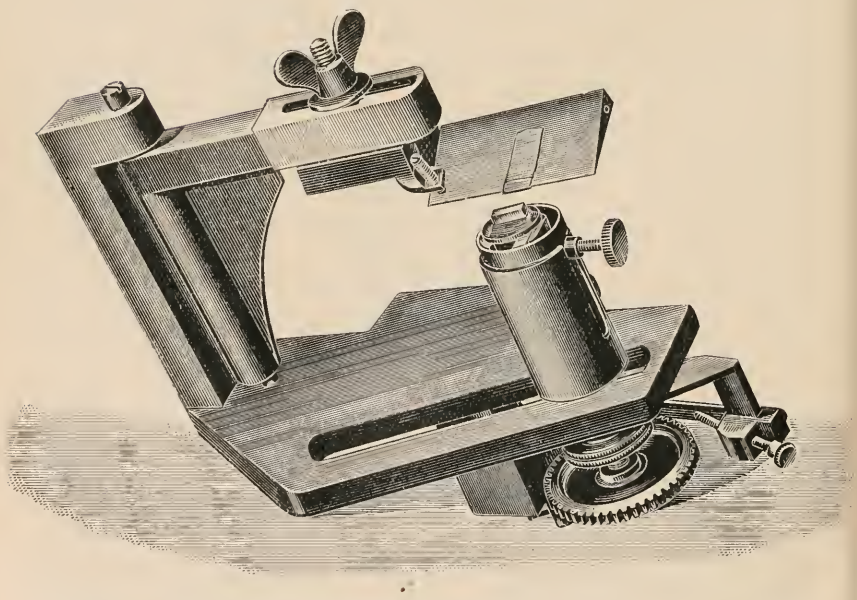


Fig. 141.

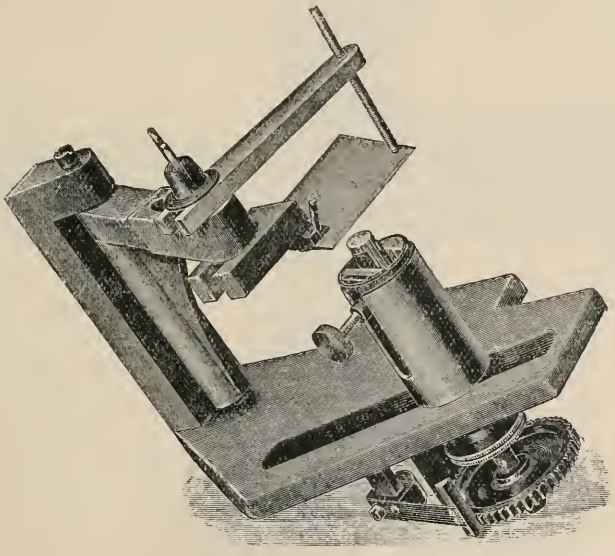


machine. Two circles, a large one of radius M A (about 11 cm.), and a small one of radius M_1 A (about 1 cm.), have external contact at A, at

which point A B is their common tangent. If the large circle and tangent revolve around the centre M, and if any force B C at B perpendicular to the radius be resolved into components B D and B E, respectively along and perpendicular to the tangent, then the component B D glides along the small circle without action, and the only effective part of the force is the component B E. If the radius M A be replaced by a revolving arm, the tangent B A by a knife-edge, and the small edge by the article to be cut, then the principle of the machine will be understood (fig. 142). The excellent results obtained seem to show that this is the right view of the mechanical problem.

A horizontal beam-like arm moves on a horizontal base plate fastened to the table, and can be rotated, through more than 180°, about a vertical axis between two steel points, of which the lower is adjustable. The

Fig. 142.

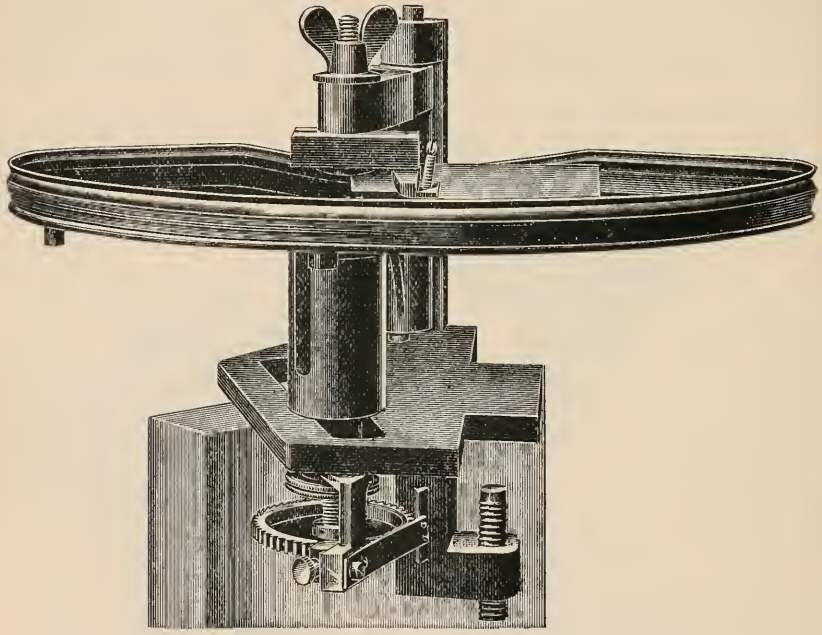


arm] in its extreme part is vertically slit, and on to it the knife, with Walb's fork, can be secured by means of a fly-nut working in this slit. When the screw is tightened, the knife can be rotated round the axis of the screw. The object-holder consists of two brass collars telescoping in one another, the outer of which can be pushed into a slit of the base plate, and in every position firmly screwed thereto from below. The inner collar is by means of a micrometer screw rotated by hand, and rises about 5 μ for every tooth of the wheel. In this inner neck is the object clamp, constructed out of two wooden brass-tipped cylinder-segments pressed against one another by a screw; the edges of these segments are always parallel. A spring with vertical catch, set in action or released by a rod in a simple way, serves as a check to the micrometer toothed wheel. Ordinarily it lies behind the micrometer screw (fig. 141), but can, by rotation of its bearer, be brought in front (fig. 142)

and then can be used, after appropriate adjustment by means of its rod, as an indicator on the wheel-tooth, if one wishes to prepare thicker sections of 20 μ and upwards, and to save wear and tear on the gear.

For cutting celluloid objects (fig. 143) under alcohol, a thin metal tray is used, which bears on its under side a soldered-on mouthpiece of the shape and size of the inner object collar, thus allowing it to fit on to the outer collar. A small piece of paraffin is melted, and cements the celluloid plug on to the proper place; the tray is then filled with 70 per cent. alcohol, and cutting proceeds. Attention must of course be paid to orientation. This arrangement is also followed for cutting sections of plants between elder pith or liver.

Fig. 143.



The microtome produces good paraffin serial sections of 5 μ, celluloid in alcohol 10 μ, and pith 20 μ. The area of the slice is about a square centimetre.

The inventor recommends the advantages as (1) manifold applicability, on account of easy adjustability of knife, object and catch; (2) small knife, with accurate cut and easy withdrawal of section; (3) low price.

Bettling, C. J.—**Ueber die neuen Bogen-Mikrotome.** (On the new Circular Microtomes.)

[An interesting review of microtomes in general and of circular microtomes in particular.] *Zeitschr. f. angew. Mikr.*, VI. (1900) pp. 1–6 (2 figs.).

(4) Staining and Injecting.

New Staining Method for Demonstrating the Finer Structure of Bacteria.*—Herr K. Nakanishi describes a method in which the stain is first deposited on a slide. The most suitable pigment was found to be methylen-blue B.B. It is easily soluble in water, blood-serum, and other animal fluids. Some of the saturated aqueous solution is filtered on to a slide, and smeared up and down with filter-paper. The stain is wiped off so as to leave only a thin layer of a sky-blue colour. Or a layer of pigment may be deposited on the slide by boiling until it dries, and the excess afterwards rubbed away until the desired colour is obtained. A small drop of the fluid to be examined is placed on a cover-glass, and this on the stained slide.

This method is very suitable for blood and for blood-parasites, as well as for bacteria. In bacteria it demonstrates the presence of a nucleus which is stained red, the rest of the protoplasm being blue. Flagella and spores do not stain. By this method the various stages of cell-division are easily followed.

Staining Bacteria in Sections simultaneously treated by Van Gieson's Method.†—Herr G. Dreyer states that the following procedure gives excellent results and beautiful pictures. The tissue is fixed with formalin and imbedded in paraffin. The sections are stuck on in the usual way with 30 per cent. alcohol, and when freed from paraffin are treated as follows:—(1) Aqueous methyl-violet (1 per cent.) or gentian-violet for 3–5 minutes; (2) wash in distilled water; (3) saturated aqueous picric acid solution for 3–4 minutes; (4) mop up with filter-paper; (5) anilin oil, to which 1 per thousand picric acid is added until the section is quite yellow and no more violet is given off; (6) careful and prolonged washing in distilled water; (7) Delafield's hæmatoxylin for 5–8 minutes; (8) careful washing in distilled water for about 5 minutes; (9) acetic acid, picric acid fuchsin (about 2–3 ccm. picric acid fuchsin, to which one drop of 1 per cent. acetic acid solution is added) for 3–5 minutes; (10) immersion and dehydration in absolute alcohol for 1/2–1 minute; (11) xylol—xylol dammar.

Staining the Karyochromatophilous Granules in Blood.‡—Dr. A. Plehn adopts the following method for staining granules in the blood of persons residing in malarious districts. Dissolve hæmatoxylin 2 in a mixture of alcohol, glycerin, and distilled water 100 each; add acetic acid 10, alum as much as may be necessary, and allow the mixture to stand for 14–21 days; then add a few grains of eosin. The preparations are fixed in absolute alcohol for at least one hour. They are then placed in an air-tight capsule and stained for 8–12 hours. Only water is used for decolorising. Finally they are dried and mounted in balsam.

Staining the Parasites of Leucocythæmic Blood.§—Prof. M. Löwit stains the parasites of leukhæmia by the following procedure. The dry

* Münchener Med. Wochenschr., 1900, No. 6. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 57–9.

† Centralbl. Bakt. u. Par., xxvii. (1900) pp. 534–5.

‡ Deutsch. Med. Wochenschr., 1899, No. 44. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 627.

§ Centralbl. Bakt. u. Par., xxvii. (1900) pp. 462–6.

blood-films are fixed by heating them for 1–2 hours at 110°–120°. When cool they are immersed in a saturated solution of thionin for half an hour. The preparations having been washed in running water are dried and placed for 10–20 seconds in iodopotassic iodide solution (iodine 1; iodide of potassium 2; distilled water 300). They are then washed again, dried, and mounted in balsam; the parasites are stained green. Fresh solutions of thionin stain only faintly, but they act better if heated till they vaporise, or by mixing 30 ccm. thionin solution with 15 ccm. of Löffler's methylen-blue solution.

Stain for Nuclei of Endoglobular Hæmatozoa.*—M. Laveran gives some further directions for making a solution especially suitable for staining the nuclei of endoglobular hæmatozoa. The stain is a mixture of three solutions:—(1) In a 150 ccm. bottle are placed a few crystals of silver nitrate and 50–60 ccm. of distilled water. When the crystals are dissolved, the bottle is filled up with soda solution, and the precipitated silver oxide is washed several times with distilled water. Saturated aqueous solution of medicinal methylen-blue (Höchst.) is added, and the mixture allowed to stand for seven or eight days; (2) aqueous solution of eosin 1 per 1000; (3) solution of tannin 1 per 100.

When required for use, the stain is made by mixing 4 ccm. of the eosin solution with 6 ccm. of distilled water and 1 ccm. of the methylen-blue solution (Borrel's blue). The eosin and methylen-blue solutions must be filtered separately at the time the mixture is made. The films are treated in the usual way.

Rapid Staining of Gonococcus in Fresh Unfixed Preparations.†—Herr Uhma describes the following simple method for staining Neisser's diplococcus. The advantages claimed are that the preparations require no fixing, and that gonococci are distinguished from other bacteria by the staining. The slides are moistened or smeared with an alcoholic (or acetic acid) 0·5–1 per cent. solution of neutral red, and dried. A small drop of pus is placed on a cover-glass, and the cover laid on the slide. The preparation is then ready for examination. The gonococci are the first elements to pick up the stain, and though very occasionally other bacteria may be stained, this is the exception rather than the rule.

Staining Gonococci.‡—Dr. E. Homberger states that he has used Kresylecht violet, a fluorescing dichromatic pigment, for some years for staining gonococci. The stain has a particular affinity for gonococci, especially in quite dilute solutions, e.g. 1 to 10,000. With this solution the nuclei of the cells become blue and the gonococci red-violet. Other bacteria are but faintly stained or not at all.

Even in sections Kresylecht violet possesses many advantages over other pigments for staining gonococci. The sections are placed in 1 per cent. solution for several minutes, then transferred to alcohol, followed by anilin oil-xylol in the proportion of two to one. If the section is overstained it may be differentiated and dehydrated by means

* C.R. Soc. Biol., lii. (1900) pp. 549–51.

† Arch. f. Dermatol. u. Syph., l. (1899) pp. 241–2. See Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 111–2. Cf. this Journal, *ante*, p. 264.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 533.

of alcohol, but if understained it should be dehydrated in anilin oil-xylol in equal proportions. Kresylecht violet is a good stain for amyloid, plasma-cells, blood-preparations, and malarial parasites.

Sudan iii. Stain for Tubercle Bacilli.* — Dr. D. M. Cowie finds that Sudan iii., recommended by Dorset† as a selective stain for the tubercle bacillus, is a failure, and this experience is corroborated by Dr. Le Doux ‡ of Grahamstown, South Africa, who states that his results are also negative.

Staining of Ligneous Tissue.§—M. J. Chalon gives the following résumé of the staining reactions of ligneous tissue after treating the sections with aqueous or alcoholic solutions of the reagents followed by sulphuric acid.

Phloroglucin (in this case hydrochloric acid should be substituted for sulphuric): the colour is a bright rose, lasting often 12 hours or more. Carbazol: red-violet. Orcine: red, passing to violet. Resorcin: pale violet blue. Naphthol A: yellow, passing to pale green. Pyrogallic acid: bronze-green. Indol: red.

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

Formalin and Alcohol as Preservatives for Zoological Specimens.‖ —Mr. J. Hornell, in discussing the respective values of formalin and alcohol as preservatives for museum specimens, expresses the opinion that the best effects of formalin are seen with Medusæ and Tunicata. Most animals should be mounted in formalin-alcohol after previous fixation. For some animals which contain lime salts, such as echinoderms and crustaceans, formalin is unsuitable, as it slowly decalcifies them and renders them very brittle.

In collecting trips formalin is more useful than alcohol, as in its concentrated form it does not occupy so much space, and is therefore more easily stowed. In microscopical technique, maceration of the objects, sections, &c., may be obviated by the use of a 2 per cent. solution, either as an addition to staining solutions, or to replace pure water in washing out fixatives.

Easy Method of Mounting and Preserving Mosquitos.¶—Mr. D. C. Rice describes the following method adopted in the London School of Tropical Medicine for mounting mosquitos. All that is required are slides, round cover-glasses, glass rings about 1/16 to 1/12 in. deep and 7/8 in. in diameter, and xylol Canada balsam. Kill the mosquito by placing in an ordinary killing bottle, or if this is not available, a little chloroform or tobacco smoke will do as well; when dead turn it over on its back, separate the legs if they are together, place a large drop of thick xylol Canada balsam on a slide, invert this gently on to the mosquito, and in this way it is picked up without any chance of injury; then with a fine needle spread out and arrange the wings and legs, and if necessary press down the thorax very carefully. Next pour on some thin xylol Canada balsam; as this runs out it straightens the

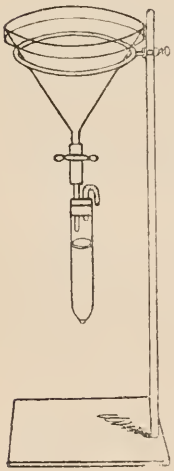
* New York Med. Journ., lxxi. (1900) pp. 16–7.
† Cf. this Journal, 1899, p. 236.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 616.
§ Bull. Soc. Belge Micr., xxv. (1898–9) pp. 106–7.
‖ Laboratorium et Museum, 1900, pp. 85–9.
¶ Brit. Med. Journ., 1900, i. p. 1468.

proboscis and antennæ, and they do not, as a rule, require to be touched. Put the specimen on one side to harden, and then chip off excess of Canada balsam, place the glass ring on, and fill up the chamber that is thus formed with Canada balsam. The upper surface of the Canada balsam should be convex, so that when the cover-glass is applied no air bubbles are included. Allow the specimen to harden before sending by post. If glass rings are not at hand, the specimen will keep quite well in the Canada balsam alone, and the last part of the mounting may be completed after the specimen has been sent home. If the mosquito is intended for photographing, great care must be taken in mounting it so that it lies as far as possible in one plane.

6) Miscellaneous.

Simple Apparatus for filling Gelatin Tubes.* — Dr. R. J. Petri uses the following simple and inexpensive apparatus (fig. 144) for filling test-tubes with gelatin. An ordinary laboratory stand with a ring about 12 cm. in diameter supports a funnel which contains the liquefied gelatin heated to about 80°–90°. The top is covered with a cap or glass plate. To the pipe of the funnel is fitted a piece of rubber tubing closed by a stopcock. Into the lower end of the tubing fits a glass tube the free extremity of which is somewhat pointed. This tube is passed through a cork stopper. The stopper has a second perforation for a short bent tube which is stuffed with cotton-wool. The stopper fits into a glass tube or a test-tube the lower end of which is melted off in the flame so as to leave a round smooth hole. A small strip of paper is then stuck on the tube to indicate 10 ccm. The manipulation of the apparatus is very simple. The funnel is filled with fluid gelatin. The tube is taken in the left hand and the aperture closed with the thumb. With the right hand the stopcock is opened and gelatin allowed to flow in up to the paper mark. A test-tube is now taken up in the right hand and the cotton-wool plug removed by the 4th and 5th fingers of the left hand. The tube is then placed under the opening and the thumb removed so that the gelatin flows in. The cotton-wool plug is then replaced. In this way dozens of test-tubes are easily filled.

Fig. 144.



New Quantitative Method for Serum Diagnosis.† — Dr. R. T. Hewlett and Mr. S. Rowland describe a new quantitative method for obtaining accurate dilutions of serum or blood.

Ordinary vaccine tubes are taken, the large, the very small, and any irregular ones being discarded, those preferred varying in diameter from about 0·9–1·2 mm. They are boiled in strong nitric acid, thoroughly

* Centralbl. Bakt. u. Par., xxvii. (1900) 1te Abt., pp. 525–6 (1 fig.).

† Brit. Med. Journ., 1900, i. p. 1015.

rinsed in tap, and then in distilled water, and dried; a large number can thus be treated at one operation. The selected tubes are charged with the blood to be examined, being preferably one-half to two-thirds filled, and are carefully sealed by melting their ends in a flame in the ordinary way. In the laboratory the length of the column of blood between the bases of the two menisci is first measured by means of a scale graduated to half millimetres, assisted by a lens mounted to avoid parallax. The end of the tube is then cut off by means of a fine file or writing diamond, and its internal diameter is measured. This, the most important of all the manipulations, is carried out in the following manner.

The tube is supported in the axis of the Microscope by means of two iris diaphragms carried respectively by the stage and by the substage. These close concentrically, and support the tube, at the same time cutting off all light reflected from the mirror. The opaque blood in the interior of the tube in the same way cuts off all light that might pass through the lumen of the tube. The only light that thus reaches the optical system is that transmitted by the glass walls of the tube. In the field of vision the lumen of the tube now appears as a black circle surrounded by a brilliantly illuminated annulus. Owing to the extreme sharpness of the image, the measurement of the diameter of the tube can be carried out with great accuracy by means of an eye-piece micrometer arranged to give readings to the one-thousandth of a millimetre. From the formula $V = D^2 \times L \times 0{\cdot}7854$, where V = volume of the cylinder, D = diameter of the cylinder, L = the length of the cylinder, the volume of the blood is calculated. If many measurements have to be made, a Fuller's slide-rule greatly expedites the calculations. It is of the utmost importance that the diameter of the tube be accurately measured, and therefore the adjustment of the eye-piece micrometer must be carried out with great care, and the scale by which it is set should be one the accuracy of which is undoubted. For, considering the formula ($V = D^2 \times L \times 0{\cdot}7854$), it will be seen that any error in the measurement of D will be increased in a geometrical ratio in the final result; hence the comparative inefficiency of a capillary tube method in which D is measured indirectly and with less accuracy.

Having ascertained the volume of blood, it remains to carry out the dilutions; this is accomplished as follows.

The capillary tube is placed in a vertical thick-walled glass tube of slightly larger bore, the lower end of which is submerged in the required amount of the diluting medium (measured out by a graduated pipette) contained in a hollowed-out block of glass, such as is used in histological and microscopical work. The capillary tube with its contained blood is then crushed *en masse* by means of a soft iron plunger, and the interior of the containing tube is washed out several times by drawing up the diluting medium into its lumen, either with the mouth or by means of an indiarubber teat. The powdered glass quickly falls to the bottom, and the mixture may be employed for conducting the serum reaction either by the microscopic or the macroscopic method.

Molybdenum Method for Demonstrating the Neuro-fibrils and the Golgi-network in the Central Nervous System.*—Herr A. Bethe de-

* Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 13–35.

scribes a method for demonstrating the primitive neuro-fibrils in the ganglion-cells and the nerve-fibres of Vertebrata and Invertebrata; at the same time the Golgi-network is also stained. The fresh material, in pieces 4–10 mm. thick, is placed in 3–7·5 per cent. nitric acid for 24 hours, and then transferred to 96 per cent. alcohol for 12–24 hours or more. The blocks are next immersed for 12–24 hours in the following solution:—Ammonia (sp. gr. 0·95–0·96) 1 part, water 3 parts, alcohol (96 per cent.) 8 parts. The temperature should not exceed 20° C. After this the blocks are again removed to alcohol for 6–12 hours, and then treated with acid-alcohol:—hydrochloric acid (sp. gr. 1·18 =37 per cent.) 1 part, water 3 parts, alcohol (96 per cent.) 8–12 parts. When this step is finished (the time required is not stated) the pieces are again transferred to alcohol for 10–24 hours before they are immersed in water (2–6 hours). The acid-alcohol stage should be omitted when the cells have many fibrils, and for obtaining good pictures of the Golgi-reticulum in the anterior cornua of the spinal cord. The blocks are now placed in 4 per cent. solution of ammonium molybdate for 24 hours. After having been washed in distilled water, the blocks are removed to 96 per cent. alcohol (10–24 hours), and then to absolute alcohol (10–24 hours). After this xylose or toluol and paraffin. The sections, 10 μ thick, are stuck on the slide with Mayer's albumen-glycerin.

