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

FOR THE YEAR

1902

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NOTES.

Holtzapffel's Microscope.

By Edward M. Nelson.

As Holtzapffel's Microscope, in which there are several original details, is little known, a short account of it may be of interest. On reference to fig. 16, it will be at once seen that the foot is similar to that of Cornelius Varley's Microscope,* inasmuch as it is a screw-clamp for attachment to the edge of a table, a form evidently suggested by the stand of Wollaston's camera lucida. The main stem, which is a cylindrical rod with a groove in it, is joined to the foot by a kind of universal ball-joint (not ball-and-socket). A mirror slides on this rod, and it is stated that the back of this mirror is flat polished brass, so that monochromatic light may be reflected by it. On the top of the rod is the lens-(Wollaston doublet) holder (fig. 17); this, instead of fitting in a V-groove, slides between three studs, of which *a* and *b* are fixed and *c* loose; *c* is acted on by a spring so as to keep the slide pressed against *a* and *b*. This lens-holder is moved by the milled head *d*; but in place of a rack-and-pinion gear, there is a steel tape which takes a round turn round the pinion, an end being fixed to each end of the lens-holder; the screw *e* is for the purpose of keeping this tape taut. A similar mechanical device was, twenty years afterwards, used by Ladd,† who fitted a steel chain with a turn round a pinion for the coarse adjustment of his Microscope.

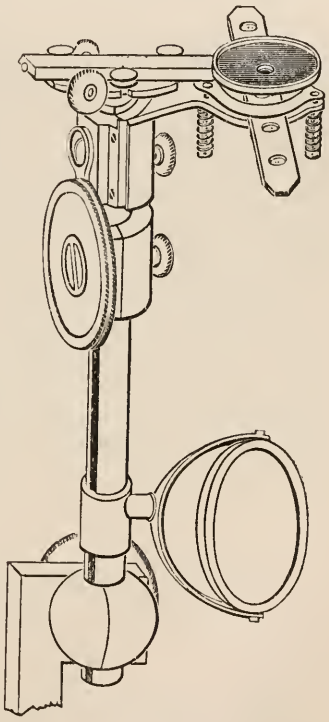

Fig. 16.

The milled head *f* is for the purpose of rotating the lens-holder

* Journ. R.M.S., 1900, p. 283, fig. 70.

† Exhibited at the Great Exhibition, 1851. This movement is said to have been applied to the Microscope many years previously by Mr. Julius Pago.

on the top of the pillar ; this gives the lens a transverse motion in arc across the object. The idea, in those days, was to move the lens over the object, so that when infusoria were being examined they might not be disturbed by the movement of the stage.

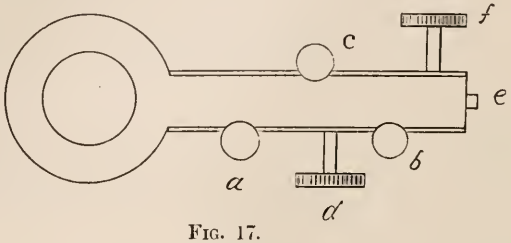

Fig. 17.

This Microscope is a stage-focusser; a rough adjustment is obtained by sliding the mechanism on the rod by the hand, and then clamping it by a pinching screw, after the manner employed in many old Microscopes, J. Cuff's for example. The mechanical adjustment is by means of an excentric strap on the head of the pinion, in fact, similar to the coarse adjustment on the Plössl Microscope lately presented to the Society by Sir Ford North, the difference being that, while the Plössl has a crank-pin and a connecting-rod, Holtzapffel's has an excentric.

The lenses were supplied by Andrew Pritchard.

The date of this Microscope is 1830, and in it we find four original devices:—(1) The clamp-foot; predating that of Varley's in 1831. (2) The polished brass monochromatic mirror. (3) The focussing movement by an excentric, which differs from and predates the somewhat analogous device of Plössl. (4) The extension movement of the lens-holder by a steel tape and pinion.

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* Probably the earliest work on Microscopical Objects.

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* The earliest English work on the Microscope.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Beck's Imperial Microscope.—This instrument has been designed for critical work of the most advanced type. At the same time it is compact, and does not stand too high from the table to be comfortably used in a vertical position. In its complete form it is provided with coarse focussing adjustment, double speed fine adjustment with graduated head, full size eye-pieces, rack-and-pinion focussing draw-tube, graduated, additional sliding draw-tube, graduated clamp to joint, graduated concentric rotating stage, rack-and-pinion movement to rotating stage, centring screws to stage, graduated vertical and horizontal stage motion, coarse focussing sub-stage adjustment, fine focussing sub-stage adjustment, centring sub-stage adjustment, swinging and sliding mirror.

The stand is made upon two models; the English tripod foot, and the Continental base and pillar. In the English or tripod model there is a splay between the front feet of 8½ in., and 9 in. from front to back. A long lever clamp is provided to fix the Microscope at any inclination, and the latter is limited in its motion in the exact horizontal and vertical positions. The Continental model stand is unusually large and steady; the base measures 6¾ in. in length by 4½ in. in width, and is provided with a similar clamp to the joint. The limb of the Microscope is pierced with a square hole and clamp screw, in which an illuminator for opaque objects may be held.

The body-tube of the Microscope is 2 in. in diameter, and 3·6 in. long, but with the nose and draw-tubes in their closed position it measures 140 mm. or 5½ in. The nose-piece and draw-tubes may be removed, and a photographic lens mounted in the centre of this short and large diameter-tube allows of the use of a wide angle for low-power photomicrographic work. The draw-tube is provided with a rack-and-pinion adjustment, and has a ring fitting at its lower extremity, which carries the object-glass screw-thread. An additional sliding draw-tube is supplied, and both are graduated in millimetres; a total extension of tube with the two draw-tubes of 260 mm. is obtained. The diameter of the tube is that of the No. 4 largest Royal Microscopical Society's standard gauge, 1·41 in., and an adapter is supplied to take the No. 1 size, ·917 in. Low-power and orthoscopic eye-pieces may be made of the full size, which give a much larger field of view than can be attained with the small size eye-piece. A small size body, with sliding graduated draw-tube with a range of length of 140 mm. to 200 mm., is supplied to the simpler forms of the instrument.

The coarse focussing adjustment is by means of a spiral rack-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.

pinion movement, actuated by large milled heads, the slide being a most substantial dovetail cradle. When at its highest point the nose-

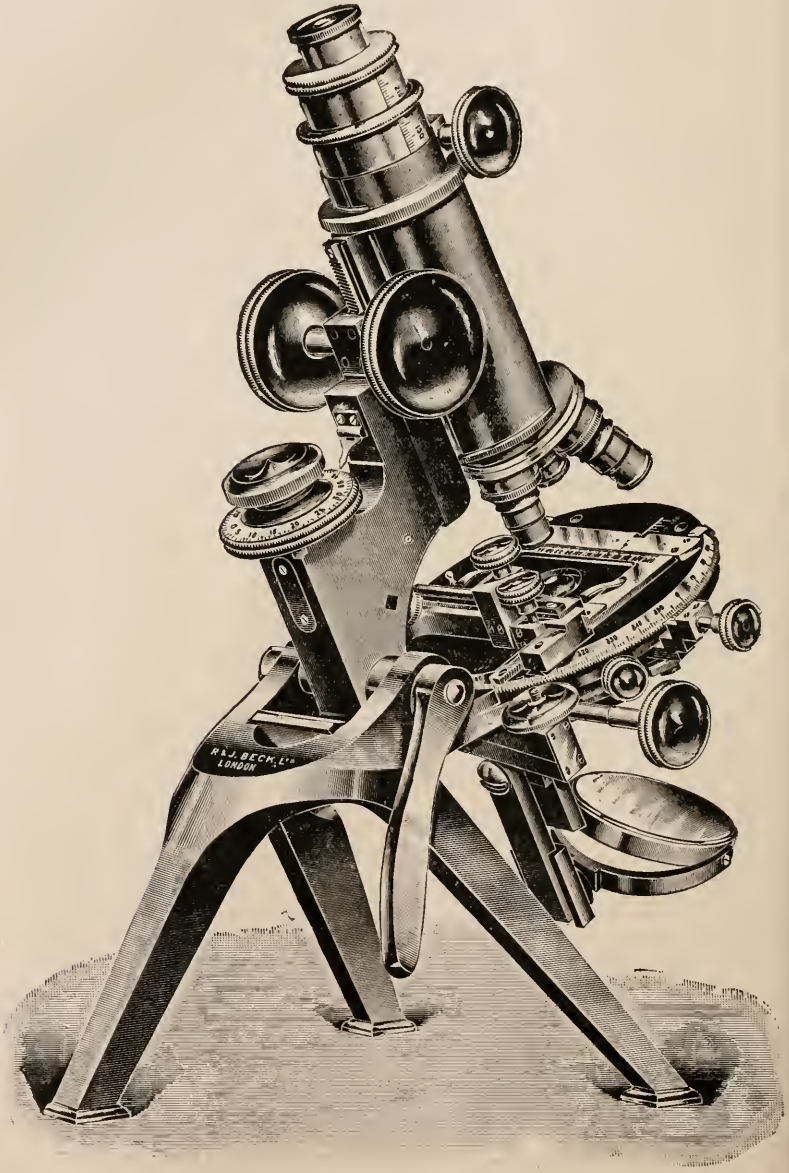

Fig. 18.

piece of the Microscope is 4·1 in. from the stage. The fine focussing adjustment is upon a new patented method invented by Mr. Ashe. A strong lever moves the cradle, which carries the body of the Microscope by means of a block which is a projecting portion of the cradle. The cradle slides in a fitting in the limb with a spring acting upon the upper side of the projection, which drives it on to the lever. The lever is moved by a steel screw with milled head; this screw works through an outer screw which is provided with a large graduated milled head, read by a folding indicator.

One screw has a comparatively coarse thread, and when revolved raises the body a distance of $\frac{1}{60}$th of an inch in a complete revolution. The other screw has a fine thread, and when revolved carries the former screw with it, moving the body only $\frac{1}{3600}$th of an inch in a complete revolution. At any moment either milled head may be used, giving a moderately fine adjustment for such powers as $\frac{1}{4}$-in. or $\frac{1}{6}$, or a very fine movement for $\frac{1}{12}$ or higher powers. The convenience of such an arrangement can scarcely be overstated.

A slow motion fine enough for focussing the highest powers is most troublesome for moderate-power lenses.

The Stage.—In the complete model of the instrument the stage is circular, 5 inches in diameter, with a graduated circle divided in degrees and moved by a rack-and-pinion, which may be thrown out of gear. Centring screws are provided to adjust the centre of rotation. A mechanical rack-and-pinion top stage works upon its surface by two milled heads having a horizontal motion of $2\frac{1}{2}$ in. and a vertical motion of $1\frac{1}{2}$ in. This is so designed that during its whole travel it does not come in contact with the substage condenser. Graduated finder-divisions are provided to both motions for recording and finding again individual points of an object, and for rough measurement purposes. When these are used the centring screws should be unscrewed to their full extent in order that the divisions should always indicate the same position. A folding stop for Maltwood's finder and folding springs are carried by the mechanical stage. Even with the mechanical stage *in situ*, except in its extreme positions of travel, a complete rotation of the stage can be obtained.

The mechanical stage can be entirely removed, leaving the stage free for large culture plates or dishes. Spring clips are provided for use with the plain stage.

The simpler models of the instrument are provided with a large square top, $4\frac{1}{2}$ in. by $4\frac{1}{2}$ in., with a removable mechanical stage, having a horizontal travel of 2 in. and a vertical travel of $1\frac{1}{8}$ in.

The substage is made to the Royal Microscopical Standard size, 1·527 in. It has coarse adjustment by spiral rack-and-pinion, and a lever and micrometer-screw fine adjustment. It has two centring screws in directions at right angles. The substage itself has no swinging-out motion, but a mount may be supplied carrying the condenser, in which the diaphragms and the optical portion swing out.

The mirror is flat on one side and concave on the other. It is $2\frac{1}{2}$ in. in diameter, and is swung on a fitting which slides up and down on a dovetailed bar. This bar is held in the optic axis by a spring stop, but may be swung to one side or the other if desired.

The Binocular.—A special form of the Imperial Microscope is made with a binocular body, in which the limb of the instrument is somewhat lengthened to give extra length of fitting for the body, or a binocular body interchangeable with the ordinary body may be supplied

Baker's Portable Diagnostic Microscope.—This instrument, which in 1896 was described in this *Journal*, has now been made of "magnalium" by Messrs. C. Baker, and was exhibited by Mr. Curties at the October Meeting, 1901. This Microscope was originally designed by Surgeon-Major Ronald Ross for the special use of officers in the Indian Army Medical Department for the diagnosis of malarial fever. It is

Fig. 19.

fitted with a spiral pinion and rack coarse adjustment, a direct-acting screw fine adjustment, a draw-tube, which when extended gives a tube length of $6\frac{3}{4}$ in. (170 mm.), a sliding tube to carry a substage condenser, and plane and concave mirrors. Its weight is 14 oz. (397 grams). When folded the instrument measures 7 by 3 by $2\frac{3}{4}$ (178 by 76 by 70 mm.), but when open the spread of the tripod is $6\frac{1}{2}$ by 6 (165 by 152 mm.). "Magnalium," an alloy of aluminium and manganese, is a tougher and much more useful metal than aluminium, though it possesses a specific gravity of only 2·5.

Seibert's Travelling Microscope.*—In this Microscope the designer has tried to reduce the weight to a minimum, and yet to adapt the instru-

* Zeitschr. f. angew. Mikr., vii. (1901) pp. 141-3 (2 figs.).

ment for the most delicate investigations likely to be required on a journey. The stand is of a simple character with parallelogram screw adjustment, illuminating apparatus, and arrangements for oblique light.

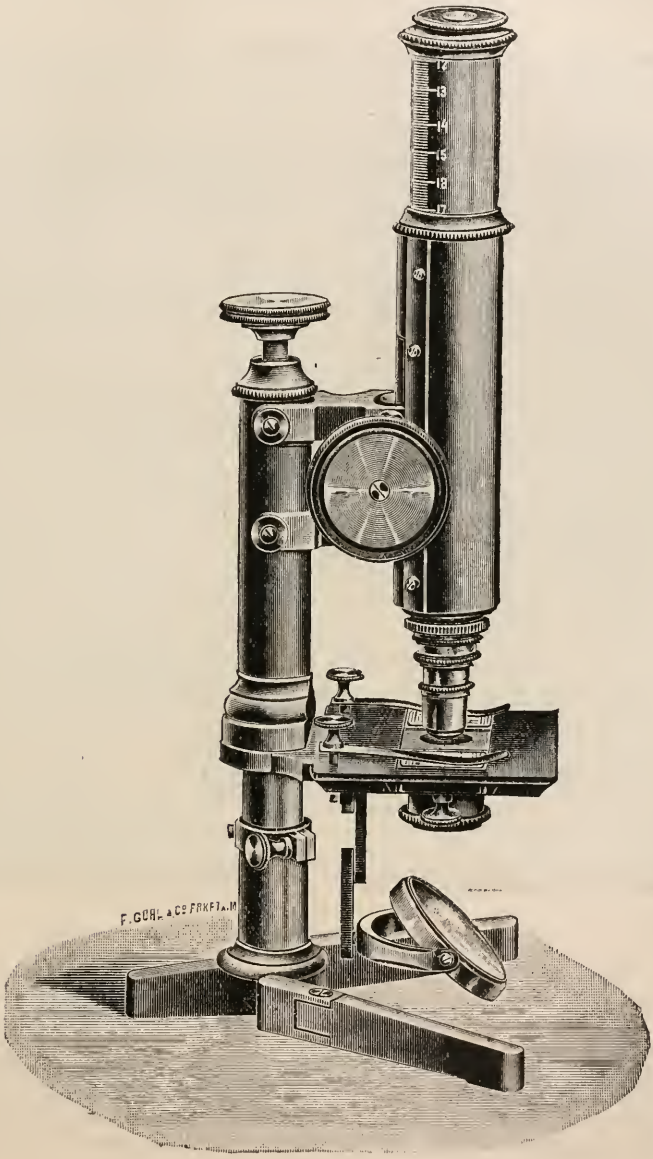

Fig. 20.

The illuminating apparatus is provided with good iris diaphragm and gives light sufficient for working with a $\frac{1}{12}$ immersion lens. The stage is large enough to receive the ordinary object-slides safely: it is strong and not removable (as is generally the case with travelling Microscopes):

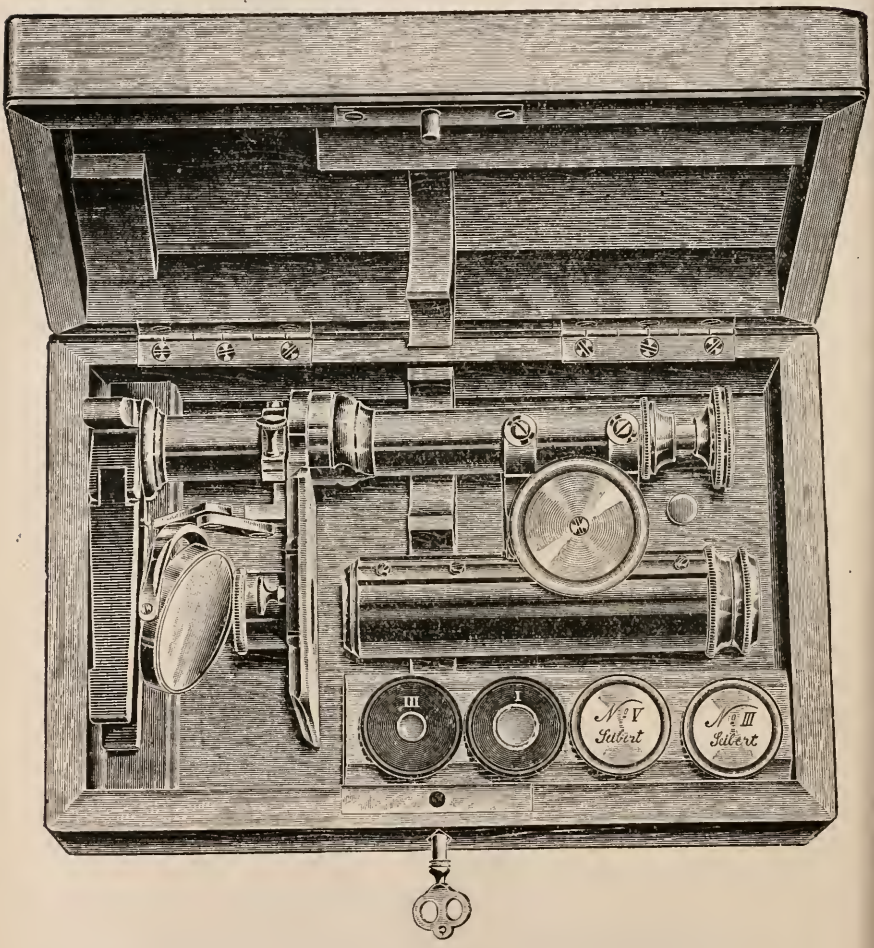

Fig. 21.

it is rigidly connected with the pillar, and so provides a permanent centring. Figs. 20 and 21 show the instrument half the full size: in figure 20 it is set up for use: in figure 21 packed away in its case. In order to prepare the Microscope for use the feet are everted, the

pillar under the stage pulled out and clamped, the tube drawn out to graduation 17, and the jointed mirror arm arranged. The coarse adjustment is by rack-and-pinion, and the fine by micrometer screw. The movement and the illumination are of such a nature that oil-immersions can be used and the instrument applied to bacteriology.

Seibert's New Dissection Microscope. — The foot and object-stage of this instrument are both of large size, the latter being 10 by 10 cm. The adjustment is by means of rackwork. The lens-carrier is movable, as is also the mirror. The support for the operator's arms can be disconnected and removed. The instrument can be fitted with a drawing apparatus (fig. 22), formed of a pillar erected on the horse-shoe foot, and

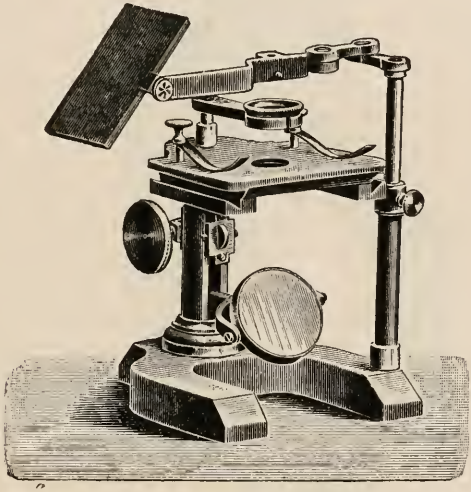

Fig. 22.

carrying a jointed arm with a camera lucida. A suitable loup and concave lenses are also supplied for drawing larger objects slightly magnified or minified.

Seibert's Large Model Microscope, No. 3. — This instrument is chiefly distinguished from the No. 2 stand by somewhat smaller dimensions, and is remarkable for its low price. It corresponds to the Zeiss ii A. It has a horse-shoe foot and no clamp for inclination.

Seibert's Laboratory Microscope. — This instrument is remarkable for its low price. As will be seen from fig. 23, the construction is of the simplest character. The body is focussed by rack-and-pinion, and the careful workmanship of the arrangement renders the instrument available for use with high-power objectives. The stage is of large size (100 by 120 mm.). The movable mirror is plane and concave. The makers recommend it for the detection of trichinæ and as a very useful laboratory adjunct.

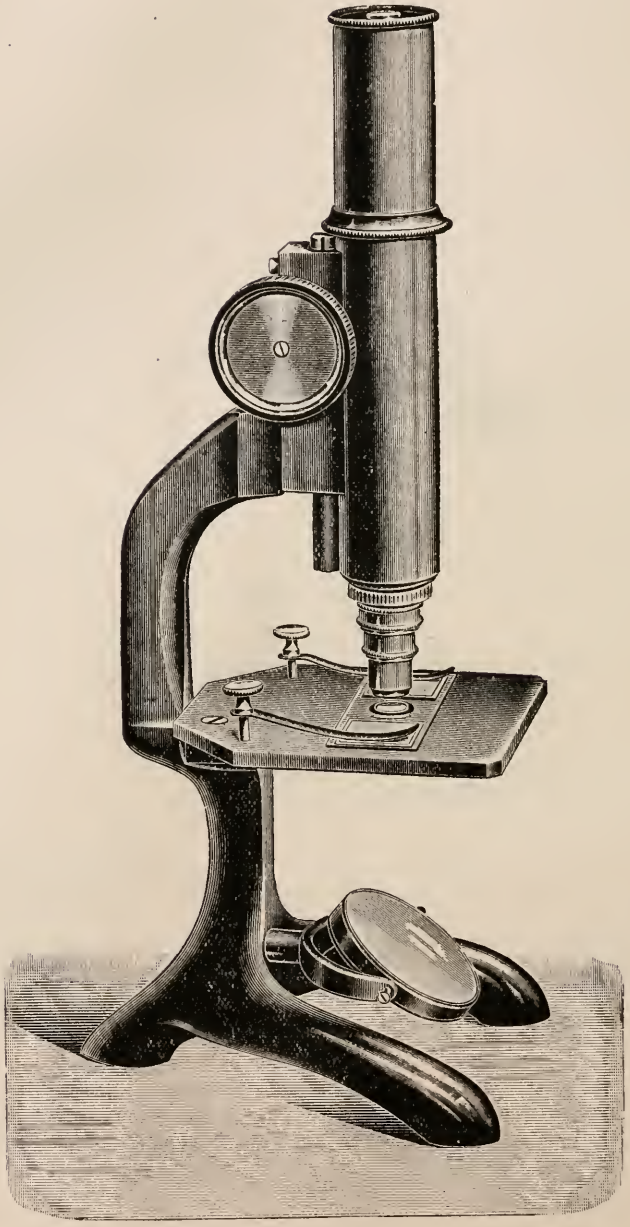

FIG. 23.

(3) Illuminating and other Apparatus.

Seibert's New Projection Microscope with Electric Light.*— The light-source of this instrument (fig. 24) is obtained from a Schuckert's arc lamp of 16 ampere, triple, large illuminating system (16 cm. diameter). A water-cooling chamber is placed between the plano-convex

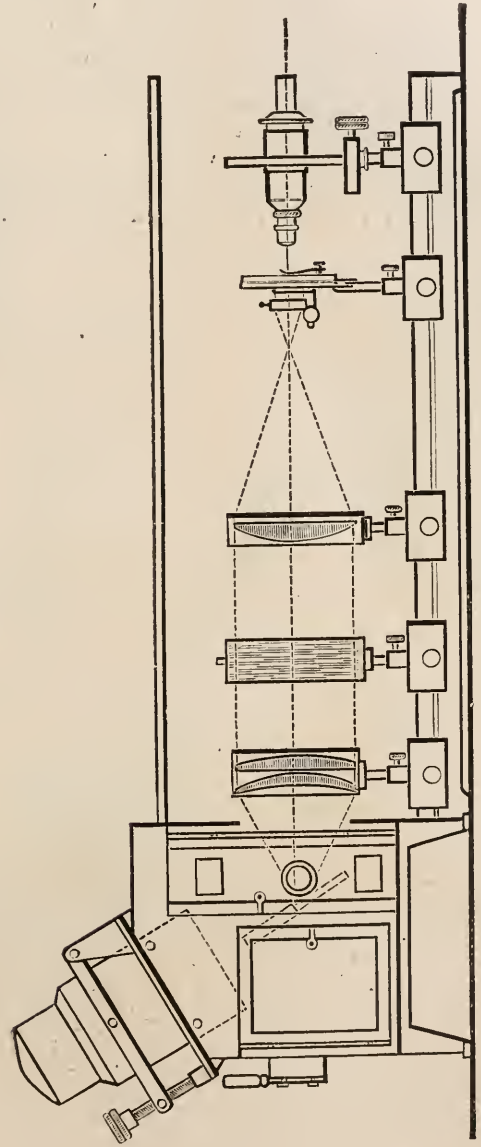

Fig. 24.

* Seibert's Catalogue, No. 18, p. 43.

lenses. The Microscope stand consists of two parts: (1) the object-stage with Abbe's illuminating apparatus and iris diaphragm; and (2) the tube with the adjustments, rack-and-pinion for the coarse, and micrometer screw for the fine. The object-stage is movable by a simple method. The Microscope parts run on iron tongues and can easily be exchanged for the apparatus for the projection of photographic slides. All other apparatus and objects for projection can be easily applied. The instrument also lends itself to photomicrography if it is connected with a corresponding camera. The apparatus can be used both with apochromatic and the stronger achromatic objectives in conjunction with projection oculars; it can also be used with the weaker achromatic and photomicrographic objectives without oculars.