The slide is now carefully washed with water to remove all traces of alcohol from the section, and its under surface and edges wiped dry. The preparation is covered with a layer of distilled water, $1\frac{1}{2}$–2 mm. thick, and the slide placed in an incubator at 55°–60° for 2–10 minutes. The water is then poured off, and replaced by a similar layer of toluidin blue solution (1–3000). The slide is then incubated for 10 minutes, after which the superfluous stain is removed, and the slide immersed in 96 per cent. alcohol for 3/4–2 minutes, during which time the unmordanted pigment is removed. When no more colour comes away, the preparation is transferred to absolute alcohol, then to xylol, and mounted in balsam. The procedure appears to require considerable care, and a large number of cautions and much advice to prevent failure at the various stages are given.

The procedure for Invertebrata is slightly different. The animals may be fixed with sublimate (12 hours), treated with iodine-alcohol (24 hours), and then imbedded. The sections (*Hirudo*) are placed for 10 minutes in 1 per cent. solution of ammonium molybdate (25°–30° C), washed with distilled water for 10 minutes, and then stained with 1–3000 toluidin-blue for 5 minutes at 58° C. For demonstrating the fibrils in the cells, the ammonia and hydrochloric acid stages must be passed through. The sections are differentiated in aqueous solution of ammonia or in alcoholic solution of sodium carbonate.

Microtomists' Vade Mecum.*—Mr. A. B. Lee's Microtomists' Vade Mecum or Handbook of the Methods of Microscopic Anatomy, has reached its fifth edition. It is only three years since the fourth edition appeared, and, excellent as it was, its successor is better. The text has undergone thorough revision, some portions, notably the chapter on

* London (J. and H. Churchill), 1900, xiv. and 532 pp.

cytological methods, having been rewritten. The amount of new matter added is very considerable ; and these additions, in order to keep within the limits of the old size, have necessitated severe condensation of the text and the rejection of superfluous methods. More space has been given to the principles of some of the methods described, and there is much additional information respecting the theory of fixation, microtome knives, serial section methods, and the like. The general features of this invaluable work are so well known that it is unnecessary to sketch them out again.

NOTES.

The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

III.—JAMES SMITH AND HIS MICROSCOPES.

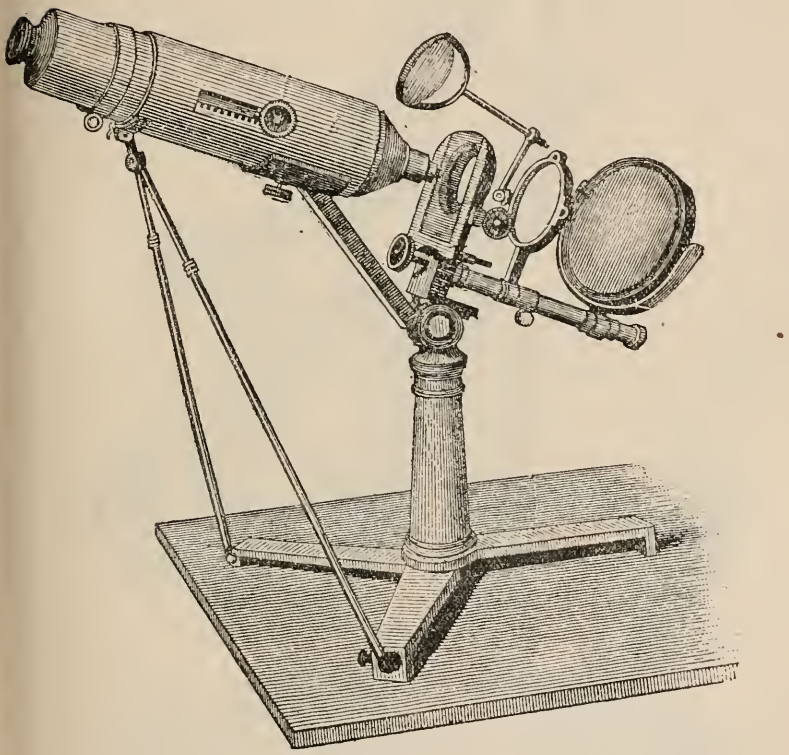
When Mr. Joseph J. Lister gave the order to Mr. W. Tulley, the celebrated telescope maker of Islington, for a Microscope to be made according to his own working drawings, Mr. Tulley put it into the hands of James Smith, a very expert philosophical instrument maker, to execute. James Smith finished this Microscope on May 30th, 1826, and therefore was the maker of the first achromatic Microscope in this country. The object-glass for this Microscope was said to have been made by Mr. Lister himself, a statement which is highly probable, as he practised lens-grinding so that he might be able to test his own formulæ.

This Microscope, seen in fig. 146, has a draw-tube into which the eye-piece was *screwed;* at the lower end of the draw-tube an erector could be fitted; rectangular movements were given to the stage by means of the pinion heads shown in the fig., one being placed in a vertical position. A substage is provided, and we are told that a compound condenser was fitted to it; it would be very interesting to know the form of this compound condenser, because the condensers of all previous Microscopes were very crude, being for the most part composed of a single biconvex lens. The steadying rods were of course suggested by the telescope mounts of that day, but the folding tripod foot, which was the usual form for Microscopes at that time, cannot now be commended. This Microscope differs from all those immediately preceding it in one essential point, viz. that it is solely a compound Microscope, whereas all Microscopes of that time and for upwards of fifteen years afterwards, were both simple and compound, or in the phraseology of that day, single and double. Very old models, such as John Marshall's (1704), Culpeper's (1738), Cuff's (1744), were solely compound Microscopes; but those of Benjamin Martin, Adams, Jones, Pritchard, Powell, and of Ross even as late as 1843, were both simple and compound; so in this respect this Microscope appears in strong contrast to those of its time. The solid limb, which clearly predated those both of Ross and Jackson, was quite an original idea.

About 1840 James Smith commenced business on his own account at 50 Ironmonger Row, Old Street, E.C., and here he made the first Microscope, with his own name attached to it, for Mr. R. L. Beck; this Microscope (fig. 147) was finished on May 29th, 1839. This instru-

ment must be regarded as an answer to the Ross Microscope, figured in the *Penny Cyclopedia* of 1839, which necessarily must have been made before the publication of that work. The flat folding tripod foot is replaced by a solid one, and rigidity is given to the body in a different way from that of Ross's model. There is a triangular bracing at the top of the limb, and a guide is placed lower down, upon which the body slides; the stage is evidently a modified form of Ross's, and there is a Wollaston condenser with rackwork focusing, the conical

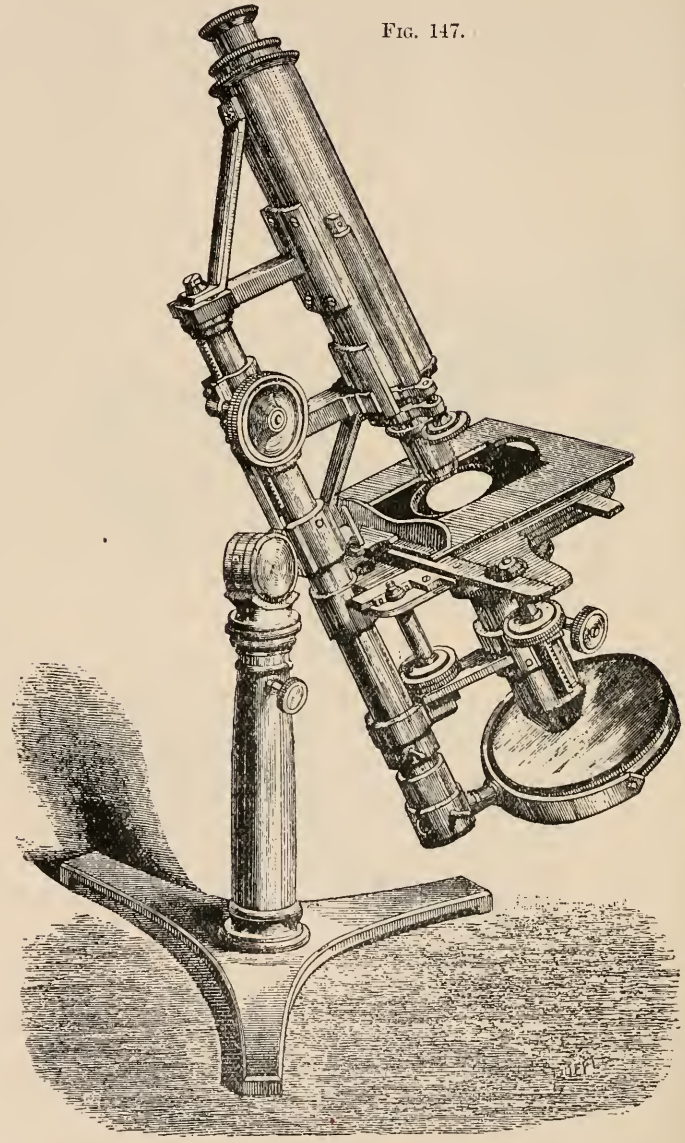
Fig. 146.



end reminding one of the cone diaphragms of earlier non-achromatic models. The fitting of this condenser to a separate arm on the limb shows a distinct improvement over all preceding models; both Powell and Ross attached theirs to the underneath part of the main stage, while in this there is an elementary kind of substage. The nose-piece fine adjustment of this Microscope possesses all the errors inseparable from those of its class. It has been stated that this Microscope was

one of Jackson's early forms, but it is certain that Mr. Jackson had nothing whatever to do with it.

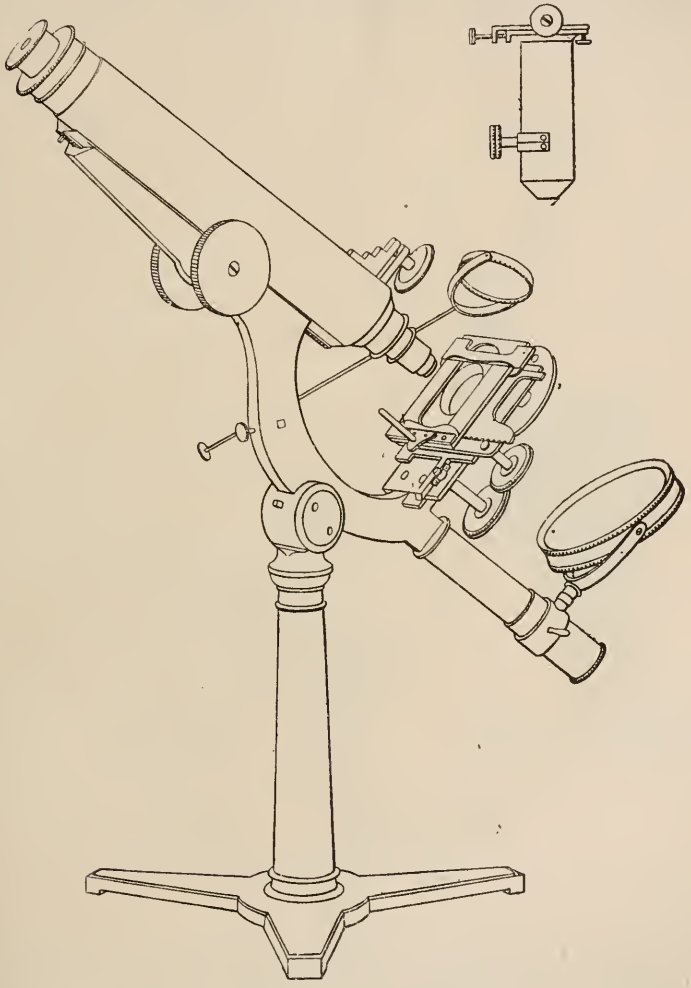
Fig. 147.



The next model made by James Smith is in our cabinet (fig. 148). It was ordered by the Society on August 19th, 1840, and was delivered

on November 24th, 1841; it is figured on the frontispiece of vol. ii. of *Cooper's Microscopic Journal* for 1842. Here we have the first example of the Lister limb with the Jackson rabbetted groove; this is an excellent form of coarse adjustment, and even to-day it works

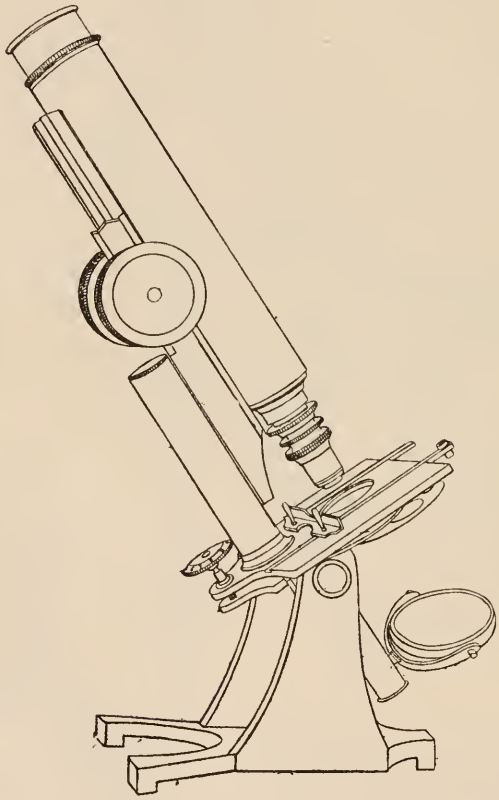
Fig. 148.



smoothly and steadily; the stage remains much the same, with the exception of the addition of a non-concentric rotating object-holder. There is an achromatic condenser, fitted with rectangular centering gear, but the substage is dispensed with, and the condenser slides in a

groove beneath the main stage, following the plan previously adopted by Powell and Ross. The foot and pillar are unaltered. This is a carefully made and well-finished Microscope. The accompanying objectives are peculiar, and need explanation. There is a $1\frac{1}{2}$ in., over the front of which a diaphragm is placed; when a higher power is wanted, the diaphragm is removed and a front is substituted for it, the combination thus formed being of 8/10 focus. To make a 1/2 in.

Fig. 149.

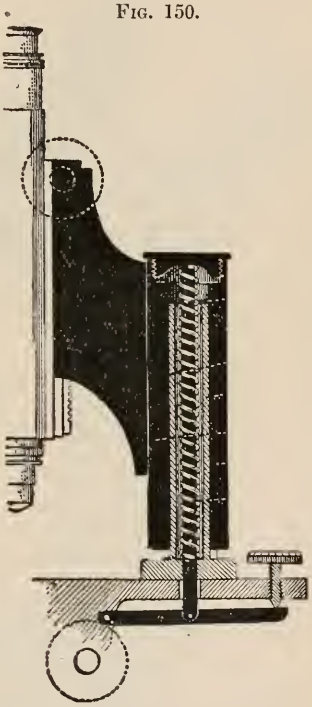


this front is exchanged for another one. This 1/2 in. front has a correctional collar graduated into ten divisions. The 1/4 in. is a complete objective in itself with a similarly graduated correctional collar. These were the first two correctional collars to be so graduated, and it was some years before this excellent plan was adopted by other makers, as they considered that two lines, marked covered and uncovered, were sufficient for the purpose. Lieberkühns were supplied

with the 8/10, 1/2, and 1/4 in. objectives. I have examined these glasses, and have found them very well corrected.

In 1846, Mr. Smith removed to 6 Coleman Street, E.C., and entered into partnership with Mr. Richard Beck. Here the model just described underwent two slight modifications, the more important of which was the addition of the Jackson method of mounting the limb on a trunnion between two pillars; the second alteration was in the stage, by placing the pinions of the rectangular motion in the same plane as the stage, instead of at right angles to it. An alternative and cheaper form of stage was also made, viz. Alfred White's lever movement, described in a paper read before this Society on November 15th, 1843. This movement was merely Varley's with the handle of the lever inverted, i.e. pointing upwards instead of downwards. Messrs. Smith and Beck's No. 2 Microscope was the same as the old one, with the exception that the feet of the flat tripod were made to fold for convenience of packing.

Fig. 150.



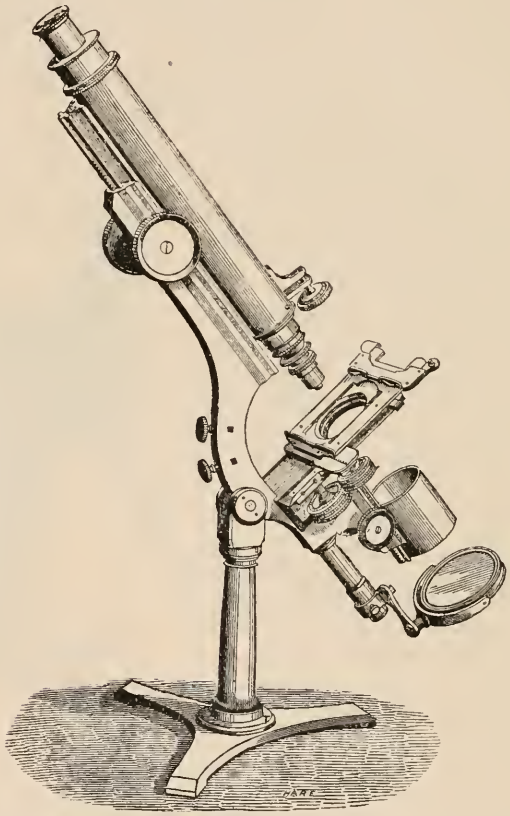
A No. 3 or Student's Microscope, which deserves special notice, was made at this time. The limb was mounted on a trunnion between two upright brass plates supported by a flat tripod, very similar to the Ross foot; the position of the flat foot was however reversed, the single toe being placed in front and the two toes behind (fig. 149). The stage was plain, with a sliding bar; the body was attached to the limb by the Jackson rabbetted groove. The important point about this instrument was its fine adjustment; rising from the stage was a strong triangular pillar, upon which the limb could slide smoothly; this limb was hauled down against an opposing spring by means of a lever of the second order, placed below the stage, as shown in fig 150. This was Smith's method of obtaining a steady fine adjustment in conjunction with Jackson's rabbetted groove coarse adjustment, and a very excellent plan it was, for it is still made, and therefore has stood the test of fifty-five years' trial.

In 1848, Messrs. Smith and Beck made the first concentric mechanical stage; this was the invention of Mr. M. S. Legg, and was described by him in vol. ii. of our *Transactions*, p. 127, pl. 27.

For the Exhibition of 1851 a new model was prepared, in which an important alteration was carried out at the suggestion of

Mr. Jackson, viz. the substage slide was made in one casting with the limb, and the rabbetted grooves both for the body and substage were ploughed in one cut. Fig. 151 is the earliest figure extant of this kind of Microscope. It will be observed that in this Microscope no centering gear is attached to the substage, because it was thought that the Jackson ploughed groove rendered such an appliance superfluous. This instrument was also mounted upon Jackson's trunnion and double

Fig. 151.



pillar (this was afterwards arranged so that the flat tripod foot could be rotated beneath the pillars) ; a concentric rotating mechanical stage was added ; and after 1860 the single body was exchanged for the Wenham binocular. In 1873 one of these Microscopes, which is frequently used at our Meetings, was presented to the Society by Mr. Charles Woodward. Fig. 152 is taken from R. L. Beck's *Achromatic Microscope.*

In 1852, Mr. Joseph Beck joined the firm, which then became

known as Messrs. Smith, Beck, and Beck; and in 1853 they removed to Cornhill. In the Exhibition of 1862 the firm's principal Microscopes did not differ at all from the one just described, but there were some new models of which a short account is necessary. First, there was a cheap class of instrument called a "Universal Microscope," introduced in October 1861; this had a flat circular foot, upon one side of which a stout vertical pillar was fixed; to this pillar the limb holding both the body and the stage was attached. There was a peculiar kind

Fig. 152.

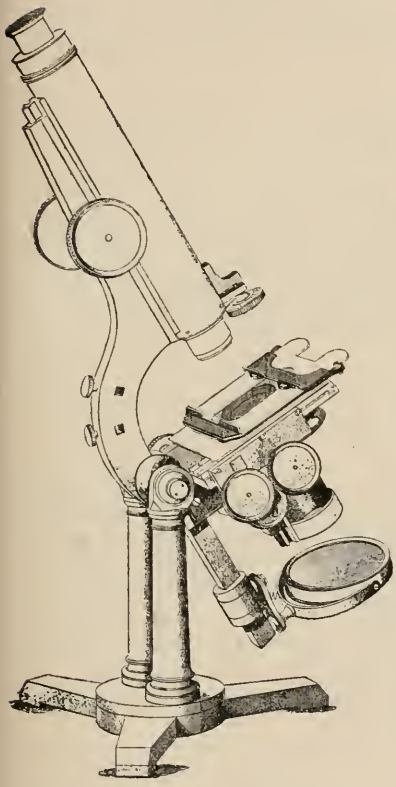
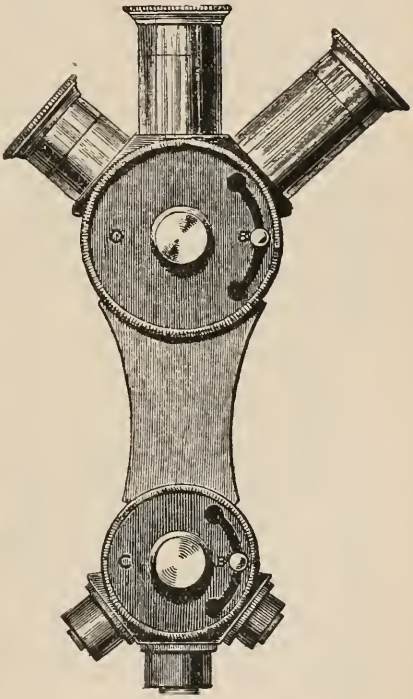


Fig. 153.