New Microscope Lamp.* — Prof. A. Meyer, in carrying out his researches on the structure of the bacterial cell, experienced the need of a suitable substitute for strong sunlight, and devised the following

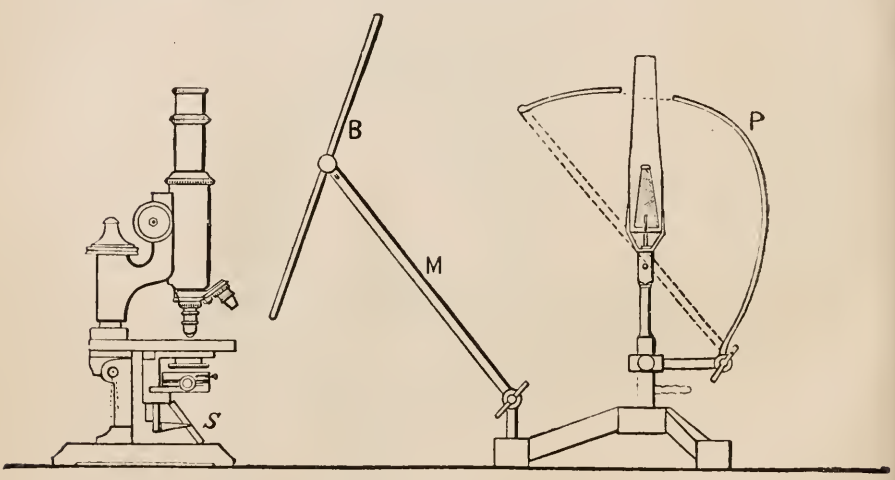

Fig. 25.

apparatus, which gave excellent results:—The source of light is an incandescent gas-lamp mounted on a tripod. The light is placed in the focus of a parabolic mirror P, which can be raised or lowered on the pillar of the tripod-stand, fig. 25. The rays pass through a ground-glass plate M to the mirror of the Microscope S. The grain of the ground-glass plate is very fine. B is a screen to intercept the light coming to the eyes of the worker. The Microscope is placed from 25 to 35 cm., according to the power of the objective in use, from the tripod-stand.

Seibert's Large Polarising Apparatus. — The polariser, with condenser combined, is shown in fig. 26, and the analyser in fig. 27. The polariser is pushed into the collar of the diaphragm-holder. The rotation direction of the nicol is fixed by the clamping of a screw-head in a groove. The analyser is combined with an ocular fitted with cross-

* Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 144-6 (1 fig.).

threads, and has two divided circles: one graduated to every ten degrees (for reading off the rotations of the fixed cross-threads): and a finer one graduated in degrees with a vernier. The prism has right-angled end planes and provides a field of the largest possible size. The instrument can be fitted, if desired, with a long glass tube provided with quadrant Bertrand's quartz plates for sugar analysis.

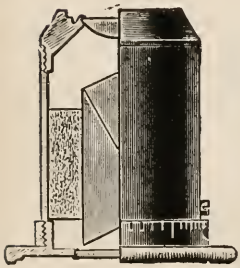

Fig. 26.

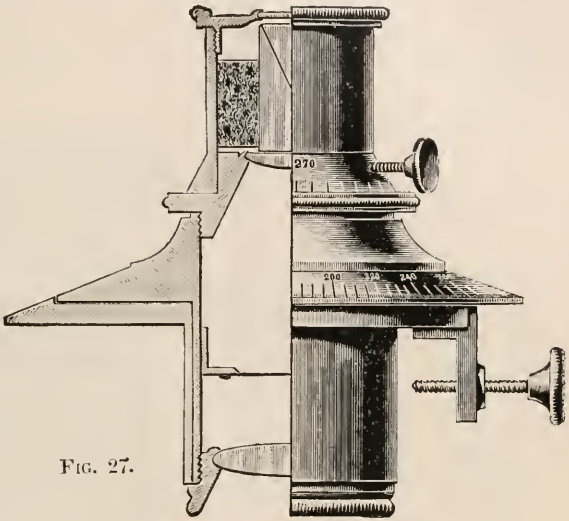

Fig. 27.

Abbe Drawing Camera. — This form of Abbe camera, made by Messrs. Zeiss (fig. 28), was designed by Dr. H. W. Heinsius (1889), and was described in this *Journal* (1890), p. 94, but was not figured. It

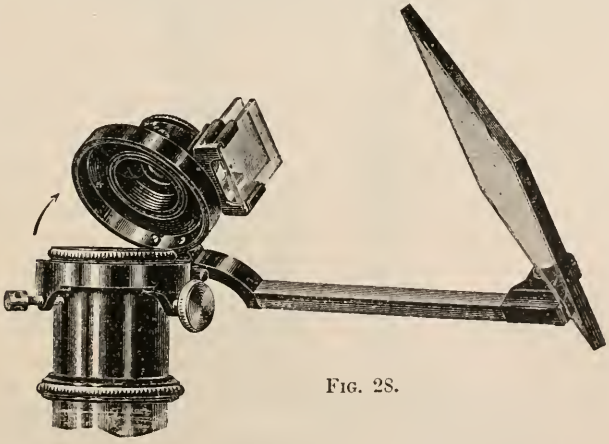

Fig. 28.

differs from the one figured in the *Journal* (1884, p. 119, fig. 18), inasmuch as it is attached by a hinge to the collar which fixes it to the Microscope. This permits it to be turned out of the way when it is not in use.

(4) Photomicrography.

Seibert's Apparatus for Vertical Photomicrography.—This apparatus, whose design is easily understood from fig. 29, is applicable to every

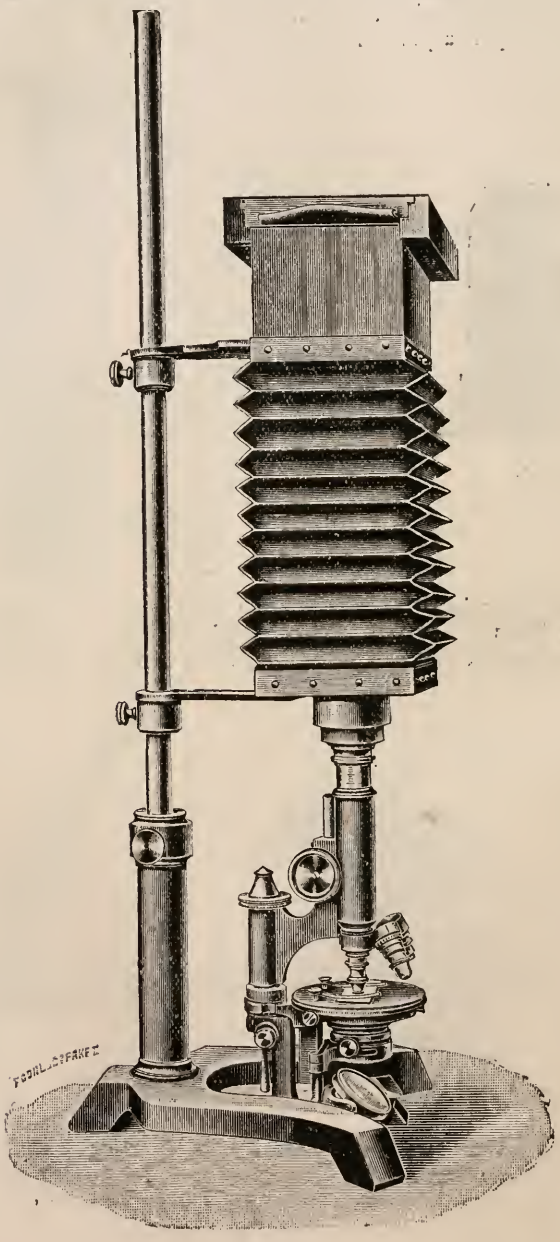

Fig. 29.

Microscope stand. It has a double dark slide and a lens for fine adjustment. The size of the image is 9 by 12 cm., and the bellows have an extension of 50 cm.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Does Anthrax form Spores under Anaerobic Conditions? — R. Slupski† answers the question whether anthrax when cultivated under strictly anaerobic conditions forms spores, in the negative. The method adopted and the apparatus used are as follows. The essential feature in the apparatus is a glass pan with a broad lip (fig. 30, *c*). This pan, which is 15 cm. in diameter, 5 cm. high, and the breadth of the lip 1½ cm., is placed inside another glass pan upon the bottom of which are two dishes *a* and *b*. The dish *a* is for pyrogallic acid, the dish *b* for distilled water. Over the dish *a* is placed a glass tripod the legs of which rest in *b*. Upon the tripod is placed a double layer of blotting paper, and on this rests an open Petri capsule. One half of the agar plate in the Petri capsule is inoculated with anthrax blood and the other with tetanus. As tetanus is an essential anaerobe its growth affords an excellent criterion of the fulfilment of anaerobic conditions. After the plate is inoculated two bits of caustic potash (about 14 grm.) are placed in the pyrogallic acid (about 25 grm.) over which has been poured some 25 ccm. of warm distilled water. The various parts of the apparatus having been adjusted, warm paraffin is poured into the outer jar to form a layer of 3–4 cm. high; and when this has cooled and set another layer of liquid paraffin. This done, the whole apparatus is removed for 40–50 hours to a refrigerator at a temperature of 5–6° C. This is to prevent the growth of anthrax while the oxygen is being absorbed. The final step is to incubate for 70–80 hours at 37°.

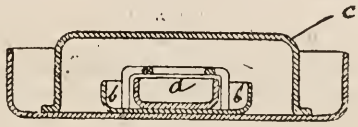

Fig. 30.

Methods for Rearing Amœbæ.‡—M. T. Cook makes a medium by boiling dead leaves. When cool, liquid and leaves are placed in a jar and unboiled leaves and enough water to stand about 1 in. above the leaves added. In 2 or 3 days scum forms, and in from 5–10 days, according to the temperature, amœbæ will be found in the scum in large numbers. They are small but very satisfactory for class purposes.

Yeast-Water for Biological Analysis.§—H. Will recommends the use of yeast-water rendered alkaline by the addition of ammonia for bacteriological purposes. 8–10 ccm. of neutral perfectly clear yeast

* 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., 1te Abt., xxx. (1901) pp. 396–400 (2 figs.).

‡ Journ. Applied Microscopy, iv. (1901) p. 1566.

§ Zeitschr. ges. Brauwesen, xxiv. (1901) pp. 289–91. See Centralbl. Bakt., 2te Abt., vii. (1901) pp. 892–3.

water are placed in Freudenreich's flasks, and just before inoculation a drop of ammonia sp. gr. 0·96 is added.

Demonstration of Enzymes.*—S. L. Schouten gives a method for more quickly demonstrating enzymes than that of Fermi. He mixes water saturated with thymol, 7½ per cent. gelatin, and an equal quantity of cinnabar. The solution, which is red, is distributed into test-tubes. By rotating the tubes under a stream of water, a thin layer of gelatin is formed above a thicker one. When the fluid which is to be examined for the presence of enzyme is put into the tube the action takes place readily on the thin layer, and the result is more easily discovered owing to the red colour of the solution. This method was adopted for examining enzymes of the Saprolegniaceæ.

Cultivation Medium for Cheese Bacteria.†—F. W. J. Boekhout and J. J. Ott de Vries, in their investigation on the ripening of Edam cheese, used cheese-gelatin which was prepared as follows:—Pieces of cheese were ground up fine in a mill and a definite quantity (1½ times its weight) of water added. The mixture was macerated for two hours at 40° and then heated to 50°, being stirred the while, so that the insoluble and partly soluble constituents might sink to the bottom. The supernatant fluid was then poured off and allowed to stand for some hours. The scum, which is composed of fat and albumen, was then skimmed off, and the residue filtered. The filtrate or cheese-broth was worked up into cheese-gelatin by the addition of 10 per cent. gelatin. This medium, suitable for aerobic and anaerobic cultures, contains no milk-sugar and is of acid reaction, thus fulfilling the conditions requisite in cheese-ripening investigation.

Cultivation of Rhizobium leguminosarum.‡ — R. Greig Smith has obtained fairly luxuriant cultures of *Rhizobium leguminosarum* in a gelatin medium containing glucose and inorganic salts, and also on a medium composed of faintly acid agar (2 p.c.) glucose (2 p.c.) and inorganic salts ($CaCl_2$ and KH_2PO_4), nearly neutralised with KOH. In the latter medium there is no nitrogen except that which may be present as impurity in the washed agar, the glucose, or the tap-water. He has also grown the organism in an agar-free fluid medium prepared exactly as the agar medium. Such a fluid, after inoculation, becomes turbid, and forms a slight sediment of organisms, together with a bulky zoogloea cloud or sedimentary film. The experimental flasks were found to contain exactly the same amount of nitrogen as the control flasks, hence no fixation of nitrogen could have occurred.

(2) Preparing Objects.

Handy Method of Preparing Slides and Slips for taking Blood Films.§—W. L Braddon draws attention to a simple method of preparing slips and slides for blood-examination. (1) A slip is placed on a slide in such a position that one of its edges coincides exactly with that of the slide. Then, for temporary use vaselin, for permanent pur-

* Konk. Akadem. v. Wetensch. Amsterdam, 1901. See Centralbl. Bakt., 1te Abt., xxx. (1901) p. 780. † Centralbl. Bakt., 2te Abt., vii. (1901) pp. 817-33 (1 pl.).
‡ Proc. Linn. Soc. N.S.W., xxvi. (1901) pp. 152-5.
§ Journ, Tropical Med., iii. (1900) p. 110.

poses white cement, is smeared round the margins of the slip except that which corresponds with the border of the slide and a small portion of the edge opposite. (2) Two slips, preferably square ones, are accurately superposed, and then vaselin or cement smeared over the combined rims except one, which is left free, and a part of the edge opposite.

To use the slips or slides, touch with the free edge the drop of blood, and when the whole space has been slowly filled the unsmeared portions of the margin are closed up with vaselin or cement. Stains are best added by placing a drop on the surface and puncturing through the drop.

The advantages claimed for this method are that an extremely thin and uniform film is secured; that the slides or slips can be used by the most unskilful; and that when prepared beforehand a large number, especially of paired slips, can be kept in a small space quite ready for use.

Formol as a Preservative and Fixative.*—K. Diederichs in some notes on the use of formalin, which is a 40 p.c. solution of gaseous formaldehyde (CH_2O) in water, alludes to its most important uses as a fixative and preservative agent. For soft animals such as Mollusca and even Medusæ it is excellent in the proportion of 1 part formalin to 20 or more parts of water. As a rule plants do not keep so well as animal specimens, though for fruit and fungi it is suitable. While formalin hardens animal objects it softens vegetables, but in the full 40 p.c. solution, plants can be hardened and thus rendered suitable for microscopical technique.

In combination with Müller's fluid 1–10 it forms an excellent medium for hardening brain. For the lens 1–40 is sufficient. At the present time it is extensively employed in bacteriological technique, many stains being made up with it, so that the specimens are stained and fixed simultaneously. It is of inestimable advantage for preserving cultures so that they shall retain their characteristic appearance at any given stage. It is equally applicable to plate and tube cultures.

Large anatomical preparations are preserved by immersing them wrapped in cotton wool in a mixture of 200 ccm. formalin, 1000 ccm. water, 15 grm. potassium nitrate, and 30 grm. potassium acetate for 24–48 hours. Alternative solutions are: (1) Formalin 100, acetate of soda 30, chlorate of potash 5, distilled water 1000. (2) Water 1000, formalin 750, nitrate of potash 10, and acetate of potash 30. (3) Formalin 50, artificial Carlsbad salts 40, water 1000. After removal from any of the foregoing the preparations are transferred to 60 p.c. alcohol for 2 days, and then for similar periods to 80 p.c., 90 p.c., and 93 p.c. alcohol. By this stage the colour is regenerated. The preparations are next transferred to the preservative which consists of 290 parts glycerin, 100 parts acetate of potassium, 1000 parts water. Alternative solutions are: (1) Water 90, glycerin 54, acetate of soda 27. (2) Water 1000, nitrate of potash 2·5, saccharum 20, chlorate of soda 250.

Formalin-gelatin has recently been applied to anatomical objects. In 200 ccm. of water at 90°, 6–7 p.c. of gelatin is dissolved without stirring. The supernatant thin opalescent layer is decanted off, filtered

* Zeitschr. f. angew. Mikr., vii. (1901) pp. 146–9.

and if necessary clarified by the addition of a few drops of nitric acid. To every 10 ccm. gelatin 6–8 drops of formalin are added. The objects, previously hardened in alcohol, are washed in water and then placed in glass vessels containing formalin-gelatin cooled down to about 60°. When the gelatin has set the jars are hermetically closed.

Another similar method consists in making a 5 p.c. gelatin solution, and then treating it with $\frac{1}{2}$–1 p.c. formalin. The objects are for this method previously fixed with formalin.

Demonstration of Cholera Vibrios.*—Prof. L. Heim states that the presence of blood in the medium much facilitates the demonstration of cholera vibrios in suspected fluids. A decoction of blood is prepared by boiling clot and then filtering the solution. To 200 ccm. of water containing cholera vibrios 4 grm. of pepton and 2 grm. of common salt are added. When these ingredients have become perfectly dissolved the fluid is distributed into two glass vessels. To one is added 50 ccm., or more, of the blood decoction, and both are incubated for 24 hours. The growth in the sample containing blood is more copious, the indol reaction more marked, and the motility of the vibrios greater, than in the pepton-salt medium. On plates containing blood the colonies are more luxuriant than on ordinary gelatin plates, the difference becoming still more striking in a few days.

(3) Cutting, including Imbedding and Microtomes.

New Ether Freezing Apparatus for the Microtome.†—Dr. A. Noll has devised a freezing apparatus, by which the necessary coldness is

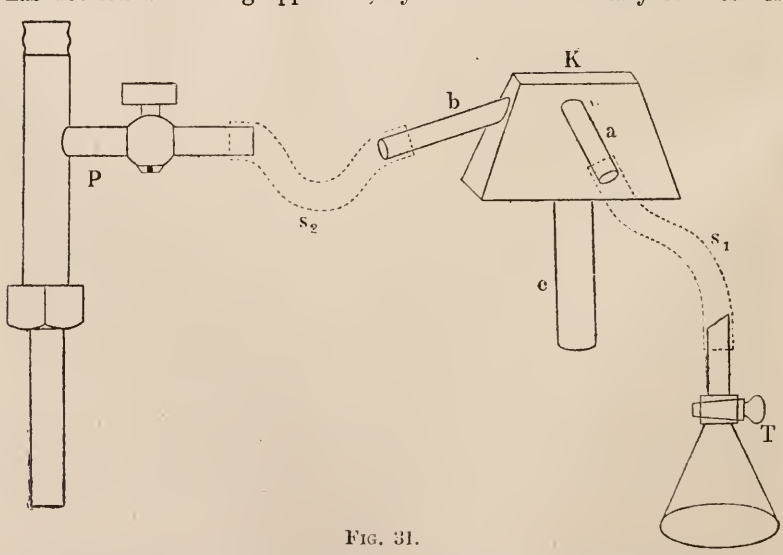

Fig. 31.

obtained by the evaporation of ether in a vacuum. It consists (fig. 31) of a metal chamber K with two side pipes *a* and *b*, and a bar *c* for fixing

* Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 570–3 (1 pl.).
† Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 141–4 (2 figs.).

to the microtome. The side pipes are connected by tubes s_1 s_2; s_1 joins on to a funnel and is supplied with a stop-cock T; s_2 connects with a suction apparatus p (water pump) which exhausts the air in the chamber.

The apparatus is worked by pouring in ether through the funnel, and then (having closed T) opening P. In about half-a-minute the specimen which lies on the surface K is frozen, and will keep so for about 15 minutes. The apparatus works well, the consumption of ether is small, and though intended for the Schanze can be adapted to any microtome. The measurements of the freezing box are: lower surface 4–2·5 cm.; upper surface 2·5–2 cm.; height 3 cm.

Electrothermal Paraffin Bath. * — Dr. R. H. Steen has devised an apparatus in which the electric current from the main is utilised to raise the temperature of a paraffin bath by means of the heat radiated from one or two ordinary lamps placed in an asbestos box beneath it. A mercurial thermostat placed in the bath maintains the temperature at a constant level by causing the lamps to be switched off and on when the temperature tends to rise or fall below the degree required. An incubator could be worked by the same apparatus, as the upper wire in the thermostat can be adjusted for any required temperature. The bath works satisfactorily without any attention, and its temperature does not alter to an extent which is appreciable to any ordinary thermometer.

Paraffin Bath heated by Electricity.†—Cl. Regaud and R. Fouilliand have devised a paraffin bath which is heated by an electric current. The inventors claim that it possesses many advantages over baths heated by gas or petroleum, that it is much lighter, and can be manipulated with greater facility. For saturating the pieces, wire baskets, suspended by a wire in the paraffin bath, are used.

Carbon Bisulphide in Paraffin Imbedding.‡—Prof. M. Heidenhain describes a new method of imbedding in paraffin, carbon bisulphide being used for saturating the objects. Three glass vessels with ground stoppers are required. One contains a mixture of equal parts of bisulphide and alcohol, the other two pure bisulphide. The dehydrated pieces are passed through these three bottles, remaining 24 hours in each. For imbedding, two thermostats are used, one at from 36° to 38°, the other from 56° to 57°. Two other similar glass-stoppered bottles are placed one on each of the two thermostats. Each bottle contains bisulphide (about $\frac{1}{5}$ to $\frac{1}{4}$ in. in height), and in each is placed as much paraffin as will dissolve. When the pieces have been passed through both mixtures, from the lower to the higher, they are removed to pure paraffin at 55°, and the last step repeated. In the two pure paraffin baths the pieces remain for an hour to an hour and a half. The repetition is necessary in order to completely remove the bisulphide. The results from the new procedure are excellent, but certain precautions are necessary. On account of the inflammability of the bisulphide the manipulation should be carried out in a part of the laboratory remote from open fire or flame. The disagreeable odour may be avoided to a great extent by refraining

* Brit. Med. Journ., 1901, ii. pp. 1733–4 (1 fig.).
† Journ. Anat. Physiol., xxxvi. (1900) pp. 574–9 (3 figs.).
‡ Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 166–70.

from shaking the bottles. When it is necessary to remove the stoppers this should be done in a closed gas-chamber.

Paraffin Imbedding in Vacuo. * — Dr. R. Kolster uses chloroform xylol or toluol as solvents, and after saturating the pieces in the usual way places them under the air-pump and exhausts the air. In the vacuum the last traces of the volatile solvent or of air are removed and a solid homogeneous block remains.

Saw for making Microscopic Preparations of Hard Objects.† — G. Arndt has devised a saw for making microscopical sections of hard objects. It is on the lines of a fret-saw but having two parallel blades which are kept in a state of tension and prevented from sagging by clamping screws. The results obtained from its use are satisfactory.

(4) Staining and Injecting.

Preparation of Pure Romanowsky-Nocht Stain.‡ — Dr. K. Reuter prepares eosin-methylen-blue by heating for three days in an incubator at from 50°–60° C. 0·5 Na_2CO_3 and 100 ccm. 1 p.c. aqueous solution of medicinal methylen-blue Höchst, and after filtering, adding saturated aqueous eosin solution. The precipitate which comes down is washed with distilled water and, having been dried, is dissolved in a water-bath in hot absolute alcohol. The solution is filtered, and to every 100 ccm. 2 ccm. of anilin oil are added. The results obtained by staining malaria blood-films are said to be very striking. It is best to keep the pigment dry and make a stock solution from time to time. Then about 0·2 grm. is dissolved in 100 ccm. C_2H_6O by the aid of heat and 2 ccm. of anilin oil added. Of this stock solution 30 drops are added to about 20 ccm. of distilled water. The preparations are stained for a half to several hours, and to obtain a good effect the films should be protected against aqueous moisture. Attention is drawn to the fact that the solution is alkaline.

Kresylecht Violet.§—R. L. Morse recommends kresylecht violet for general staining purposes, and prepares the solution by mixing together 5 p.c. aqueous solution of phenol 80 cc. and 95 p.c. ethyl alcohol 20 cc., and then adding 1 grm. of the pigment. After all the stain is dissolved the solution is filtered. Stain for 1–5 minutes. Wash in distilled water. Mop up. Anilin-xylol (2–1). Pure xylol balsam.

Very good results are obtained with Gonococcus, mucin, amyloid, plasma-cells, and cancer bodies.

New Fat-staining Pigment.‖—Dr. L. Michaelis recommends a scarlet or poppy-red pigment for staining fat. The chemical name of the new dye is Azo-orthotuloazo β-naphthol; its trade name Scharlach R, or Fettponceau. The pigment is insoluble in water, soluble with difficulty in alcohol, but easily soluble in chloroform, oils, and melted paraffin. It is soluble in strong H_2SO_4, the solution being blue; all other solutions are red. A saturated solution of Scarlet R in 60–70 p.c.

* Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 170–3.
† Tom. cit., pp. 146–59 (9 figs.).
‡ Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 248–56 (2 pls.).
§ Journ. Applied Microscopy, iv. (1901) pp. 1492–4.
‖ Virchow's Archiv., clxiv. (1901) pp. 263–70.

alcohol is made and the preparations treated therewith for $\frac{1}{4}$ to $\frac{1}{2}$ hour. Even the smallest drops of fat are stained a bright red. The preparations may be contrast-stained with Böhmer's hæmatoxylin, and should be mounted in glycerin or in lævulose syrup.

Staining Woody Tissue. * — L. Mangin has examined the selective staining action of naphthylamin, toluidin, benzidin, tolidin and dianisidin. The first two stain the ligneous tissue yellow, while benzidin and dianisidin impart a red-brown hue. Tolidin gives a dull brown. He prefers benzidin, of which a solution is prepared by dissolving 1 grm. together with 1 grm. of acid (citric, tartaric, or lactic) in 100 ccm. of water. After boiling the mixture is filtered. The simple solution may be used, or some glycerin added to the filtrate.

Demonstration of the Cell-nucleus of Saccharomyces. † — C. Hoffmeister recommends the following solutions for fixing, viz. von Rath's and Merkel's solutions, perchloride and iodo-potassic iodide.

The best staining results were obtained with Böhmer's hæmatoxylin and with Heidenhain's iron-hæmatoxylin. The procedure adopted was the following:—The yeast-cells were fixed with von Rath's mixture, and after washing out the fixative, films were made on cover-slips from suspensions. When dry the slips were floated on 2·5 p.c. iron-alum solution for 6–24 hours. They were then washed again, and transferred to 0·5 p.c. aqueous hæmatoxylin solution for at least 24 hours, after which they were differentiated in $\frac{1}{4}$ p.c. iron-alum solution. The cytoplasm is decolorised, the nucleus remaining black, violet, or dark grey.

Modifications of Weigert's Method of Staining Elastic Tissue. ‡— Dr. R. Minervini has obtained satisfactory results from the following procedures:—(1) Staining in bulk: the pieces are fixed in formalin alcohol or Müller's fluid. Pieces about 1 ccm. are immersed in the staining fluid for 48 hours, after which they are transferred to alcohol with 1 per cent. HCl for 24 hours; next, to 90 per cent. alcohol for a similar period, and finally to absolute alcohol, turpentine, or xylol, and imbedded in paraffin. The pigment is made by precipitating an aqueous solution of fuchsin with iron chloride and dissolving the precipitate in alcohol.