½ size.

of coarse and fine adjustment formed by a lever gripping the coarse adjustment pinion, the coarse adjustment being a chain movement like Ladd's. But the interesting feature in this Microscope was its body (fig. 153), which had three objectives at one end and three eye-pieces at the other; this seems to be an excellent idea, and it is difficult to understand why it has not been largely adopted. This Microscope, probably on account of its inadequate focusing adjustments, had an ephemeral existence. Secondly, there was a "Museum Microscope"

holding 500 objects, which were arranged round large cylinders, the instrument being something like a musical box. I cannot see why some such appliance as this should not be displayed in our museums. Foraminifera, Polycystines, and many other objects requiring low powers, are not only very suitable for exhibition in this manner, but are more instructive and interesting than wall pictures; a few typical objects might be placed under glass alongside the instrument so that their actual size might be directly compared with their magnified images; this would give to the uninitiated a better idea of the real size of the objects than any amount of tabulated magnifications in diameters. It is also obvious that a Microscope exhibiting the objects themselves would not only be cheaper but would occupy far less space than a quantity of enlarged models.

In 1864 Mr. James Smith retired, the Microscopes, in the perfecting of which he had bestowed so much labour, long surviving him.

The objectives of James Smith will not require a prolonged notice, because his early ones were made under the directions of Mr. Lister, and therefore did not materially differ from those made by Andrew Ross. Smith, however, was singular in the production of separating or dividing lenses, i.e. an objective capable of forming a lower power by the removal of its front lens; these have already been noticed above. The following is a list of objectives, dating 1852, with their apertures.

1½ N.A. ·11	1/4 N.A. ·57	1/8 N.A. ·71
2/3 „ ·23	1/5 „ ·68	1/8 „ ·82
4/10 „ ·46	1/5 „ ·77	1/10 „ ·87
4/10 „ ·54		

With regard to Smith's illuminating apparatus, it is probable that his achromatic condensers did not differ greatly from those of Powell and Ross already mentioned; but in 1850 Smith was the first to construct a Wenham's parabolic reflector; this was made of metal, and not, as afterwards, of glass. The parabolic reflector, which is figured by Pritchard in his *Micrographia* (1837), was, we are told, the invention of the Rev. Mr. Packman, but Smith appears to have been the first actually to make it. The original one is in our cabinet. I am informed that James Smith died about 1870.

MICROSCOPY.

A. Instruments. Accessories, &c.*

(1) Stands.

Deschamps' Simplified and Improved Solar Microscope.† — The simplification depends primarily on the working of the movable mirror, which is moved without pinions or engaging gear by means of a vane and a wire. The vane produces the left-to-right (or contrary) motion; the wire attached to the top of the mirror raises or lowers it, and, being set in a caoutchouc disc, enclosed in a small copper cylinder, can be regulated with extreme niccty. By the help of this system the most inexperienced operator is, after a few minutes' practice, a perfect master of the direction of the solar beam which he easily controls and directs upon any desired point of the screen. The objective is, moreover, adjusted without a micrometric screw, and the diaphragm is fixed to the objective without forming a separate piece. All the movable parts are carried on a single guide-bar on which they slide, or are fixed by means of clamp screws.

The improvement secures the elimination of injurious heat, and this elimination is secured by a simple arrangement of lenses, and without a trough of water or alum.

The condenser is first selected of diameter sufficient for light, without accumulating a harmful excess of heat. The focus is replaced by a system of two non-achromatic lenses of equal focal length and separated from each other by the same distance. This system is situated in relation to the condenser at a point such that there is formed, in the first place, not an exact focus to which the rays converge, but an elongated focus at no point of which the luminous beams entirely converge. In the second place there is produced (and this is the chief cause of elimination) an effect of dispersion and of partial recomposition; the aggregation of lenses doing the work of a prism, and, as the rays of the infra-red (heat rays) are the less refrangible, they are kept in the periphery, and therefore removed from the line of the object, which is placed outside the violet cone in a spot where white light is recomposed slightly tinted with blue, green, or yellow, colours which diminish neither the intensity nor the brilliancy.

A living animalcule can be examined and studied at leisure without losing life or sensibly suffering. The magnification exceeds 1500 diameters without loss of clearness, so perfectly achromatic are the lenses of the objectives.

The results obtained by this instrument are inferior in no respect, from the point of view of perfection of the images, to those given by the best apparatus hitherto in use.

Deschamps' Telemicroscope.‡—The telemicroscope is so called because, whilst loupes magnify three or four times at 1 cm. distance, and it

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

† Comptes Rendus, cxxx. (1900) pp. 1175–6. ‡ Tom. cit., pp. 1176–7.

is necessary, in order to obtain a greater magnification, to still further diminish this small distance, this instrument gives at 25 cm. an amplification more than 12 diameters. Hence it offers facilities for observing insects without frightening them or forcing them to quit their natural habits. Thanks to its large field, and to its property of seeing several planes at once, the instrument is equally suitable for observing a large plant. An extraordinary effect of relief is also produced, comparable to that of a stereoscope.

In reality the telemicroscope is only a telescope of a special kind. Its objective is composed of two achromatic lenses separated by a distance less than the principal focal distance of the most convergent; therefore they act as one. Achromatism is increased by this arrangement, whence results the clearness of the images. The objective is Dollond's with four plano-convex glasses. The eye-piece has been chosen as convergent as possible, in order to increase the enlargement and the extent of the field without affecting the clearness.

Amici's Microscope. — The following interesting holograph letter from Prof. Amici, together with a description of his Microscope, has been recently found among the papers belonging to the Society.

Mr. John B. Carruthers, F.L.S., has most kindly translated the letter, together with the description of the Microscope. The cuts are photographic reproductions of Prof. Amici's own drawings. It will be recollected that Amici was the first to demonstrate the part played by the pollen-tube in the fertilisation of flowering plants.

"Most Honoured Sir,

"I send you the description of the Microscope which you have obtained, and the flat glasses necessary for the observations. I add also the ground glass which is mentioned in describing the use of the instrument. When the objects are prepared, I shall make it my duty to send you some which will serve as specimens, and will show the comparative power of the Microscope. With high esteem, I am your obedient servant,

"G. Batta Amici. At home. 18 Dec. 1841."

"Amici's upright Microscope, acquired by Mr. Sebright, contains ten achromatic objectives, variously marked, which are used combined in series of two, three, or even four, united together. Figs. 2^a, 3^a, 4^a, and 5^a [fig. 155] show the series as they ought to be fixed below the tube of the Microscope to obtain different magnifying powers.

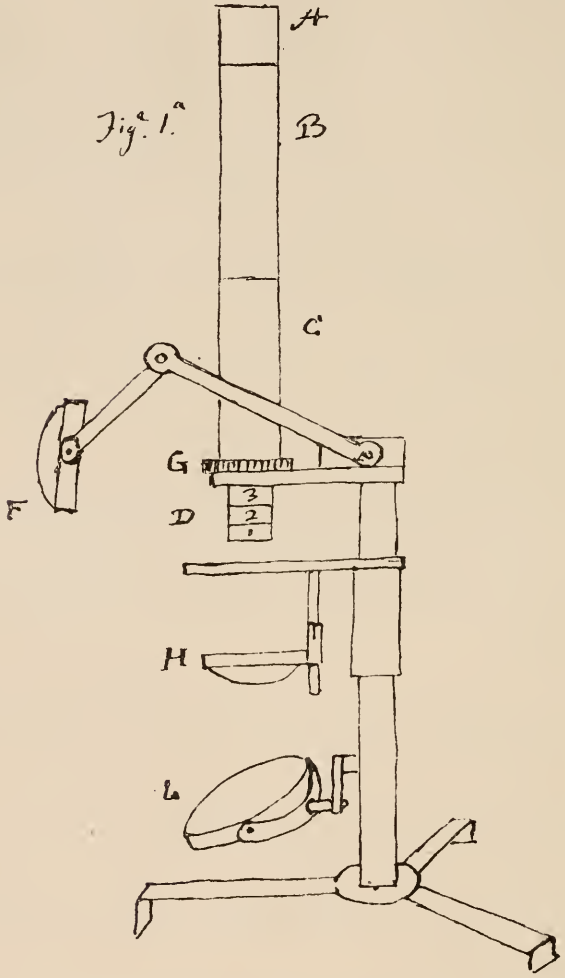
"The four objectives marked with dots form the strongest combination; their focal distance being very short, only permits their use with minute transparent bodies, which bodies, if immersed in a fluid, should be observed by covering them with a very thin plate of mica, so as not to wet the last, that is to say the lowest, lens, which is brought almost into contact with them.

"The combination of objectives marked 3, 2, 1, in the order shown in fig. 3^a, serves only for transparent objects, but has been constructed so that, in order to see these objects clearly and distinctly, they must be enclosed between two flat glasses of which the upper one (i.e. the one which covers the object) must be 1 mm. in thickness. For this purpose the instrument is provided with a good number of cover-glasses of

the needed thickness of 1 mm. *N.B.*—If it is desired, with the same combination as fig. 3ª, to work with uncovered objects, and not objects under glass, it is sufficient to separate No. 1 by two turns of the screw from No. 2.

"If No. 1 is removed and the other two are left, as in Fig. 4ª, the

Fig. 154.



magnification is lessened, but there is an increase of focal distance, whereby bodies of larger size, and even opaque ones, can be observed, and it matters not whether they be covered with glass or mica, or be uncovered.

"The three objectives marked 6, 5, 4, as in fig. 2ª, are the series of

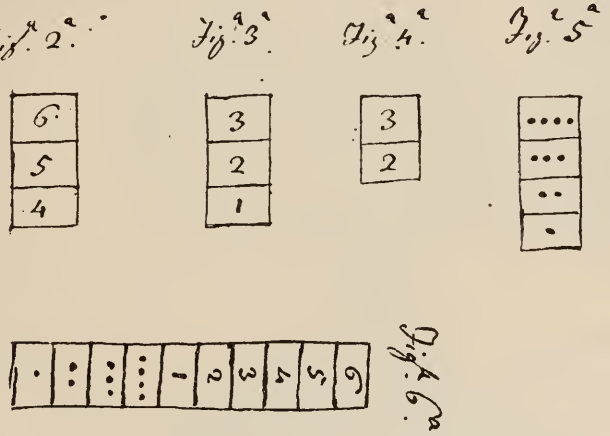
smallest power, and, possessing a long focal distance, are of use for all kinds of objects, transparent or opaque.

"There are two eye-pieces, each with two lenses, which can be successively placed at A at the end of the tube [fig. 154] made up of the two parts B and C, or simply at the end of C. Thus with the four series of objectives, figs. 2, 3, 4, and 5 applied separately at D, sixteen different magnifying powers are obtained.

"Taking away next the tubes B and C and the eye-piece A, leaving only the milled head G, with one or more objectives, these latter act as common lenses (or "loupes"), and the Microscope—in that case equivalent to a simple Microscope—may be used in observing large bodies and for their preparation and dissection.

"Opaque bodies are illuminated by means of the lens F, which is so

FIG. 155.



inclined as to throw the light from a lamp or the daylight upon the object.

"Transparent bodies are illuminated by the reflection from the mirror L underneath, through the lens H. This lens slides along a vertical arm, and can be approximated to or removed from the object and placed more or less obliquely to it. Clearness of vision depends chiefly on the satisfactory placing of the illuminating lens, and it is well to get considerable practice, so as to ascertain the most favourable position for illumination, according to the nature of the object and the particular series of objectives which is in use. For the weaker objectives the lens H is usually covered by the black diaphragm placed above it.

"There is a flat ground glass which is introduced between the little springs under the stage only when it is desired to use direct sunlight as an illuminant, so as to increase the brilliance of the bodies without burning them.

"All the glasses, eye-pieces, and objectives alike, are kept bright by cleaning with the reverse side of a thin piece of glove-leather. This pre-

liminary operation is recommended whenever it is desired to compare this instrument with other Microscopes.

"The objectives are enclosed in a little box, inserting them all together, as they are in fig. 6ª. If they are inserted in a different order, there is a risk of breaking the glass of one against the other.

"Florence, 17 Dec. 1841."

KNIPE, O.—**The Projection Microscope.**

[An elementary description of method of use.]

Micr. Bull., Febr. and April, 1900, pp. 1 and 2.

DISNEY, A. N.—**Modern Microscopes.**

[The author reviews the most notable instruments which have been noticed in the Journal of the R.M.S. during last three years.]

Nature, lxii. (1900) pp. 154-6 (2 figs.).

(2) Eye-pieces and Objectives.

Eye-piece Diaphragms.* — M. Malassez has communicated to the Société de Biologie several inventions of his own for obtaining certain cheap accessory apparatus. One of these is an *Ocular Diaphragm with movable index*. In the eye-piece at the position of the ordinary diaphragm he inserts a disc of blackened cork with a kind of watch-hand pointer; one extremity (ring-shaped) is pivoted by a pin-head near the periphery of the disc, the other extremity (finely pointed) projects into the field. A rotation of the eye-pieces exerts sufficient friction to make the hand appear or disappear at will. Thus the position of any point in the Microscope image can be indicated.

M. Malassez also describes several simple contrivances for procuring effective home-made micrometer eye-pieces; also a new form of lens-carrier.

(3) Illuminating and other Apparatus.

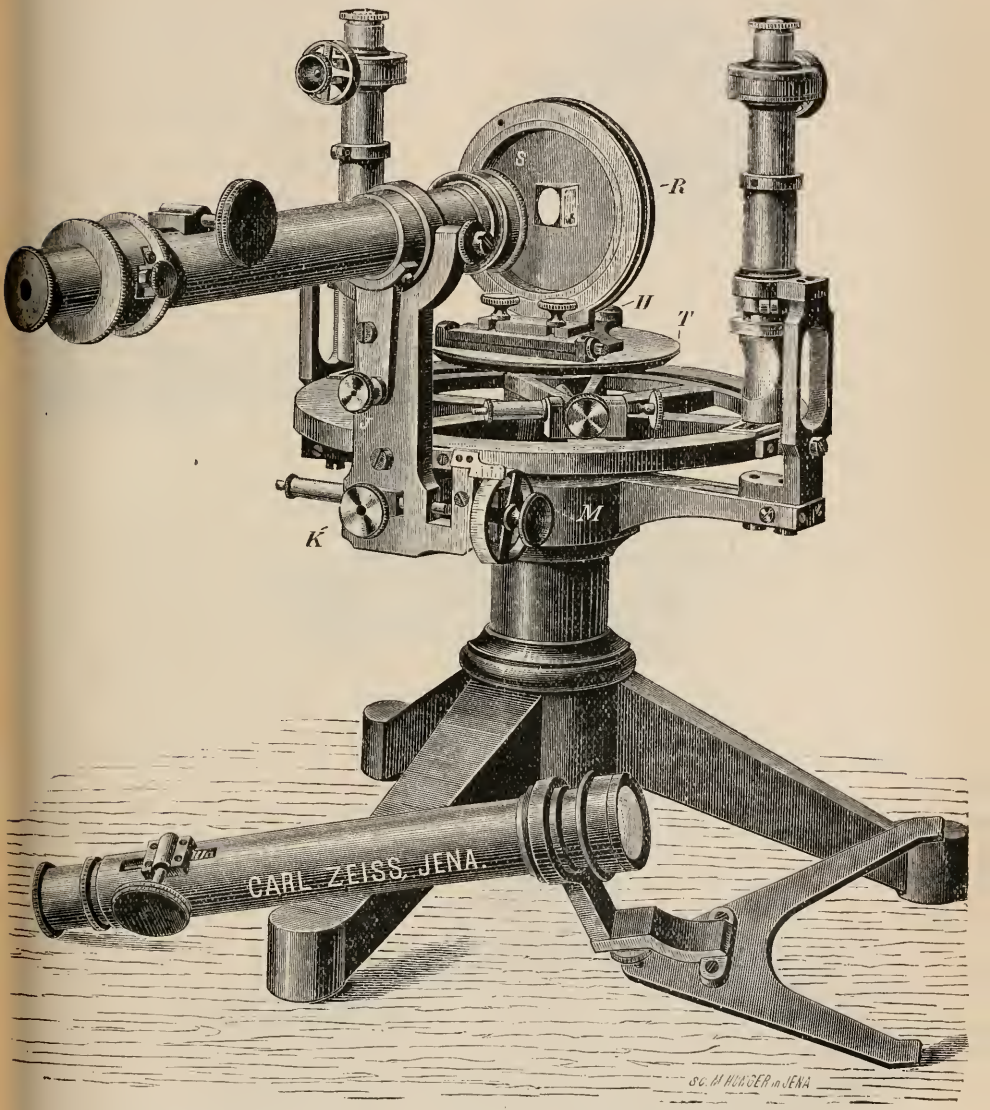
Abbe's Spectrometer.—This apparatus, originally designed by Prof. Abbe as far back as 1874, has undergone various improvements, and is now made by the Zeiss firm in the form shown in fig. 156. The principle is that known as "autocollimation," whereby the incident ray, after suffering normal reflection at the back face of the prism, issues in the same direction as it entered (fig. 158). In the adjustment of the ocular head (fig. 157) the width of the slit S is regulated from the under side by a screw. The course of the light is from the left through the illuminating prism P. The lower half of the field of view is free for the observation of the spectrum. The adjustment point (the intersection of two threads crossing at a sharp angle) is applicable both for dark lines on a bright ground and for light lines on a dark one. The focusing of the telescope is by rack-and-pinion: and its normal position with regard to the rotation axis of the graduated circle is ob-obtained by the adjustment screw.

For determining the refractive index, Abbe's method has all the advantages of Fraunhofer's without its disadvantages. For the ray-path (fig. 158) is exactly identical with the path of a ray in the minimum of deviation through a prism of twice the refractive angle. But the mode of measurement is essentially simpler. It is only necessary to rotate the prism just so far round the vertical axis of the spectrometer

* C.R. Soc. de Biol., lii. (1900) pp. 629-33, 724-7.

that the spectrum line to be measured coincides with the adjustment mark. The minimum of deviation is thus automatically given; whilst

Fig. 156.



with Fraunhofer's there is required the repeated adjustment and the simultaneous testing of the adjustment of the telescope obtained by the rotation of the prism about its vertical axis. Abbe's method also

possesses the advantage that, under otherwise similar conditions, only half of the material is used.

Fig. 157.

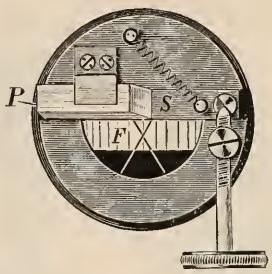


Fig. 158.

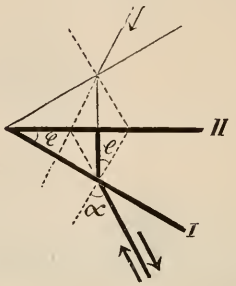
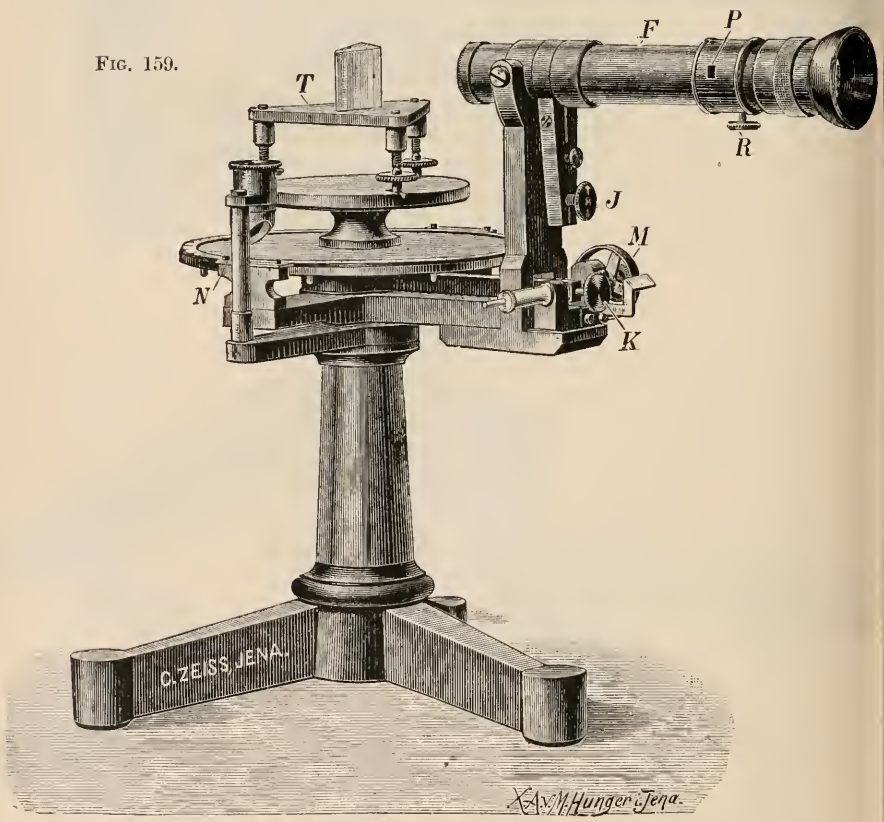


Fig. 159.



The determination of the dispersion follows independently from the graduated circle as the difference measurement by help of a special

micrometer arrangement (M, fig. 156). The advantage of this determination method, in contrast with the direct determination of the refractive index, consists in a considerable simplification of the measurement and in, under otherwise similar conditions, great increase of accuracy. The limits of attainable accuracy for the refractive index affect the fourth decimal place to the extent of one unit, and for the dispersion (difference of the refractive indices) one or two units in the fifth decimal place.

The second telescope shown in the figure is only occasionally essential.

Fig. 159 is a simpler form of the same instrument adapted for students' use in physical laboratories.

Zeiss' High Temperature Spectrometer. — Figs. 161, 162, show this instrument, which is specially adapted for the examination of the influence of temperature on the refraction of solid bodies (glasses, &c.). It is applicable to temperatures of 400° C. and upwards.

The tube A (fig. 162) fastened on the rotation axis of the spectrometer, carries a small table T fitted with adjustable screws, on which is a glass tube G with a lid, and upon it the prism to be examined. The coarse rotation is by hand movement, and the fine by micrometer screw. The warming of the object is attained by heating a kind of copper jacket, weighing about 50 kilos., with vertical cylindrical perforations; within this jacket the prism-carrier freely rotates. The flame-gases from the Bunsen burners pass up

Fig. 160.

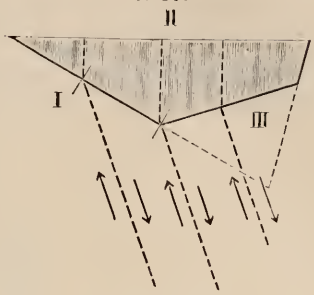
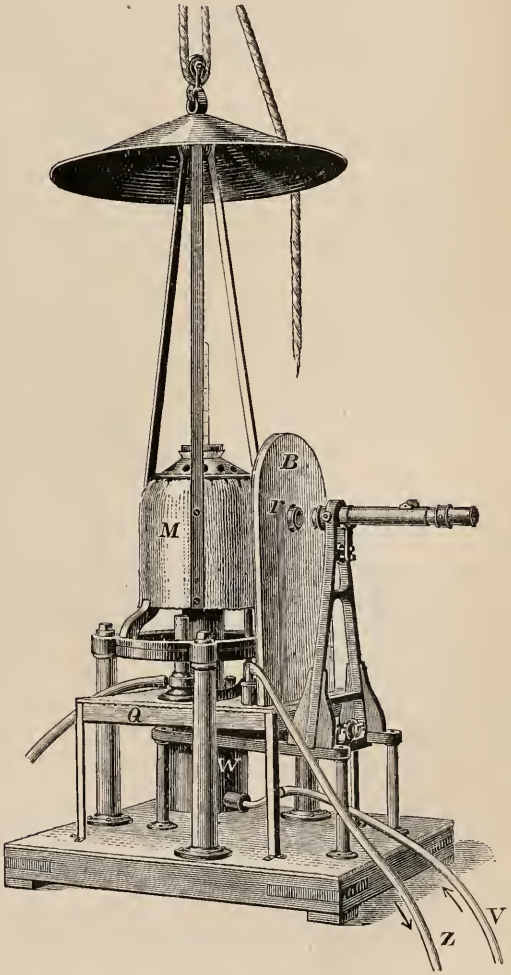
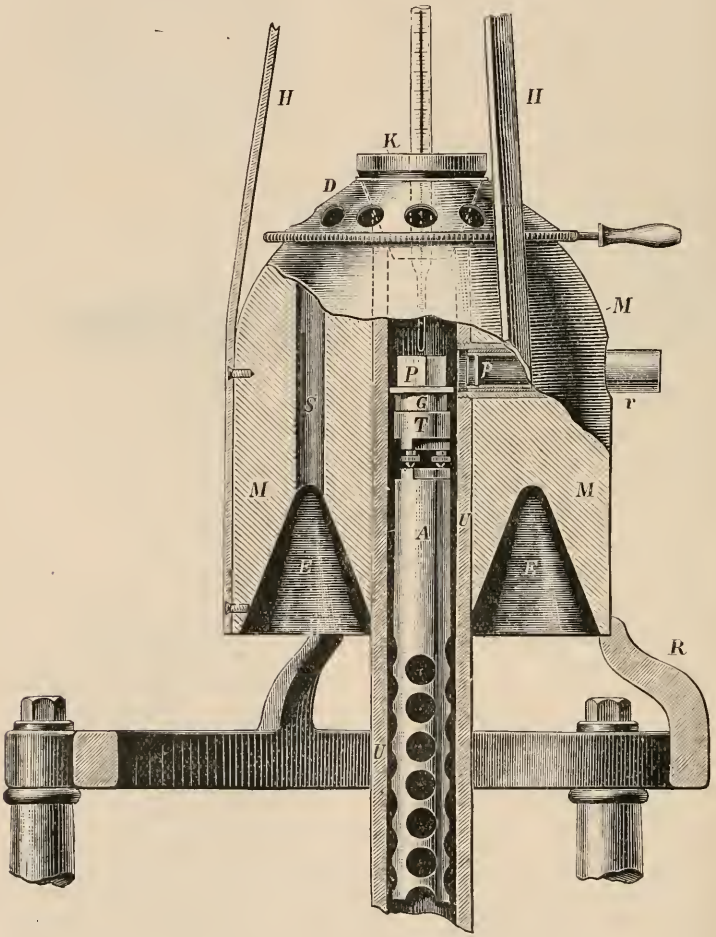


Fig. 161.



through the conical openings E, and escape through ten flues S, whose orifices can be closed or not at pleasure. The inner tube is closed at the top with a cone into which is fitted a thermometer. Inspection of the interior is by the metal tube r, which has two glass plates with parallel faces at p. The rotation axis and micrometer movement are

FIG. 162.



shielded from the influence of the heat by a constant stream of water through the iron troughs Q and W (fig. 161). A metal shield B protects the telescope. The whole copper jacket is wrapped in asbestos cloth.

For the convenient raising and lowering of the copper jacket, it is suspended on pulleys fastened to the ceiling of the room and counter-

poised. The form of the glass prism and the autocollimation of the rays are shown in fig. 160.

Modification of Rousselet's Compressor. — At the meeting of the Society held on June 20th, Mr. G. H. J. Rogers, of Maidstone, exhibited a modification of the Rousselet compressor, the chief feature of which

Fig. 163.

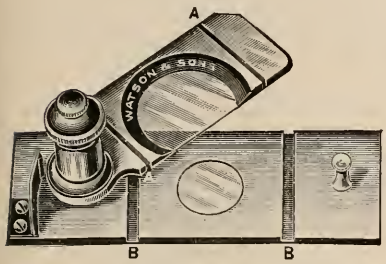
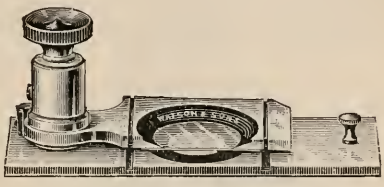


Fig. 164.



consisted in the employment of two indiarubber bands in suitable grooves to keep the glass in position, instead of having it cemented. It was claimed that this saved trouble and time in the event of the glass being broken. Fig. 163 shows the instrument open; A A are the indiarubber bands; B B the grooves to receive the bands; in fig. 164 the instrument is shown closed.

Marktanner-Turneretscher, G., F.R.M.S.—**Bemerkungen über Lichtquellen für Projectionsapparate und mikrophotographische Zwecke.** (Observations on Light Sources for Projection Apparatus and Photomicrographic Purposes.)
[The author reviews the various kinds of available artificial light and especially Liesegang's ether jet.]
Laterna Magica, xvi. (1900) April, pp. 17–26 (1 fig.).

(4) Photomicrography.

Cheyney, J. S.—**Photomicrography.**
[A practical treatment of the subject.] *Micro. Bull.*, June 1900, pp. 17–9.

Marktanner-Turneretscher, G.—**Fortschritte auf dem Gebiete der Mikrophotographie und des Projectionswesens.** (Progress in the Department of Photomicrography and Projection.)
[A descriptive catalogue of the chief novelties pertaining to the subject collected from international scientific journals for past year.]
J. M. Eder's Jahrb. f. Photog. u. Reproductionstechnik f. 1900.
(Also as a separate pamphlet, 18 pp. and 8 figs.)

(5) Microscopical Optics and Manipulation.

Abbe's Refractometer.—This instrument, first designed by Prof. Abbe in 1874, has lately undergone some improvements by Dr. Pulfrich.* The optical improvement consists in removing the polish from the plane of the under part of the double prism and replacing it by a frosted surface. It is found that the effect is to obliterate the troublesome images of adjacent objects which were apt to obtrude themselves into the field of view and distract the observer. The Zeiss firm recommend the

* See Zeitschr. f. Instrumentenkunde, 1898, pp. 107–12 (5 figs.).

improved instrument as one of most convenient manipulation. It can be used with any kind of light, and is self-reading, i.e. the refractive index (1·3 to 1·7) can be read off on the divided circle without calculation. A very few drops of fluid suffice for observation, and therefore the instrument can be used in the most delicate investigations. Its excellence for liquid observations with transmitted light has long been admitted, but the new form of prism permits of the application of reflected and obliquely incident light (figs. 165–167), by means of which observations can be made on solid bodies. For this latter purpose the telescope is placed approximately vertically, and the frosted surface illuminated by the mirror R (fig. 168).

Fig. 165.

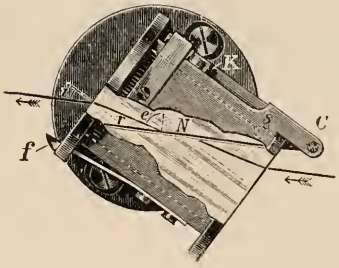


Fig. 166.

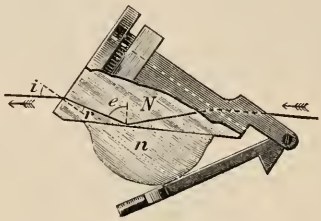
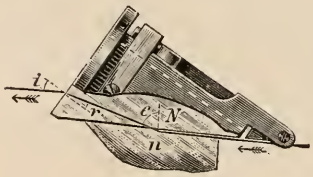


Fig. 167.



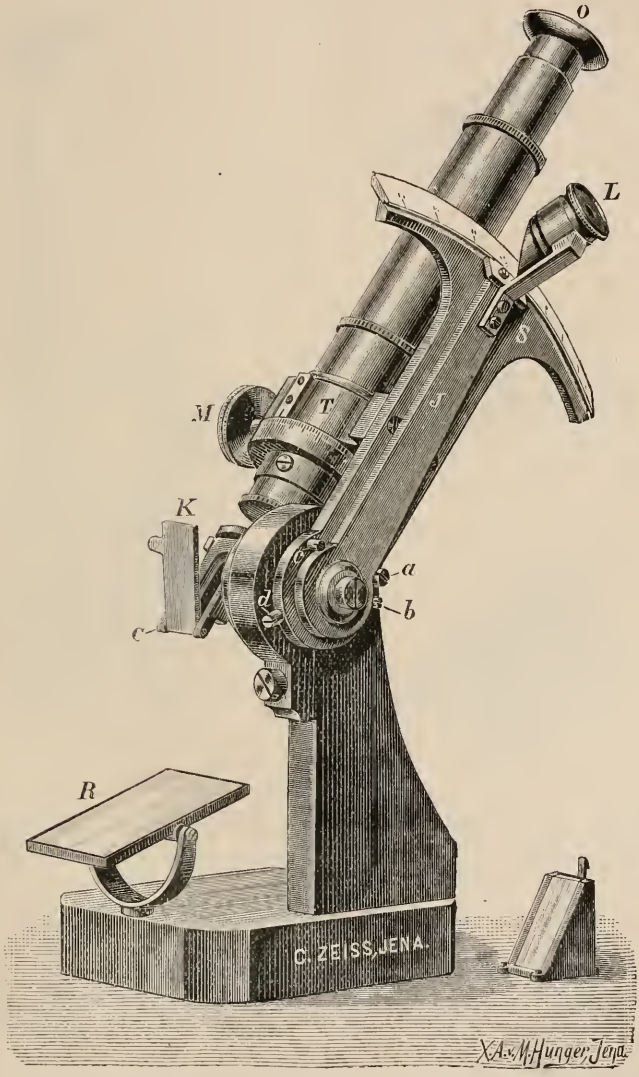
Another improvement consists in the addition of a so-called compensator placed in the ray-path between the double prism and the telescope. This renders possible the use of white light, and consists of two Amici prisms (exactly adjusted for the D line) of equal dispersion, which by rotation at M can be equally turned about the telescope axis. The dispersions at the two prisms coalesce, and form a resultant dispersion which causes a colourless ray exactly incident on the same spot as the ray from a sodium light. Fig. 168 shows the earlier form of the refractometer fitted with the new compensator.

The instrument can also be procured fitted with a heating apparatus.

Zeiss' Educational Refractometer.—This form of instrument is intended for use in physical and chemical laboratories, and depends on the properties of a flint glass prism ($\mu = 1{\cdot}72$) of 61° refractive angle. Its claim to its title is justified by the fact that all the necessary optical constants (the prism angle and the refractive index of the prism) can be determined on the instrument itself. Also the apparatus is provided with adjustments by assistance of which the whole of the various

illuminating methods (reflected light, obliquely incident light, and transmitted light, figs. 169–171) can be brought into play and their appropriate effects in defining the boundary lines demonstrated. The

Fig. 168.



suitability of the instrument to solid and fluid bodies ranges between refractive indices of 1·0 and of about 1·7 (the index of the flint-glass prism).

The adjustment of the apparatus (fig. 172) is by free hand motion. The observer's right hand grips the telescope with its divided circle

Fig. 169.

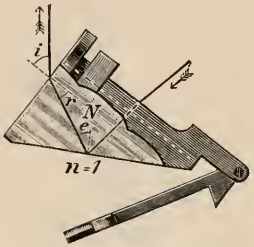


Fig. 170.

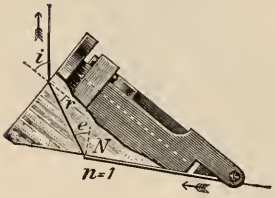


Fig. 171.

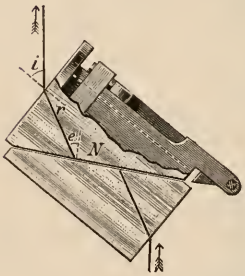
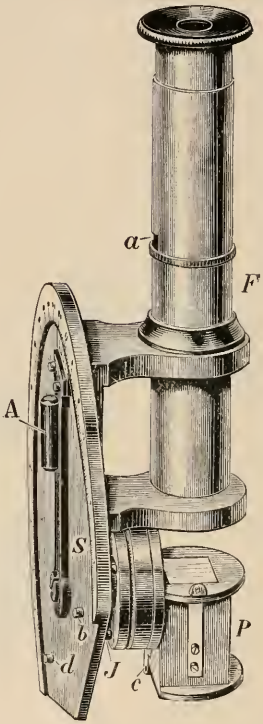


Fig. 172.



(0°–180°) while his left hand guides the arm A attached to the vernier and to the prism. The vernier reads to 1′. The prism is provided with a movable stop for changing the illumination.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Medium for Cultivating Diphtheria and other Organisms.†—Herr P. Glaessner, in a dissertation on the value of some new albuminous

* 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., xxvii. (1900) pp. 724–32.

preparations for culture purposes, describes his experiences with pepton, asparagin, somatose, nutrose, and Heyden's medium. To the last are ascribed numerous cultivation virtues, and the following procedure is recommended for making a mixture suitable for most purposes. One gramme of Heyden's medium is stirred up in a little water; 0·5 grm. salt, 0·1 grm. meat extract, 1·5 grm. agar, and 100 ccm. distilled water are added. The mixture is well boiled and afterwards steam-filtered. The filtrate is perfectly clear and transparent, but sets somewhat slowly. Slants should be kept in the oblique position for 12–18 hours.

The foregoing medium seems specially adapted for diphtheria bacilli, and it is not favourable to the growth of Streptococci.

New Medium for Growth and Differentiation of Bacillus coli communis and B. typhi abdominalis.* — Mr. A. T. MacConkey draws attention to a medium having a marked inhibitory effect on soil and water organisms, and therefore useful for the examination of water, soil, and food-stuffs. It is composed of sodium glycocholate 0·5 per cent.; pepton 1·5 per cent.; lactose 0·3–0·5 per cent.; agar 1·5 per cent.; tap water q. s. The lactose is added after filtration.

If stab-cultures be made and incubated at 42° C. for 24–48 hours, the tubes containing *B. col. com.* will be found to have become cloudy, while those inoculated with *B. typhi abd.* remain quite clear.

If glucose be used instead of lactose, both tubes become cloudy; but the cloudiness due to *B. coli* begins from below, and that from *B. typhi* from above. In plates made with the glucose medium, incubated at 42° C. for 48 hours, and then left at room temperature for 3–4 days exposed to the light, the colonies turn orange-colour.

Piorkowski's Medium for Diagnosing Typhoid Bacilli.† — Dr. G. Mayer finds that urine is effectively rendered ammoniacal by infecting it with *Proteus vulgaris*. 5 ccm. of a bouillon culture grown for 24 hours at 22° C. are added to about 2 litres of morning urine. In 15 to 20 hours the urine has acquired the correct grade of ammoniacal reaction. This procedure is extremely convenient for Piorkowski's method for detecting typhoid bacilli. The medium used is composed of alkaline urine, 3·3 per cent. gelatin, and 0·5 per cent. pepton. When cultivated on this urine-gelatin, the typhoid colonies assume characteristic shapes distinguished by root-like ramifications proceeding from a central core of variable dimensions. Forty-five different samples of bacterial growth are depicted. These are subdivided into five groups. The first example resembles a sphere with a few radiating stumpy processes, the last a piece of thistledown.

Medium for Isolating the Typhoid Bacillus from Stools.‡—Dr. L. Remy used the following medium for isolating the *Bacillus typhosus* from the stools of typhoid patients:—Distilled water 1000 grm.; asparagin 6 grm.; oxalic acid 0·5 grm.; lactic acid 0·15 grm.; citric acid 0·15 grm.; bisodic phosphate 5 grm.; magnesium sulphate 2·5 grm.; potassium sulphate 1·25 grm.; sodium chloride 2 grm. All the salts except the magnesium sulphate are pounded up in a mortar, and then placed in a

* Lancet, 1900, ii. p. 20.

† Centralbl. Bakt. u. Par., I^te^ Abt., xxviii. (1900) pp. 125–36 (1 illustration).

‡ Ann. Inst. Pasteur, xiv. (1900) pp. 355–70.

flask with a litre of distilled water and 30 grm. of pepton. The flask is then heated in an autoclave for 1/4 hour. The contents are then poured into another flask which contains 120–150 grm. of gelatin. After the gelatin is dissolved, some soda is added to render it slightly alkaline. It is then kept for 1/4 hour in an autoclave at 110°, after which it is acidified with a deminormal solution of H_2SO_4 in such wise that the acidity of 10 ccm. of the gelatin is neutralised by 0·2 ccm. of a deminormal solution of soda. This acidity is equivalent to 0·5 of H_2SO_4 per litre. The mixture is again heated for 8–10 minutes, filtered, and the acidity tested with phenolphthalein and deminormal soda solution. If red colour appears when 0·2 ccm. of soda solution have been added to 10 ccm. of the gelatin, the magnesium sulphate may be added in the proportion of 2·5 per litre of gelatin. The mass is then distributed into tubes (10 ccm. each) and sterilised thrice. When about to be used, 1 ccm. of a 35 per cent. solution of lactose and 0·1 ccm. of a 2·5 per cent. solution of phenol are introduced into each tube.

This medium is stated to give very certain results for isolating the typhoid bacillus from stools in the presence of *B. coli*, more especially in the earlier stages of the malady.

Neutralisation of Media.*—Dr. Eyre, after calling attention to the important influence exercised by the reaction of the medium upon the growth of an organism cultivated thereon, advocated the adoption of media (broth, gelatin, and agar) of a definite "standard" reaction for ordinary laboratory use, and pointed out that litmus, the indicator chiefly used in this country, was totally unsuited for exact work, as it was not sufficiently sensitive to weak organic acids and acid phosphates. Phenolphthalein, however, was a sensitive and reliable indicator, and gave a sharp and definite "end-point." At the meeting of the Pathological Society at Cambridge, Dr. Eyre exhibited a series of flasks of agar and gelatin, demonstrating the colour produced when the end-point or neutral point to phenolphthalein was reached, and showing the marked effect of the addition of minute quantities of decinormal solution of caustic soda to the medium after that point had been reached, an effect which proved that it was hardly possible for the most inexperienced worker to make a greater error than 5 per cent. when titrating with $\frac{N}{10}$ NaOH, and using phenolphthalein as the indicator.

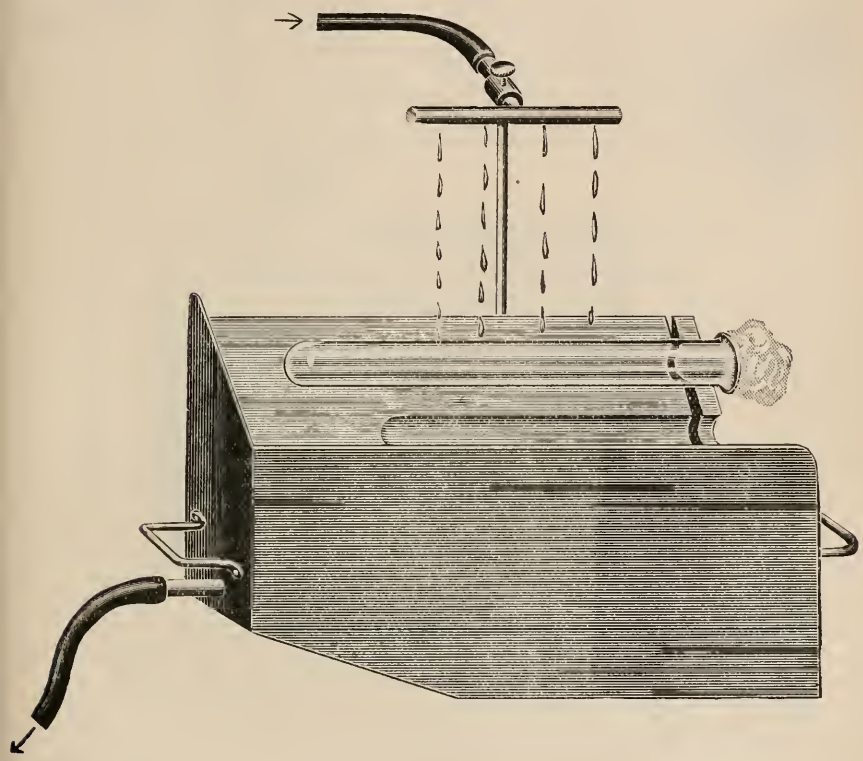
Apparatus for Making Roll-cultures.† — Dr. G. H. F. Nuttall has devised a convenient apparatus for making roll-cultures (figs. 173, 174). The principal parts are a marble block and a tin box. The upper surface of the block is polished, and has two grooves for tubes, the section of the grooves being less than a semicircle. About 1 cm. from the edge is a third groove for carrying off the water which might wet the plugs. In order to make the surface of the block perfectly smooth, a very thin layer of melted paraffin is brushed over it and rolled smooth with a hot tube. Should the layer get worn, it is easily wiped off with a cloth damped with turpentine or xylol, and a fresh film applied. The block is kept in an oblique position, and prevented from touching the sides of

* Brit. Med. Journ., 1900, ii. p. 21.

† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 605–9 (2 figs.).

the pan by means of supports (not shown in the illustrations). The bottom of the pan is quite flat, and the front and left sides are higher than the other two. The front and back sides, which are prolonged downwards to form a support for the box, are sloped off on the left side. There are two handles and an outflow pipe near the bottom. To the

Fig. 173.