(2) An aqueous 1 p.c. solution of safranin with 1 p.c. resorcin is made. When cool it is filtered. To the filtrate a quarter of its bulk of iron chloride is added. The solution is heated to boiling, and the residue after filtering is washed, dried, and dissolved in 100 parts of 90 p.c. alcohol with 1 p.c. HCl. The sections are stained for two hours, decolorised in alcohol, and may be contrast-stained with hæmatoxylin or methylen-blue. This pigment is quite suitable for staining tissue in bulk, especially if fixed with some chromic acid salt solution. Indeed, Weigert's method or its modification is always improved by the presence of chromic acid or one of its salts.

(3) An aqueous 1 p.c. solution with 1 p.c. resorcin is prepared by the aid of heat. When cold it is filtered, and a quarter of its volume of

* C.R. Soc. de Biol., liii. (1901) pp. 837–9.

† SB. Deutschen naturwiss.-med. Vereins f. Böhmen "Lotos," xx. (1900) pp. 251–63 (1 pl.). See Bot. Centralbl., lxxxvii. (1901) pp. 129–30.

‡ Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 161–5 (1 pl.).

2 p.c. chromic acid or of 5 p.c. potassium bichromate is added. The solution is heated to boiling, and when cold filtered. The residue is dried in an incubator at 30°, and then dissolved in 90 p.c. alcohol (100 parts). After acidulation with 1 p.c. HCl it is filtered. The sections are immersed for two hours and then transferred to 90 p.c. alcohol for half an hour. The elastic tissue is stained a dark violet.

Neutral Red for Staining Nucleated Red Blood-Corpuscles.* — Dr. Bettmann has found neutral red a most satisfactory reagent for demonstrating the presence of nucleated erythrocytes. The technique is simple. It is sufficient to mix with a drop of blood some saturated solution of neutral red, or to add a granule of the solid pigment. But by adopting Arudd's elderpith method (see this *Journal*, 1897, p. 81) still better results were obtained. The nuclei of the erythroblasts show up as dark brownish-red masses surrounded by the pale brown cell-body.

Demonstrating the Seminal Tubules of the Rat by means of Renaut's Fluid.† — C. O. Regaud demonstrates the membrane of the seminal tubules of the rat by injecting Renaut's fluid into the testicle. The fluid consists of saturated aqueous solution of picric acid 80 vols., 1 p.c. osmic acid 20 vols.; to 3 vols. of this mixture 1 vol. of 1 p.c. nitrate of silver solution.

New Method for Staining en masse.‡—A. Spuler describes a method for staining pieces which has the advantages of imparting a regular staining to each section, and of affording excellent preparations for demonstration with the projection-apparatus. The fixed pieces are treated with cochineal solution prepared by boiling finely powdered cochineal in distilled water, filtering, and evaporating down almost to dryness. Distilled water is again added and the mixture filtered. In this solution the pieces are left for 24 hours or more on the top of a paraffin oven. After having been washed they are mordanted in a thin solution of iron-alum. This converts the red colour to black. The mordanting over, the pieces are thoroughly washed with distilled water and then imbedded in the usual way.

New Method for Staining Nervous Tissue.§ — Dr. T. Kodis has devised the following procedure, in which hæmatoxylin molybdate is the effective ingredient:—Pieces of fresh tissue ½–1 cm. thick are placed in saturated aqueous solution of mercury cyanide for 1–2 days, or longer. They are then put straight away without washing into 10 p.c. formalin for 1–3 days. Sections are made by a freezing microtome, and stained for 1–2 minutes in much-diluted solution of the hæmatoxylin molybdate (hæmatoxylin crystals 1; molybdic anhydride 1·5; aq. destill. 100; H_2O_2 0·5, or a crystal of HgO: the solution is ready for use in a few days). The stained sections are washed for 1–2 minutes in water, and having been contrast-stained with alcoholic solution of Lichtgrün, are mounted in balsam.

* Zeitschr. f. angew. Mikr., vii. (1901) pp. 177–82.

† Arch. Anat. Microscop., iv. (1901) pp. 101–53 (2 pls.).

‡ Deutsch. Med. Wochenschr., xxvii. (1901) No. 14, Vereinsbeilage, p. 116. See Zeitsch. f. wiss. Mikr., xviii. (1901) pp. 183–4.

§ Arch. f. Mikr. Anat. u. Entwickl., lix. (1901) pp. 211–20 (1 pl.).

The author also mentions that the foregoing fixation is suitable for iron-hæmatoxylin staining. The sections, made by freezing microtome, are immersed for 2–5 hours in 2 p.c. iron-alum solution, and having been washed in water, are placed for 10–12 hours in ½ p.c. aqueous solution of hæmatoxylin. They are next differentiated in 2 p.c. iron-alum solution (from 1–3 hours). The medullary sheath of the nerves is dark blue, the rest of the tissue being unstained. The sections are then washed very thoroughly (several hours), and afterwards mounted in the usual way in balsam.

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

Examination of Hairs for Medico-legal Purposes.*— E. S. London states that hairs intended for medico-legal examination should be mounted dry in balsam without any preliminary preparation or treatment, as reagents cause them to lose many of their characteristic features. From many thousand examinations of hairs of man and of animals (39 species) he comes to the following conclusions. By the use of the Microscope it is easy to distinguish the hair of man and of animals from any body or substance of a similar appearance. With a little practice it becomes easy to discriminate between human hair and that of the lower animals; and if all the peculiarities be taken into consideration the original site of a hair may be diagnosed. From the appearance presented by the roots it is possible, if several specimens be available, to determine whether the hairs have fallen out naturally or have been plucked out. By means of the polariscope a grey hair can be diagnosed from a pale blond. With crossed nicols blond hair gives a golden yellow band on a black ground, while grey hair gives a particoloured band (*cordon*), the red-purple predominating.

In arsenic poisoning the metal passes into the hair. This was shown by injecting arsenic solution into animals hypodermically and testing the hair by the usual chemical methods. The control animals gave a negative result.

Substitute for Cover-slips.†— Dr. V. Pranter recommends gelatin-paper as a substitute for the more expensive glass slips of large size. The paper consists of pure gelatin, is almost colourless, perfectly transparent and smooth. It can be used with advantage for all preparations which do not contain, or are not mounted in water or glycerin. It allows examination under oil immersions. Though less suitable than glass for permanent preparations, the specimens will keep for months without deterioration provided they be stored in a cool, dry place. Dirt or grease on the surface is easily removed by means of xylol or benzin.

Preparation and Preservation of Urinary Sediment.‡ — G. Marpmann prepares and preserves urinary sediment as follows:—Some 100 to 200 ccm. of urine are placed in a conical vessel, and when a sediment of, say, 20 ccm. has been deposited the supernatant fluid is decanted off. To the sediment 1 ccm. of eosin and 1 ccm. of methylen-blue in aqueous

* Archiv. Sci. biologique St. Petersb., viii. (1900) pp. 136-57 (6 pls.).
† Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 159-61.
‡ Zeitschr. f. angew. Mikr., vii. (1901) pp. 182-4.

solution are added. In about twenty minutes 1 ccm. of formalin is added, and in another twenty minutes the vessel is filled up with water. After standing for 1–2 days the deposit, about 1 ccm., is removed and mixed with 10 parts of liquid glycerin jelly. A drop of this is placed on a slide and covered with a cover-slip. The preparation is then placed in a closed glass jar containing a few drops of formalin. In the course of a few days the external layer of gelatin becomes set by the action of formalin, so that a ring of varnish or balsam becomes unnecessary.

(6) Miscellaneous.

Dropper for Sterile Fluids.*—G. Wesenberg describes a dropping apparatus (fig. 32) which is of simple construction and of especial advantage in disinfection experiments for washing the disinfectant out of the object to be tested. It consists of a caoutchouc plug, which is inserted into a test-tube or the neck of a flask. The plug has two perforations, one for a bent tube *a* through which air enters, and the other for the bent tube *b*. The latter is narrowed at *c* so that it can be broken off or sealed up in the flame. The way of using the apparatus is obvious. If the fluid does not flow freely it may be forced on by blowing through *a*.

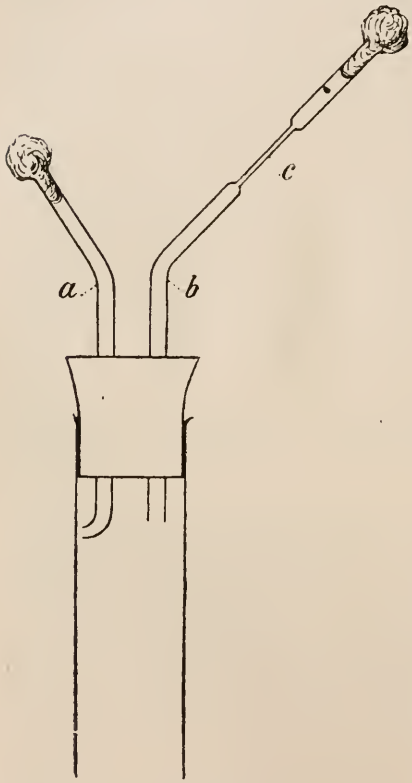

Fig. 32.

There is little chance of air-infection if the end of *b* be held close to a flame when the tube is set upright after using it.

Immersion Oil in Collapsible Tubes.†—C. W. Dodge mentions that he has used immersion oil stored in metal collapsible tubes for over a year, and has found the method satisfactory and without signs of deterioration in the oil.

Raising the Melting-point of Gelatin by means of Formalin.‡—Dr. J. G. C. Vriens alludes to H. J. van't Hoff's remarks on raising the melting-point of gelatin by means of formalin, and points out that this property was employed by Brown, in 1897, for hardening the gelatin layer of

* Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 703-4 (1 fig.).
† Journ. Applied Microscopy, iv. (1901) p. 1567.
‡ Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 74-2. [Cf. this Journal, 1901, p. 719.

negatives by immersing the plates in a formalin bath (4 ccm. formalin and 30 ccm. water.) In 1898 Trillat devised a method for the estimation of gelatin in gums and food-stuffs which was based on this property of formalin. A 4 per cent. solution of formalin is employed with success for preserving and hardening microscopical objects, while in the bacteriological laboratory it has many uses, among which may be mentioned that of inhibiting the growth of cultures. The vapour of formalin acts very detrimentally on the pigment of chromogenic bacteria and on the fluorescence of micro-organisms. It would be of great value if the exact strength of formalin, which was harmless to the growth and development of microbes, and which did not affect the good properties of gelatin, could be determined.

Useful Caliper Gauge.—This convenient little out-and-in caliper gauge (fig. 33), which may be purchased for 3*s.* or 4*s.* at any watchmakers' tool shop, is a very cheap and handy gauge for a microscopist's outfit. Among other uses it is convenient for measuring the thickness of coverglasses. It reads by a vernier to 0·1 mm. It is graduated both ways, and the points A and B form an end gauge. For low-power work the scale may be placed on the stage of a Microscope, and the constant of an eye-piece micrometer found by comparison with the mm. divisions.

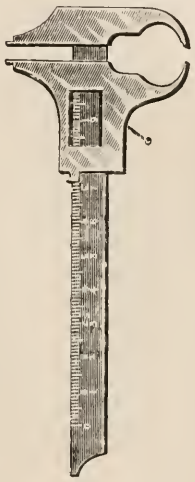

Fig. 33.

Methods for Examining Trypanosoma Lewisi.* —A. Laveran and F. Mesnil remark that observations on *Trypanosoma* in fresh blood are quite easy. The blood obtained by puncturing the tip of the tail of an infected rat is spread on a slide and covered with a slip. For prolonged observations the hanging drop is recommended. The blood may be mixed with physiological salt solution, then defibrinated with citrate solution to prevent coagulation, or mixed with rat serum. The length of time *T. Lewisi* can be preserved depends greatly on the temperature: in summer rarely beyond four days; in winter as long as eighteen days; in a glaciarium (5° to 7° C. above 0°) they will keep for four to seven weeks. For studying the structure of *Trypanosoma* it is necessary to use stained preparations, and the following procedure gave the best results. A thin film of blood is spread on a slide, dried quickly, and fixed in absolute alcohol (ten to fifteen minutes). For staining, three solutions are necessary:—(1) Borrel's blue. To make this, place some crystals of nitrate of silver in a bottle capable of holding 150 ccm. and 50 to 60 ccm. of distilled water. When the crystals are dissolved the bottle is filled with soda solution. The black oxide of silver thus formed is washed several times with distilled water to remove the soda. Over the silver oxide is then poured a saturated aqueous solution of methylen-blue (Höchst). The mixture is allowed to stand for fifteen days, being shaken up frequently the while. (2) A one per thousand aqueous solution of eosin. (3) A 5 per cent. solution of tannin.

* Ann. Inst. Pasteur, xv. (1901) pp. 678–82 (2 pls.).

When required for staining, the solution is prepared by mixing together 4 ccm. of the eosin solution, 1 ccm. of the Borrel's blue solution, and 6 ccm. of distilled water. The slide with the fixed film is immersed in the foregoing for 20–30 minutes. After removal, it is washed freely with water, and then treated with the tannin solution for 10–15 minutes. It is then washed again with tap and afterwards with distilled water, and then dried.

If there be a precipitate on the film this may be removed with oil of cloves followed by xylol, and the surface wiped with a cloth dipped in xylol.

In default of the foregoing stain, Romanowsky's method may be adopted or the preparation may be stained with alcoholic solution of fuchsin or with carbolate of thionin.

Gage's 'The Microscope.' *—The eighth edition of Prof. S. H. Gage's well-known and much appreciated work on the Microscope, an introduction to microscopic methods and to histology, has recently appeared. For the present issue the work has been revised and enlarged, and though preserving the same general features as its predecessors contains new matter of some importance. In re-writing this edition the author has re-cast the work and has added new figures as well as textual matter. Chapters on Class Demonstrations in Histology and Embryology and on the Projection Microscope are not only extremely valuable in themselves but also indicate one of the paths along which microscopical science is advancing, and the pioneering efforts of the author to keep his work abreast of the knowledge of the time.

Micro-chemical Reactions of Wood affected with Dry Rot. †—G. Marpmann mentions that wood affected with dry rot gives the following micro-chemical reactions:—(1) Iodol + dilute HCl or H_2SO_4 turns the diseased parts yellow, or brownish-yellow, healthy wood staining a carmine red. (2) Chlor-zinc-iodin or iodine + H_2SO_4 turns the attacked places blue in about ½ hour, the healthy wood remaining yellow. (3) Nessler's reagent imparts a dark brown hue to the diseased parts, the apparently healthy portions being yellowish-grey or grey.

* Comstock Publishing Company, Ithaca, New York, 1901, viii. and 299 pp. and 230 figs.

† Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 775–82.

V.—*New Methods in Microscope Work.*

By Edward M. Nelson.

(*Read February 1st*, 1902.)

Polarizing with the Microscope.

Polarizing work with the Microscope is of two distinct kinds:—

1. The magnification of minute objects under polarized light.
2. The investigation of phenomena due to the interference of polarized light (known as "rings and brushes").

With reference to the first kind the images are much sharper, i.e. more critical, if a pair of tourmalines be substituted for the Nicol prisms usually supplied by the opticians for this purpose.

One tourmaline should be selected with care; it should be of a smoky tint with the slightest dash of pink, free from veins and specks, and not less than $\frac{1}{4}$ in. in diameter. It should be mounted in a cap to fit over the eye-piece.

The other tourmaline may be of the ordinary yellow-green variety, but it should be larger than the first; a rectangle $\frac{4}{10}$ by $\frac{6}{10}$ would be a convenient size and shape. This tourmaline should be mounted in a metal screen, say $2\frac{3}{4}$ by $3\frac{1}{2}$, with an aperture in it of such a size as to exclude all light that does not pass through the tourmaline. This screen may be mounted either on a separate stand, or on an arm attached to the lamp, as the position it is intended to occupy is in front of, and close to the lamp chimney.

The method of using this apparatus in the first kind of investigations needs no explanation. The Microscope is set up in the usual way; the image of the edge of the lamp flame is sharply focussed by the substage condenser on the object; the screen holding the tourmaline is placed close to the chimney of the lamp. The object is then examined and, when all the adjustments (collar correction, tube length, size of illuminating cone, &c.), are completed, the second tourmaline, in the cap of the eye-piece, is applied, and the eye-piece and object rotated until the desired effect is obtained. If the substage condenser were an achromatic Abbe, and a large axial illuminating cone was required, under the old regime a very large, and therefore expensive, Nicol would be necessary, because the Nicol would have to be large enough to pass a beam equal to the size of the back lens of the Abbe condenser; but with this new method a tourmaline large enough to show the middle portion of the lamp flame is sufficient, even when the widest angled cones are employed

with any kind of condenser. The images obtained by this new method will be just as critical as those in a Microscope when no polariscope is used.

In the old method the polarizing prism interfered with the correct performance of the substage condenser; the analysing prism also, when mounted immediately above the objective, destroyed the sharpness of the image, and when placed over the eye-piece removed the eye too far from the eye point; it also caused a deterioration of the image, but not to the same extent as when placed above the objective. Mr. Gordon has shown that the Microscope image is sharpened up when the size of the antipoints is reduced, and that one way of obtaining small antipoints is by using large axial cones of illumination. The importance of being able to fill the back lens of the condenser is therefore manifest.

An apochromatic condenser should not be used in polariscope work, because the fluorite of which it is composed itself polarizes.

Rings and Brushes.

I have previously described * a method of investigating these by the apparatus supplied in an ordinary microscopical outfit, and therefore will, without repetition, merely point out that large cones of illumination are essential for the demonstration of wide angled biaxial crystals, and other allied phenomena. The substitution of tourmalines for Nicols is of much advantage, because the illuminating cones may be made as large as possible, and the size of the back lens of the objective on the nose-piece need not be restricted to the width of an analysing prism. The tourmalines are used in the same position as before, viz. one close to the chimney of the lamp, and the other in the cap over the eye-piece. The Zeiss large *a* * objective is a convenient lens to use at the bottom of the draw-tube.

It is a pity that these interesting and very beautiful phenomena are not more generally studied. One meets microscopists who own perhaps more than one Microscope, with polariscopes fitted and all the necessary apparatus, and yet who have never seen a ring and brush.

The Measurement of W.R., W.A. and N.A.

While on the subject of improved methods of microscopical manipulation, attention might be directed to a most useful piece of apparatus, which hitherto has only been used in connection with a telescope. I allude to Ramsden's Dynamometer, two examples of which are shown in figs. 34 and 35.

The arrangement of the micrometer screw, as invented in 1639 by William Gascoigne, was very ingenious. On a pinion, which

* Journ. R.M.S., 1892, p. 683, fig. 81.

terminated in a drum-head, two threads were cut, one being twice the pitch of the other; if, for example, one screw gave one millimetre the other would give half a millimetre of movement for each complete revolution of the drum-head. There were two separate sliding plates, one, which we will call A, carried the other B, with it. The slow-speed screw was connected with the sliding plate A and moved it, together with the plate B, in a certain direction, at the rate of half a millimetre for a revolution, but the other screw was attached to the plate B, and moved it in an opposite direction at double the speed; the resultant of these motions being that the plates were either separated from, or brought to, a certain point at a uniform speed of half a millimetre for each revolution of the drum-head.

A similar action is now obtained by means of right and left-handed screws, but as such things were quite unknown in Gascoigne's time, one cannot help admiring the ingenuity of his invention.

Each plate carries the half of a biconvex lens, and by this simple device measurements of small intervals can be made with great accuracy; so also the diameter of the disc of light, seen in front of

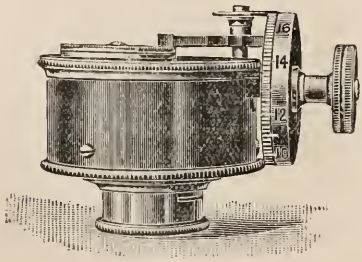

Fig. 34.

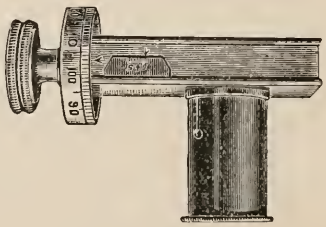

Fig. 35.

the eye-piece of either a telescope or a Microscope, commonly known as the Ramsden disc, can be readily determined.

This ingenious system of micrometry by means of a divided lens or two lenses is due to Savary in 1743, but Dollond in 1754 effected a substantial improvement by making the lenses move in the line of their section.

It appears then that Gascoigne invented the screw movement, and Dollond the divided lens, so it is not easy to see where Ramsden comes in; but he may have been, and probably was, the first to apply this form of micrometer to the measurement of the diameter of the emergent pencil of a telescope, for the purpose of finding its power; at any rate he made micrometers on this principle, and they were known as "Ramsden's Dynameters." These instruments are still made and sold by opticians who keep accessories for the telescope, but they are now called dynamometers.

In fig. 34 complete revolutions of the drum-head are indicated on

the small dial seen at the top of the instrument at right angles to the drum, but in fig. 35 they are shown on the engraved plate which traverses across a fixed arrow-head.

Having described the instrument we will now pass on to its application for microscopical purposes. In the *Journal* for 1901, p. 243, it was pointed out that a dynamometer would be a very convenient, if costly, instrument for the determination of the Working Ratio or Aperture, and, on account of the expense, an alternative device was recommended. Experience has since shown that, while this alternative apparatus is quite suitable for the determination of the Working Ratio, it fails to measure the precise diameter of the back lens of the objective, because of the difficulty of finding the exact point when the back lens is in focus. But, by measuring with a dynamometer the diameter of the eye-discs, representing both the full aperture, and also that portion of it which is illuminated, not only can the Working Ratio be found, but the N.A. be determined as well.

In order to measure any interval by a dynamometer the constant of the instrument must first be found out: in other words, a tenth of an inch, or one millimetre, on a well divided scale must be measured, and all other measurements referred by proportion to this standard; thus, in one of the instruments in fig. 34 one-tenth of an inch requires five complete revolutions and $\frac{35}{100}$ of a revolution, which may be written as 5·35; then, if some other interval measured 3·8 revolutions, it would represent $\frac{3{\cdot}8 \times 0{\cdot}1}{5{\cdot}35}$ or 0·071 inch.

It should be mentioned that these instruments are supposed to read off in inches directly, but although several have been examined only a single one gave a correct reading; they mostly read too high. For instance, the drum-head in fig. 34 is divided into twenty primary divisions, so that the real reading in the observation above is not 5·35, but the double of this, or 10·70, which ought to have been 10·00, if the instrument indicated correctly.

By far the better plan is to disregard these readings altogether, and to find the constant of the instrument once for all, and apply it in the manner pointed out above. It will be noticed that in carrying out this idea, the drum-head in fig. 34 is read decimally, and not as it is engraved; thus 14 is read 7, 16 read 8; in brief, the reading on the drum-head is halved, and the complete revolutions left as they really are. The drum-head in fig. 35 is divided decimally, and one-tenth of an inch reads exactly five revolutions, or 500. The reading of these instruments is affected by myopia and presbyopia, therefore every observer should find out his own constant of the instrument.

If the Working Ratio be required the two dynamometer drum-head readings need not be converted into linear measure, as their

quotient is the Working Ratio; but in order to find the N.A. it is necessary to measure both the diameter of the eye-disc, corresponding to the entire back lens, in linear measure, and also to determine the magnifying power of the entire Microscope, either by projection, or by means of some convenient camera, the distance of the eye-disc to the paper, or screen, being 10 in. Then if B be the diameter of the back lens,* and e, that of the eye-disc for the full aperture, ϕ being the focal length of the entire Microscope, and f that of the object glass, M being the magnifying power of the entire Microscope at a projection distance of 10 in., and m the initial magnifying power of the objective. The following relations between these quantities will subsist:

$$M = \frac{10}{\phi}\ ;\ m = \frac{10}{f};\ \text{and}\ \frac{e}{B} = \frac{\phi}{f} = \frac{m}{M};$$

$$e = 2\ \text{N.A.}\ \phi\ ;\ \text{and}\ B = 2\ \text{N.A.}\ f;\ \text{so N.A.} = \frac{M\,e}{20}.$$

$$\text{The optical index} = \frac{50\ M\,e}{m} = 50\ B.$$

All that is required, then, in order to find the N.A. is to multiply the magnifying power of the complete Microscope by the diameter of the eye-disc, corresponding to the full aperture, and divide the product by 20.

When the measurement of the eye-disc is made, it is important that the back lens of the objective be either filled with light by the substage condenser directly, or if, on account of insufficiency of aperture in the condenser, that cannot be done, indirectly, by dispersed light from a coarse diatom, or other suitable object, placed on the stage.

It therefore becomes a question of practical microscopy whether to purchase an Apertometer or a Dynamometer. As an Apertometer will only do the one thing, viz. measure the aperture of an object glass, the preference will probably be given to the Dynamometer, which, besides measuring the N.A., will measure either the Working Ratio, or Working Aperture, and also is useful for many other purposes.

The Measurement of the Focus of a Lens.

In the *Journal* for 1901, p. 126, a formula is given for finding the true focal length of any objective, by the help of a reciprocal table, *without calculation*, the magnifying power, at a projection distance of 100 in. from the micrometer to the screen, being known. Another method of accomplishing the same object may be of interest.

* In this article "Back lens" means of course the optical, and not the actual back lens; its diameter equals the Optical Index divided by 50.

Project a stage micrometer on to a screen at any convenient distance, measured from some part of the lens mount; determine the magnifying power, and call it M. Move the screen nearer the lens, and again measure its distance from the same point on the lens mount, and call the difference between these distances d; determine the new magnifying power, and call it m; then, the focal length is given by the formula

$$f = \frac{d}{M - m}.$$

During the operation the position of the lens must on no account be shifted. The distance the screen has been moved d, may with advantage be made 10 or 100, and then the result can be found in a reciprocal table, *without calculation.* This formula is a very convenient one, and the necessary measurements may be easily made when a photomicrographic outfit is available.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Ross' New Microscope.—Messrs. Ross have brought out a new Microscope which follows their "Standard" model and is specially intended for the use of medical students (figs. 36 and 37).