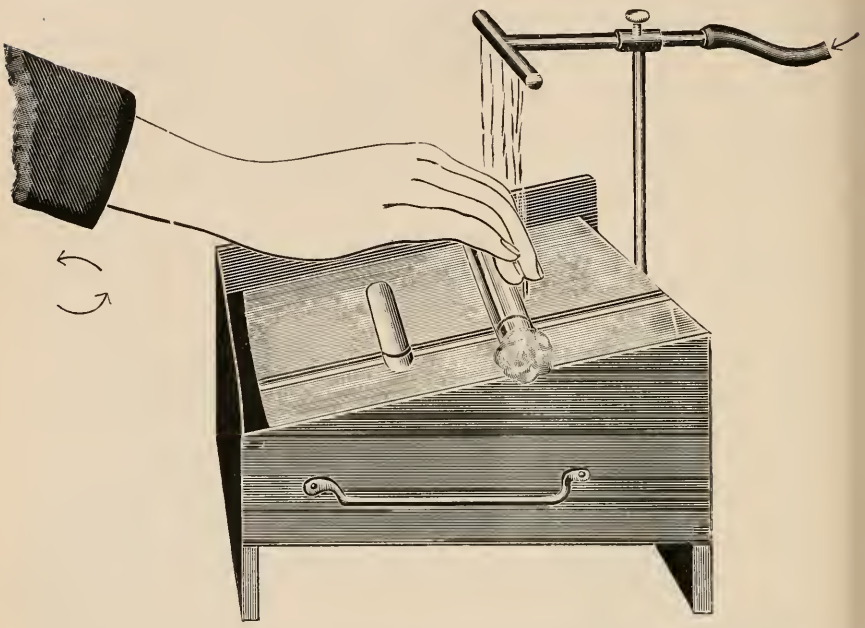
back of the pan is fixed a bar which carries a T-shaped tube, through the leg of which the water enters, passing out through holes in the arms. When the apparatus is used, it is tilted by pressing on the left handle, the tube is inserted in a groove and rolled round in the direction indicated by the arrows, and then the apparatus restored to the horizontal position.

Incubator for Student Use.*—Prof. V. A. Moore describes an incubator which he has devised for the use of a large class. It consists of a chest of drawers after the Lillie paraffin oven pattern, which are placed within the jacket of the incubator. Each drawer is of sufficient size for the working cultures of one student. The apparatus is heated by gas-

* Trans. Amer. Micr. Soc., xxi. (1900) pp. 103-6 (4 figs.).

burners placed underneath, the heat being radiated from a metal plate at the bottom and one at the top, and the metal tubes connecting them. The tubes are arranged at the sides and back, and are placed close to one another. The drawers are made of sheet zinc with a wooden front.

Fig. 174.



Each is 49 cm. long, 10·5 cm. wide, and 19 cm. deep. The sides and back are perforated. The drawers are provided at the top with a narrow flange which runs in a metal groove, and in which the drawers are supported. In front of each drawer are a pull and a frame for a card. The Roux bimetallic regulator is inserted at the back.

Improved Cultivation Capsules.*—Dr. R. J. Petri describes some improvements and modifications of his well-known culture dishes. The covers are now made of yellowish-brown glass in order that the growth of the colonies should not be interfered with by the harmful action of the red and violet rays. The dishes and covers, which are circular as of yore, are of two patterns. In fig. 175 the dish has upright sides; the flange of the top-piece is twice as thick as the rest of the cover, and its upper edge projects above the general level in order to prevent slipping of the dish above. In fig. 176 the side of the dish is sloped outwards, while the margin of the cover is bent to an acute angle into which the side of the dish is received. At *, figs. 175 and 176, is shown a plate made of yellowish-brown glass, having a circular rim within which the lowermost dish is inserted. This serves to make a pile of dishes quite

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 79–82 (6 figs.).

steady. The colour of the cover-piece in no way interferes with observation of the growth.

Fig. 175.

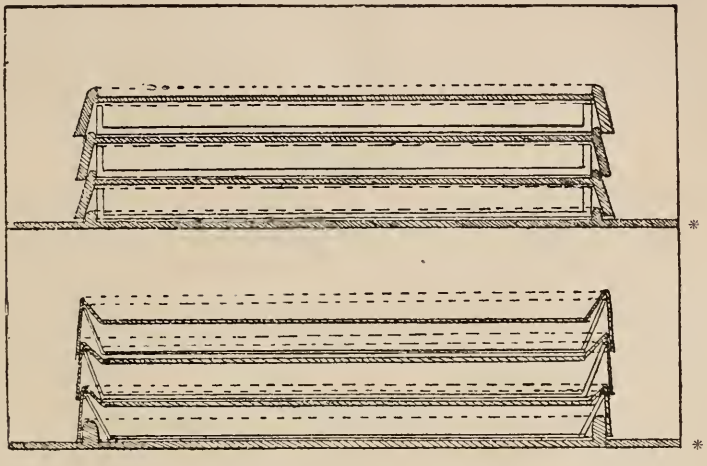


Fig. 176.

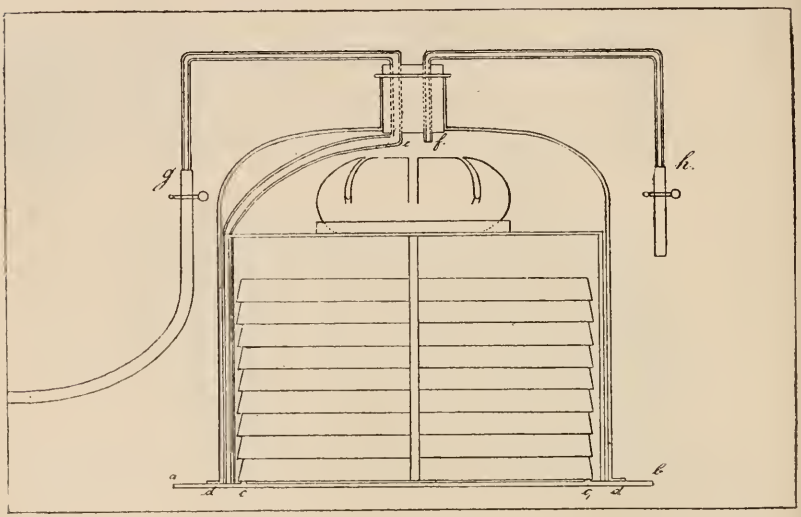
New Anaerobic Culture Apparatus.*—Dr. R. J. Petri describes a new apparatus for anaerobic cultivation in which the improved capsules are employed. As shown in the illustration (fig. 177) the pile of capsules is covered with a bell-jar through the stopper of which pass two tubes; the entrance tube *g* for the introduction of hydrogen reaches to near the bottom, while the exit tube *h* stops short at *f*. Over the pile of capsules is placed a four-footed wooden stand, and on this a circular plate which supports a basin having eight clefts in its side, so that it looks something like an artichoke. The basin contains caustic potash solution, and into the clefts are inserted strips of blotting-paper which have been saturated with pyrogallic acid and afterwards dried. The bell-jar is placed upon a glass plate, and the junction smeared with fat to make it air-tight. This plate is made of yellow glass, and has a circular elevation *c c* upon which the lowermost capsule rests. After hydrogen has been passed through for a sufficient time, the test for determining the entire expulsion of oxygen is applied. The apparatus is slightly tilted so as to wet one of the paper strips, and if it is not discoloured all the oxygen has been driven out. If, however, the colour alter (yellow to black) more hydrogen must be passed through, and then the test applied to another strip, and so on. In this apparatus the potash-pyrogallic acid is used as indicator; the oxygen is not absorbed but driven out.

Cultivating Gonococci on Simple Media.† — Dr. Thalmann has successfully cultivated *Gonococcus* on media with an acid reaction. The

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 196–9 (2 figs.).
† Op. cit., xxvii. (1900) pp. 828–34.

media used were brain, meat-water agar, serum, and bouillon. The acidity was calculated by means of phenolphthalein. In the case of brain, 100 ccm. was found to have an acidity of 1·4 ccm. normal acid (= 56 mg. H_2SO_4). To meat-water agar containing 1 per cent. pepton and 0·5 per cent. NaCl was added sufficient soda solution to neutralise two-

Fig. 177.



thirds of the acid. Serum was treated with two-thirds to three-fourths of the neutralising soda solution. Bouillon gave the best results when 70 per cent. of the total acid was neutralised. The simple expedient of mixing 7 parts neutral and 3 parts acid bouillon was quite unsuccessful.

The author is of opinion that a mixture of neutral and bibasic phosphates is necessary for the growth of *Gonococcus*.

Cultivation of Dictyostelium mucoroides and other Amœbæ.*—Herr G. A. Nadson finds that it is not difficult to cultivate *Dictyostelium mucoroides* on sterilised manure, and also on gelatin mixed with manure, on malt extract, on alkaline meat-pepton, gelatin, or agar. The colonies look pure to the naked eye, but careful microscopical examination shows that this is not the case. *D. mucoroides* does not liquefy gelatin; it is strongly aerobic, prefers slightly alkaline media, but can exist on acid substrata. Fluid media are not advantageous for growth, but pure cultures were obtained in the following nutrient solution:—Aq. dest. 100 ccm., glucose 5 grm., pepton Witte 1 grm., potassium phosphate 0·1 grm., magnesium sulphate 0·1 grm., traces of calcium and iron phosphates. In most media bacteria were a constant accompaniment, and their presence was favourable to the development of the organisms. The usual companion of *D. mucoroides* is *B. fluorescens liquefaciens*,

* Scripta Botanica, 1899, fasc. xv. Petersburg. See Bot. Centralbl., lxxxii. 1900, pp. 227–8.

and between the two exists an association or symbiosis. The presence of the bacterium is favourable to the development of the amœba, as it forms ammonia and thus maintains the alkalinity of the medium. On the other hand the amœba supplies the bacterium with organic substances. Though pure cultures of *D. mucoroides* can be obtained on gelatin and agar media, yet their development is not nearly so good as when they are accompanied by their customary followers.

Perfectly pure cultures are weak, easily perish, and produce mostly dwarf forms. Pure cultures do not give at all a correct picture of the normal growth of these organisms.

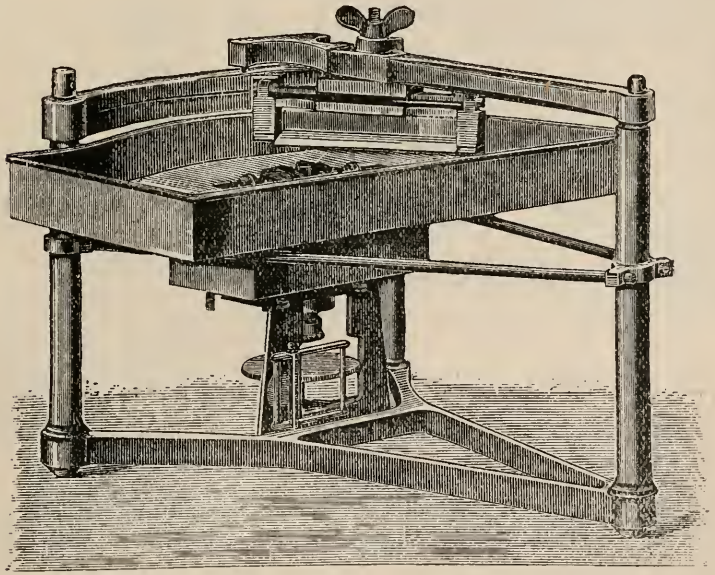
(2) Preparing Objects.

Demonstrating Bone Lacunæ.* — Dr. G. Schmore demonstrates bone lacunæ and canaliculi by means of thionin and picric acid.

The thionin solutions recommended are:—(1) a saturated solution in 50 per cent. alcohol 2 parts; water 10 parts. (2) 1 per cent. carbol water 90 parts; saturated solution of thionin in 50 per cent. alcohol 10 parts.

After staining with thionin for 5–10 minutes the sections are washed and then immersed in saturated aqueous solution of picric acid for a half to one minute. Excess of stain is removed in 70 per cent. alcohol. The sections are mounted in balsam.

Fig. 178.



(3) Cutting, including Imbedding and Microtomes.

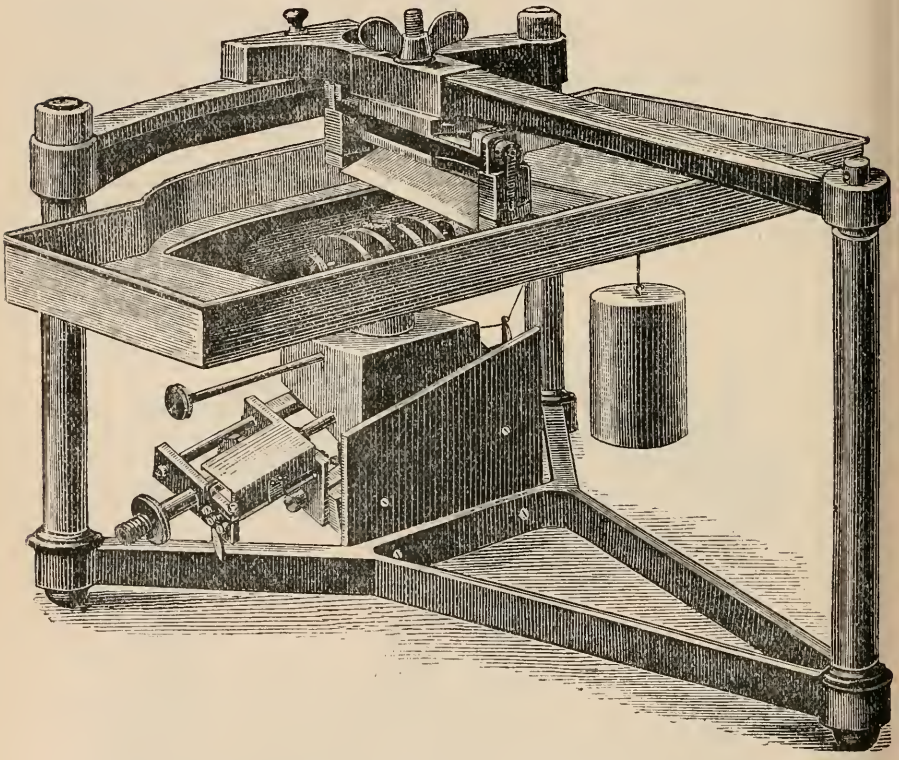
Microtome with Arc-movement of Knife for Section-cutting under Water, Alcohol, &c.†— Herr Paul Thate, of Berlin, describes a form

* Centralbl. f. allgem. Pathol. u. pathol. Anat., x. (1899) pp. 745–9.

† Zeit. f. angew. Mikr., June 1900, pp. 73–6 (2 figs.).

of microtome (figs. 178 and 179) brought out since 1888, and of interest as being the first to exhibit a completely circular knife-movement. The frame is a cast-iron tripod on a triangular base, the three pillars being connected with one another. One of these pillars is provided at its upper end with a socket in which a ball of corresponding shape fits, forming the extremity of a travelling arm. The two front pillars are connected at their upper ends by a strong cast-iron arc-piece, on whose upper plane face the distal broadened end of the traveller finds support and guidance. Two small round-headed steel knobs, screwed into the under side

Fig. 179.



of the broadened end of the traveller, give it a steady support and easy movement on the circular frame. Thus the traveller moves circularly round the ball-and-socket joint as its centre. The traveller is mortised about 20 cm. from the free end for the purpose of taking the knife-holder, which is adjustable at any point of the mortise, and is clamped by a butterfly nut. The knife is fastened at each end by screws to the lower faces of a pair of lateral flanges, whose heads are perforated and connected by a horizontal arm forming part of the knife-holder. An indicator at one extremity of this arm regulates the setting of the knife,

which can be sloped as desired. Below the plane swept out by the knife is the clamp for holding the preparation, and around it is a kind of trough for receiving the liquid (water or alcohol) under which the cutting is to be done. A micrometer screw bearing a notched disc raises the preparation 0·005 mm. for each tooth. A balance weight over a pulley takes the pressure off the micrometer screw.

Fig. 178 shows the earlier form in which trough and preparation were both simultaneously moved; fig. 179 a later form in which the trough remained stationary and the preparation alone was raised.

(4) Staining and Injecting.

Fungus and Bacterial Pigments.*—M. L. Matruchot advocates the use of a pigment derived from Schizomycetes (*Bacillus violaceus* and *Bacterium violaceum*), which he calls *violacein*. Experiments on its reactions with the protoplasm of a fungus, *Mortierella reticulata* (see p. 614), showed that it has selective properties, staining only the granular protoplasm and leaving the hyaloplasm and the cell-membrane uncoloured. Similar properties are possessed by the green pigment of *Fusarium polymorphum*. This staining property must be distinguished from "false pigmentation" (simple coloration by a foreign chromogenous organism) (*Mucor*, the Pyrenomycete of green wood), and from "auto-pigmentation" (the coloration of an organism by the excretion of its own pigment) (*Monascus purpureus*, *Eurotiopsis Gayoni*, *E. Saussinei*, the *Peziza* of green wood, *Mollisia Jungermanniæ*, *Bacillus erythrosporus*).

Kreso-fuchsin, a new Pigment.†—D. P. Röthig reports on a new pigment, kreso-fuchsin, which appears to be a specific stain for elastic tissue. Kreso-fuchsin is an amorphous powder, easily soluble in acetic acid, sparingly soluble in alcohol, and very slightly in water. The alcoholic solution has a blue, the aqueous a red colour. The alcoholic solution stains elastic tissue dark blue, cartilage, keratin, and mucus red. The aqueous solution does not stain elastic tissue at all, but cartilage, &c. red. The formulæ given by the author are two. The first or stock solution is composed of kreso-fuchsin 0·5 grm., alcohol 75 per cent. 100 grm., hydrochloric acid 3·0 grm. The second or staining fluid consists of stock solution 40 ccm., alcohol 95 per cent. 24 ccm., picric acid 1–2 ccm., aq. dest. 32 drops.

The sections remain in the staining solution 2 hours or more; an immersion of 24 hours does no harm. They are then transferred to 95 per cent. alcohol, and afterwards to absolute alcohol in order to remove excess of pigment and to dehydrate them. After passing through xylol the sections are mounted in Canada balsam. In sections thus prepared the elastic fibres are stained deep blue. Contrast and nuclear stains may be used; for these, orange G, carmin, borax alum, and lithium carmin and hæmatoxylin are recommended.

Neutral Red as a means for Diagnosing Bacterium Coli.‡—Herr W. Scheffler finds that *B. coli commune* produces a green fluorescence

* Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 33–60.
† Arch. f. Mikr. Anat. u. Entwicklungs., lvi. (1900) pp. 354–61 (1 pl.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 199–205.

when cultivated in neutral red-grape-sugar agar in from 24–48 hours. The medium is composed of 100 ccm. fluid agar, 0·3 grm. grape sugar, 1 ccm. saturated aqueous solution of neutral red.

Romanowski's Stain for Bacteria. * — Prof. Zettnow gives the following information as to his modification of Romanowski's method of staining bacteria.† 50 ccm. of 1 per cent. solution Höchst's medicinal methylen-blue are mixed with 3–4 ccm. of 5 per cent. solution of crystallised soda. The mixture is ready for use in 2–3 weeks. The eosin stain is a 1 per cent. solution Höchst's eosin B.A. When required for use, 1 ccm. of the eosin solution is added drop by drop to 2 ccm. of the blue solution, and the mixture kept well stirred the while.

Some of the mixture is poured or pipetted on to the cover-glass films and allowed to act for 5 minutes. The preparation is then washed in water and inspected in this under the Microscope, after which it is differentiated with eosin, &c. These preparations when mounted in balsam keep better than might be anticipated.

Modification of Romanowski's Stain for Bacteria.‡—Dr. Feinberg recommends the following modification of Romanowski's method for staining bacteria. The films are air-dried and fixed in absolute alcohol for ½–1 hour. They are then stained in a mixture made by heating 1·5–2 per cent. solution of methylen-blue to 70°–80° C. on several successive days, to get rid of the red pigment in the methylen-blue. To 1 ccm. of this solution 4–6 ccm. of 1 per thousand eosin solution are added. The cover-glasses are immersed in the mixed eosin-blue solution for 20 minutes, and on removal are washed with water. They are next decolorised in absolute alcohol. This takes some minutes. In successful preparations the nucleus is red and the plasma blue. The nuclear division in diphtheria bacilli is specially well seen by this method.

New Method for Staining Fibrin.§ — Prof. Kockel adopts the following procedure for staining fibrin. The sections are stuck on with albumen-glycerin, and when freed from paraffin are immersed for 5–10 minutes in 1–5 per cent. chromic acid solution. After washing they are stained for 15–20 minutes with Weigert's hæmatoxylin. They are again washed and then immersed in 1 per cent. alum solution until they become dark blue. After washing, the sections are differentiated in Weigert's ferridcyanide solution, and then washed again. Next, they are transferred to a saturated solution of alum for 15 minutes to 1 hour. After washing they are contrast-stained with carmin or safranin, and having been dehydrated are passed through clove oil or xylol and mounted in balsam. The fibrin is dark blue to bluish-black.

New Method of Staining Actinomyces.‖—Dr. A. Sata gives the following method for staining Actinomyces in sections. The pieces are fixed in formalin solution and the sections stained with a dilute hæmatoxylin solution. The sections are then immersed in alcohol for

* Centralbl. Bakt. u. Par., 1te Abt, xxvii. (1900) pp. 803–5.
† See this Journal, 1899, p. 664.
‡ Deutsche Med. Wochenschr., xxvi. (1900) pp. 256–7.
§ Centralbl. f. allgem. Pathol. u. pathol. Anat., x. (1899) pp. 749–57.
‖ Op. cit., xi. (1900) pp. 101–2.

some minutes, and afterwards transferred to a saturated solution of Sudan iii. in 96 per cent. alcohol for 12–24 hours. They are then washed in alcohol and mounted in glycerin.

Staining Envelope of Ascospores.*—Mr. W. A. Riley recommends a strong aqueous solution of Bismarck-brown for staining ascospores. Fifteen minutes is sufficient, though it is impossible to overstain. The spores are then washed in water and mounted in glycerin jelly.

Rapid Conversion of Hæmatoxylin into Hæmatein in Staining Solutions.†—Dr. H. F. Harris uses mercuric oxide for rapidly converting hæmatoxylin into hæmatein. The first formula given is one which makes a solution much the same as Mayer's hæmalum:—Hæmatoxylin 1 grm., alcohol 10 ccm., alum (potash or ammonia) 20 grm., distilled water 200 ccm. The alum is dissolved in the water by the aid of heat and then the hæmatoxylin solution is added. The mixture is then brought to the boil as rapidly as possible and half a gram of mercuric oxide added. The solution, which is now dark purple, is at once cooled by plunging the vessel into a basin of cool water. It is then ready for use. Its nuclear effect is heightened by dilution.

By adding 4 per cent. glacial acetic acid to the foregoing, a solution which corresponds to Mayer's acid hæmalum, and much resembles Ehrlich's hæmatoxylin, is produced. The addition of 30 to 70 ccm. of the hæmalum solution serves to keep the stain well, and the mixture is termed glychæmalum.

A hæmacalcium solution is prepared as follows:—(A) Hæmatoxylin 0·5 grm., aluminium chloride 0·5 grm., glacial acetic acid 2·5 ccm., 70 per cent. alcohol 150 ccm. The hæmatoxylin and aluminium chloride are dissolved in the alcohol, the solution brought to the boil, and then 1 grm. of mercuric oxide is gradually added. When it becomes dark purple the solution is rapidly cooled. The acid may be added before or after boiling. (B) Calcium chloride 25 grm., acetic acid 2·5 grm., 70 per cent. alcohol 150 ccm. The calcium is dissolved in the alcohol. The two solutions may be mixed, but it is better to keep them apart till just before use. Delafield's hæmatoxylin is prepared as follows:—Dissolve hæmatoxylin 1 grm. in alcohol 6 ccm. and add saturated solution of alum 100 ccm. Boil, and add 0·5 grm. of mercuric oxide. When the liquid assumes a dark purple colour, cool rapidly. When cool add 25 ccm. both of methylic alcohol and glycerin.

For staining mucin the following solution, termed muchæmatein, is advised. Aluminium chloride 0·1 grm., hæmatoxylin 0·2 grm., 70 per cent. alcohol 100 ccm.

Dissolve the aluminium chloride and hæmatoxylin in the alcohol, boil, and add gradually 0·6 grm. mercuric oxide; when purple, cool. A drop of hydrochloric acid should be added just before or after boiling.

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

Simple Method of Fixing Blood-films.‡—Dr. A. Edington has used the vapour of formic aldehyde for fixing blood-films, with extremely good results. He uses a bell-jar, the diameter of which is

* Journ. Applied Microscopy, iii. (1900) pp. 781–2. † Tom. cit., pp. 777–80.
‡ Brit. Med. Journ., 1900, ii. p. 19.

135 mm., and the height to the lower border of the neck about 150 mm. There is an opening at the top of the bell-jar, and this is closed by an indiarubber stopper, on the bottom of which is glued an ordinary cover-glass. The cover-glasses the films on which are to be fixed are laid on a glass plate and covered by the bell-jar. The stopper is removed and a drop of formalin is placed on the attached cover-glass at its lower end, and the stopper immediately replaced. The films, which must be quite dry, are exposed to the vapour for 15 minutes or more, but not longer than 30 minutes. The films should be thin, as thick ones are liable to crack.

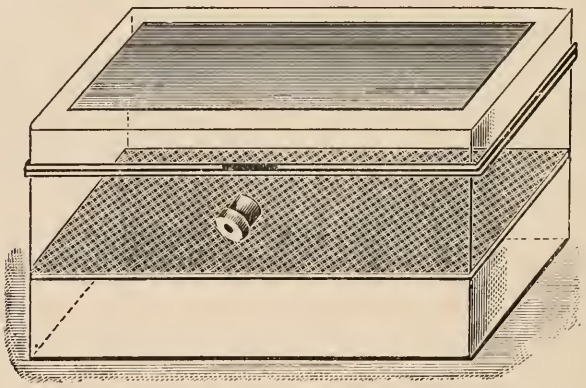
Mounting of Mosquitos.*—Dr. G. M. Giles recommends the following method for mounting mosquitos. As microscopical specimens, mosquitos should be mounted dry, and for this purpose Carpenter's foraminifera slide is best suited. This consists of a wood slip 3 in. by 1 in. by $\frac{1}{16}$ in. thick, with a hole about $\frac{3}{4}$ in. in diameter in the middle. This hole is converted into a cell by means of a cover-glass secured by gummed paper. The mosquito is spread out in the cell, which is then closed by means of another cover-slip, secured in the same way.

By this dry-mounting method the colour characters, only visible by reflected light, are preserved. When wet or balsam-mounted the specific distinctions are lost.

(6) Miscellaneous.

Apparatus for Ascertaining the Effect of Disinfectants.† — Dr. Piorkowski describes an apparatus (fig. 180) which he has found very valuable for determining the effect of disinfectants. It consists of a metal box made air-tight when closed by means of a rectangular bayonet

Fig. 180.



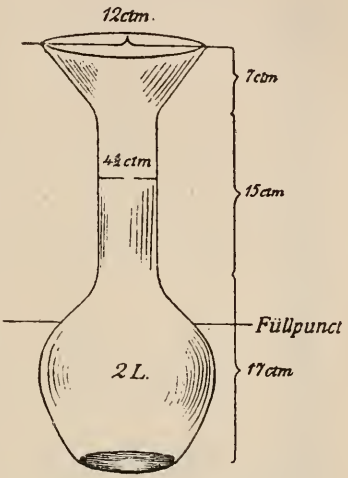
fastening. About half-way down the well is fitted a removable wire net tray. In the front (and at both ends if necessary) is a small tube which can be closed with a metal cap. Through this tube the disinfectant in the form of spray is introduced and made to play on the various objects

* Brit. Med. Journ., 1900, ii. pp. 459-60. Cf. this Journal, *ante*, p. 527.
† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 609-10 (1 fig.).

deposited on the tray. A glass plate is inserted in the lid for inspecting the distribution of the spray.

Glass Flask for Preparing Nutrient Media.*—Dr. A. von Borosini describes a glass vessel which obviates the inconvenience of overheating nutrient gelatin. The upper part of the flask is funnel-shaped. The illustration (fig. 181) gives the measurements for a two-litre flask.

FIG. 181.



Some Laboratory Apparatus.†—Professor S. H. Gage, in order to meet the requirements of a large class, has made use of flat-headed stove bolts as holders for the paraffin blocks to be sectioned by the Minot microtome (fig. 182). For small blocks the bolts answer without any modification, but for most objects a larger surface than the head of the bolt is necessary. To increase the surface an American cent, or some coin still larger, is soldered on to the head of the bolt. The convenience of having a sufficient supply of holders for a large class is obvious. The blocks can be kept ready for use in a glass phial; the fore end should be sealed with paraffin and the holder placed with the block end downwards (fig. 183).

Another apparatus described is a tray for holding ribands of sections. They are made of wood and measure 30 × 40 cm. The illustration, fig. 184, shows the face and sectional views. The bottom of the tray is covered with paper on which the ribands are deposited; this facilitates the numbering of the sections. The trays may be piled one upon another and so used as covers.

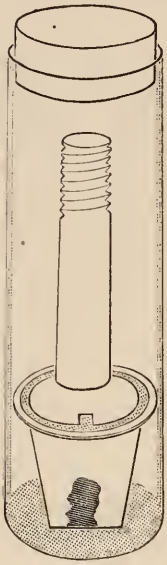
For the bichromate and sulphuric acid cleaning mixture a low iron kettle lined with heavy sheet lead is recommended, as the lead is not appreciably corroded and the kettle does not burst with the heat.

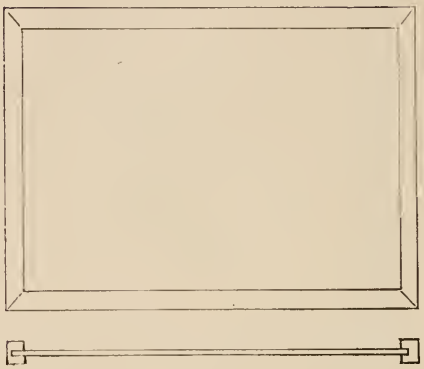
New Method for Counting Bacteria.‡ — Herr A. Klein describes a new method which is specially adapted for counting bacteria in the moist condition. A definite quantity (e.g. 0·5 ccm.) of a liquid culture, or an emulsion of a solid culture in physiological salt solution, is thoroughly mixed with an equal quantity of anilin water-gentian violet. In 2–3 minutes the bacteria are deeply stained. The mixture is again stirred so as to distribute the bacteria fairly equally throughout the fluid, and then a standard loopful removed to a clean cover-glass and carefully spread out. When dry the film is mounted in balsam. Fifty fields are then counted, and the number of bacteria in one ccm. of culture or

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) p. 23 (1 fig.).
† Trans. Amer. Micr. Soc., xxi. (1900) pp. 107–9 (3 figs.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 834-5.

emulsion is calculated from the known size of the loop, the cover-glass, and the field of vision. The complete details of this method are promised later.

FIG. 182. FIG. 183. FIG. 184.





Method of Identifying Butter.* — Mr. J. A. Hummel made an examination of Brown and Taylor's official method of identifying butter. In the manufacture of renovated butter, the butter fat is melted and then rapidly cooled in a stream of cold water; this induces a semi-crystallisation of the fat which may be recognised by the Microscope. A small piece of the sample is placed on a glass slide and pressed into a thin film with a cover-glass; it is then at once examined with a polarising Microscope magnifying 120–150 diameters. A selenite plate is placed between the slide and the lower Nicol's prism. In every case normal butters gave a uniform blue-coloured field, showing the entire absence of crystals; but the renovated samples gave a blue field mottled with yellow, which varied in intensity, but was very distinct in each case.

STINE, W. M.—**The Microscopic Study of Metals.**
[An interesting introduction to the subject.]
Journ. of App. Micr., March 1900, pp. 786–91 (2 figs.).

CHAMOT, E. M.—**Micro-chemical Analysis.**
[A series of introductory articles.] *Journ. of App. Micr.*, Jan. et seq. 1900.

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* Journ. Amer. Chem. Soc., xxii. (1900) pp. 327-9. See Journ. Chem. Soc., lxxviii. (1900) Abstr. ii. p. 582.

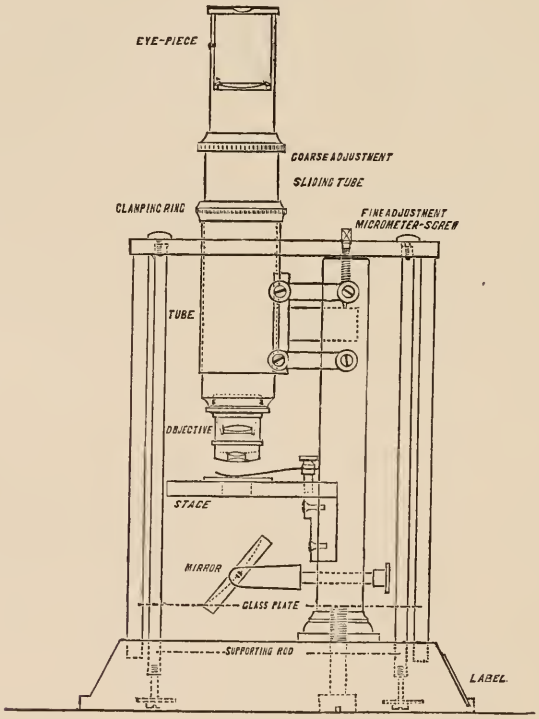
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

New Exhibition Microscope.†—Figs. 185 and 186 show an arrangement of Microscope permanently set up in the systematic museum of the New York Botanical Gardens. The stand adopted is the Leitz V, the foot being removed and the upright support fastened to a base of hardwood 6 by 6 by 1 in., blackened and with bevelled edges. The mirror

Fig. 185.



swings in two axes, and the square stage is furnished with a wheel diaphragm. The whole stand is enclosed in a case made of sheets of plate-glass cemented at the joints, the outside measurements being $4\frac{3}{4}$ by $4\frac{3}{4}$ by 6 in. The top of the case is not cemented, but is held in

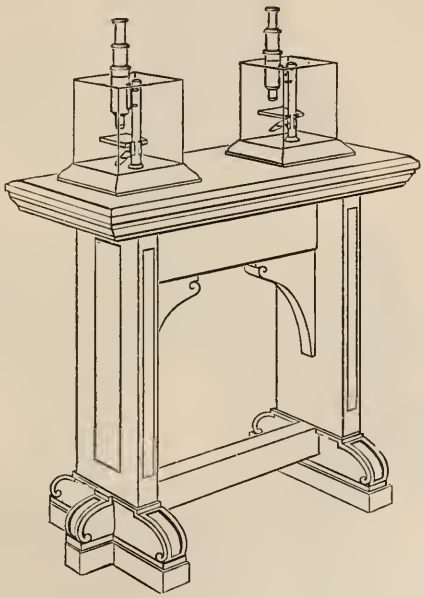
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Journ. New York Bot. Garden, i. (1900) pp. 139–41 (2 figs.).

its place by four upright rods which pass down through the base and are fastened by nuts, both on the lower side of the base and on the upper side at the top.

The instrument is furnished with fine adjustment only, and the milled head is removed, allowing the top of the case to rest on the head of the support. The square head of the micrometer-screw projects through a small aperture in the plate, and is manipulated by a detachable key kept by an attendant. The upper end of the Microscope body is provided with a clamping-ring which fixes the tube immovably in its place. The ocular is likewise fastened by a set-screw. All joints and openings are

Fig. 186.



sealed with felt in such a manner as to be dust-proof. The instruments are fitted with ocular ii. and objective 3, giving a magnification of 70, but this combination may be changed from time to time. Fig. 185 is a sectional view of the case. The instruments are fastened in pairs to tables of special design (fig. 186), and the objects placed under observation aid in the illustration of exhibits in the cases. Suitable explanations are given by labels placed on the tables at the side of the instrument. The tables are furnished with heavy iron sills to secure stability, and hold the instruments at a height above the floor convenient for the use of the majority of observers.

"London" Microscope.—Figs. 187, 188, represent the "London" Microscope exhibited by Messrs. R. and J. Beck (Ltd.) at the Meeting of the Society on November 21st. There is no special novelty in the

construction ; it is made on the Continental model ; its chief characteristic being its comparatively low price.

Fig. 187.

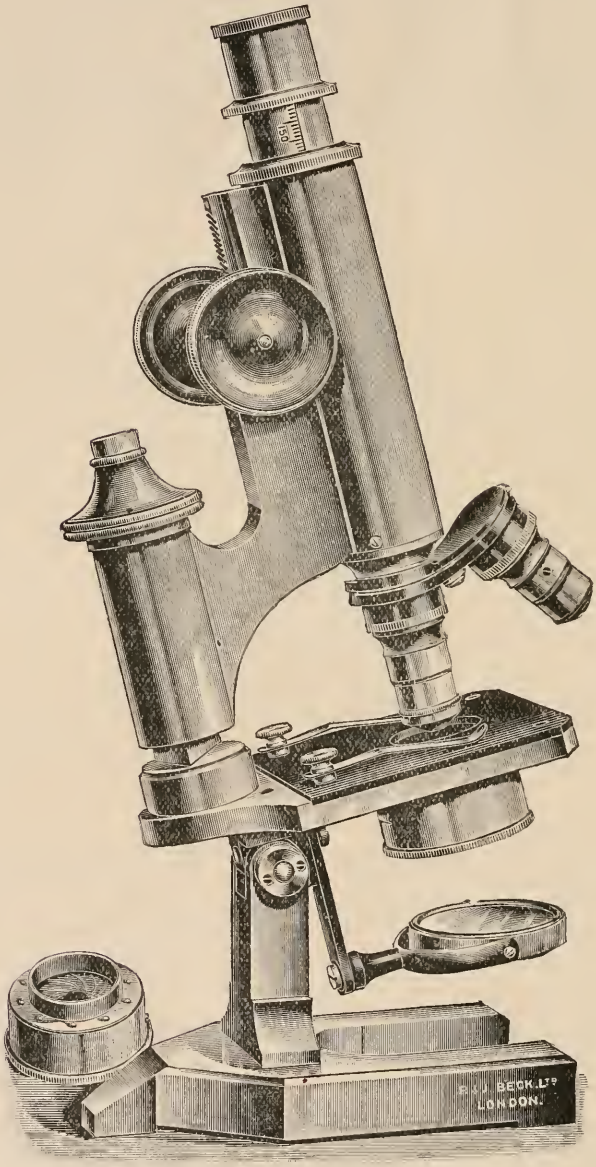
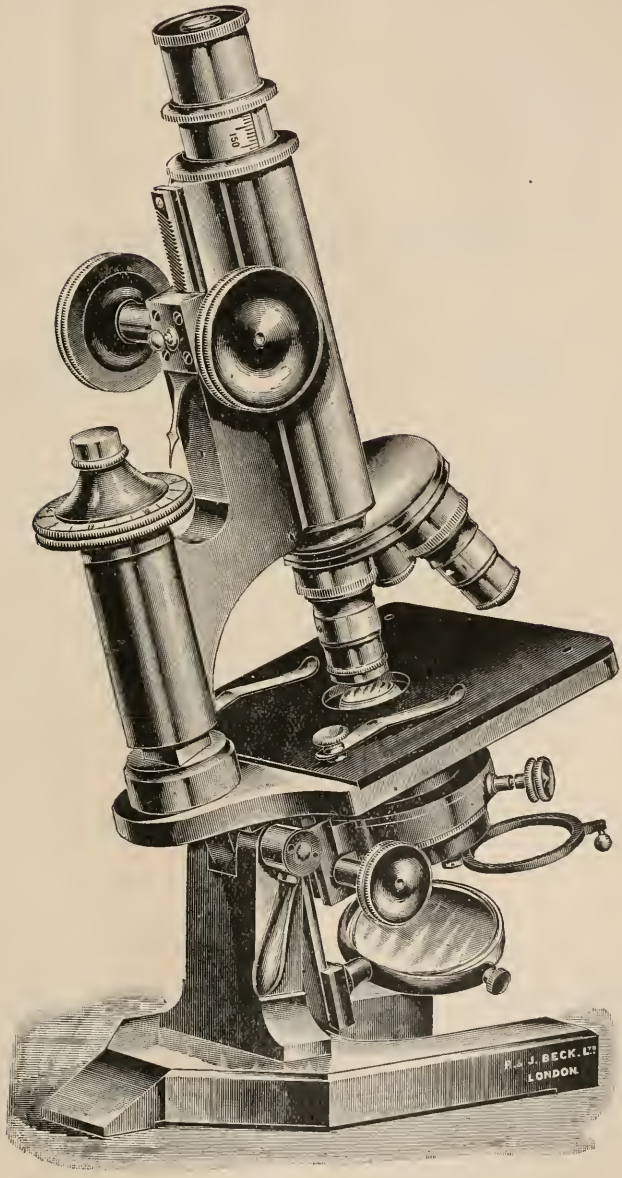


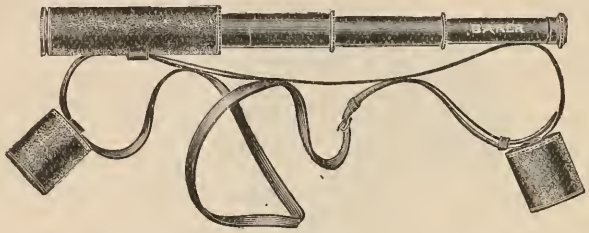
Fig. 188.



Cary's Microscope.*— With regard to this portable Microscope, presented to the Society by Mr. F. Gleadow,† the reference there alluded to has been found by Mr. Parsons in a small book in the Society's Library on "C. Gould's improved pocket compound Microscope," published by Cary, 181 Strand, 1828.

A Naturalist's Telescope.—A telescope capable of focussing objects only a few feet distant has been introduced by Mr. Baker for naturalists and others who require to watch birds, insects, or other animals, and is

Fig. 189.



represented in fig. 189. It is a portable instrument measuring 15½ in. extended and 6 in. when closed; it is fitted with a sling with leather caps. It has an object-glass of 1·2 in. aperture, working at $\frac{f}{8}$, and its power is 15.

Old Microscopes.‡—A collection of twelve old Microscopes has been presented to the New York Botanical Garden Laboratory by Mr. Charles F. Cox. Among these are three Culpepers, a John Cuff, a Wilson's "screwbarrel" by G. Adams, an Ellis' aquatic, a Jones' improved compound, a Chevallier, and a Cary's portable.

(2) Eye-pieces and Objectives.

The Society's Standard Eye-pieces. — The firm of C. Baker, High Holborn, announce, in their Catalogue for 1900, 1901, their adoption of the Society's Standard Eye-pieces.

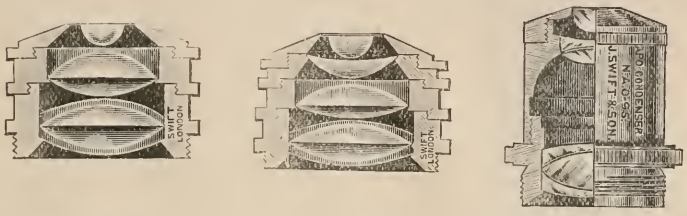
(3) Illuminating and other Apparatus.

Swift's Substage Condensers. — Figs. 190–192 represent the new substage condensers manufactured by Messrs. Swift. Fig. 190 is the pan-aplanatic condenser with a N.A. of 1·0, back combination clear diameter 0·55, and an aplanatic cone of 0·92. It is a very perfectly corrected combination, and as carefully made as an objective. Fig. 191 is Messrs. Swift's latest form of pan-aplanatic oil-immersion condenser; it has a N.A. of 1·40, and an aplanatic cone of fully 1·30; the back combination has a diameter of 0·65. Fig. 192 represents Swift's apochromatic dry condenser. The combination is made throughout with

* Cf. this Journal, 1898, fig. 82, p. 474. † Cf. this Journal, 1899, p. 673.
‡ Journ. New York Bot. Garden, i. (1900) pp. 68–70.

the new kinds of glass and fluorite. It has a N.A. of 0·95, an aplanatic cone of 0·90; and the back combination a clear diameter of 0·45.

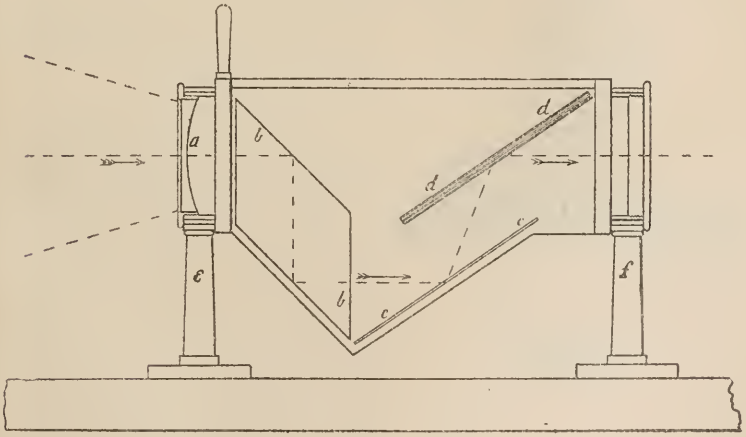
Fig. 190. Fig. 191. Fig. 192.