Its special feature is a new patent fine adjustment which, instead of

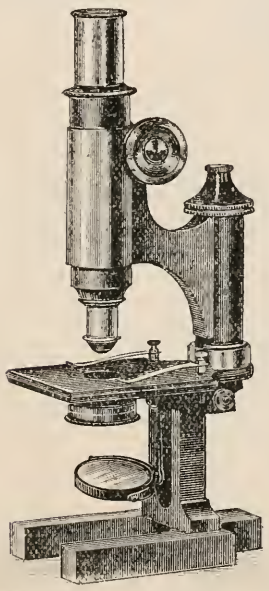

Fig. 36

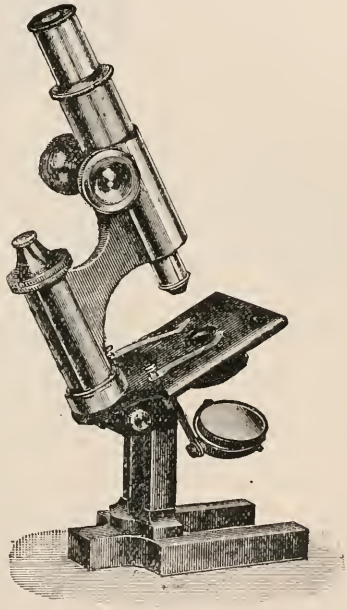

Fig. 37.

the triangle bar, consists of a parallel slide fitting, firmly fixed to the stage.

The moving part is cast on the limb carrying the optical tube, and held in its place by a sleeve-piece bolted securely at the back. A spiral spring, which is placed forward to compensate for the overhanging weight of the body, raises the limb, while the micrometer screw, with its point working on a hardened steel surface, depresses 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.

Besides the ordinary accessories, the instrument can be supplied with a dust-proof nose-piece, and a swing-out substage for a condenser (figs. 38 and 39).

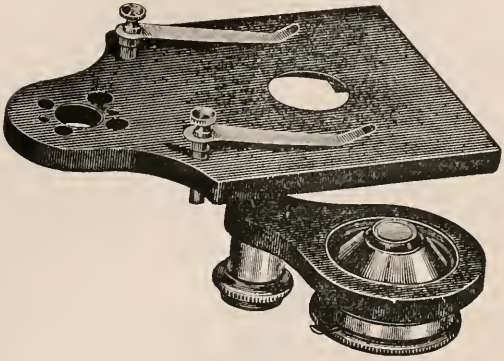

Fig. 38.

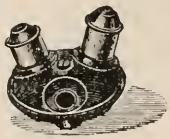

Fig. 39.

Ashe's Two-speed Fine Adjustments.†—A. Ashe's designs are intended to produce an adjustment which should combine the slowest and smoothest motion possible with the capability of giving a far more rapid motion when needed. Fig. 40 shows his first arrangement. It consisted

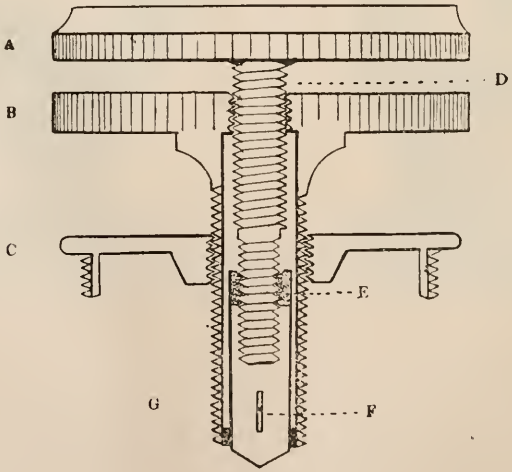

Fig. 40.

of a hollow screw of comparatively coarse pitch G, to which the lower milled head B was attached. This worked in the cap C on the top

* Journ. Quek. Micr. Club, viii. (1901) pp. 131–6 (3 figs.).

of the pillar, and formed the rapid movement. The slow movement was produced by a differential screw D passing through the first and inserted into the top of the rod E actuating the lever. The rod was prevented from rotating by a slot and pin F. The differential screw was rotated by the upper milled head A. When the upper head was rotated and the lower untouched, the slow motion obtained was derived from the action of the differential screw. If both were turned together, the resulting movement would be derived from the lower head only. This form of fine adjustment was designed for lever instruments in which efficiency is the chief consideration. Its principal drawback is that it involves the use of a differential screw, which would require to be very accurately made.

For many instruments with direct-acting fine adjustments, especially

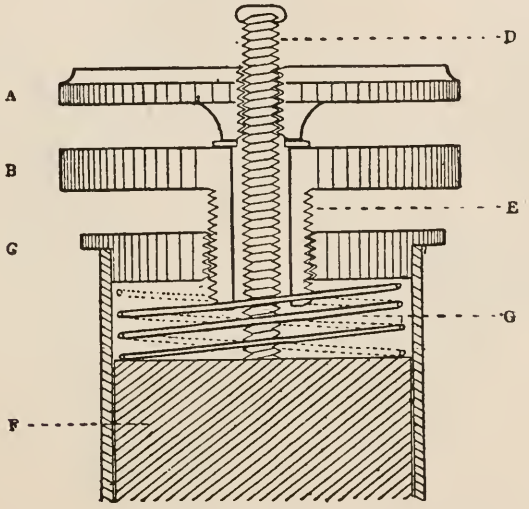

Fig. 41.

instruments of the Continental type, a more simple plan is recommended. In many Microscopes of this class the limb of the instrument is attached to a sleeve, C in fig. 41, sliding up and down outside a prismatic bar F, which is a fixed part of the stand. A micrometer screw D, secured at its base to the top of the upright bar, is carried upwards through an aperture in the cap, and the milled head A is really a loose nut working upon this screw, whilst the cap, limb, tube, &c. are forced up into contact with the milled head by the action of a spring G. This very simple adjustment may, by a single addition, be converted into one having two rates of speed, it only being necessary to insert under the ordinary head A, a second head B attached to the hollow screw E, working into the cap. The latter screw is made hollow, so that it may slide freely over the first screw D. The relative action of the two milled heads in this case is as follows:—the upper head when turned to

the right operates downwards, lowering the focus by depressing the sleeve C carrying the body of the Microscope, and compressing the spring G. The lower head B has, in this instance, simply the action of a washer placed between A and C. A left-handed rotation of A, like the loosening of a nut, permits the expansion of the spring to force upwards both C and B, until stopped by A. When, on the contrary, B is turned to the right it screws itself into C, thereby tending to leave a space between A and B. But this space is at once taken up by the expansion of the spring, thereby raising the cap C together with B, and consequently the focus. Thus, although both screws are right-handed, the milled heads produce opposite motions in the adjustment. Hence the simultaneous rotation of the two heads in the same direction will give the same effect as a differential screw, provided the screws are not of the same pitch.

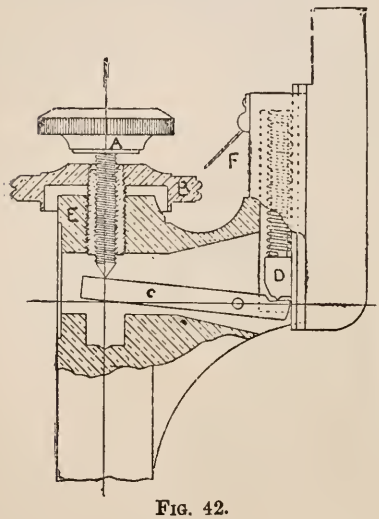

Fig. 42.

In another common type of instrument the limb, actuated by a lever, moves in a slot cut in the pillar. To this Microscope the adjustment just described cannot be applied, and as the differential screw is unnecessary for the purpose, Mr. Ashe replaced it by a fine micrometer screw, leaving the rest intact as in fig. 40. Fig. 42 shows how this design has been carried out by Messrs. R. and J. Beck, who have co-operated with the author for the purpose. A strong, quick-moving screw A in the centre forms the coarser adjustment, whilst, in place of a central fine micrometer screw, a thread is cut upon the exterior of a cylinder of large diameter, attached to the milled head B, thus reducing wear and tear to a vanishing point, and adding greatly to its durability. In this form the upper milled head controls the quick screw, which in practice proves to be a more convenient arrangement than does the converse. Fig. 42 is essentially the same adjustment as that adopted by Reichert in one of his latest instruments,* but it was worked out independently and was completed and manufactured before Reichert's instrument was heard of in England.†

Seibert's Mineralogical Stand.‡—This stand (fig. 43) is the most developed member of a set of four "Polarization-Microscopes," made by the Wetzlar firm. The unusually high projection of the arm joining the pillar and tube permits the examination of very thick objects with weak magnification, as well as the application of rotatory apparatus on

* See The Microscope and its Revelations, 8th edition, pp. 210–1.

† The idea of a two-speed fine adjustment is not new. It was worked out by Anderson in 1886. See this Journal, 1886, p. 325, fig. 62.—Ed.

‡ Catalogue No. 30, pp. 28–36, fig. 12.

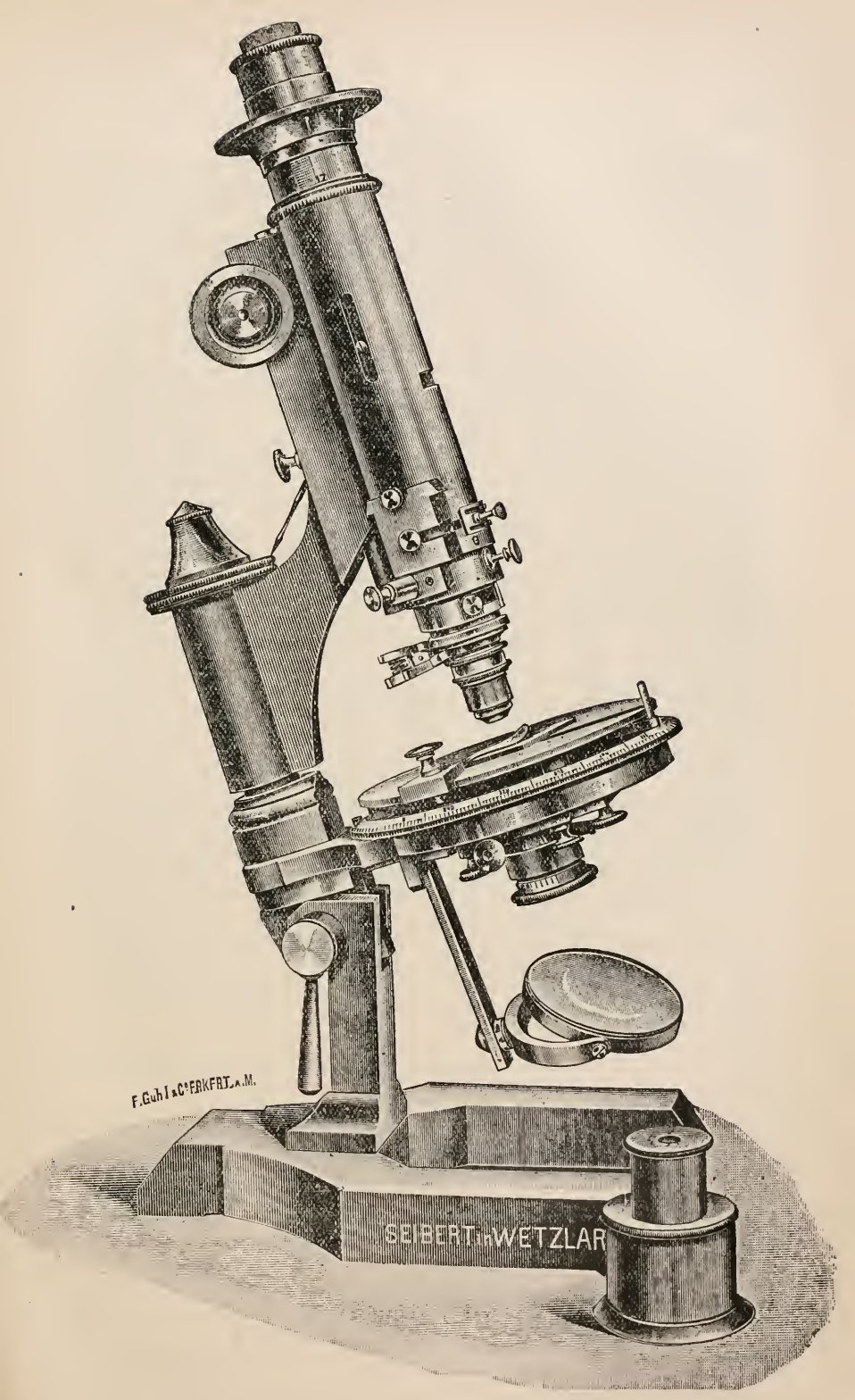

Fig. 43.

the object-stage. The stand is hinged with a clamping lever. The coarse adjustment is by rack-and-pinion; the fine by a micrometer screw, whose head is divided for thickness measurements (1 division = 0·01 mm.). The draw-out tube has millimetre graduations. The object-stage is circular (diameter 105 mm.) and rotatory; the rim is graduated and has a vernier. Under the stage is a screw for securing the rotatory plates. For orientating the object two radii perpendicular to one another are scored on the stage. Centring is performed at the lower end of the tube by two fine screws. The illumination is effected by concave and plane mirrors with universal movement. There are two analysers. One, provided with graduations and verniers, is applied above the ocular; the graduated disc belonging to it being placed close to the ocular end of the draw-tube. The second analyser can be pushed in and out of the tube immediately above the objective without being detached from the tube. The change in the focal length of the objective due to the insertion of the analyser is rectified by the application of a lens of long focus over the prism, so that after the insertion of the analyser no new adjustment of the object is necessary. The inner nicol of the second analyser is rotatory, and a graduation shows its position. The prisms of the analysers have right-angled end-planes, and give a maximum field of view. The polarizer is placed in a push-sleeve under the object-stage; at other times this sleeve may contain diaphragm-holders; it is provided with a lever arrangement for convenient elevation and depression. The rotation movement of the nicol is controlled by a screw working in a slot. Over the polarizer a double condenser is placed for axial images. The polarizer can be exchanged for a cylindrical mounting provided with three diaphragms of various diameters. A Bertrand lens for the magnification of axial images can be used with the ocular, and is slipped into the tube from above into the position of the diaphragm of the draw-out tube. The oculars are all provided with cross-threads, and specially designed for polarizing work; a screw engages in a notch in the tube and so fixes the direction of the cross-threads, this direction being rendered visible by a mark on the outer rim of the mount. Other marks are placed on the side of the ocular at angles of 45° to the cross-threads in order to reveal the direction of minimum elasticity in the application of the gypsum plate. The illustration shows the objective and condenser, fitted with Weinschenk's pliers, which hold the lens firmly to the tube, and yet allow a rapid and easy exchange.

Voinow, D. N.—**Principii de Microscopie.** Bucaresci (Göbl), 1901, 8vo, 271 pp.

(2) Eye-pieces and Objectives.

Hastings Apochromat.*—A. A. Adee, after testing the 5 mm. apochromatic objective designed by Prof. Hastings of Yale University, speaks very highly of its performances in difficult photomicrography. He finds it superior in working quality to any apochromatic lens he has yet tried, except the Zeiss apochromat of 4 mm.; and, as regards that, the Hastings lens holds its own in photomicrography. The

* Journ. App. Micr., 1901, pp. 1442 and 3.

correction for actinic rays is surprisingly good, so that exquisite definition is obtainable, even with a projection ocular No. 4. Notwithstanding the extremely wide aperture, the field is perfectly flat, so that perfect photographic definition is obtained at the edges of a large circle on the focussing screen. The lens can take an unusual quantity of light, and the condenser and diaphragm can be opened at least 40 p.c. more than with other lenses, and excellent photographic results still be obtained.

Magnifiers.*—J. Dearness, of London, Canada, finds that many students are incapable of getting the best results out of the simple Microscope. Instead of a folding lens or tripod he uses, in his classes, a watchmaker's glass with two lenses. The lens on the tip may be removed, thereby rendering the remaining lens lighter to hold in the eye, while at the same time giving sufficient amplification for most work. The great advantage of this magnifier is that both hands are free; but the objection is that many students are unable to retain the magnifier by the eyebrow. He has therefore had a detachable heavy watch-spring added to the mounting. This spring goes round the head and, when properly adjusted, holds the lens comfortably in a suitable position. Even those who can use the lens in the ordinary way, find the necessary fatigue minimised by this device. As the spring is detachable the glass can be carried in the pocket, and used for simple hand magnification if desired.

Hénocque.—Oculaire spectroscopique destiné aux études de micro-spectroscopie. *Comptes Rend. Soc. de Biol.*, LII. (1901) No. 37, p. 1009.

(3) Illuminating and other Apparatus.

Lens for Dark-Ground Illumination.—Messrs. Ross have added to their list a new simple lens for dark-ground illumination. It consists of a meniscus lens bored through the centre to receive a spot turned out of vulcanite, and having a stem to drop into the hole in the centre of the lens. A most perfect dark ground with the object brilliantly illuminated is obtained. It can be fitted to any Microscope.

Albrecht's Objective-Carriers.†—This piece of auxiliary apparatus is adapted for receiving any desired number of objectives, which it sets rapidly and accurately in their proper optical positions; it also effects any easy interchange among the objectives, and securely protects them from dust. Fig. 44 gives a section, and fig. 45 a plan seen from above. The apparatus consists essentially of a broad ring *a*, in reality, the circular section of a hollow cone, and by means of a collar *b*, with bayonet clutch *c*, it is fastened under the tube *d*, and can be easily removed. This ring *a* is immovable, and is provided under *d* with an opening which forms a continuation of the tube. An arm *f* of the collar *b* supports the ring at its centre. On its under side *a* possesses a concentric dovetailed groove which a ring *g* engages pushwise; this ring is on its inner side also provided with a dove-tailed tenon. The hollow part of the ring *a* is provided, at the proper place, for receiving an objective

* Journ. App. Micr., 1901, pp. 1448–9.
† Central-Zeit. f. Opt. u. Mech., xxiii. (1902) p. 2 (2 figs.).

with two cross-walls forming a species of shaft open on top. In the dovetailed grooves set in these shafts are situated the special objective-

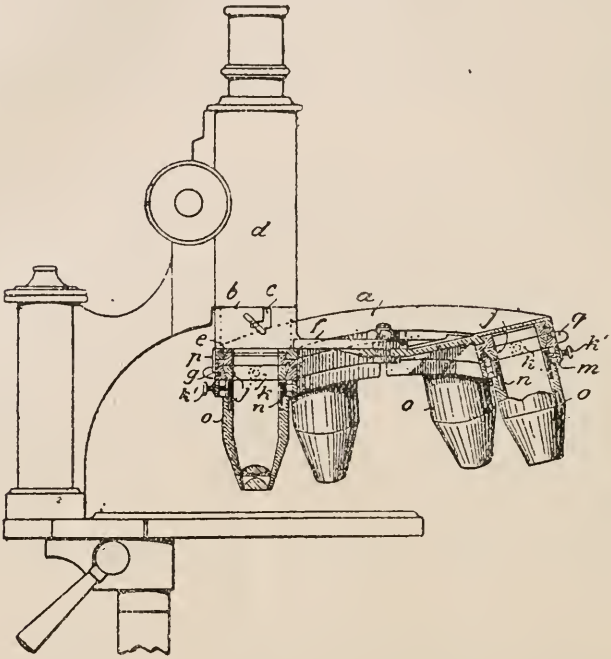

Fig. 44.

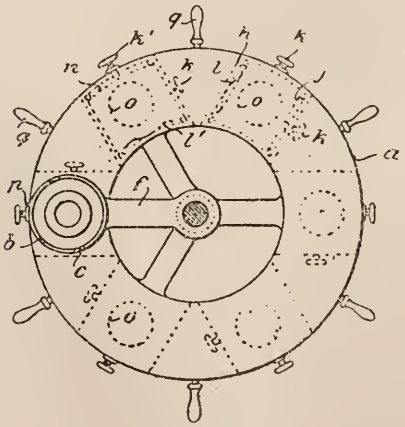

Fig. 45.

carriers *j*, in such a manner that the space between the shafts serves as free room for adjusting the carriers. This adjustment is conveniently

done by a set-screw *k*, on the one side, and a spring *l* on the other. On the under side the carriers *j* form bars *m*, of the breadth of the ring *g*, to which they are closely applied while, sideways, they somewhat project beyond the partitions *h*, so that no dust can penetrate into the objectives between these walls and the carriers.

In use, the ring *g* is pushed round until the desired objective is under the tube *d*. When this occurs, a spring automatically snaps and holds the objective rigidly in its place. Any adjustment required is easily done by the set-screws *k*, *k*. The rotation of *g* is to be done by means of the little handles *q*, in order to avoid any possible disturbance of the centring of the objectives. To prevent entrance of dust during an exchange of oculars, the ring *g* is rotated so that one of the inter-shaft spaces comes under the tube *d*.

Microscopist's Electrical Lamp. * — Fig. 46 represents this lamp about half size, as devised by T. Tammes. The light source is an

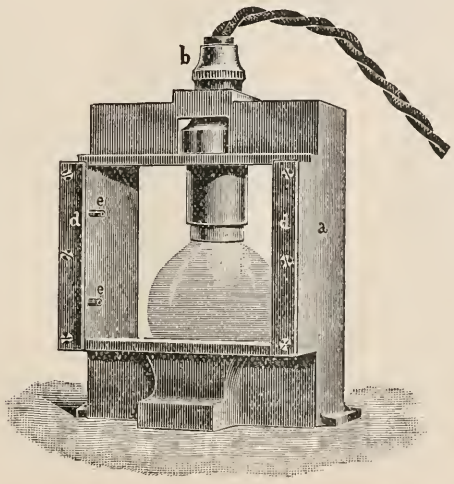

Fig. 46.

almost spherical electric incandescent lamp of about 4 cm. diameter. It is made of 5 or 10 candle-power, the first sufficing for ordinary purposes. The carbon filament is wound several more times than is usual, and when in use the planes of the coils should be perpendicular to the observer. In the figure the thread is not visible as the glass is ground. The frame is of cast iron, and of such a height as to just fit between the foot and stage of an ordinary Microscope. The lamp can thus be brought close to the mirror. The sides so enclose it that an operator is confined to his own lamp, and not affected by that of an adjoining observer. The open back reduces inconvenience from excess of heat. The open front permits of the insertion from above of coloured screens.

* Zeitschr. f. wiss. Mikr., xviii. (1902) pp. 280–5 (1 fig.).

The ground glass of the lamp is of a kind not to absorb much light, and yet of a fine grain. The 5-candle lamp suffices for magnifications of 500 to 600 diameters; the 10-candle for immersion systems. The electromotive force recommended by the inventor is 105 volts.

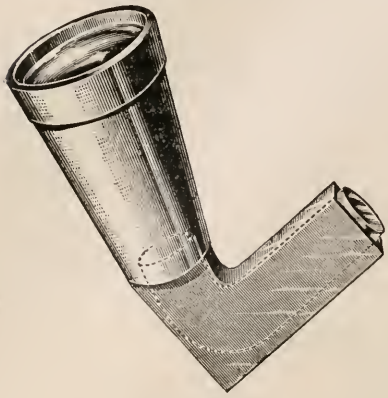

Fig. 47.

Glass-rod Substage.*—F. W. Leggett has found that a glass rod gives a fine illumination with $\frac{1}{6}$ objective and No. 3 eye-piece. The rod consists of Bohemian glass $\frac{1}{2}$ in. diameter, $3\frac{1}{4}$ in. long, bent at an angle and polished at both ends; this is incased in metal, the inner surface of which is polished. Attached to the end toward the light there is a funnel $3\frac{1}{2}$ in. long, expanding from $\frac{1}{2}$ in. to $1\frac{3}{4}$ in. in diameter and highly polished in its interior. At the end near the light is inserted an ordinary bull's-eye lens, so placed that the rays of light pass through the rod to the object on the stage of the Microscope. Should the light be too intense for low powers, it can be modified by removing the bull's-eye condenser.

(4) Photomicrography.

Photomicrography.†—D. W. Dennis, in the first of a series of articles on this subject, gives in the following words his opinion regarding the choice of apparatus.

"One reason why photomicrography has not hitherto succeeded better is that a cheap apparatus, scraped together from a microscopic and a photographic outfit, has been recommended. This cheap apparatus was always the most expensive to be had, for the reason that the time consumed in getting ready for, and making, a successful exposure costs, in the end, more than the investment for a correct outfit. In the second place the results, for reasons above given, were never valuable except in the case of slides so perfectly prepared that they had to be the best of an expert microscopist's work. I, again and again, concluded, while using these makeshifts, that histological slides could not be successfully photographed. I thought photomicrography was an art, the usefulness of which was confined to the resolving of lines on diatoms, and reproducing the silhouettes of bacteria so prepared that the contrast was sharp and the field flat. The cheap way to make successful photomicrographs is to have a complete apparatus: Microscope, stand, lenses, camera, and illuminating appliances dedicated to this one work, mounted to stay, on tables adapted to the purpose, resting on a floor that cannot be jarred, with a fully equipped dark room immediately at hand." An example of Mr. Dennis's high-power work (× 1500) is given. It represents the

* Journ. New York Micr. Soc., xvi. (1901) pp. 16-7 (1 fig.).
† Journ. App. Micr., 1901, pp. 1399-1403 (6 figs.).

early telophase of mitosis in *Ascaris megalocephala* var. *bivalens*; the polar bodies and the egg-cell wall are seen; the centrosome is divided just below the polar bodies.

A Notable Advance in Colour Photography.*—"It is now possible for a newspaper correspondent in China to take snap-shots in his ordinary camera, fitted with a newly perfected screen, to send the negative to New York, and there have the picture reproduced in all its original colours, the printer having no previous knowledge of the colours themselves."

The preceding quotation is Messrs. Brasseur and Sampolo's own description of their new process in three-colour work. But, in contradistinction to the older methods, only one negative is required, and the exposure is not more than one-tenth to one-sixtieth of a second. All makes of polychrome screens can be used to obtain the negatives, but

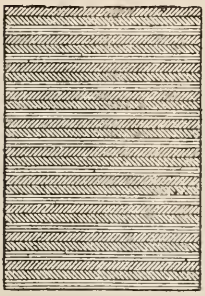

FIG. 48.

Enlarged 53 times. Positive on glass made from original negative; successive groups of coloured lines, each colour repeated every third line.

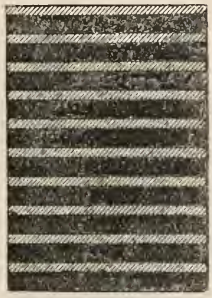

FIG. 49.

Black and white screen placed over positive and showing only one of the positives.

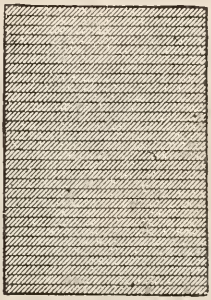

FIG. 50.