Polarised Light without Iceland Spar.* — Mr. J. S. Cheyney has arranged a method of avoiding the use of Iceland spar, thus getting rid of the main item of cost in a large polariscope: yet his beam of light is brilliant, perfectly polarised in any plane, and of any diameter required.

Fig. 193 gives a sectional view of his apparatus. The rays from any strong source of light, such as the electric arc or sunlight, are converged by a condenser to the diameter of beam required, and then

Fig. 193.

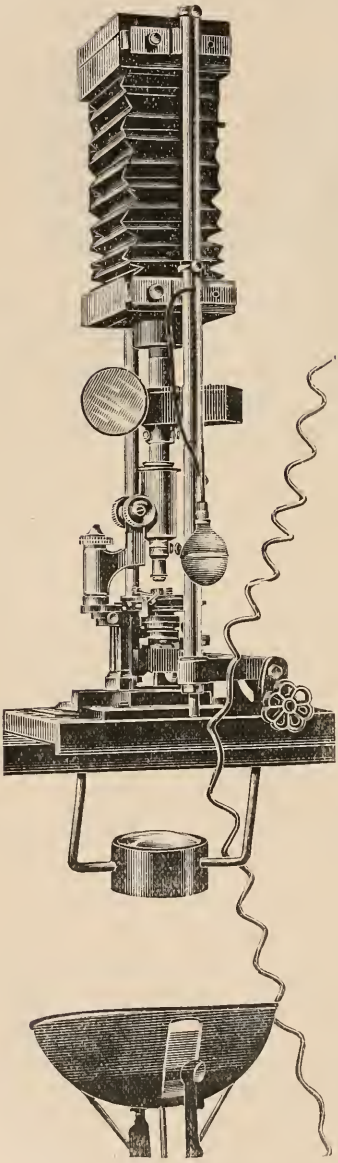


rendered parallel, as usual, by a concave lens *a*. The parallelised beam is received either by a compound totally reflecting prism, with two totally reflecting surfaces, *b*, *b*, or by two right-angled totally reflecting prisms similarly placed; or by two silvered mirrors set at 45° to the direction of the beam. These carry it forward; the two former without loss, the latter with a slight loss from the successive reflections, to impinge upon a silver mirror *c*, *c*, so set as to bring it to the proper angle for complete polarisation by reflection from a bundle of plates of

* Micr. Bull., June 1900, p. 19 (1 fig.).

white glass at *d*, *d*. The beam, now perfectly polarised, may be converged or used parallel as desired. The prisms and mirrors are firmly mounted in a metal frame or box which rotates in the bearings of the supports *e* and *f*, rising from the optical bars of the lantern, and thus, as with the large Nicol or Foucault prism, the plane of polarisation may be turned to any angle with the vertical. This compound polariser is almost exactly the same length as a Nicol of the same clear aperture, and gives very nearly as much light.

Fig. 194.



A very convenient size for the polarisers is a 2-in. aperture; but they may be made 3 or 4 in. in diameter if desired. For experiments where parallel rays only are used, a pair of these compound polarisers give results not inferior to those obtained with the Spottiswoode prisms used by Prof. Tyndall. In general, however, it is better to use as an analyser a Nicol prism of 20 mm. aperture, as recommended by Wright, using the new prism as a polariser only.

(4) Photomicrography.

Scott's Apparatus for Instantaneous Photomicrography.*—Mr. A. C. Scott, of Rhode Island College, has succeeded in obtaining instantaneous photographs of living organisms. A very powerful light is required, and he gets this from an arc light of 2200 watts, which gives about 4000 candle-power. This light is placed at a distance a little greater than the focal length of the condensing lens, so that the intensity of light upon the object and objective is considerably greater than would be the case without the lens. Of course a different position of the lens and light would greatly magnify the intensity of the light, but that is undesirable beyond a certain limit, as the heat would be detrimental to the Microscope objective. The important items of com-

* Journ. App. Micr., March 1900, pp. 797–9 (4 figs.).

bination shutter and view-tube are made to be clamped by means of three thumb-screws to the draw-tube of the Microscope; this apparatus (fig. 194) is fastened on after the ocular has been inserted in the draw-tube. The details will be understood from the following description. Upon a movable brass plate inside a light-tight box, placed just below the camera bellows, is a 90° glass prism mounted in such a way that all of the light which passes through the Microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object, when it is properly focussed upon the ground glass of the camera directly above the Microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the Microscope directly to the photographic plate, when the prism is moved by means of a spring and pneumatic release; finally there is a sufficient area of the brass plate to cover the opening when exposure has been made. To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on, and the shutter so set that the object may be focussed upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animal are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way, and the light passes to the plate. Although the apparatus has not reached the perfection desired by the inventor, he has had satisfactory results with exposures as short as 1/40 of a second, and considers that 1/100 of a second is attainable with low-power objectives. The magnification has ranged up to 200 diameters.

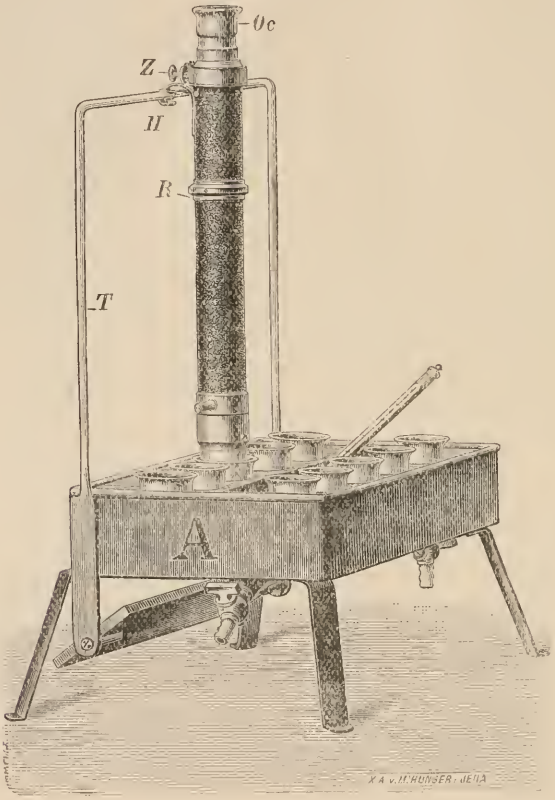
(5) Microscopical Optics and Manipulation.

Zeiss' Immersion Refractometer.—This instrument (figs. 195, 196) is intended for the examination of liquids of low refractive index, such as dilute solutions. The scale value ranges from 1·325 to 1·367. Its nature is that of a special form of Abbe's refractometer, the outer glass prism (which transmits the light to the fluid layer) being made removable, so that the lower end of the instrument may be dipped into the fluid to be examined. At the same time, by means of a special trough, or by careful hand motion, the operator finds a position by which the incident ray suffers total reflection. The advantage is that the refractive index is ascertained with the same ease as its temperature with a thermometer or its specific gravity with a hydrometer. But even more useful is the fact that the removal of the prism causes a much brighter definition of the emergent ray than that from a mere layer of fluid between Abbe's two prisms; a greater telescope magnification becomes therefore possible, as well as a corresponding accuracy of measurement. The hand telescope is of about 10 diameters magnifying power; the prism P is of 63° refractive angle and made of hard glass of refractive index 1·51. The apparatus is so adjusted that at a temperature of 17·5 C., the line for distilled water falls on division 15·0 of the scale. In order to measure the line for any other liquid a micrometer Z is fitted in the ocular. The floor of the trough A is furnished with a suitable window. A pair of Amici prisms at A (fig. 196) neutralise chromatism.

In the case of volatile fluids or others which suffer by exposure to air, the apparatus is modified as shown in fig. 196. A cap M is fitted on to the lower end of the refractometer and then closed by a screw lid D; thus a prism of the given fluid is obtained and the illumination is now through the side of a suitable trough.

The limit of error in the value of n is $\pm 3{\cdot}7$ units of the fifth decimal place.

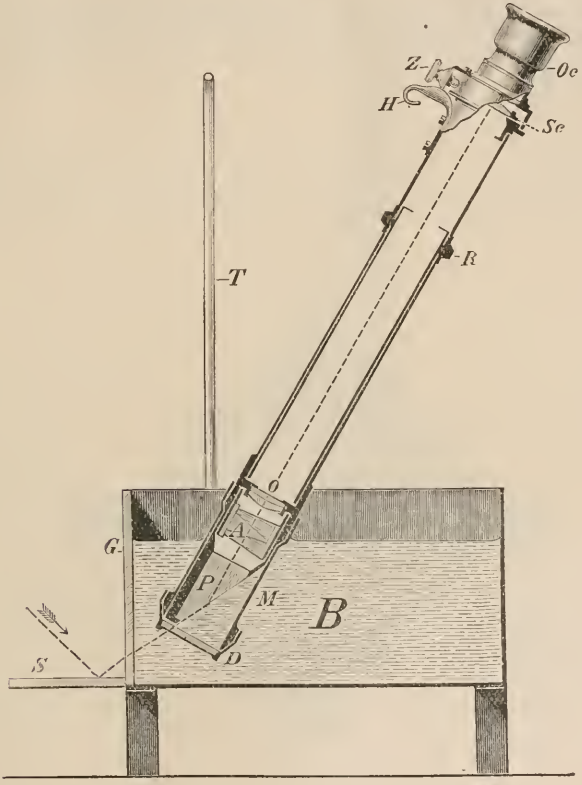
Fig. 195.



Zeiss' Differential Refractometer. — The object of this instrument, recently reconstructed, is the direct determination of the refractive difference of two fluid prisms of equal refractive angle set up behind one another but sloped in opposite ways. The deviation of such a double prism is directly proportional to the difference of the refractive indices of the two fluids; it is dependent only on the difference of the indices, not on the refractive index itself. The method is practically without limit as regards the magnitude of the index, and is therefore applicable for liquids of high and low index as well as for gases and vapours. The

temperature variations, either of the room or of the water-jacket, are practically without influence, since both fluids are equally affected. On the other hand the method offers the advantage of measuring these effects with the greatest accuracy. For measurement it is not necessary that the observation tube should be set in a rigorously invariable position with regard to the double prism. The foregoing peculiarities seem to suggest the especial adaptability of the instrument for many kinds of scientific and technical investigations, such as the determination of

Fig. 196.



alcohol in alcoholic solutions, the degree of concentration of saline solutions, &c.

The instrument is made in two models. Model i. is for ordinary, and Model ii. for more highly accurate (but slower) determinations.

Fig. 197 shows diagrammatically the double prism of Model i. The prism is arranged by placing in a hollow metal cylinder a parallel-sided plane glass plate diagonally, so that it is inclined at 45° to the glass end planes. Thus we have a sort of glass box divided into two independent

prismatic chambers by a medial glass diagonal partition inclined at 45° to the two vertical glass ends. The back surface is silvered for reflection. The deviation (really doubled) is read off on a suitable scale (Fig. 200).

Fig. 197.

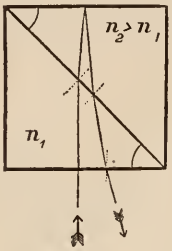
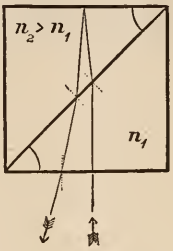


Fig. 198.



In Model ii., the metal cylinder K is divided horizontally by a partition in the axis of the cylinder. There are now two glass plane parallel-sided vertical partitions set at 45° to the end vertical glass

Fig. 199

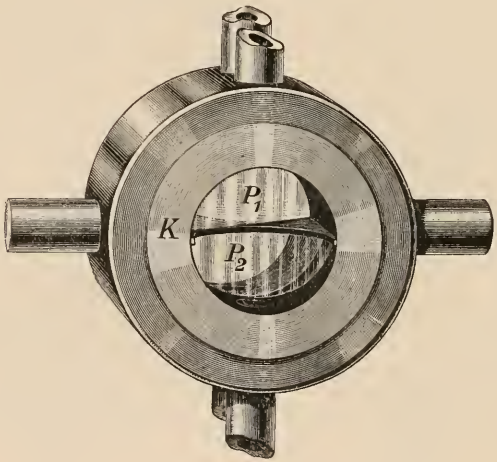


Fig. 200.

planes, but set so as to produce the deviation in opposite directions (figs. 197 and 198). The horizontal partition is cut away so as to place the two front compartments in communication; the two rear compartments are also similarly in communication. The deviation is now

the sum of those produced by each double prism, and is in reality the true deviation magnified four times. Fig. 199 is a perspective view of this prism combination.

Fig. 201.

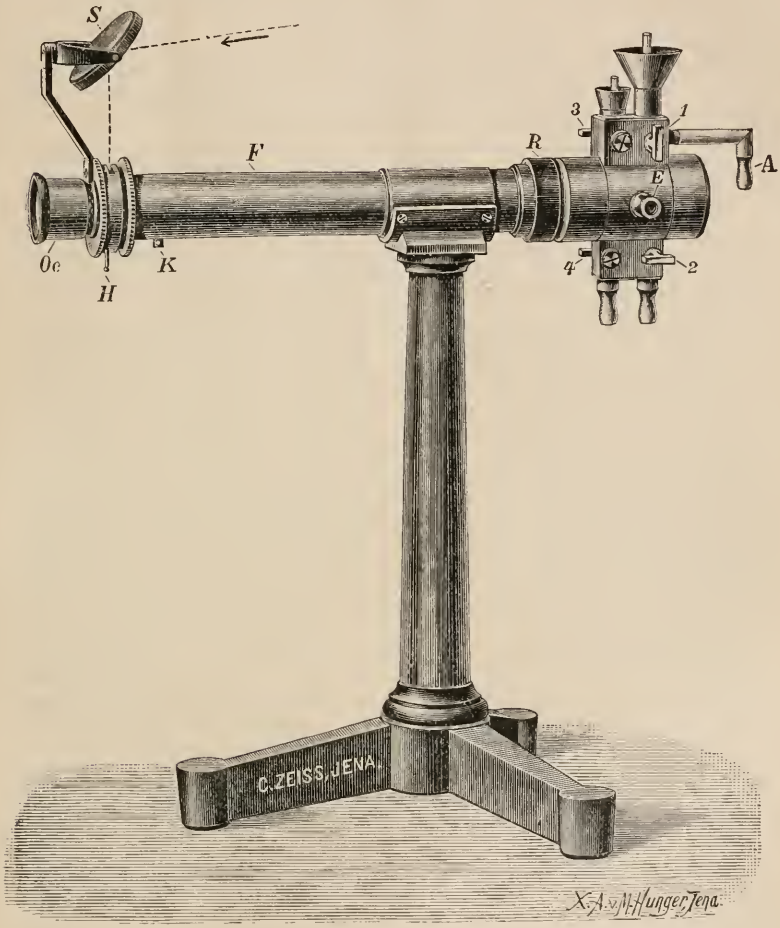


Fig. 201 gives a general view of the instrument. A is a tube for admitting a stream of water of known temperature.

If ϕ be the refractive angle of the prism (ϕ has been made 45°), f the focus of the telescope measured in millimetres, w the value of a scale interval also in millimetres, A the scale reading, then the refractive difference (Δn) is given by

$$\Delta n = \frac{w\,\mathrm{A}}{2f} \tan \phi \quad \text{(Model i.)}$$

and

$$\Delta n = \frac{w\,\mathrm{A}}{4f} \tan \phi \quad \text{(Model ii.).}$$

If the optical constants should be: $\phi = 45°$, $f = 204$ mm., and $w = 0{\cdot}2$ mm., then for every uncertainty of $\pm 0{\cdot}1$ of the scale reading, a corresponding uncertainty of $\pm 4{\cdot}9$, or $\pm 2{\cdot}5$ units of the fifth decimal place is produced in the value of Δn.

(6) Miscellaneous.

Thompson's Optical Tables and Data.—These are intended by their compiler, Dr. Silvanus P. Thompson, for the use of opticians, and his name is an ample guarantee for the efficiency of the collection. The tables number 93 in all, and the following list will give an idea of their character. Nos. 1–13, Logarithmic relations of British and metric measures. 14, 15, Velocity of light, and wave-lengths. 16–26, Refractive indices of various glasses, liquids, and minerals. 27–56, Spherometer, optical formulæ, lenses, prisms, combinations. 57–64, Chromatic and spherical aberration. 65–68, Magnification. 69–71, Eye and presbyopia. 72, 73, Refractive indices of fluids used in Microscopy, tube-length of Microscopes. 74, Magnifying power of Microscopes, standard screw. 75, 76, Numerical aperture. 77–80, Resolving power of objectives, depth of vision, and penetrating power. 81, Diffraction. 82, Distance of optical lantern from screen. 83, 84, Reduction and enlargement. 85–93, Eye-sensation to different lights, photometry, colours of thin films. The tables are preceded, wherever necessary, by full explanatory sections, and are accompanied by diagrams. The print is clear, and the book is likely to be an indispensable auxiliary to all interested in practical optics. The publishers are Messrs. E. & F. N. Spon.

Resolution of Striæ.*—Dr. R. H. Ward, of Troy, N.Y., recommends, for the resolution of striæ, &c., the old method of obtaining oblique light by the decentralisation of the substage condenser.

The late Mr. Herbert R. Spencer.—We regret to have to record the death, on February 7th, in the 51st year of his age, of Mr. Herbert R. Spencer, Superintendent of the Spencer Lens Company. Mr. Spencer was born in the little rural village of Canastota, N.Y., where his father, Mr. Charles A. Spencer, had established, in a rude workshop, a manufactory of Microscope objectives of such excellence that they soon attracted the attention of the scientific world, and obtained the highest award from the Paris Exhibition. In 1873, the Spencer workshop at Canastota was destroyed by fire, including nearly all the tools and machinery. In 1875, the firm moved to Geneva, N.Y., where, for about two years, they were connected with the Geneva optical works. Mr. Spencer's father died in 1879. After several changes, in 1890, Mr. Herbert R. Spencer settled in Buffalo, N.Y., in partnership with Mr. Frederick R. Smith; and, in 1895, became Superintendent of the "Spencer Lens Company" of Buffalo. The foregoing particulars have been furnished to us by Dr. John A. Miller, of Niagara University, Buffalo, from a biographical sketch of the late Mr. Spencer, by Dr. George E. Blackman.

Scales, F. Shillington—**Microscopy for Beginners.**
[A series of articles.] *Science-Gossip*, July 1900 *et seq.*

* Trans. Amer. Micr. Soc., 1900, p. 111.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Nutrient Media of "Standard" Reaction.† — Dr. J. W. H. Eyre contributes a valuable article on the standardisation of nutrient media by exact titration methods. After a short historical review of the chief methods adopted in the past for obtaining media of definite composition and reaction, the author deals with the indicators, the reaction of the raw materials, neutralising solutions, the optimum reaction, and the preparation of standard media. The procedure for standardising media is as follows:—

Solutions required.— $\frac{n}{10}$ NaOH, accurately standardised. $\frac{n}{1}$ NaOH, accurately standardised; 0·5 p.c. solution of phenolphthalein in 50 p.c. alcohol (in bottle with pipette holding 0·5 ccm. through the cork).

Apparatus required.—25 ccm. burette graduated in tenths of a ccm. 25 ccm. measure or pipette. Bohemian glass flask, fitted as a wash-bottle, filled with distilled water and kept boiling on a tripod stand. Several 60 ccm. Erlenmeyer flasks or conical beakers. Some squares of white blotting-paper.

Method.—The burette is filled with $\frac{n}{10}$ NaOH; 25 ccm. of the fluid medium are measured out into one of the flasks or beakers, the measures rinsed out with a small quantity of boiling distilled water from the wash-bottle and added to the medium already in the flask, then half a cubic centimetre of the phenolphthalein solution run in. To this colourless fluid $\frac{n}{10}$ NaOH is added cautiously from the burette until the end-point is reached, as indicated by the development of a pinkish tinge. A control, a second, or even a third may be titrated, but such is the sharpness of the end-point, that after a little experience with this indicator there will not be a greater difference than 0·1 ccm. of the $\frac{n}{10}$ NaOH between the several estimations, and as a matter of fact, it is almost impossible to overshoot the end-point of even the first titration by more than 0·2 ccm. of the decinormal solution. From these estimations, the amount of $\frac{n}{1}$ NaOH requisite to neutralise the remainder of the medium can be easily calculated; and from this figure is deduced the amount that is necessary to add to the remainder of the medium, in order that it may still remain acid to phenolphthalein to the extent of 1 p.c.; in other words, have a reaction of + 10.

The differences in technique between this method and that recommended by the Americans are:—

(1) The use of 25 ccm. of medium instead of 5 ccm. of medium + 45 ccm. boiling distilled water.

* 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.

† Brit. Med. Journ., 1900, ii. pp. 921–3.

(2) The use of $\frac{n}{10}$ NaOH in the place of $\frac{n}{20}$ NaOH.

(3) Regarding the first appearance of a pinkish tinge as the end-point, instead of producing a purple red by an excess of alkali.

(4) And, as a result of (3), adopting a reaction of + 10 instead of + 15.

(5) And finally, in adding only sufficient $\frac{n}{1}$ NaOH to leave the medium of the desired acidity, rather than adding enough to render the medium neutral to phenolphthalein, and producing the desired reaction by the subsequent addition of $\frac{n}{1}$ HCl.

(2) Preparing Objects.

Method for Paraffin Infiltration. * — Mr. C. M. Thurston has employed the following procedure for paraffin infiltration with great success. The essential feature of the method consists in applying heat to the upper surface of the paraffin and of such an intensity as to melt only the paraffin for a sufficient depth to submerge the tissues to be infiltrated. The object lies on the unmelted paraffin, and recedes from the heat if the heat increase and the paraffin melt deeper.

Glass cups (4 cm. in diameter by 5 cm. deep) are filled with melted paraffin which is allowed to cool. The cups are then placed under a copper plate, which is supported over a flame by a tripod or retort-stand. The flame should be at such a distance and of such intensity as to melt the paraffin 1 or 2 cm. deep.

Aceto-picric and Formalin Fixatives.—M. C. Garnier † states that a mixture of formalin and picric and acetic acids gave good results for fixing gland-tissue. The formula is:—Saturated aqueous solution of picric acid 30 parts, formalin 10 parts, acetic acid 2 parts.