Completed negative of one of the images. Entire surface is now occupied by image which on original only occupied one-third.

the best are those ruled in groups of threes, one line being in a reddish-yellow, one in a yellowish-green, and the other in a blue-violet colour. The screens made by Mr. Brasseur have 531 lines per inch, with no mistakes in any inch of more than one fifty-thousandth of that space. When the negative has been obtained a positive on glass must be made. This positive apparently does not differ from ordinary positives; but when examined under the Microscope it is found to consist of three interwoven images corresponding with the three sets of lines of the taking screen (fig. 48). Suitable printing plates must now be made from each one of these interwoven images. This is done by placing over the positive a black and white screen ruled in such a way that each black stripe exactly corresponds to two adjacent stripes, and each

* Annual Report of Smithsonian Institution, 1900, pp. 523-6 (5 figs. and 1 coloured plate; and The World's Work, Dec. 1900.

white stripe to one stripe of fig. 48. Thus all the stripes corresponding to one colour of fig. 48 are exposed, say the yellow (fig. 49). A half-tone negative is made of this, and during the exposure the most important step occurs: the negative plate is moved continuously until the image which occupied the one-third of the plate occupies the entire surface (fig. 50). This is essential, as in order to obtain the proper colours the prints must be superposed, and not juxtaposed as in the original positive. The screen is now shifted the width of one line, covering up the image of which a printing plate has been made, and exposing a new image, say the red one. A plate is made of this one, and the operation repeated for the third image, the blue one. A set of photographs of a tiger are given to illustrate the different stages of the process. The final result is very lifelike.

Dennis' High-power Photomicrography.*—Fig. 51 shows D. W. Dennis' arrangement of the 1899 Zeiss apparatus, which was placed on

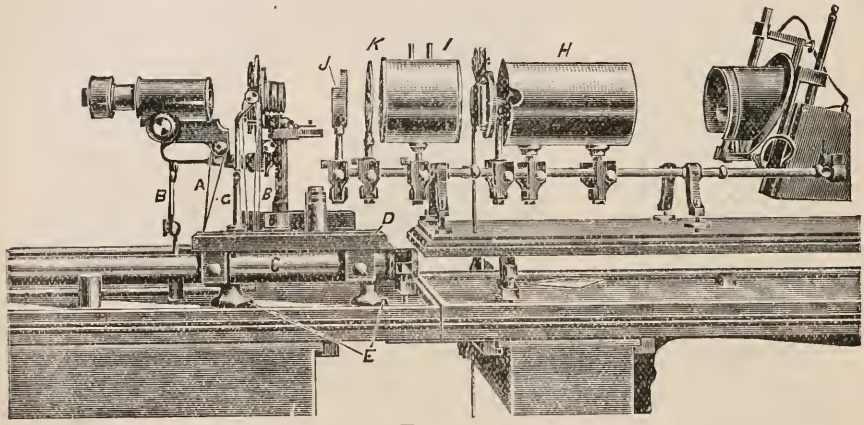

FIG. 51.

an unshakable stone floor, and consisted of two tables supported on adjustable metal legs, the combined length being 10½ feet. One table, 4 ft. long, carries the arc light and illuminating accessories; the other carries the Microscope and camera. The objectives are apochromatic, from 70 mm. to 2 mm., with compensating and projecting eye-pieces. The fine adjustment screw is controlled by a brass rod, which lies on the bench under the camera, and has a pulley and cord attachment A, with the milled head of the micrometer screw. The Microscope is so supported by an adjustable brass pillar B, that this pulley cannot in the least affect it. The camera is carried on two nickeled steel tubes C, which rest on adjustable metal supports, and the board D, on which the Microscope rests, is bound also by clamps to these same tubes. Four strong adjustable pillars E hold the board firmly at one distance from the table. The total effect of these arrangements is to make the Microscope and its supports immovable.

* Journ. App. Micr., Nov. 1901, pp. 1525-7 (3 figs.).

The movable stage is also controlled from the ground glass 6 ft. away by brass rods with milled heads and cord and pulley attachment, and the stage is supported against the strain of these by an adjustable brass pillar G. The stage can thus easily and quickly be searched over a space $\frac{3}{8}$ in. square. The coarse adjustment of the Microscope is similarly controlled.

The adjustable pillar B, under the Microscope, to offset the pull of the cord on the fine adjustment screw, was specially added by Mr. Dennis, and seems to suggest that the Zeiss model in its original form was not sufficiently steady for very high powers. Mr. Dennis has also added the controlling arrangements of the coarse adjustment, the stage, the adjustable pillars under the Microscope bench, and the adjustable pillar under the stage. He has, moreover, placed scales on both the camera table and the optical bench, so that all parts of the apparatus can be quickly brought into any desired relationship.

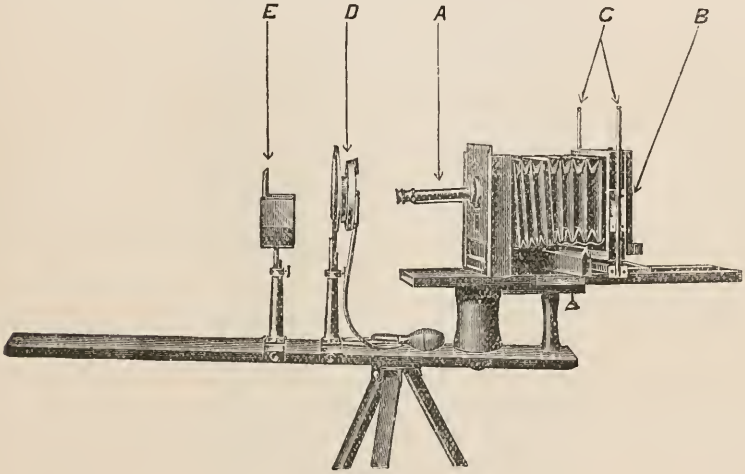

Fig. 52.

Colour Photomicrography.* — F. L. Richardson makes some contributions to our knowledge of this subject. He considers that, of the plates now in use, the orthochromatic approaches most nearly the ideal colour plate, but that this is not perfectly satisfactory, as it does not give sufficient contrast. He therefore undertook some investigations to determine the relative merit of various photographic plates. The apparatus, as illustrated in fig. 52, consisted of a direct vision spectroscope, so mounted in the front board of an ordinary camera (with lenses removed) that the spectrum, when projected on the plate, would come in the centre horizontally and at the top of the plate. The back of the camera was constructed in such a manner as to allow of its being moved

* Journ. Boston Soc. Med. Sci., 5, pp. 460-4; and Journ. App. Micr., 1901, pp. 1489-92 (3 figs.).

in the vertical plane; thus four exposures could be made on the same plate, and therefore an accurate comparison was possible between them. In the figure A is the spectroscope; B the back of the camera, carrying screen and plate-holder; C, supports upon which the back B may be moved; D, shutter; E, colour-screen in colour-screen-holder. The plates examined were grouped, according to their degree of perfection, as follows:—

Group i.—Characterised by a very high degree of sensitiveness, a little above the line D, falling off abruptly on either end, and only slightly sensitive to greens and blues.

Group ii.—Characterised by two distinct maxima, one a little above the D line, and the other in the blue-green. Between these two maxima the sensitiveness falls very considerably.

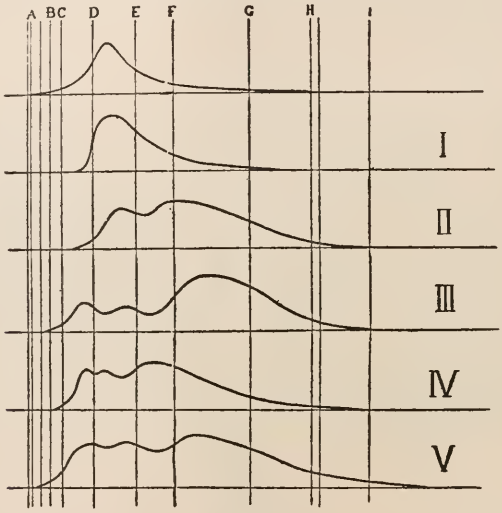

Fig. 53.

Group iii.—Characterised by having its maximum sensitiveness in the blue (as with ordinary plates), with lesser bands of sensitiveness extending below the D line.

Group iv.—Characterised by bands of sensitiveness extending below line D, with greatest intensity in the yellow-green, and falling off at the violet end before H_2.

Group v.—This group most nearly approaches perfection. It is characterised by a sensitive band well below line D, and somewhat below the red end of Groups iii. and iv. This plate gives an almost uniform degree of sensitiveness with a maximum intensity in the green.

In fig. 53 the upper curve shows the visual intensity of the spectrum (from Fraunhofer). Curves i.–v. represent the photographic intensity of the spectrum taken on plates corresponding to the groups of the same number. Group i., Cramer isochromatic (slow); Group ii., the

standard orthochromatic (slow); Forbes orthochromatic (slow); Carbutt orthochromatic (slow); Otto Perutz; Group iii., Lovell colour-differentiating; American spectrum plate. Group iv., Cadett and Neal spectrum plate (slow); Group v., International "Erethro."

If sensitiveness to the spectrum were the only feature to be considered in the selection of a plate for photomicrographic work, a plate from Group v. would be chosen, but the general working of the plate as well as the keeping qualities are factors that must be considered. For practical work and keeping qualities the author found the Cadett and Neal special slow spectrum plate of Group iv. most satisfactory, and used it in the preparation of the spectrographs illustrated in fig. 54, which is a reproduction of spectrographic analysis of some of the common

Fig. 54.

stains. The red end of the spectrum is on the left. The principal Fraunhofer's lines are marked. The name of the stain is on the left, while on the right is the name of the proper screen for increasing the photographic intensity. To decrease the contrast, a screen of the same colour should be used; to increase the photographic intensity a screen of complementary colour should be used. The colour screens were made by soaking a cleared lantern-slide in a solution of the desired stain until the gelatin was saturated, and then by rinsing and removing the surface liquid with a cotton pad. The screen was then dried and covered with a cover-glass, as in mounting a lantern slide. The depth of colour in these screens is dependent upon the degree of concentration of the staining solution rather than upon the duration of soaking.

Stringer's Focussing Attachments to Photomicrographic Cameras.* Among the various methods invented for making an effective connection between the Microscope fine adjustment and the long rod from the end of the camera, the favourite has been an endless band passing round the milled head of the Microscope and round a similar head attached to the camera-rod. The arrangement has, however, possessed the drawback of not being readily detached from the Microscope. E. B. Stringer's method of overcoming this is shown in fig. 55, which shows an adjustable roller to keep the cord taut. The usual milled head of the camera-rod, around which the cord is passed, is mounted on a frame, the lower portion of which fits into a sleeve A, and permits the rod on which the milled head is carried to be tilted forward, when the band is to encircle the fine adjustment head, or to be removed; the band is then made taut by setting the fitting vertical again, a clamping screw B being provided for securing it. The long camera-rod then engages with it.

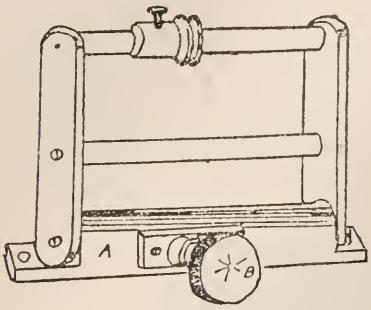

Fig. 55.

Simple Means of Producing Microphotographs with an ordinary Camera.†—Mr. W. Forgan describes how, with a simple accessory to an ordinary camera, small photographs of large objects may be obtained. The camera should have a rigid front, and that portion carrying the dark slide should be capable of being fixed rigidly in the position it is to occupy while the photograph is being taken. The old form of box camera would seem the very best for the purpose. The flange in the camera front, used along with the accessory referred to, was that taking the Ross portable Symmetrical and other lenses having the same size of screw. Into this flange there was screwed a thick drawn tube, as large as the aperture would allow, and on its outside was soldered a ring, screwed to take the screw in the flange. The tube entered inside the flange about 2 in. and was sprung at the end inside with cuts resembling the letter T placed horizontally. The other end of this tube or jacket was cut with an inside screw of 50 threads to the inch. Another piece of telescope drawn tube was selected about 6 in. long and made to slide easily in this jacket. A ring about $\frac{1}{4}$ in. broad was soldered outside within an inch from the other end of this last tube, and was also cut with a screw of 50 threads to the inch, so that, when this tube was placed inside the jacket and turned round, it could be made to approach or recede from the sensitive plate in the dark slide by a very minute quantity. To enable this to be done easily a large ring, knurled on the edge, was soldered on to the extreme outer end of the tube. The effect of the whole arrangement was that the tube could be rotated without the least apparent movement of the image on

* Knowledge, Dec. 1901, p. 285 (1 fig.).
† Proc. Scot. Micr. Soc., iii. (1901) pp. 79-82.

the screen during focussing. The inner end of the inside tube had the universal Microscope screw to take the object-glasses used, which were the 75 and 35 mm. of Zeiss. A single dark slide was employed, and a carrier made to fit it having an aperture in the centre to take plates the size of a twelfth of a quarter plate. One of these small plates was emery ground on one side and used for rough focussing. Another was marginally ground leaving a clear space of about $\frac{1}{2}$ in. square in the centre, and this was evenly smeared with thin virgin wax. This was the fine focussing screen. The negatives to be copied were quarter plates, illuminated by a 4-in. condenser placed immediately behind them, and in almost close contact with them, their distance from the camera being regulated by the size of the microphotograph desired with each object-glass used. An ordinary paraffin lamp was the source of light. It will be seen that no focussing screen on a separate frame was used, the focussing glass being carried in the dark slide itself, and removed each time the sensitive plate was put in, thus preserving the perfect register obtained.

Hinterberger, Hugo.—**Ueber Mikrophotographie.**
[An interesting lecture to the Vienna Camera Club. Describes the various methods, and gives several good examples of photomicrography.]
Published as a pamphlet from the *Wiener Photographische Blätter*, 8 pp. and 6 figs.

„ „ **Einiges aus der mikrophotographischen Praxis mit Zeiss' grossem Instrumentarium.**
[A pamphlet of 6 pp. and 1 fig., detailing the method of using the instrument—apparently intended mainly for his laboratory students.]

„ „ **Eine Notiz über mikrophotographische Aufnahmen von Insektenpräparaten.**
[A practical pamphlet of 4 pp. and 4 pls. on the proper preparation and treatment of insect specimens for photomicrography.]
Published as a tract from the *Photographischen Centralblatt* (Callwey), München.

„ „ **Versuch der farbenrichtigen Reproduction eines doppelfarbigen mikroskopischen Präparates nach zwei mit den gewöhnlichen Hilfsmitteln der Mikrophotographie hergestellten Aufnahmen.** (Investigation of the reproduction in proper colours of a doubly stained microscopical preparation with the ordinary accessories of photomicrography after two suitable exposures.)
Camera Lucida, 1901, 8vo, H. 24, 3 pp. and 1 pl.

Mittheilungen aus dem photographischen Privat-Laboratorium des Universitäts-Lehrers Hugo Hinterberger in Wien.
[A Report of the work for 1901, mainly in the department of photomicrography.] Wien, January 1902.

M'Clung, C. E.—**Laboratory Photography. High-power Photomicrography.**
Journ. App. Micr., IV. (1901) p. 305.

„ „ **Photomicrographic Apparatus.** Tom. cit., p. 1199.

Penny, R. G.—**Photomicrographic Apparatus.** *Amer. Mon. Micr. J.*, 1900, p. 310.

(5) Microscopical Optics and Manipulation.

Strehl, Dr. Karl.—**Bericht über optische Fortschritte.** (Review of progress in Optics.) *Central-Zeit. f. Opt. u. Mech.*, XXIII. (1902) p. 1.

(6) Miscellaneous.

The New Spectrum.* — Dr. S. P. Langley has now thoroughly mapped out the infra-red spectrum. As far back as 1884 he had ascer-

* Annual Report of Smithsonian Institute, 1900, pp. 683-92 (1 pl.).

tained that this invisible part of the solar spectrum extended as far as a wave-length of 5·3 μ. But with the bolometer then in use, delicate though it was, the mapping out would have involved a labour of fifty years. He has since then succeeded in increasing the sensibility of the instrument from the detection of a temperature variation of one-thousandth of a degree Centigrade to that of one hundred-millionth of a degree. He has also connected it with a self-recording photographic apparatus of extreme precision. By these methods he has six series of observations which differ inappreciably from their mean, and the spectrum is found to contain over 700 lines.

Tape Measure for Adjustment of Projection Oculars.* — Dr. A. Köhler, in order to minimise the difficulties connected with the adjustment of projection eye-pieces, has devised a rearrangement of the scale on the oculars. If the index stands on the zero then the front focus of the projection system lies in the plane of the ocular diaphragm; if the index is set on another figure then the focus is pushed a corresponding number of millimetres behind the diaphragm plane.

In order to conveniently adjust the ocular head for any desired projection distance (within its due limits) a specially marked tape measure is used. One side of this measure is blue and marked with the figure P_2; it is intended for oculars 2 and 3. The other side is red, marked P_4, and intended for oculars 4 and 6. The tape is divided into divisions corresponding to the graduations on the oculars. In using the tape the operator brings the first graduation into the plane of the screen, measures towards the ocular, and discovers at what interval the plane of the ocular-division will lie; the figure, found there, gives the number of millimetres by which the ocular head must be screwed out in order to throw, at the required distance, an image of the diaphragm on the screen.

Details are given of the method by which the calculation of the scales on the tape was made.

Some Evidences of Unscientific Conservatism in the Construction of Microscopes.†—The Rev. G. C. F. Haas, whilst fully admitting the immense improvements of the last half century in the construction of Microscopes, points out that many objectionable features seem to be retained in various types of instruments simply from the makers' disinclination to adopt a change. He thus severely criticises the horse-shoe foot, the want of an inclination joint, small stages, stage-clips, immovable mirror-bars, non-parfocal eye-pieces, &c. There is a Society screw; why then not one, or at most two, diameters of tube and substage ring? Why have we a dozen or more different tube-lengths instead of one short and one long one; both measured in the same way? When shall we have adjustable objectives marked in a rational manner, instead of being engraved with a series of numbers that have no relation whatsoever to thickness of cover-glass or to tube-length, and only serve as a continual puzzle to the memory?

Images of Diatom Structure.‡ — W. Balfour Stokes discusses the "white dot" and "black dot" images and concludes that *Pleurosigma*

* Zeitschr. wiss. Mikr., xviii. (1902) pp. 273-9 (3 figs.).
† New York Micr. Soc., xv. (1900) pp. 2–6.
‡ Journ. Quek. Micr. Club, 1901, pp. 109–12.

formosum, in which with an axial cone the black dot image occurs above the white dot (the reverse of the usual order), is structurally peculiar. He suggests that the minute perforations in this diatom are silted up with silica, and that what has been taken for special structure, as seen in the black dot image, is really irregular openings in the siliceous material.

Double-Image Discs and Complementary Interference Colours.*— J. Rheinberg, by placing a disc above the objective, obtains two images of the same diatom in complementary colours. The disc is prism-shaped, but a circular central portion has plane parallel sides. The effect is to produce a direct dioptric image and a diffraction image of the first order. When the dioptric image of a diatom shows colour due to interference, the diffraction image shows the complementary colour.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

New Method for Isolating the Typhoid Bacillus from Water.‡— G. Vallet takes a large quantity of water and treats it with lead nitrate. The precipitate which carries down the bacteria is dissolved in sodium hyposulphite and is then submitted to bacteriological examination. Another method is to precipitate with alum or with barium nitrate. For example, 200 ccm. of water to be tested is treated with 25 ccm. of either precipitate. In 1 to 2 hours a deposit containing the bacteria is formed.

A still better method is a combination of mechanical and chemical precipitation: centrifuge tubes of 20 ccm. content receive 4 drops of saturated sodium hyposulphite solution and 4 drops of saturated barium nitrate solution, both sterilised. After centrifuging for 3–4 minutes (3000 turns) the clear fluid is decanted off, and to the sediment is added, drop by drop, hyposulphite until it is dissolved. The dissolved precipitate is then distributed over Elsner's gelatin plates. After 3 or 4 days the differentiation may be begun, and for this litmus-lactose-agar is recommended. Instead of this, lactose-bouillon may be used. The coagulation or non-coagulation of milk should be tried and also the agglutination test.

Cultivation of the Leprosy Bacillus.§ — W. J. Kedrowski successfully cultivated the microbe of leprosy from three cases; the bacilli thus obtained, however, were less resistant to acid than the leprous organisms in the human tissues. The nutrient media used were meat-pepton-bouillon and agar mixed with aqueous extract of human placenta filtered through a Chamberland bougie. The media were inoculated with blood and also with pieces of leprous skin. By the second or third day there was a luxuriant growth in both the solid and liquid media. On gelatin the

* Journ. Quek. Micr. Club, 1901, pp. 151–2 (1 fig.).

† 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.

‡ Arch. Méd. expér. et d'Anat. pathol., 1901.

§ Zeitschr. f. Hygiene u. Infekt., xxxvii. p. 52. See Centralbl. Bakt., 1te Abt., Ref., xxxi. (1902) p. 90.

growth was scanty and the medium was not liquefied. On egg-yelk and blood the growth was very good, but the bacilli were very short and resembled diplococci. On other media the bacilli were like those found in the living body, being slightly bent, one end often thicker than the other, and undoubtedly motile.

Medium for Isolating Bacillus Typhosus in presence of Bacillus coli communis.*—R. Cambier uses a freshly made bouillon prepared by mixing cold 50 ccm. of a 3 p.c. pepton solution, 4–6 ccm. of 1 p.c. soda, and 4–6 ccm. of sea salt, all sterilised at 115°. With this nutrient medium and the bougie method he has been able to isolate in pure culture the typhoid bacillus from a liquid consisting of equal parts of coli and typhoid bouillon cultures, and under even more difficult conditions. The method appears to be specially adapted for seeking the typhoid bacillus in stools.

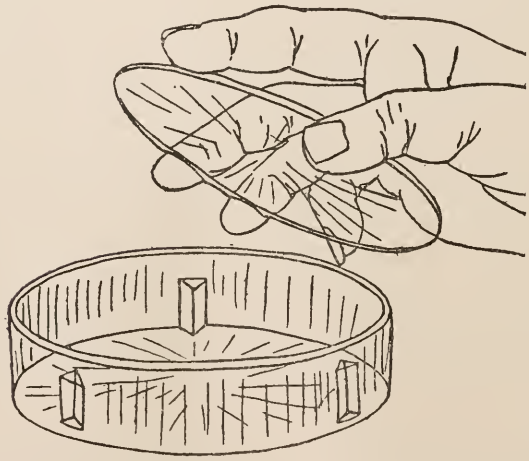

Fig. 56.

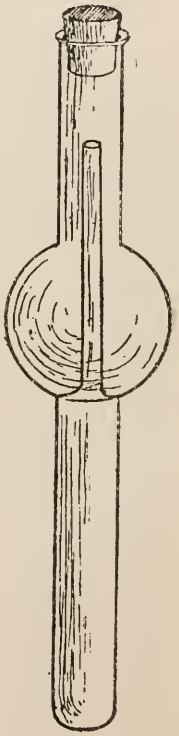

Fig. 57.

Apparatus for Anaerobic Cultures.†—R. Turró claims that his simple apparatus is an improvement on its predecessors for isolating anaerobic bacteria. It consists (fig. 56) of a glass pan on the inside of which are fixed three angular pieces of glass. These serve to support a round plate or

* Comptes Rendus, cxxxiii. (1901) pp. 1226–9.
† Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 175–6 (2 figs.).

disk. On this disk plates of air-free agar or gelatin are made and are then inoculated with properly diluted cultures or fluids containing bacteria. On the bottom of the pan are placed pyrogallic acid solution and a piece of caustic alkali. The plate is then turned over and placed in the dish so that it rests on the three supports. The edge of the disk is then made air-tight with paraffin or wax. The apparatus is then placed in the incubator, and after the necessary time has elapsed the plate is removed and examined in the usual way.

Another apparatus devised by the author obviates two difficulties, viz. the slow withdrawal of the air and the difficulty of direct observation of the culture. It consists (fig. 57) of a flask into the bottom of which is let a tube, the long thin neck of the latter projecting into the broad neck of the flask. The nutrient medium is placed in the lower tube, and in the upper caustic alkali and pyrogallic acid. The neck of the flask is closed with a rubber plug and rendered air-tight with paraffin.

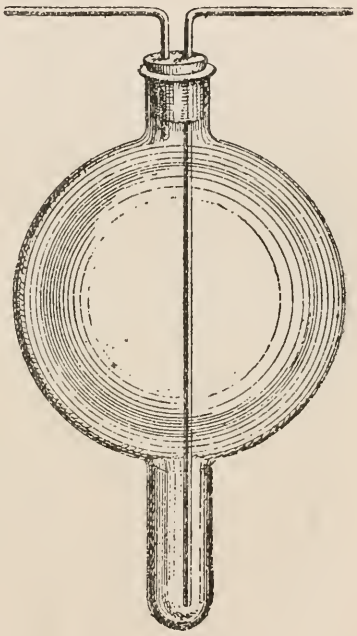

Fig. 58.

Apparatus for Cultivating Anaerobes.*—Bombicci uses an apparatus for cultivating anaerobes, which consists of a flat flask drawn out at the bottom into a flat tube (fig. 58). This receptacle holds about 10 ccm. of nutrient medium, and after inoculation, a caoutchouc stopper with two tubes bent at right angles is inserted. Hydrogen gas is passed through in the usual way for half an hour and then the tubes are closed with sealing-wax, after which the apparatus is placed in the incubator.

(2) Preparing Objects.

Demonstrating the Malaria Parasite.† — Prof. P. Argutinsky fixes the films in sublimate alcohol. 7 grm. of sublimate are dissolved in 100 ccm. of hot 1 p.c. aqueous salt solution, and when the solution is sufficiently cool 100 ccm. of absolute alcohol are added. The films are immersed in the foregoing for from 5–8 minutes and then washed in absolute alcohol, after which they are treated with iodine-alcohol. The iodine-alcohol is prepared by mixing 100 ccm. of absolute alcohol and 2 ccm. of 1 p.c. alcoholic tincture of iodine. In this they remain for 10 minutes and are then transferred to absolute alcohol for 10 minutes, after which they are dried with blotting-paper and stained at once or on some following day.

* Centralbl. Bakt., 1te Abt. Ref., xxxi. (1902) p. 154.

† Arch. f. Mikr. Anat. u. Entwickl., lix. (1901) pp. 319–28 (4 pls. and 107 figs.).

For staining the blood-film, soda-methylen-blue and eosin are exclusively used. The author uses both solutions, freely diluted, without subsequent differentiation and 1 p.c. solutions of soda-methylen-blue and eosin followed by differentiation. The former procedure gives good results for clinical observations, while the latter is more advantageous for the study of nuclear changes.

For the first method the stock solutions consist of (1) 0·1 p.c. eosin solution; (2) 1 p.c. methylen-blue solution, to every 100 ccm. of which are added 6 ccm. of 5 p.c. soda solution; the mixture is then inoculated for 48 hours at 55°–60° C. The eosin solution may be added immediately after removal of the methylen-blue solution from the incubator or at any subsequent period. When required for staining films 3 ccm. of the methylen-blue solution are diluted with 42 ccm. of distilled water and 5 ccm. of the eosin solution with 25 ccm. of distilled water. The eosin is poured slowly into the methylen-blue solution, and the mixture kept stirred the while. The time required for staining is about 15 minutes. On removal the preparations are washed with water, dried with blotting-paper, and mounted in balsam.

In the second method or that followed by differentiation, the methylen-blue solution is the same, but the eosin is a 1 p.c. and they are mixed in the proportion of 5 of the former to 2 of the latter. The staining takes from 3–5 minutes. The overstained films are decolorised and differentiated with the following solution:—120 ccm. of 95 p.c. alcohol, 4–5 drops of acetic acid, and 2 ccm. of aqueous 1 p.c. eosin solution. The time required for differentiating is from 5–15 seconds. The preparations are then washed with water for 1–2 minutes, and having been dried in the usual way, are mounted in balsam. Judging the right moment to cease differentiating requires a little practice and experience. The coloured illustrations are extremely effective.

Examining Blood-plates. — Dr. Deetjen * used films of agar, to which were added small quantities of sodium chloride, metaphosphate of soda, and potassium biphosphate. Some blood from the finger was placed on the agar film, and the preparation examined at once, or after fixation with osmic acid and staining with hæmatoxylin-eosin. By this method it was shown that blood-plates of mammalian blood are nucleated masses of protoplasm, exhibiting amœboid movements.

H. Hirschfeld † fixed blood-films by heat at 110° for 5–30 minutes, and afterwards stained them with eosin-methylen-blue, and also with Delafield's hæmatoxylin. By this method it was demonstrated that blood-plates originated from red corpuscles.

M. C. Dekhuyzen ‡ employed the following methods for examining thrombocytes or blood-plates. For the study of living blood-cells he used physiological salt solutions which were, as far as possible, isotonic with the blood itself, about 0·8 p.c.

For permanent preparations a mixture of osmic and acetic acids and methylen-blue was used for fixing and staining. This mixture (osmacet)

* Virchow's Archiv, clxiv. (1901) pp. 239–63 (1 pl.).

† Tom. cit., pp. 195–211 (1 pl.).

‡ Anat. Anzeig., xix. (1901) pp. 529–40. See Zeitschr. wiss. Mikr., xviii. (1902) pp. 539–41.

consisted of 3 or 9 vols. of 2 p.c. osmic acid and 1 vol. of 6 p.c. acetic acid and 0·125 p.c. methylen-blue. A trace of acid fuchsin imparted some advantage, but it was not indispensable. The 9/1 osmacet cooled with ice is suitable for the demonstration of thrombocytes or blood-plates in mammalian blood. The finger, or ear of rabbit, is pricked through the cold osmacet.

F. Kopsch,* who confirms Deetjen's observations, recommends, as well as the other fixatives previously alluded to, 1–2 p.c. osmic acid, or iodopotassic iodide solution.

P. Argutinsky † points out that it is advantageous to use the Romanowsky-Nocht stain for malaria, as it is excellent for chromatin staining in blood preparations. The films should be fixed in sublimate alcohol, and then stained with the eosin-soda-methylen-blue solution, which gives good pictures of the blood-plates (thrombocytes).

Method of Making Microscopical Preparations for Photographic Purposes.‡ — G. von Wendt communicates the following procedure for making preparations suitable for photomicrography :—(1) Fixation and hardening. The material is cut up into blocks not exceeding 3 mm. thick, and fixed in 3 p.c. nitric acid for 12–20 hours. Nitric acid-alcohol and picric acid are also good fixatives. From the fixative the blocks are transferred to 90 p.c. alcohol for at least 24 hours. (2) Before the blocks are treated with the first mordant they are immersed in ammonia 1 part and 75 p.c. alcohol 10 parts for 6–10 hours at a temperature not exceeding 15° C., and afterwards in 90 p.c. alcohol for about 24 hours. From this they are transferred for 4–6 hours to a mixture of 75 p.c. alcohol 12 parts, hydrochloric acid 1 part, and then again to 90 p.c. alcohol for 24 hours, after which to water for some hours. (3) Mordant A. As mordants, are used 5 p.c. tungstate of ammonium or ammonium molybdate solution. The process lasts about 24 hours, and the temperature should at first be 17°–20° C., but during the last few hours should not exceed 12°–15° C. After this mordanting the preparations are washed in cold water, and then immersed in 90 p.c. alcohol. (4) The blocks are imbedded in paraffin in the usual way. (5) The sections must be smoothed out over warm alcohol and stuck on with Mayer's albumen-glycerin, and then passed through xylol to water in the usual way. (6) Mordant B. After the water has been run off from the slide, the section is flooded with 2 p.c. iron-alum solution. The slide is then placed in a thermostat at 55° for 2–7 minutes. The mordant is then washed off with cold water. (7) Staining. The stain is made from a saturated alcoholic solution of hæmatoxylin by dropping this into distilled water until the mixture is of a yellowish-brown hue. This staining fluid must stand for some time before it can be employed with advantage. It is used by flooding the section, and then incubating the preparation for 10 minutes at 55°. (8) Differentiation. The stained preparations are differentiated in cold iron-alum solution. (9) After which they are washed in water and mounted in balsam in the usual way.

* Tom. cit., pp. 541–51. See Zeitschr. wiss. Mikr., xviii. (1902) p. 541.
† Tom. cit., pp. 552–4. See Zeitschr. wiss. Mikr., xviii. (1902) p. 342.
‡ Zeitschr. wiss. Mikr., xviii. (1902) pp. 293–5.

(4) Staining and Injecting.

Staining Dysenteric Amœbæ.*—Dr. S. Amberg bases the diagnosis of amœbic dysentery on the finding of motile amœbæ containing red corpuscles in the stools. A suitable piece of material is stained with aqueous solution of toluidin-blue, or with methylen-blue and neutral red. The two last may be used in aqueous solution or in substance. With neutral red the erythrocytes are at first of a brassy colour, and finally red. The results with methylen-blue were very similar. The methods are only successful with living amœbæ, and the staining fades out in a few hours. Attempts to preserve the specimens were unsuccessful. The presence of Charcot-Leyden crystals and eosinophilous cells in the fæces was almost constant.

Iron Impregnation of Nerve Fibrillæ.†— Dr. S. Meyer gives the following method for impregnating nerve fibrillæ with iron. Pieces of moderate size are fixed for 24 hours in 10 p.c. formalin solution. They are then transferred for 8–20 days to 2½ p.c. ferrocyanide of potassium, followed by 10 p.c. iron-alum for 2–4 days, after which they are washed for some hours. The subsequent treatment is absolute alcohol 2 days, xylol 2 hours, paraffin 2–4 hours. The sections, 10–60 μ, are stuck on with albumen-glycerin; xylol, balsam. By this the fibrillæ are better stained than by other procedures, and it also has the advantage of not depositing a granular or crystalline precipitate among the stained elements.

Staining Nerve-Fibrillæ of Neurones in Electric Lobes.‡—Shinkishi Hatai fixed the material in 10 p.c. formalin. Then a thin piece was cut from the electric lobe of *Torpedo occidentalis* and immersed in distilled water for about six hours. The material was then removed to 35 p.c. alcohol for about an hour, after which it was carried through graded alcohols and imbedded in paraffin. The sections, about 12 μ thick, were stained with saturated aqueous solution of toluidin-blue and contrast-stained with alcoholic solution of erythrosin. By this procedure the fibrillar arrangement of the cytoplasm was shown.

New Method of Examining Sputum.§—Dr. U. Quensel mixes the sputum to be examined with an equal bulk (or more) of a mixture composed of 1 vol. 25 p.c. formalin and 1 vol. 95 p.c. alcohol. The mixture is shaken up vigorously for 1 or 2 minutes, and is then allowed to sediment or is centrifuged. A small drop of the sediment is then squeezed out between the cover-glasses and the films dried in the air. They may be fixed in the flame, but this step is unnecessary.

The films may be stained with carbol-fuchsin, though the author prefers anilin-water gentian-violet, and after decolorising, contrast-stains with vesuvin or with an aqueous solution of auramin. Instead of the gentian-violet solution, which is somewhat unstable, the following is recommended as it keeps better:—One vol. of saturated solution of crystal violet in 70 p.c. alcohol, 1 vol. of 1 p.c. solution of hydrochloric acid in 70 p.c. alcohol, and 2 vols. anilin-oil-water.

* Johns Hopkins Hosp. Bull., xii. (1901) pp. 355–63.
† Anat. Anzeig., xx. (1902) pp. 535–43.
‡ Journ. Cincinnati Soc. Nat. Hist., xx. (1901) pp. 1–12 (1 pl.).
§ Nord. Med. Arkiv, Afd. ii. xxxiv. (1901) No. 22, pp. 1–3.

Should it be desired to stain both tubercle bacilli and elastic fibres the preparation should be stained with the anilin-gentian solution, decolorised with hydrochloric acid-alcohol, and then stained with Weigert's solution for 20–30 minutes. After this it is again decolorised in hydrochloric acid-alcohol and then stained with auramin. By this method the tubercle bacilli are blue and the elastic fibres grey-blue, both standing out sharply against the yellow background.

Picro-carmin Solutions.*—In connection with radula preparations K. Diederichs gives the following list of picro-carmin solutions, all of which are suitable for staining radulæ.

(1) Ranvier's. A saturated solution of picric acid and a saturated solution of ammoniacal carmin are mixed and evaporated in a water-bath to one-fifth of the previous volume. The carmin precipitate is filtered off when cold. On further evaporation the solid picro-carmin is obtained as a yellowish-red powder, which is dissolved in distilled water and used as a 1 p.c. solution.

(2) Bizzozero's is made by dissolving 0·5 grm. of carmin in 3 ccm. of ammonia and 50 ccm. of water. To this is added, stirring constantly the while, a solution of 0·5 picric acid in 50 grm. water. The fluid is evaporated to half its bulk (50 ccm.) in a water-bath, and when cold 10 ccm. alcohol are added.

(3) Friedlaender's. To 1 part of ammoniacal carmin, 1 part of ammonia, are gradually added 2–4 parts of a saturated solution of picric acid. The mixture is constantly stirred the while, and the picric acid solution is added until it ceases to be dissolved. After filtration a few drops of phenol for every 100 ccm. are added. Subsequent cloudiness is removed by addition of ammonia.

(4) Weigert's. 2 grm. carmin and 4 ccm. of ammonia are mixed, and after 24 hours 200 ccm. of cold saturated aqueous picric acid solution are added. After a further 24 hours acetic acid is added until a precipitate forms. Then the solution is treated with ammonia until it becomes clear.

(5) Hoyer's. 1 grm. of carmin is dissolved in 1–2 ccm. of ammonia and 6–8 ccm. of water, and then the mixture is heated in a sand-bath until the ammonia is driven off. When cold the solution is filtered, and then 4–6 times its bulk of alcohol are added. The precipitate which forms is filtered off, washed and dried, and then dissolved in a strong solution of neutral picrate of ammonia.

(6) Orth's picrolithium-carmin. Lithium-carmin solution 1 part, saturated aqueous solution of picric acid 2 parts.

(7) Blochmann's Lyons-blue borax-carmin. Stain first with borax-carmin and afterwards with aqueous solution of bleu de Lyon with 10 p.c. alcohol (96°). When the sections look blue extract with alcohol.

(8) Orange G alum-carmin. Stain for 24 hours in saturated aqueous solution of orange G, then in Grenacher's alum-carmin for 10 minutes. Wash and treat with alcohol.

(9) Carmin-hæmatoxylin (Fritsch). After dissolving carmin in ammonia the latter is evaporated off. When required for use, a small

* Zeitschr. angew. Mikr., vii. (1901) pp. 30–3.

quantity of the foregoing is mixed with water and then stirred with a glass rod dipped in acetic acid. The solution turns bright red. The sections are immersed therein for 1 hour, after which they may be stained with logwood.

(10) The process may be reversed by first staining with Böhmer's hæmatoxylin and afterwards with neutral carmin.

Rapid Method of Iron-Hæmatoxylin Staining.* — Dr. A. Gurwitsch has for a long time adopted the following procedure which takes about 10 minutes instead of the usual 36 hours. The sections, stuck on by the water or albumen method, are, after the paraffin has been removed and they have been further treated with alcohol and with water, flooded with 2·5 p.c. iron mordant and then placed in the steam of an open water-bath. In this they remain until the mordant begins to bubble or become turbid, when they are washed with water, after which they are treated in a similar way with the hæmatoxylin solution. Although the sections are usually stained effectually with one application a repetition of the stain may be required. Differentiation is carried out at ordinary temperature.

New Method of Staining Elastic Tissue.† — Dr. H. F. Harris has discovered that hæmatein solutions have an affinity for elastic tissue when made in the following way:—hæmatoxylin 0·2 grm., aluminium chloride 0·1 grm, 50 p.c. alcohol 100 ccm. Dissolve the hæmatoxylin and aluminium chloride and heat to boiling, then add slowly 0·6 grm. mercuric oxide. As soon as the mixture turns purple remove from the flame and cool rapidly. The solution is filtered and one drop of hydrochloric acid added. The solution is then set aside for some weeks in order to ripen. When ripe the stain is used by immersing those sections of tissue in it for 5–10 minutes, then washing for about a minute in a 1 p.c. solution of nitric acid in alcohol, after which the sections are cleared and mounted. On account of the close relationship of this stain to Mayer's machæmatein the name of elasthæmatein is suggested. In connection with the present notice a previous paper by the author may be consulted.‡

Differential Staining for Tubercle and Smegma Bacilli.§ — L. Nencki and T. Podczaski state that smegma and tubercle bacilli may be differentiated by treating the acid-decolorised preparations with alcohol and then contrast-staining with methylen-blue. The smegma bacillus is much less resistant to alcohol than the tubercle bacillus.

Platinum Method for the Central Nervous System.‖—The platinum method, says Dr. W. F. Robertson, consists essentially in placing small pieces of formalin-hardened tissue in a mixture of platinum bichloride ($\frac{1}{2}$ p.c.) and formalin (5–20 p.c.) for several weeks or months. Sections are cut by the dextrin freezing method, and mounted in balsam in the usual way. A deposit of platinum-black occurs in the tissues, tending specially to take place in certain elements.

* Zeitschr. wiss. Mikr., xviii. (1902) pp. 291–2. † Tom. cit., pp. 290–1.
‡ Cf. this Journal, 1890, p. 649.
§ Gazeta Lekarska, 1901, No. 45. See Centralbl. Bakt., 1te Abt. Ref., xxxi. (1902) p. 90. ‖ Proc. Scot. Micr. Soc., iii. (1900–1) pp. 122–3 (1 pl.).

New Triple Stain.* — Dr. A. Pappenheim has devised a new triacid stain, the basis of which is Unna's polychrome methylen-blue. It is apparently useful for staining blood-films. It gives three colours, red, blue, yellow, in various shades, and hence has a selective action. The stain is made by Grübler, and can be obtained in aqueous solution or in powder.

Staining the Capsule of Anthrax.†—Räbiger treats air-dried films of anthrax with a solution of 15–20 gentian-violet to 150 formaldehyde, thus simultaneously fixing and staining the preparation. The time required is about 20 seconds, after which the preparation is washed with water and examined.

(6) Miscellaneous.

Microtechnique of Animal Morphology.‡—The second portion § of Prof. S. Apáthy's work on the microtechnique of animal morphology has recently appeared. It contains the sections E, F, G, of which the first deals with methods for more closely appreciating the microscopic pictures of living objects, their measurement, and representation by photomicrography. The second treats of the methods of illuminating preparations by non-polarised light, while section G reviews the methods of illumination with polarised light for biological purposes, and the methods for determining the refractivity of microscopic objects. The facts, which are arranged in chronological sequence, are positively astounding in number, and their mere enumeration tells of the extraordinary labour which the author has bestowed on the work, and the knowledge of the subject exhibited therein.

Distinguishing between Pleurosigma angulatum and balticum under Low Powers.‖ — According to G. Marpmann, *Pleurosigma angulatum* and *Pl. balticum* can be discriminated by low powers and direct illumination, the former being greenish-yellow, the latter yellowish-brown. With dark-ground illumination the valves of *Pl. balticum* pass through blue, green, yellow, to red on the dark blue ground, while the colours of *Pl. angulatum* only come out later. Some of the discoid species exhibit analogous phenomena when examined under similar conditions.

Gelatin as a Substitute for Glass.¶ — G. Schneider mentions, in connection with Pranter's suggestion of gelatin cover-slips, that gelatin capsules, such as are used by chemists, are very convenient for keeping specimens in, and for sending them by post, &c. The tubes are filled with a solution of formalin, or with 70 p.c. alcohol, and after inserting the specimen along with a ticket, are closed with another gelatin tube, which is slipped over it. Several of these tubes may be placed, for preservation or transport, in a large vessel filled with formalin solution

* Deutsch. Med. Wochenschr., No. 46. See Zeitschr. angew. Mikr., vii. (1901) pp. 237–40.

† Zeitschr. f. Fleisch- u. Milchhyg., xi. No. 3. See Centralbl. Bakt., 1te Abt., xxx. (1901) p. 937.

‡ Die Mikrotechnik der thierischen Morphologie, 2nd part, Leipzig, 1901, pp. 321–60. § See this Journal, 1896, p. 690.

‖ Zeitschr. angew. Mikr., vii. (1902) pp. 253–4.

¶ Zeitschr. wiss. Mikr., xviii. (1902) pp. 288–90.

or 70 p.c. alcohol, but too many should not be inserted, as overcrowding distorts and damages the tubes and their contents.

Use of Formaldehyde for Preventing Liquefaction in Glycerin-jelly Mounts. * — Dr. A. Forti states that the chief defects inherent in glycerin-jelly may be obviated by the use of formalin. He uses Kaiser's gelatin; i.e. to 1 part of gelatin dissolved in 6 parts of water are added 6 parts of glycerin; to every 100 grm. of the mixture add ½ grm. of carbolic acid, and heat, stirring the while, until the acid is thoroughly incorporated. The formaldehyde used is the ordinary commercial formalin diluted to 10 p.c. if fresh, to 25 p.c. if old. A piece of the jelly is placed on the slide and warmed, and then a droplet of the formalin solution is thoroughly mixed with it. Then place the specimen in position, and wait until the air-bubbles have risen to the top, when they may be pricked out if they do not spontaneously disappear, after which put on a warmed cover-slip. In this way permanent preparations may be obtained free of air-bubbles, and without requiring the edges to be luted down with some cement.

New Fluid Medium for Preserving Zoological Objects. † — G. Marpmann recommends a solution composed of glycerin 10, chloral hydrate 5, common salt 5, water 80. After the animals are washed they are immersed in the above fluid, which in about a week is replaced by a fresh quantity. The old fluid can be used for the preliminary treatment of other preparations. If the animals be soft, or the specimen contain much blood, it is advisable to add about 5 p.c. of formalin.

Modification of Cornet's Forceps.‡—Dr. Leshure devised a modification of Cornet's cover-glass forceps, which has the advantage of being able to manipulate a slide as well as a slip. The jaws terminate in T-pieces which, being ground on their opposing surfaces, grasp a slip or slide firmly and allow of no sliding motion, the effect being enhanced by extra stiffness of the spring handles.

Preserving Intestinal Worms.§—Barbagallo recommends a 2–3 p.c. solution of formalin in distilled water with ¾ p.c. common salt for preserving worms and other soft animals. The parasites do not shrink, and keep their colour well.

Mounting Fish for Museums. ‖—S. E. Meek describes the method adopted in museums for putting up fish. The procedure consists of 3 parts: (1) preparation and preservation; (2) painting; (3) setting up the glass boxes. The animals are killed with 10 p.c. alcohol and are afterwards preserved in strong alcohol, or fixed first in formalin 1–20 and afterwards transferred to strong spirit. The natural colours are represented by means of water-ground pigments and occasionally some marine blue. Paints containing lead or chrome yellow are unsuitable. The fish are fastened in oblong glass boxes by means of gelatin. For the details of the manipulation the original may be consulted.

* Bull. Soc. Bot. Ital., 1901, pp. 224–6.
† Zeitschr. angew. Mikr., vii. (1901) p. 235.
‡ Med. News N.Y., lxxiv. (1899) p. 556.
§ Berlin Tierärztl. Wochenschr., 1901, No. 36. See Zeitschr. angew. Mikr., vii. (1901) p. 241. ‖ Amer. Naturalist, xxxvi. (1902) pp. 53–61 (1 fig.).

New Injection Syringe for Bacteriological Purposes.*—Dr. F. Inghilleri has invented a syringe (fig. 59) which consists of a glass tube divided by constrictions into three portions A B C. B is the receiver for the fluid to be injected. It may be made of different capacities, is marked with a scale, and ends in a nozzle on which the trocar fits. The expansion C is intended to provide against the fluid being accidentally drawn into the air chamber A, the lower part of which is stuffed with cotton-wool. The piston D works in A. The piston-rod is a hollow

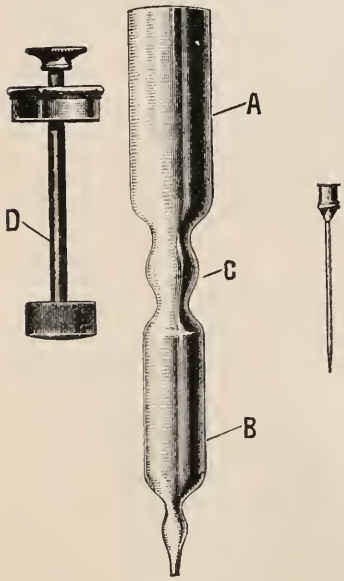

Fig. 59.

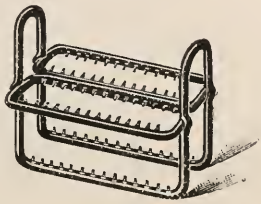

Fig. 60

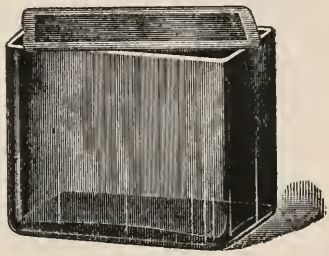

Fig. 61.

tube and its upper end carries a cap over which the thumb is pressed during injection. When the apparatus is to be sterilised the piston is removed and the trocar inserted in A after the lower end has been plugged with cotton-wool. The object of the hollow piston-rod is to allow the plunger to be pushed down if the receiver B does not fill sufficiently.

Stand for Holding Slides.†—K. Holzapfel describes a frame or stand for holding a considerable number of slides. The apparatus is intended for the treatment of paraffin serial sections. It is made of glass and is so constructed that it fits inside a glass jar. The construction and the way it is intended to be used are easily gathered from an inspection of the accompanying illustrations (figs. 60 and 61).

* Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 171–3 (2 figs.).
† Arch. Mikr. Anat. u. Entwickl., lix. (1901) pp. 457–9 (2 figs.).

New Cover-glass Forceps.*—T. J. Davis has invented a forceps for holding cover-glasses whilst staining and decolorising in bacteriological work. The material, which is an alloy used by dentists, possesses con-

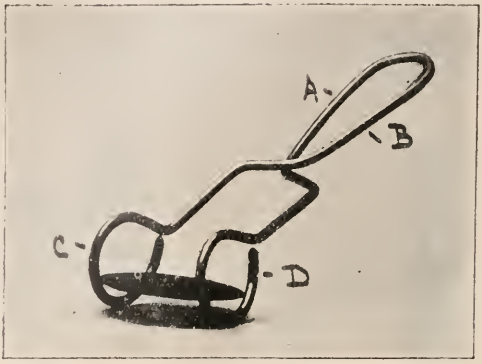

Fig. 62.

siderable elasticity and is not damaged by dilute acids. The shape of the instrument is shown in the illustrations (figs. 62 and 63), and from these it will be seen that when A and B are compressed C and D open to receive the cover-glass, which is then held in position by slight

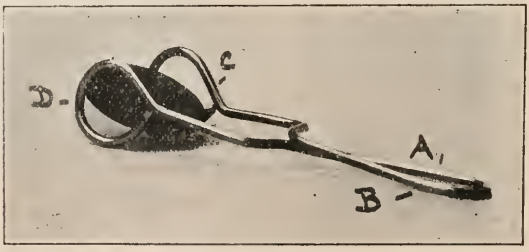

Fig. 63.

pressure on four points of C and D. From the construction of the instrument it is evident that it may be laid down without fear of contaminating the film.

Practical Filtering Apparatus.†—Prof. H. Preisz has devised an apparatus for filtering diphtheria serum and such like fluids. It consists of two parts, the upper being the filter proper and the lower the receptacle. The filter is a Nordtmeyer-Berkefeld bougie, the lip of which (see fig. 64, one-third natural size) is clamped to that of the receptacle, caoutchouc rings intervening to render the joints air-tight.

* Journ. Quek. Micr. Club, viii. (1901) pp. 155–6 (2 figs.).
† Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 173–4 (2 figs.).

The lower portion or receptacle has a funnel-shaped upper end, the tube of which passes through a rubber stopper into the flask. Into the main tube is let a secondary tube bent at right angles, the outlet end of which is connected with an exhaust apparatus. The method of action is easily understandable from the accompanying illustration.

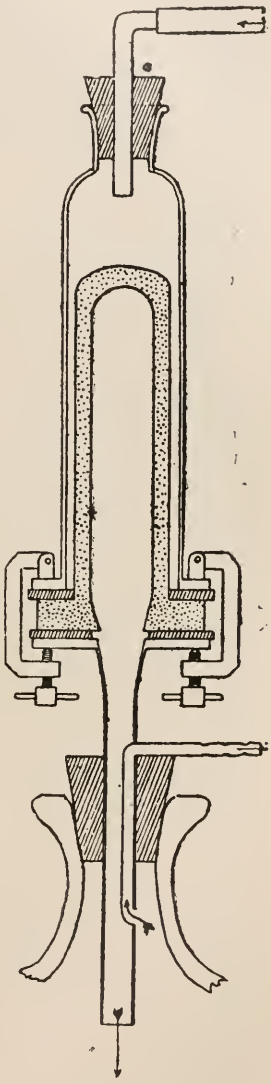

Fig. 64.

Results of Chilling Copper-Tin Alloys.* —Messrs. Heycock and Neville describe their experiments. Their results, which do not lend themselves to abstraction, are illustrated by a series of photomicrographs showing very remarkable changes in the metals under the influence of the treatment.

Crystallisation produced in Solid Metal by Pressure.†—W. Campbell describes the change of micro-structure produced by hammering a button of tin. He found that even the slight pressure exerted in the use of a file affected the structure. Lead, cadmium, and zinc were similarly affected.

Copper-Iron Alloys.‡ — After quoting the results obtained by previous investigators in the formation of copper-iron alloys, J. E. Stead surmises that their discordancies must be due to disregard of the presence or absence of carbon in their irons. He therefore first describes his experiences with copper and commercially pure iron, and concludes, as the result of very many experiments, that:—

(1) Copper and iron alloy in every proportion by direct fusion, and in none of the alloys is there any tendency for the metals to separate into two conjugate liquid layers.