Herren E. O. Haltgren and O. A. Andersson ‡ recommend the following mixture which they have used for the adrenals of cats, rabbits, and dogs:—5 p.c. solution of potassium bichromate 50 grm., absolute alcohol 40 grm., formalin 10 grm.

(3) Cutting, including Imbedding and Microtomes.

New Method for Imbedding in Celloidin. § — Mr. E. M. Stepanow has found that the following mixture answers well for imbedding in celloidin:—Dry thin celloidin shavings 1·5 grm., oil of cloves 5 ccm., ether 20 ccm., absolute alcohol added, drop by drop, up to 1 ccm. The dehydrated object is soaked in 4–5 ccm. of this solution in a tightly stoppered bottle for 3–6 hours or more. The stopper is then removed to allow of slow evaporation, and afterwards the object is exposed freely. As the mixture thickens the object clears up. When the mixture is sufficiently thickened and the imbedding completed, the object may be cut by the wet or dry method, or may be transferred to benzol in which

* Journ. Applied Microscopy, iii. (1900) pp. 897–8.

† Journ. Anat. et Physiol., xxxvi. (1900) pp. 22–94.

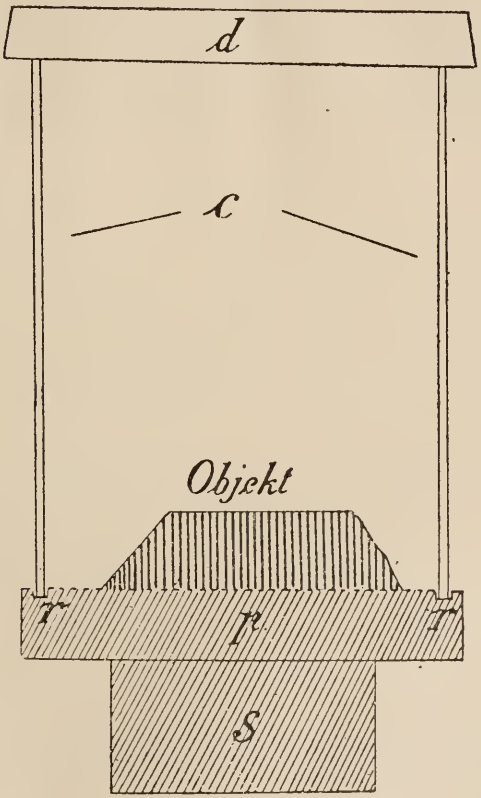
‡ Skandinav. Arch. f. Physiol., ix. No. 2, p. 5. See Zeitschr. f. wiss. Mikr., xvii. (1900) p. 215.

§ Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 185–91.

the mass gradually hardens and may be preserved for an indefinite period. Objects prepared by the last procedure may be transferred to anise oil, to paraffin, to cedar oil for dry cutting, or to 80 p.c. alcohol for wet cutting.

Method of Orienting and Imbedding in Paraffin. * — Mr. M. T. Denne describes a process which allows of a number of objects being oriented rapidly and fixed in position before infiltration. The imbedding is done in postal or specimen tubes, and the object is cemented to the

FIG. 202



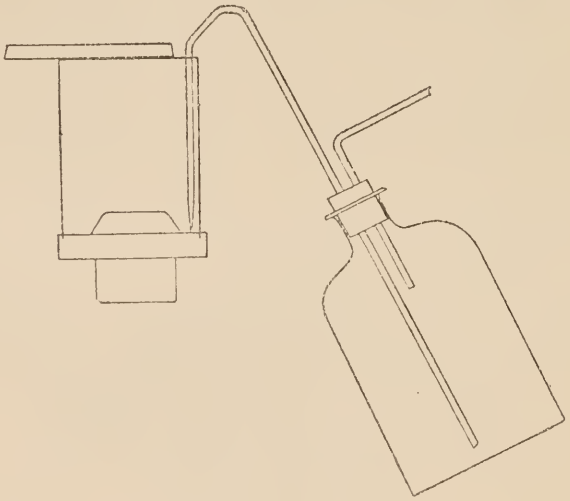
centre of a paper disk rather less in diameter than the bore of the tube, and carried when in the bath by a wire holder. The cement is a solution of celloidin in equal parts of ether and alcohol, to which as much oil of cloves is added as will give the mixture the consistency of thick honey. The holders are made of brass wire, bent twice at right angles, and curved at the upper end to form handles. A thin sheet-brass disk loosely fitting the tube is soldered between the angles. The piece is

* Journ. Applied Microscopy, iii. (1900) pp. 888-90 (1 fig.).

drained on filter paper, placed on a small drop of cement in the centre of a paper disk, and oriented. When in the desired position, some xylol is applied at the joint with a pipette to fix the object. Directions are then given for imbedding in paraffin.

Apparatus for keeping Celloidin Blocks moist and perforated Capsules for Staining Celloidin Sections.*—Dr. J. J. Streiff describes a convenient device for keeping celloidin blocks moist. To the piece S (fig. 202) is fixed the plate *p* by means of four screws. On the plate the object imbedded in celloidin is fixed in the usual way, and a series of ten sections are cut. A glass cylinder, the edge of which is smeared with vaselin, is then placed in the groove *r r* on the plate. The jar thus made is filled with 80 p.c. alcohol and covered with a lid. In this way the object can be kept moist for a long time. The fluid can be withdrawn rapidly by means of the apparatus shown in fig. 203, the working of which is self-evident and does not require description.

Fig. 203.



For staining and washing the sections, the author uses perforated capsules. These have a diameter of 5 cm., and the sides are 3 cm. high. In the bottom are four holes, 2 mm. wide, and in the sides are two holes near the bottom $2\frac{1}{2}$ mm. wide. The capsules are numbered from 1–10. The idea of these perforated capsules is not new, but they deserve mention on account of the trouble saved. The ten capsules are placed in a large pan containing the staining or other fluid, which flows in or out according as the capsules are placed in the pan or lifted out therefrom.

* Arch. f. Mikr. Anat. u. Entwick., lvi. (1900) pp. 940–6 (3 figs.).

(4) Staining and Injecting.

New Staining Mixture.* — Dr. A. Pappenheim recommends the following stain for bone-marrow, gonorrhœal, and other suppurative secretions, and spermatosomata hominis; viz. a mixture of a saturated aqueous solution of two basic pigments, containing 3–4 parts methyl-green and 1–1·5 parts pyronin.

Method for Preparing Neutral Picrocarmin.† — Herr J. W. van Wyhe prepares a neutral picrocarmin by the following simple and rapid method. It is best to start on an old strong carmin solution, composed of 30 grm. carmin dissolved in a mixture of 2 parts of distilled water and 1 part 10 p. c. ammonia. When two years old it is sufficiently ripe. The mixture may, however, be rapidly ripened by boiling 10 grm. carmin with 10 ccm. ammonia and 20 ccm. peroxide of hydrogen. 25 ccm. of the carmin solution are mixed with 100 ccm. of 96 p.c. alcohol and the solution filtered. The precipitate on the filter is washed with 100 ccm. of 96 p.c. alcohol, and dried for 24 hours in a thermostat at 40°–45° C. The ammonia-carmin obtained in this way is completely soluble in aqueous solutions of ammonium picrate. This salt may be purchased, or made as follows:—9 grm. of picric acid are dissolved in 100 ccm. 96 p.c. alcohol, and 15 ccm. ammonia added. The solution is evaporated to dryness in a thermostat at 60°.

The best proportion between ammonia-carmin and ammonia picrate is 0·5 p.c. of the former to 1 p.c. solution of the latter. The solution is invariably alkaline, but by boiling in a water-bath for a quarter of an hour it is rendered neutral. The fluid lost is to be replaced by the addition of distilled water. One per cent. chloral (Hoyer) may be added as antiseptic.

Method for Staining with Neutral Eosin-methylen-blue.‡ — M. E. Laurent first describes how to prepare the neutral stain. One gramme of potassium-eosin and 1 grm. of medicinal methylen-blue are dissolved each in one litre of water. Then to 1000 ccm. of 1 per thousand eosin solution, 882 ccm. of 1 per thousand methylen-blue are added, and the mixture allowed to stand for 24 hours. The mixture is, however, now purchasable. When required for use one part of the mixture and four parts of water are boiled and then cooled down. While still warm the object to be stained is immersed therein for from half an hour to six hours. If any precipitate be found on cover-glass films it is brushed off, and the preparation then treated with xylol before mounting in balsam. Sections are washed in 96 p. c. and then differentiated in absolute alcohol. This step takes from two minutes to some hours. Instead of alcohol, anilin oil and xylol (3–1), or anilin oil and alcohol (1–3) may be used.

Staining the Malaria Parasite.§—Dr. R. Ruge finds that the red-methylen-blue staining (Romanowski-Ziemann) of the malaria parasite

* Biol. Centralbl., xx. (1900) p. 373. See Centralbl. Bakt. u. Par., 1 Abt., xxviii. (1900) p. 403.

† Koninh. Akad. van Wetenschappen te Amsterdam, Proc., Feb. 1900. See Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 200–1.

‡ Centralbl. f. Allgem. Pathol. u. pathol. Anat., xi. (1900) pp. 86–91.

§ Zeitschr. f. Hygiene, xxxiii. part 2. See Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 403–4.

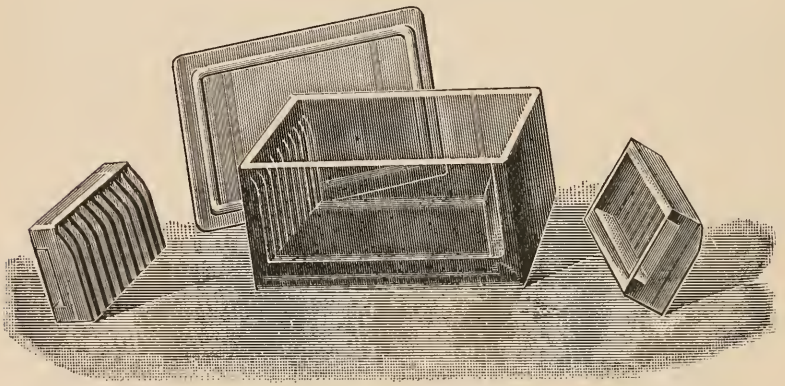
can be easily obtained by simply heating the solution gently several times. Precipitation is avoided by freely diluting the staining solution. By the addition of eosin (in quantity more than half necessary for saturation) the stippling of the red corpuscles affected by parasites was brought out.

New Method for Staining Tubercle Bacilli.* — Dr. R. C. Rosenberger advises a moderately thick film of sputum which is stained in the usual way with phenol-fuchsin. The film is then contrast stained and decolorised by treating it for one or two or more minutes with a mixture of sweet spirits of nitre and methylen-blue, malachite-green, Bismarck brown, and gentian-violet. The preparation is then washed with water. For sections the time required is longer (5 minutes). They are then washed, nearly dried, immersed in carbol-xylol for 2 or 3 minutes, and then mounted in balsam.

The smegma bacillus is decolorised by this method.

Microscopical Injections with Albumen-Ink.†—Dr. O. Grosser recommends a method which appears to be very suitable for injecting freshly killed small animals. White of egg is beaten up and afterwards filtered through dry filter-paper. A stick of indian ink is then rubbed up with the filtrate on a stone or on ground glass. Only a few drops of the fluid are used at a time. The colour should be dark grey and the consistence such that it will pass easily through the canula. The advantages of this medium are that the albumen is coagulated by the fixatives used, and therefore does not drop out or swell up. The best fixatives are Müller's fluid or picric acid in conjunction with formalin.

Fig. 204.



Glass Staining Troughs.‡—Prof. P. Schiefferdecker, after pointing out the defects of stoneware staining troughs, states that glass vessels

* Journ. Applied Microscopy, iii. (1900) pp. 898–900.
† Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 178–81 (1 pl.).
‡ Tom. cit., pp. 167–8 (1 fig.).

of the same shape (fig. 204) give very satisfactory results. The troughs are made for slides of the English size, but other patterns are provided for by means of grooved slips which are supplied with the trough. A tight fitting lid is also supplied if required. The trough may be used for staining, as a bath, and as a moist chamber.

Stain for Neuroglia.* — Dr. Yamagiwa has devised the following modification of Stroebe's method for axis-cylinder, and applies it to the demonstration of neuroglia fibres which are stained red. The tissue is fixed in Müller's fluid and after-hardened in alcohol. Celloidin sections are then stained with a saturated alcoholic solution of eosin for 12 hours or more, and afterwards with saturated aqueous solution of anilin-blue for 4–6 hours. The sections are then differentiated in alcohol made alkaline by the addition of a few drops of 1 p.c. KHO. The sections are then washed in water and afterwards in weak alcohol, after which they are dehydrated in absolute alcohol, cleared up in oleum origanum, and mounted in balsam.

6) Miscellaneous.

Micro-structure of Bronzes.† — Mr. A. E. Outerbridge, jun., concludes, as the results of some experiments with various bronzes under the influence of different etching fluids, as well as of similar etching fluids employed for a longer or shorter time :—

"(1) Variations in treatment of specimens cause variations in the results which may be misleading, and it would, therefore, seem to be desirable that some uniform system should be adopted by all investigators in this field.

"(2) The rate of cooling of a mass of metal affects the micro-structure, so that two specimens of the same ladle of metal are taken :— one from a small casting quickly cooled, the other from a large casting slowly cooled ; or two photomicrographs taken from different portions of the same specimen may show variations in micro-structure that may lead to error.

"It is desirable, therefore, that some uniform size of specimens should be selected by micro-metallurgists as a standard with which to make comparisons."

Mr. Outerbridge is also of opinion that structure is affected by "method and time of etching."

Herr Heyn, of the Royal Micro-metallurgical Department at Charlottenburg (Prussia), agrees in the main with the former statements about the micro-structure varying with the rate of cooling, &c. ; but denies that it is in any way changed by the character of the etching. By using different etching fluids and marking their effects, the observer is able to acquire a knowledge of the various properties peculiar to the different elements of which the structure of a metal is composed, and thus to form a general idea of the micro-structure as a whole. He thinks that the establishment of standard methods would at present, in many cases, tend to misunderstandings.

* Virchow Archiv., clx. (1900) pp. 358–65 (1 pl.).

† Micr. Bull., Feb. 1900, pp. 2, 3 ; and Journ. Franklin Institute, Jan. and June 1899.

Apparatus for Drawing Objects Natural Size. * — Mr. H. Bausch describes an apparatus (figs. 205, 206) for drawing objects. The optical parts are attached to a horizontal arm supported by a cylinder which sheaths and is freely movable up and down upon an upright post, and which is fixable by a side-screw. The eye-piece consists of a combination of right prisms, and is attached to the horizontal arm opposite the supporting post. Rectangular mirrors, rigidly fixed to each end of the bar,

Fig. 205.

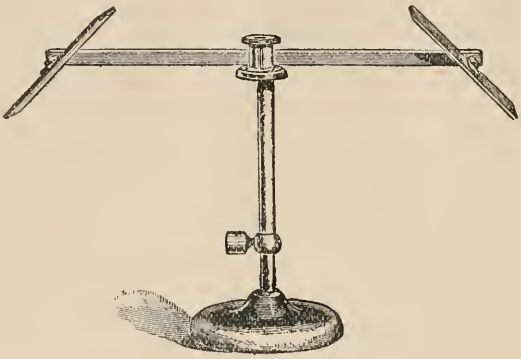
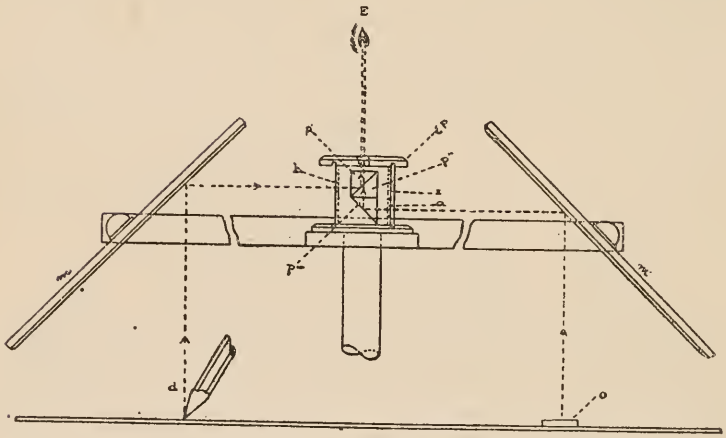


Fig. 206.



are inclined at an angle of 45° to the horizontal. The optical parts of the eye-piece consist of a cube formed by cementing two right prisms together, the facing surfaces, with the exception of a very small area in the centre, being silvered, thus forming a diagonal mirror through the cube, the mirror being pierced at its centre by a small hole. To the lower side of the cube is cemented a third right prism with its diagonal

* Journ. Applied Microscopy, iii. (1900) pp. 891–3 (2 figs.).

surface silvered. When it is desired to make a drawing, the object is placed under one of the mirrors and the paper under the other. An accurate outline is easily traced, and the drawing will be the natural size of the object as long as both object and paper are on the same horizontal plane. Modulating glasses for equalising the illumination of the two sides are supplied with the apparatus.

Modified Sedimentation Method for Demonstrating the Presence of Bacteria.*—Dr. E. Strasburger recommends the addition of two parts alcohol to one part fluid (urine, fæces diluted with water, &c.) when centrifuging for bacteria. This addition lowers the specific gravity of the fluid and facilitates the deposit of bacteria. The device is stated to be specially adapted for tubercle bacilli in stools.

New System of Obtaining Directing Marks on Microscopical Sections for Reconstruction by Wax-plate Modelling.†—In the method described by Prof. J. T. Wilson, the lines of direction are constituted by actual definite strands of organised material imbedded in the substance of the paraffin block itself and in the closest and most intimate relation to the object to be reconstructed. The materials used are the root-bundles of the human cauda equina. These, kept straight by means of a weight, are stained with osmic acid and imbedded in paraffin. For the imbedding a glass base-plate and a pair of imbedding bars are needed. The glass plate should not be more than 2 or 3 mm. thick, and on the centre part of its upper surface should be drawn or engraved a square with sides measuring 2 cm. The outline should be blackened. On the under surface of the plate deeply engraved lines are ruled parallel to two of the sides of the quadrilateral. It is convenient to have these lines at alternating intervals of 1 and 2 mm. The imbedding bars must be rectangular throughout, with plane surfaces, and the length of the arms should correspond to the dimensions of the quadrilateral engraved on the base-plate.

Two pieces of sufficient length are placed parallel to each other on the glass plate and fixed thereto by means of heat. Over these the imbedding chamber is made. The object, oriented in the usual way, is now in immediate apposition with the two black parallel lines, and these lines have a definite relation to the sides of the paraffin block and to the object. The steps of the process are detailed with great care and minuteness; but for these the original should be consulted.

Biochemical Arsenic Reaction.‡—Herr G. Marpmann describes at some length and with approval the biochemical test for arsenic. This test is well adapted for detecting arsenic in small quantities, e.g. hundredth part of a milligram, and in organic solutions. The most convenient method is to inoculate sterilised bread-pap with a pure culture of Penicillium, and moisten with the suspected fluid. A garlicky odour arises in from 24 to 48 hours if arsenic be present. Selenium, tellurium, and phosphorus give off characteristic odours with some resemblance to garlic, but with a little practice and a normal nose the peculiar arsenic

* Münchener med. Wochenschr., 1900, No. 16. See Bot. Centralbl., lxxxiii. (1900) p. 237. † Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 169–77.

‡ Zeitschr. f. angew. Mikr., vi. (1900) pp. 143–53 (1 fig.). Cf. this Journal, 1899, p. 239.

odour is easily perceived and distinguished from somewhat similar smells. For detecting the presence of arsenic in urine, the residue, after treatment with nitric-sulphuric acid, should be saturated with ammonia, and then a few cubic centimetres of magnesia mixture added. After standing for 24 hours the sediment is washed into the culture flask.

Besides species of Penicillium and Aspergillus, the Mucorinæ also give the reaction. The author mentions that *P. brevicaule* exhibits macroscopic differences on different media such as apple, pear, potato, bread.

Distribution of Alkali in Vegetable Tissue.* — Herr A. C. Hof demonstrates the presence and location of alkali in vegetable tissue by the method adopted by Prof. Ehrlich in animal histology. The reaction is applicable only to dry tissues, and is monochromatic. The pigment used is iodine-eosin which forms a deep red aqueous solution, but is not soluble in ether, chloroform, or toluol. On the other hand, when acid is added, the precipitate is but slightly soluble in water, though easily in organic solvents. When a dry tissue is treated with the acid ethereal solution, the parts containing alkali are stained deep red owing to chemical union of the free pigment acid and the tissue alkali. The solution is made by adding to the alkaline solution of iodine-eosin a corresponding quantity of acid and shaking the precipitate up with ether. The supernatant ethereal solution of iodine-eosin-acid is then ready for use. After ascertaining that the glass vessels, &c. are free from alkali, the sections are immersed in the staining fluid. Those parts where alkali is present are at once stained. They are then transferred to pure ether, which is renewed until the ether remains quite clear. The still wet specimen is then at once mounted in *neutral* balsam, the ordinary balsam being quite useless for the purpose. The morphotic elements of preparations treated in the foregoing manner retain their shape perfectly, and show in those places where alkali is present a deep red staining, the non-alkaline parts remaining uncoloured.

Labelling Blocks and Slides.†—Mr. C. M. Thurston labels celloidin and paraffin blocks in the following way. The number or name is written on one end of an oblong piece of filter-paper; on the other end is placed a drop of egg-albumen, and this end is pressed on the surface of the block opposite that to be sectioned. The albumen is coagulated sufficiently well to fix the label firmly enough for ordinary purposes.

The author ‡ labels slides and cover-glasses by writing on them with a fluid composed of equal parts of egg-albumen and glycerin to which enough lampblack has been added to pigment it sufficiently. The solution flows readily from a steel pen. The writing is then fixed in the flame.

Behrens, H.—**Mikrochemische Technik.** 2nd edition, Hamburg, 1900, 8vo, 68 pp.

Hanausek, T. F.—**Lehrbuch der Mikroskopischen Technik.** Stuttgart, 1900, part i. 8vo, 160 pp. and 105 figs.

* Bot. Centralbl., lxxxiii. (1900) pp. 273–80 (1 pl.).

† Journ. Applied Microscopy, iii. (1900) p. 894. ‡ Tom. cit., p. 900.