(2) That the complete series of alloys may be classed into three distinct sections:—

A. Alloys with traces to 2·73 p.c. iron and 97·20 p.c. copper.

B. Alloys with between 2·73 p.c. iron and 97·20 p.c. copper, and 92·00 p.c. iron and about 8·00 p.c. copper.

C. Alloys containing between 8·0 p.c. and traces of copper.

In his experiments with a carbon-iron

* Proc. Roy. Soc., lxviii.; Metallographist, v. (1902) pp. 41–52 (7 figs.).
† Metallographist, v. (1902) pp. 57–8 (3 figs.).
‡ Tom. cit., pp. 25–41 (6 figs.); and Iron and Steel Institute, Sept. 1901.

he found that the effect of the carbon was to limit the amount of the copper which could be alloyed with the iron.

Crystalline Structure of Metals. * — The above was the subject of the Bakerian Lecture by Prof. Ewing and Mr. Rosenhain before the Royal Society. The writers dealt with a branch of the subject hitherto somewhat overlooked, viz. the effects of strain. They believe that they have established the fact that the structure of metals is crystalline, even under conditions which might be supposed to destroy crystalline structure. They found that the plastic yielding of metals when severely strained occurs in such a manner that the crystalline structure is preserved. The distinction which is often drawn between crystalline and non-crystalline states in metals appears to be unfounded. The difficulty of obtaining a good surface on the more fusible metals (e.g. lead, zinc, and tin) by polishing was avoided by pouring the molten metal upon glass or polished steel, in contact with which it was allowed to solidify. In the case of lead, another method of obtaining a good surface was also used. A face of the specimen was freshly cut to remove the tarnish, and was then pressed against a smooth surface of plate glass. Whenever a sufficient pressure could be reached without breaking the glass, a very beautiful surface was obtained. In some specimens a quantity of air-bubbles appeared arising from the imprisonment of air between the metal and the glass surface, or arising from air occluded or dissolved in the metal itself. These bubbles always took a geometrical form, and they were of great assistance in elucidating the phenomena. It was found that, although the "grains" (or crystal aggregates) suffered deformation, the individual crystals preserved the same orientation. The effect of strain was in reality to cause a slipping of one grain in whole or in part over another. The effects of such movements were to cause a series, or several series, of lines in the microscopic field, and their true nature was recognised by oblique illumination.

In their second paper † on this subject the authors state that their object was to study the phenomena of annealing. It is well known that prolonged annealing tends to produce large crystals in iron and steel. But even short exposure at a suitable temperature produces complete recrystallisation, and it has been suggested that these changes occur at critical points corresponding to the arrest-points in the cooling of the metal. These arrest-points indicate evolutions of heat, and it is natural to suppose that they are evidences of rearrangement of the structure of the metal. It was hoped that this change could be observed under the Microscope; but, although the experimental difficulties of keeping a specimen under microscopic observation while it was being heated were successfully overcome, the attempt to watch the recrystallisation of iron failed. It was found that it could not be expected to see the process of recrystallisation in any metal where etching, staining, or relief polishing is needed to differentiate the constituents. Attention was therefore turned to more fusible metals, especially lead. With this metal great success was obtained, and it was found that in lead which has been severely strained recrystallisation goes on at all temperatures, from that

* Phil. Trans., cxciii. (1899) pp. 353–75 (14 pls. of 51 microphotos).
† Op. cit., cxcv. (1900) pp. 279–301 (13 pls. of 38 microphotos).

of an ordinary room up to the melting-point. A set of plates illustrates the results obtained. These give a series of views of a single specimen of crushed lead taken at intervals during six months, showing the growth of crystals at the air-temperature, seen under oblique light and magnified 12 diameters. The metal was scored in unsymmetrical shapes, so as to facilitate identification of the same crystals. Great pains were taken to secure a constant direction of the oblique light. The metal was always prepared by etching a piece of ordinary plumbers' lead by dilute nitric acid, and by viewing when wet. The large size of the crystals rendered low powers and oblique light very suitable.

GAGE, SIMON H.—**The Microscope.**
[Includes for the first time the microscopical examination of photomicrography of metallic surfaces.]
8th ed., Comstock Publishing Co., Ithaca, New York.

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Comptes Rend. 13 *Congr. internat. de Med. Sect. d'Hist. et d'Embryol.*, Paris, 1900, p. 145.

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[Gives much attention to metallography.]
Published by Boston Testing Laboratories.

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MALCOLM, J.—**Influence of Stain Solvent on Protoplasmic Staining.**
Proc. Scot. Micr. Soc., III. (1900–1) pp. 76–8.

MASCHKE, O.—**Mikroskopische Studien über die Krystallisation des Gypses.** (Microscopical Studies on the Crystallisation of Gypsum.)
Zeit. f. Krystallogr., XXXIII. (1900) p. 57.

MILROY, T. H.—**Protoplasmic Staining.**
Proc. Scot. Micr. Soc., III. (1900–1) pp. 73–5.

RICHTER, O.—**Mikrochemische Nachweis des Kobalts als Ammonium-Kobaltophosphat.** (Microchemical Determination of Cobalt as Ammonium cobaltophosphate.) *Tschermak's Mineral. u. Petrog. Mittheil.*, XX. (1901) pp. 99–109.

SCHMORL, G.—**Die pathologisch-histologischen Untersuchungsmethoden.** (Pathological and Histological Investigation Methods.)
2nd ed., Leipzig (Vogel), 1901, 8vo, 263 pp.

SMITH, SYDNEY, W.—**The Microstructure of Metals and Alloys.**
[A useful practical paper, mainly dealing with general methods.]
Journ. Quek. Micr. Club, Nov. 1901, pp. 125–30 (1 pl. of 6 figs.).

STREHL, K.—**Ueber Achromasie.**
[Explains the formulæ: specially with reference to telescopes.]
Central-Zeit. f. Opt. u. Mech., XXIII. (Feb. 1902) p. 21.

TEDESCHI, A., & A. ROSSELLI—**A Self-regulating Electric Thermostat.**
Centralbl. Bakt., 1te Abt., XXX. (1901) pp. 969–76 (5 figs.).

WILLIAMS, J. LEON—**Use and Value of the Microscope in Dentistry.**
Journ. Brit. Dental Ass., XXIII. (1902) pp. 1–19 (13 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Two Early Microscopes by Andrew Ross (?)—Mr. E. M. Nelson has sent the following account of the two old Microscopes which Mr. J. C. Webb kindly exhibited at a recent meeting of the Society.

The Microscope shown in fig. 65 is not signed, but we may conclude from the style and finish of the workmanship that it was made by Andrew Ross. It will be noticed that the peculiarly shaped flat tripod foot is precisely similar to that figured by Andrew Pritchard in his *Microscopic Illustrations* (1838), but we know that Microscopes sold by Andrew Pritchard were made by Ross and Powell, both of whom at that time worked for the trade. To this tripod foot is fixed a tubular pillar holding an extension-rod which can be clamped in any position by an ordinary screw-ring; at the top of the rod is a compass-joint to which the limb of the Microscope is attached.

The limb is, in section, an equilateral triangle, the front angle being cut with teeth for stage focussing rackwork; below the stage is a concave mirror. The body is attached to the arm by a screw-clamp, and when a "single" Microscope is required the arm can be turned aside and another arm to hold Wollaston's doublets used in its stead. A fine adjustment is obtained by a direct-acting screw operating on a nose-piece, but without the usual spring; below this nose-piece there is another sprung nose-piece, which is simply a safety device. This separation of the sprung nose-piece from the fine-adjustment screw is a rare form, and at the same time, a very crude idea.

There are two objectives, one a single non-achromatic of the same date as the instrument, the other a French button combination of later date. The eye-piece is Huyghenian with a double eye-lens, a form first introduced by Benjamin Martin and subsequently employed by Coddington. In design this Microscope looks older than it really is, but we know that this kind of solid tripod foot was introduced in 1837, and this probably is the date of the instrument.

The second Microscope (fig. 66), which is smaller, although signed "Carpenter and Westley, Regent Street," was probably made by the same hand and about the same time as the first. The foot, which is a little different in shape, has the same peculiar cut to the front toes; but the instrument differs from the other in having no pillar, the lower end of the limb being attached to the foot by a compass-joint. It, like the

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

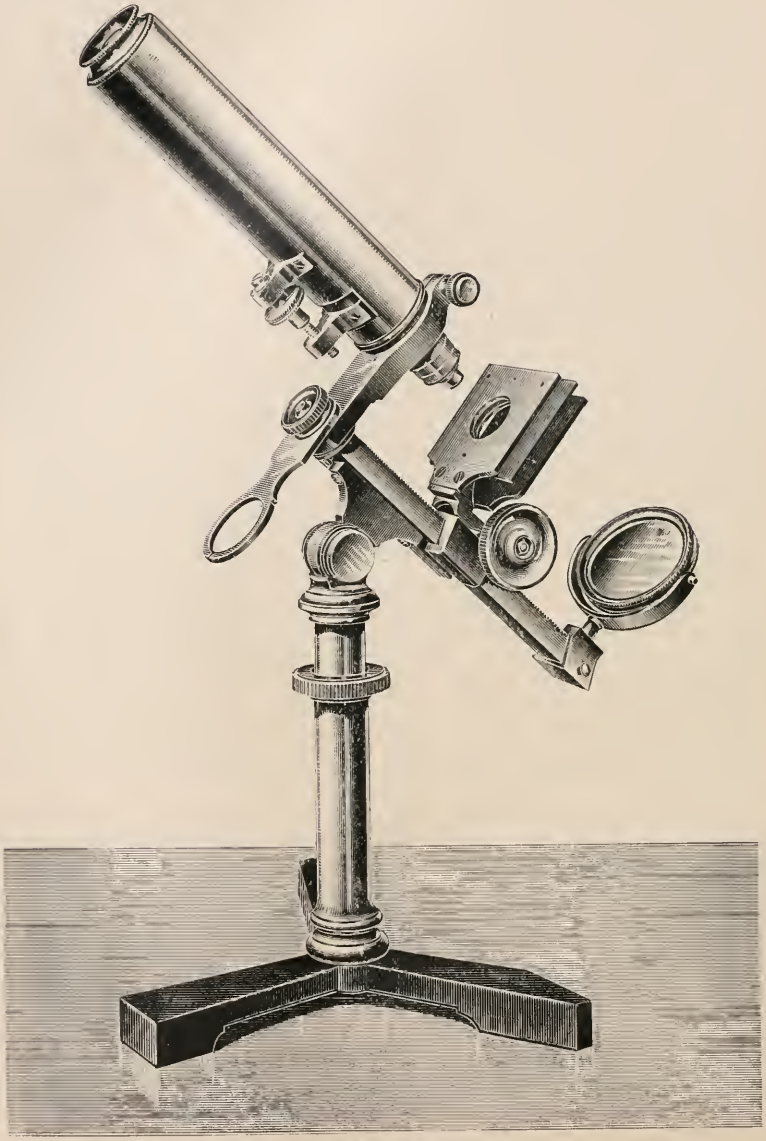


Fig. 65

former, is a stage focusser, and has a concave mirror. Both the objective and the eye-piece are of a much later date.

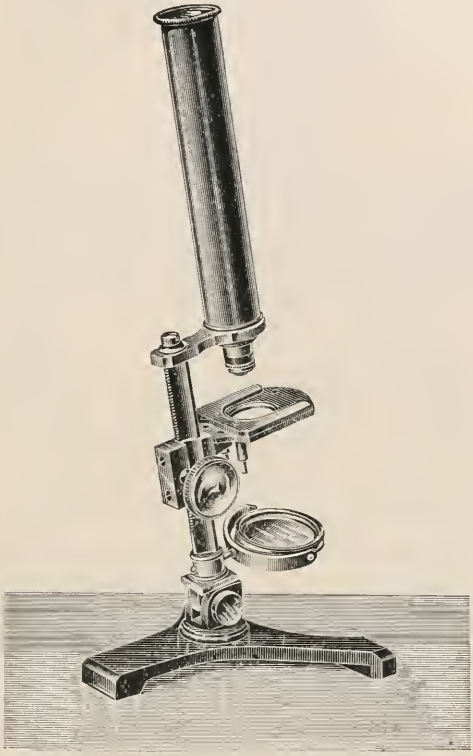


Fig. 66.

Pillischer's "Lenticular Microscope."—Mr. J. Pillischer, of Bond Street, has most kindly presented this very interesting portable, really pocket, Microscope to the Society's Cabinet. It was designed by the late Mr. M. Pillischer, the donor's uncle.

The instrument is figured and described in *Urinary Deposits* by Golding Bird (p. 29, fig. 13, 1857, 5th ed.), but it will be noticed that the figure differs slightly from the original, inasmuch as a second spring to hold the slide has been added, and a semicircular segment cut out at both ends instead of at one end of the base-plate as there shown.

The design of this instrument (fig. 67) is most ingenious: there is neither stand nor limb, the main basis of the instrument being the slide-holder, at one angle of which is a short pillar containing a direct-acting screw fine adjustment, which acts upon a swinging arm carrying the lens. Below the stage is a mirror attached to a jointed arm, and a wheel of diaphragms. The lenses, three in number, are Coddingtons of $\frac{1}{4}$, $\frac{1}{10}$, and $\frac{1}{25}$-in. foci.

It may be pointed out, says E. M. Nelson, that an instrument of this kind, fitted with achromatic loups, would be very serviceable to a microscopist for field work.

It will be remembered that three of Dr. Gairdner's Microscopes, made by Bryson of Edinburgh, were exhibited, figured, and described in the *Journal* for 1899, p. 643, fig. 149.

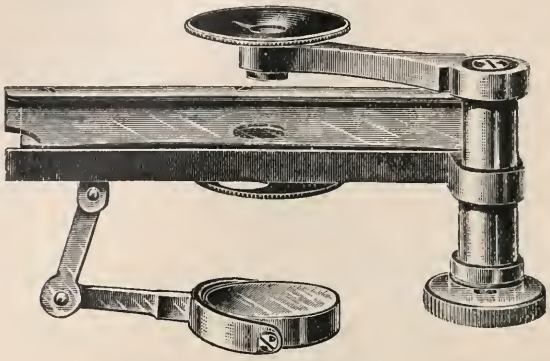


Fig. 67.

These had Coddington lenses, each power having a separate Microscope to itself. Gairdner's Microscope was described in the first edition of Carpenter on the Microscope, 1856, p. 74, fig. 15, and there it is said to be of use in bed-side investigations of urinary deposits.

In design, Gairdner's Microscope is far inferior to that of Pillischer's, inasmuch as there is no possibility of either moving the slide under the lens, or the lens over the slide, so nothing can be seen except the single point in the axis of the lens.

Seibert's Large Model Microscope No. 2. — This stand (fig. 68) closely corresponds to Zeiss' Model 1A; but is sold at a much less price. The fine adjustment, unlike Seibert's largest model, is by a prismatic bar, the micrometer screw being placed on the prism collar. When inclined the Microscope can be clamped by a lever. The stage is circular, graduated on rim, rotatory, and provided with centring screws. It is interesting to note that the horse-shoe foot is replaced by a flat tripod.

Watson's New "Holos Fram" Microscope. — This instrument (fig. 69) is Messrs. Watson and Sons' "Fram" Microscope, fitted with a rigid mechanical stage, and centring rackwork substage.

New Two-speed Fine Adjustment.—Messrs. W. Watson and Sons' new two-speed fine adjustment (fig. 70) is an ordinary single micrometer screw, having the usual larged milled head, and a projecting spindle-head, also milled, and of convenient length. When the latter is made

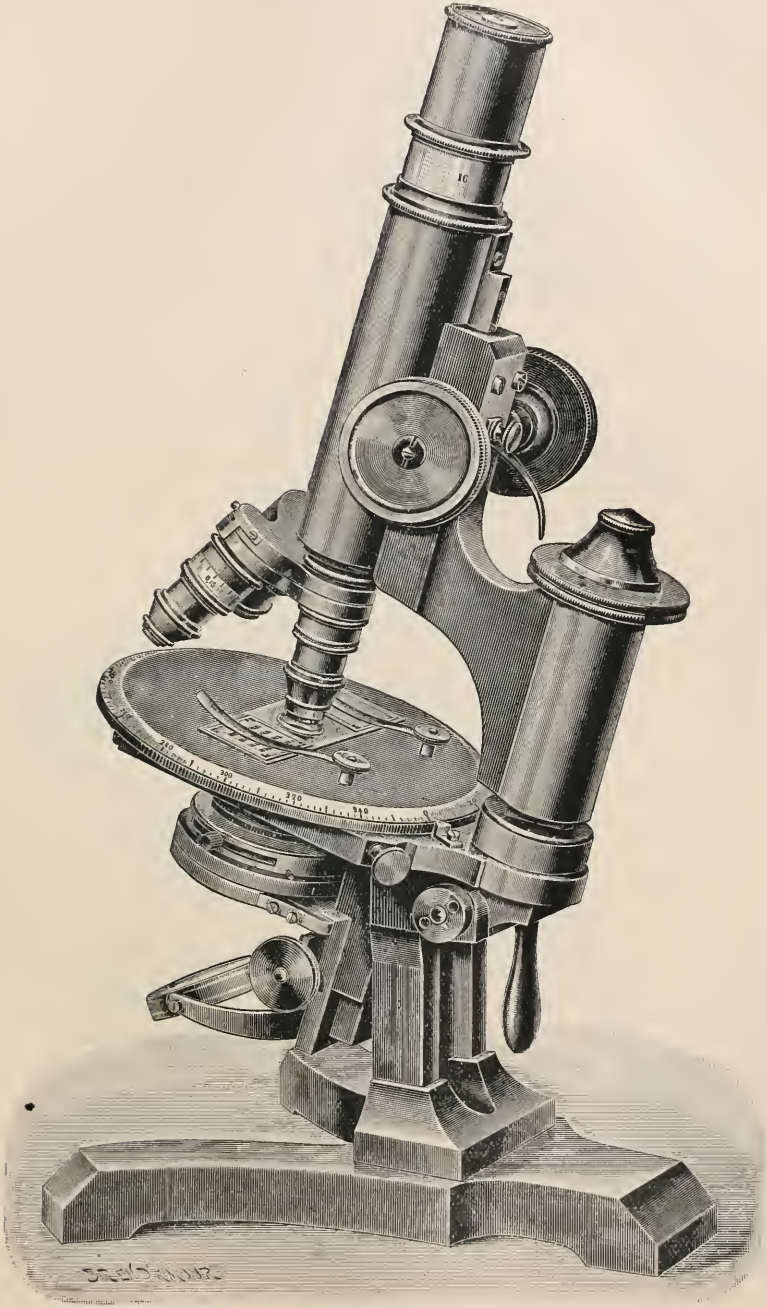


FIG. 68.

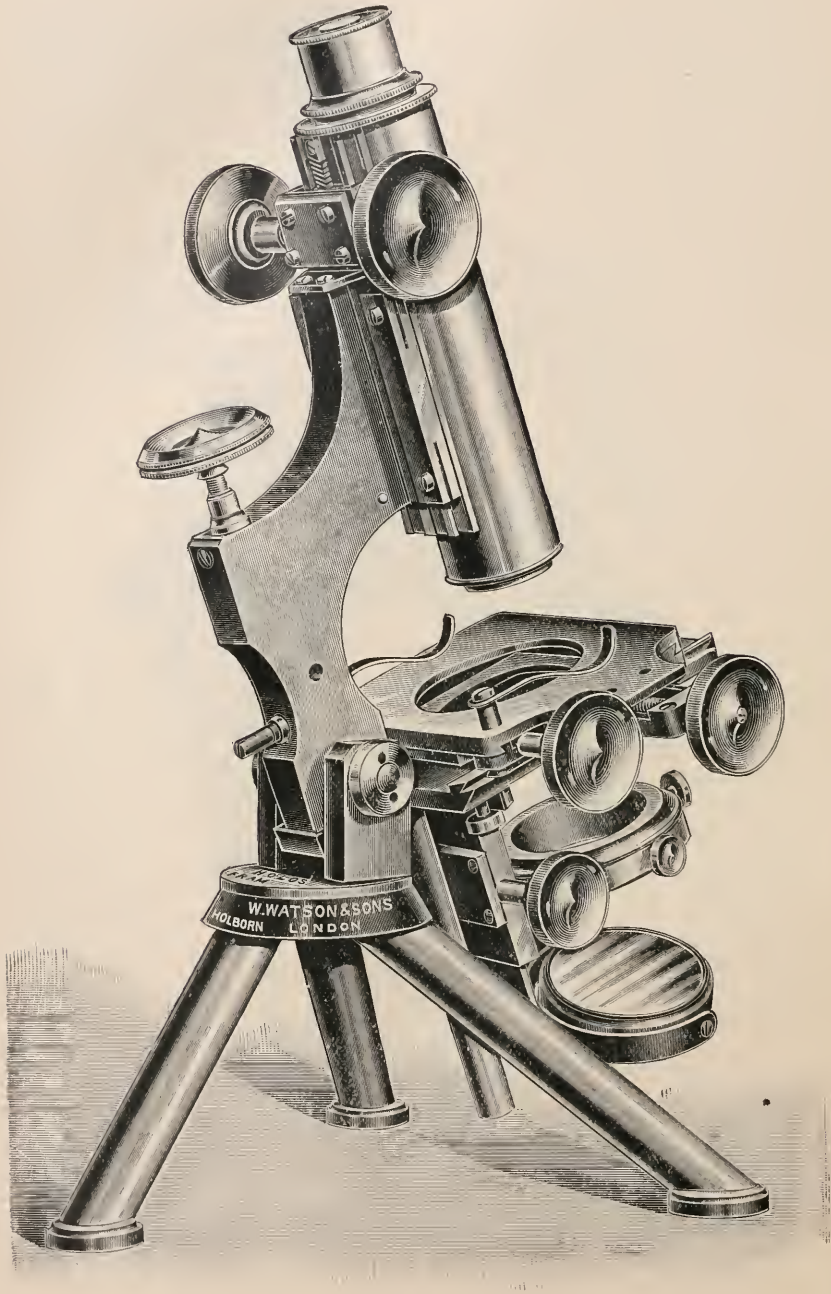


Fig. 69.

to revolve rapidly a quiek adjustment, suitable for low powers, is obtained, while the large milled head is available for delicate adjustment and high powers.

Fig. 70.

Beck's Micrometer Microscope.—This instrument (fig. 71) is intended for the accurate measurement of either opaque or transparent objects. The eye-piece has cross lines, and the whole Microscope is traversed across the object by means of a fine micrometer screw. On the upper portion of the stand is a scale representing the number of turns of the screw, whilst the drum of the milled head records to $\frac{1}{100}$th of a millimetre. The Microscope has a rack-and-pinion focussing motion, a graduated draw-tube, and carries the standard Royal Microscopical Society screw.

The stand is so made that the entire portion carrying the Microscope and micrometer screw may be removed, and attached in a horizontal position. A telescope object-glass may then be used in place of the

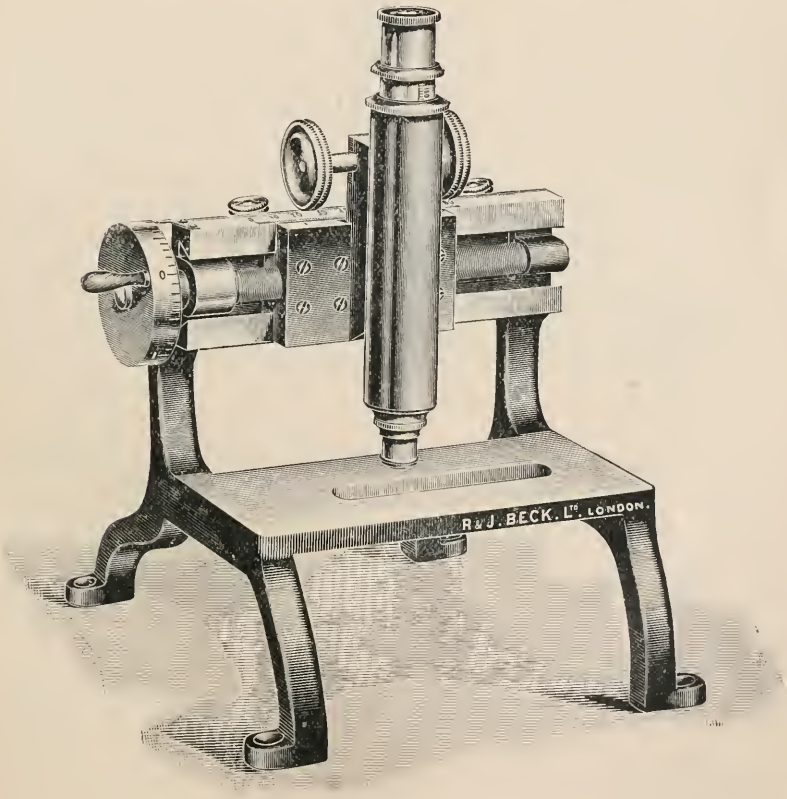


Fig. 71.

Microscope object-glass, and focussed by means of the draw-tube. In this way the instrument may be used for readings at a distance.

Albrecht's Microscope for Measuring Plant-Growth.*—The modern form of this instrument is shown in fig. 72. The tripod base is carried on levelling screws *s*, and the adjustment of the Microscope-tube is controlled by the level L. The sleeve H forms a part of the heavy base and contains a pillar S, which is raised or depressed by the screw

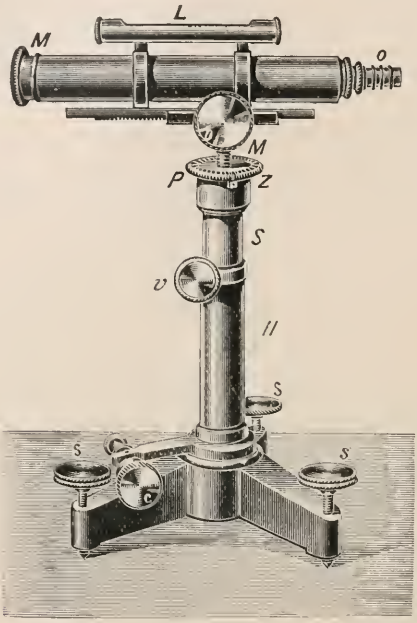


Fig. 72.

v, which thus acts as a coarse adjustment. The finer vertical adjustment is effected by the micrometer screw M, an indicator Z serving, in conjunction with the graduated plate P, to read off the movement. The screw *b* regulates the motion and the direction of the tube-length, and another screw *c* imparts a slight lateral movement of the entire upper part. Dr. Zimmermann considers that an arrangement for adding rotation about a horizontal axis would be a desirable addition. The optical parts are made by Seibert, of Wetzlar.

Pye's Reading Microscope.—Messrs. W. G. Pye and Co.'s reading Microscope (fig. 73) is designed on the geometric slide principle. A steel cylinder, to which is clamped, in any position, the Microscope arm, and forms the carriage, works in a pair of V's cut in the uprights of the base. These V's are parallel to the top plane edge of the base,

* Zimmermann, Das Mikroskop, 1895, p. 106, fig. 77.

on which rests a steel pin fixed to the under side of the arm, thus forming a perfect-fitting slide.

The carriage is actuated by a micrometer screw working against one

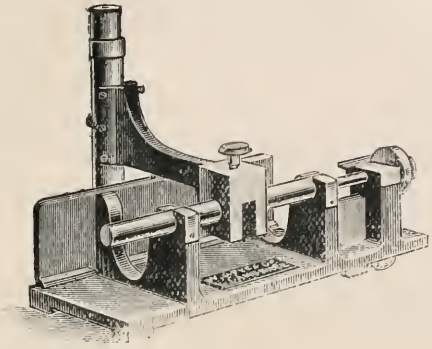


Fig. 73.

end of the steel cylinder, the latter being kept in contact by pressure with the finger on the other end. The screw is of 0·5 mm. pitch, with a head divided into 100 parts, and a traverse of 30 mm.

The instrument is also made without the micrometer screw, in which case a millimetre scale is fixed to the top edge of the base, the carriage being furnished with a vernier reading to 0·05 mm. The Microscope is provided with a Ramsden eye-piece with cross wires. It is held in position against four points by a flexible steel spring, and the vertical cradle that supports it will receive any other Microscope-tube in place of the one supplied.

Short Table Cathetometer. — This instrument (fig. 74), made by Messrs. W. G. Pye and Co., is constructed on the geometric slide principle. The base, provided with three levelling screws, carries a steel rod $\frac{7}{8}$ in. in diameter, with a millimetre scale divided on it, which can be read when the telescope is in any position. A brass ring with V bearings, carrying the telescope cradle and micrometer, fits on the column, and is capable of being revolved without altering its height. The V's in this annular ring are kept against the column by a spring on the opposite side.

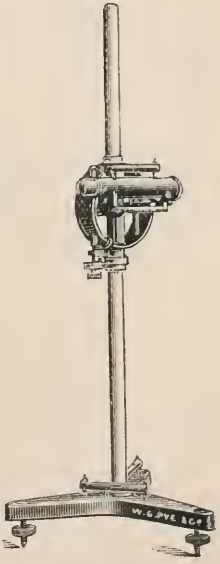


Fig. 74.

The micrometer slide consists of two steel rods carried by the ring. Against one, which is fixed to the ring, one point of the telescope cradle is pressed by a spring. The other is fixed to the telescope cradle, and works in two V's cut in the annular ring. One end of the latter rod

rests on the point of the micrometer screw, by means of which it is actuated. The screw has a pitch of 1 mm., and its head is divided into 10 parts.

The telescope rests in V's, and is reversible. It has a Ramsden eye-piece, adjustable diaphragm with cross wires, and a movable object-glass for focussing. Two spirit levels are supplied on the base and one on the telescope.

An Old Rackwork Draw-tube. — Mr. Nelson writes to say that he was shown an old monocular Microscope fitted with a rackwork draw-tube; the tube was graduated in inches and tenths. The milled head on the pinion, which was geared to the rack, was divided into five or six equal portions by small countersunk holes, into which a spring-catch pressed. When the milled head was revolved, so that the spring-catch passed out of one countersunk hole into the next, the draw-tube was moved exactly one-tenth of an inch. Therefore by feeling or hearing the spring click the amount of movement given to the draw-tube would be known, without the necessity of removing the eye from the eye-piece for the purpose of reading the graduated scale.

The legend engraved on the Microscope was "M. Pillischer, 398 Oxford Street, London. 167." Its date is 1847–48.

(2) Eye-pieces and Objectives.

Beck-Steinheil Orthostigmats.—These lenses (fig. 75) were primarily introduced for photography pure and simple, but owing to their exceptional qualities as to their corrections both for colour values (severely tested in connection with the photo-mechanical three-colour work) and also for spherical and astigmatic errors, Messrs. Beck have introduced a number of shorter foci lenses specially for the most difficult photo-micrographical research. Each surface is polished and figured on the principle adopted for the manufacture of large astronomical telescope objectives, and the accuracy of the test employed is such that a surface error not exceeding a fraction of a wave-length may be detected. No mechanical measuring machine has ever been constructed which will measure the errors of curvature with a tithe of the accuracy of the method adopted. The series at present includes three members, whose focal lengths are respectively 1, 2, $3\frac{1}{2}$ in.; their corresponding apertures being $\frac{1}{8}$, $\frac{1}{4}$, $\frac{9}{16}$ in.

Fig. 75.

Leitz' Spherically, Chromatically, and Astigmatically corrected Objective.*—E. Leitz, of Wetzlar, has taken out a German patent † for the above, and the spherical and astigmatic corrections are accomplished by a pair of reversed combinations separated from one another by a film of air (fig. 76). The outer members form a biconvex lens A, and the inner consist of a pair of plano-concave lenses B, and two positive menisci C. The biconvex A is made out of a highly refractive crown glass and serves for the rectification of the astigmatism. The spherical

* Deutsche Mechaniker-Zeitung, No. 2 (Jan. 1902) p. 19 (1 fig.).

† No. 118433, Cl. 42, 16.7.1899.

correction depends, as with aplanatics, on the inner surface of the cemented double lens, of which one lens B is made from a negative flint glass lens, and the other is a positive meniscus C of weakly refractive crown glass; the resultant focal length of the double lens being negative.

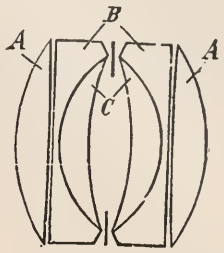


Fig. 76.

(3) Illuminating and other Apparatus.

Winkel's Drawing Apparatus for Weak Magnifications.*—A horse-shoe foot supports a pillar S which carries, by means of the screw A, the object-table T and the mirror E (fig. 77). The screw B serves as a clamp. The large perforation of the object-table renders the instrument applicable to large preparations, and the carrier T permits the insertion of a disc of ground glass for uniform illumination of the field. The optical portion is placed at the upper

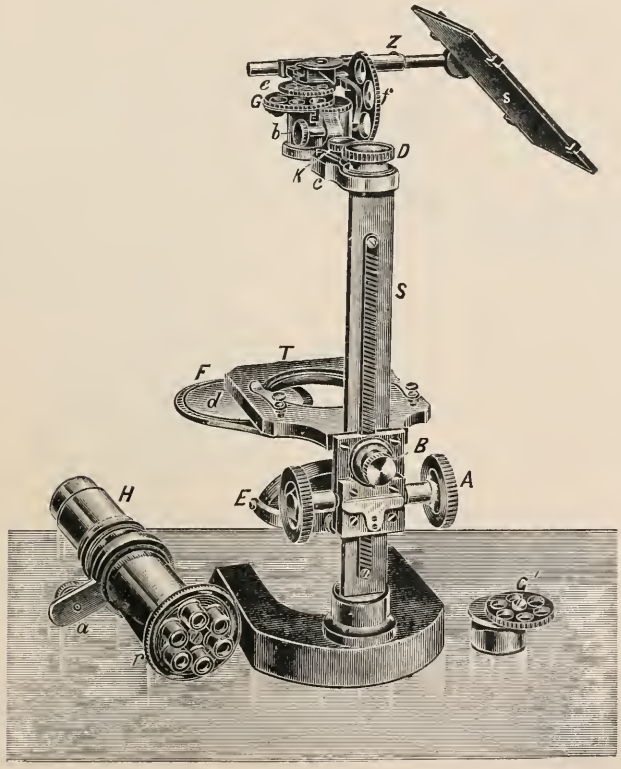


Fig. 77.

* Zimmermann, Das Mikroskop, pp. 138, 9; and Zeitschr. wiss. Mikr., x. (1893) p. 289.

end and is fixed by a dovetailed slide *c*, and clamped by a screw K; this part is rotatory about the pillar. Simple loups are placed in the rotatory disc G, revolver fashion, of magnifying power 1·7 to 10. For higher magnifications the Microscope-tube H with the help of the plug *a* is inserted, and bears at its lower end six objective systems of magnifying powers 12 to 38. The drawing is effected by the arrangement shown, which was fully described in a previous number of the *Journal*.*

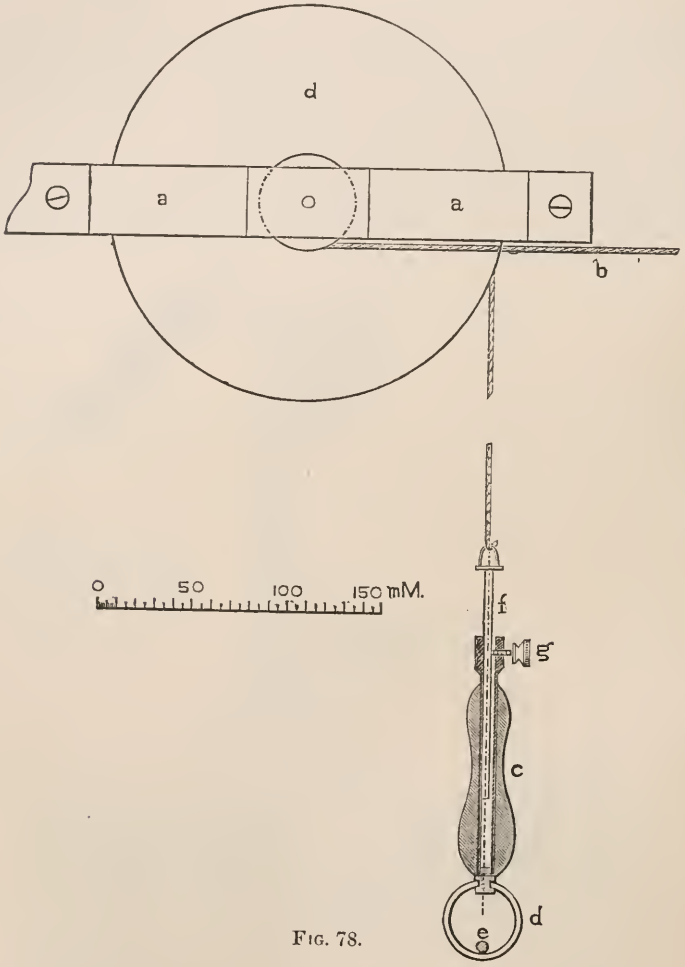


Fig. 78.

Moll's Apparatus for the Adjustment of a Projection Microscope.†—The object of this apparatus is to enable the lecturer, who

* Journal R.M.S., 1892, p. 264.

† Zeitschr. wiss. Mikr., xviii. (1901) pp. 129–37 (2 figs).

prefers to stand near the screen, to have control over the fine adjustment of the ocular so that he may arrange a sharp definition of any desired part of the image. It is in actual operation at the Botanical Laboratory, Groningen. Dr. Moll has designed a sort of wheel-and-axle arrangement (fig. 78) consisting of two grooved discs of radii 2·1 and 10·5 cm., rotatory about a horizontal axis and firmly fastened together. They are enclosed in a metal frame which is secured to a convenient beam in the ceiling. The cord *b* is fastened at one end to the small disc, and, at the other, to the ocular mount. To the larger disc is fastened the vertical cord terminating in a handle *c*, which is gripped by the lecturer. The size of this larger disc is important as it increases the delicacy of

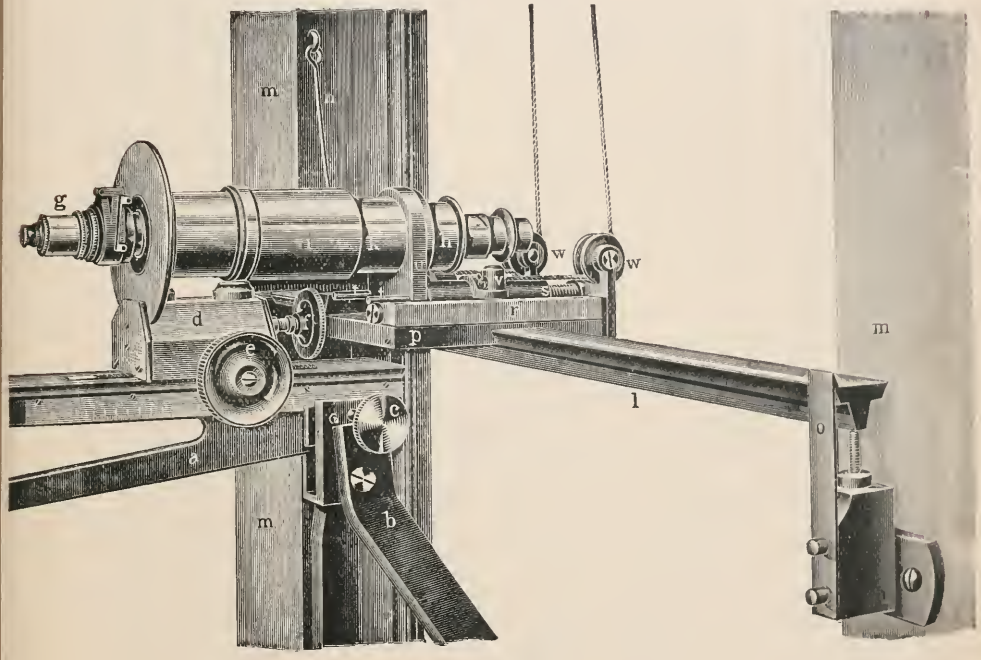


Fig. 79.

the ocular fine adjustment. The range of this latter is 5·5 cm.; but the corresponding stroke of the lecturer's handle is about 26 cm., and the precision attainable in image definition is proportionately increased. In many cases, and especially at the beginning of a demonstration, a medium position would be convenient: this is attained by making the handle terminate in a ring *d*, which may be then secured to a nail *e* in the wall. For better attainment of this medium position an adjustable rod *f* is contrived in the hollow handle, and its suitable length determined by a screw *g*.

To the ocular mount itself (fig. 79) strong spiral springs *s* are attached. These work in a frame at whose extremity are a pair of

pulleys *w* under which pass the limbs of the cord-loop. The ocular part of the Microscope-tube is mounted on a strong metal base-plate which, by means of a dovetailed groove, rests on a cast-iron bar supported by the upright beams *m* of the projection chamber. At the left-hand end of this bar is a hinge (not visible in figure) so that the bar and instrument can be raised, and by means of the hook *n* kept in an oblique position if projection apparatus of another kind should be required. At the right-hand end a strong spring *o* suffices to keep the bar in its place. The lantern is one of Newton's "patent electric lantern Microscope and micropolariscopes."

(4) Photomicrography.

Study of Growing Crystals by Instantaneous Photomicrography.*—Messrs. Richards and Archibald in their experiments used

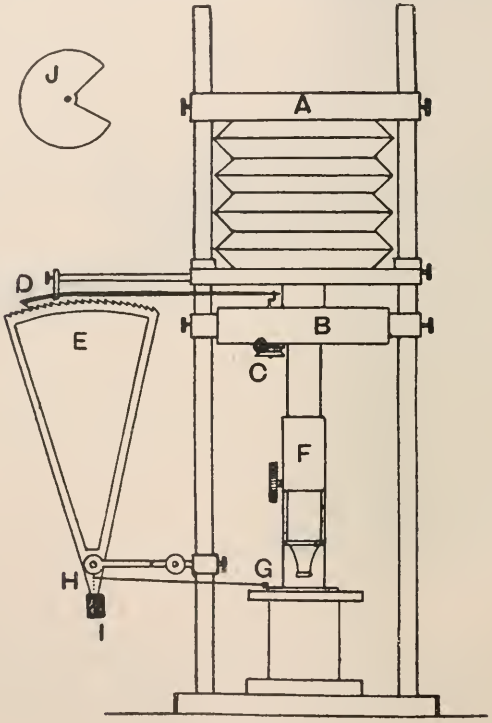


Fig. 80.

Bausch and Lomb's ordinary photomicrographic apparatus with a vertical camera. Between the Microscope F (fig. 80) and the camera, in a suitable light-tight box B, was placed a revolving shutter, which

* Amer. Chem. Journ., xxvi. (1901) pp. 61–74 (16 figs. and pls.).

allowed an exposure equal to one-fifth of the time of its revolution. Thus, when the shutter made two revolutions in a second, the exposure was one-tenth of a second. A Henrici hot-air motor, combined with speed-reducing double pulleys, enabled the experimenter to use any rate of revolution desired; the power was communicated by the pulley C. The rate was reasonably constant, but no attempt was made to make it absolutely so. The sensitive plate or gelatin film was held above in a suitable holder A, which was put in the place of the ground-glass plate used for focussing just before each series of exposures. In a first series of experiments it was arranged so that the image should be bright on a dark ground, and for this purpose it was found more convenient to move the crystallising solution than to move the photographic plate. For effecting this the slide G bearing the drop of liquid was attached by a wire to a point just below the centre of a segment provided above with saw-teeth E. The segment was moved gradually by the oscillating motion of a connecting-rod D, fastened by a crank to the revolving shutter at one end and playing into the saw-teeth on the other. In order to make the motion certain, the stroke of the connecting-rod slightly exceeded the distance between the saw-teeth. The segment was suspended in such a way that its centre of gravity coincided with its point of support, and the friction of its bearings was so adjusted that it would move easily, and yet remain stationary during the return stroke. I is a weight for balancing the segment. The distance through which the observed object was moved was easily varied by altering the relative lengths of the lever arms: holes H bored at distances varying from one-tenth to one-fiftieth mm. were generally used. The shutter was so arranged that during the exposure the segment and slide were at rest, the shift in position being effected during the four-fifths of the revolution through which the shutter was closed. Fig. 80 represents the apparatus an instant before an exposure begins. J is a horizontal projection of the revolving shutter in detail. The best light-source was found to be sunlight directed by a suitably arranged mirror and condensed by reflectors and lenses. The chief, though not serious, difficulty of this arrangement was the great heat caused by the converging rays, a difficulty which was obviated partially by an absorbent screen. The first trials were taken by reflected light, but were less satisfactory than those obtained by polarised light. The images were now much more clearly defined, but the magnification (30 diameters) was too low to warrant conclusions about the genesis of crystals. Among other substances, sodic nitrate, boric chloride, cupric sulphate, and ferrous ammonic sulphate were found to give satisfactory images. A photomicrograph shows the crystals of sodic nitrate obtained under a higher magnification of 110 diameters with an exposure of ·12 second. Light-ground illumination was now tried, as it was considered that an initial globular condition, if it ever existed, would probably not be visible through the nicols. The slide and crystallising solution were allowed to remain stationary, and a 2·5 in. Eastman cartridge gelatin film was moved as in the common film-carriers. At first a power of 100 diameters was employed, and very satisfactory pictures of the growth of crystals of potassic iodide were obtained. They do not, however, reveal anything new. Higher powers of magnification were used and

the utmost intensification of light obtained, but none of the results favoured the theory that crystals develop from a transitory liquid phase.

Stereo-Photomicrography.*—F. M. Duncan points out that as stereo-photomicrography comes under the head of low-power work the Microscope itself is not required; the Stephenson's prisms and objective being attached directly on to the front of the camera. These prisms obviate

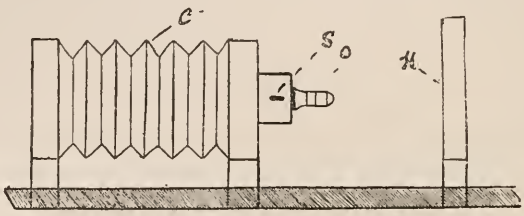


Fig. 81.

the necessity of cutting and transposing the photographs as in the case of ordinary stereoscopic work. The camera should be mounted on a travelling stage of sufficient length and breadth to afford a firm support to the camera when its bellows are racked out to their fullest extension. To the base of this camera-stage two grooved blocks of wood should be

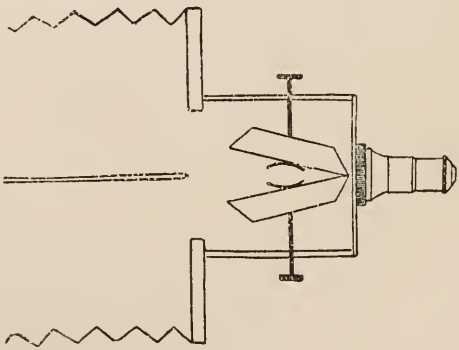


Fig. 82.

firmly attached, the grooves corresponding in angle to the two V-shaped rails which run the whole length of the baseboard. The baseboard to carry the camera, object-holder, &c. should be made of well-seasoned pine, 10 in. wide, 5 ft. long, and 1 in. thick. Fastened on the edge and running the entire length of the baseboard, there should be two V-shaped rails, on which the camera, &c. can be moved into the required position. The object-holder must be so constructed as to bring the specimen

* English Mech. and World of Science, lxxiv. (1901) pp. 354, 5 (2 figs.); and British Journal of Photography (loc. non cit.).

exactly in front of the lens, and in a central position. A small well-made box must be carefully constructed to carry the prisms and objective; or better still, a short wooden cylinder. In either case the interior must be perfectly smooth and painted a dead black, and at one end must be fastened a lens-flange for attaching the box or cylinder in such a manner as to be immediately behind the objective and as near to its back lens as possible. The prisms should be fitted with two adjusting screws capable of being manipulated from the sides of the box or cylinder, so that the angle at which the prisms are inclined to one another may be altered if necessary. Fig. 81 shows the apparatus in position: S is the adjusting screw of prism; O the micro-objective; and H the stage for carrying specimen. Fig. 82 shows the apparatus in place. A telescopic partition must be constructed to run through the length of the camera in an exactly central position. To obtain the best results a full exposure should be given, so as to obtain vigorous negatives full of detail with good contrasts.*

Panoramic View Camera.—In 1850 Andrew Pritchard, on p. 83 of his Appendix to *Optical Instruments*, in Natural Philosophy, Library of Useful Knowledge (1832), says, "In taking panoramic views M. Lerabours has ingeniously constructed a camera, the lens of which revolves about a vertical axis; the plate is curved, and a screen is interposed, which revolves with the lens; this screen has a slit opposite the centre of the lens, so that only a small part of the image impinges upon the plate at one time. By properly regulating the time and motion, to suit the varied brilliancy of the different parts of the landscape, and also by making the slit opposite the sky narrowest, a very perfect panoramic view is obtained."

It is needless, says E. M. Nelson, to point out to photographers that this description, now fifty years old, is precisely applicable to one of the latest forms of cameras, thereby proving that "there is nothing new under the sun."

If a similar adaptation were to be made to a microscopic camera, the object would have to be mounted upon a curved slide, while the negative plate remained a plane surface. This might be useful in taking low-power instantaneous photomicrographs of long and narrow objects such as living worms.

(5) Microscopical Optics and Manipulation.

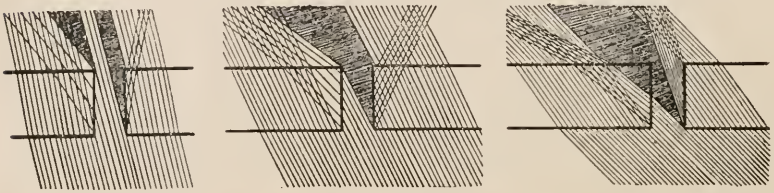
The Black and White Dot Phenomenon.†—J. Rheinberg suggests that the origin of the black and white dot phenomenon in diatoms arises primarily from the fact that the perforations in a diatom form approximately vertical partitions between two media differing in refractive index. A certain portion of the light which impinges from below on the partition from the side of the denser medium, is reflected as at the surface of an ordinary mirror. Such reflected light is that which reaches the plane of partition beyond the critical angle. In consequence darkness is brought about on the less dense side of the partition in the space

* This method is essentially the same as that described by E. R. Turner, Illustrated Ann. Microscopy, 1900, p. 52.

† Journ. Quek. Micr. Club, viii. (Nov. 1901) pp. 113–8 (6 figs.).

where the light has been unable to get through from the side of greater density; and darkness is also brought about on the denser side of the partition because throughout the whole of a certain solid space a direct and a reflected wave-stream, emanating from the same points of the light-source, meet in opposite phase. Figs. 83–85 represent a diatom denser than the imbedding medium; in figs. 86–88 the imbedding material has the higher refractive index. In figs. 83 and 86 the light impinges at an angle greater than the critical angle; in figs. 84 and 87 at the critical angle; in figs. 85 and 88 at an angle less than the critical angle. The closely shaded portions (when uncrossed by other lines) show where no light has been able to get through; and it will be seen that no light reaches a space in the upper surface plane of the diatom just at or near one of the edges of the vertical walls forming the partition.

Fig. 83. Fig. 84. Fig. 85.



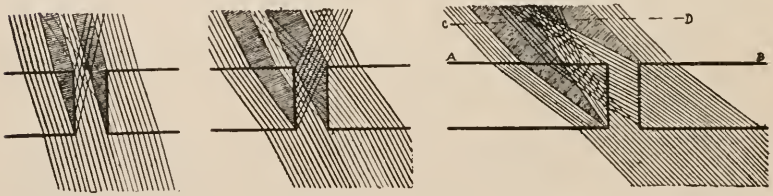


Fig. 86. Fig. 87. Fig. 88.

It will further be observed in figs. 83 and 84 and also in figs. 86 and 87, that the rays which impinge on to one of the vertical partitions are thrown back on themselves. A change of phase occurs where they are then reflected, and, if we take any point where one of these rays meets one of the unreflected rays, we find the two have travelled the same length of path and, being now in opposite phase, they cancel one another and produce darkness. Thus darkness is formed in the surface plane of the diatom both sides of the partition, though due to different causes in the two cases. There are, in fact, two bands of darkness which issue upwards from an angle to each other from the horizontal plane in which the top of the vertical partition lies, in the case of a diatom which is studded with perforations—in other words, with vertical positions—there is an immense number of the bands parallel to each other in each of the two directions forming a sort of trellis-work of light and darkness. And, as sections of trellis-work taken one below the other would show

alternately light and dark spaces, so do the diatoms when the focus is adjusted to different planes. Mr. Rheinberg prefers the black dot image, and gives full reasons for his preference, and states also that different effects will be produced, according to the different media in which the objects are mounted; and that the positions which the black and white dots take up are not the same, because careful examination will show that the rows of white dots occupy intermediate positions to those which the black dots previously occupied.

E. M. Nelson,* in discussing this subject, applied the same lens and illumination to diatoms marked with various degrees of fineness. He considers that Mr. Stokes is right in assigning to spherical aberration an important function, for in those cases where there is a white dot both above and below the black dot, the upper or lower white dot can be made the stronger or weaker, or both made alike, by means of screw-collar or tube-length adjustments. He has also reason for thinking that the upper black dots observed by Mr. Stokes with annular illumination must have been images of the stop at the back of the condenser. The examination of a considerable number of specimens has shown that there is more variety in the association of the blackness and whiteness than is commonly supposed. Thus a balsam-mounted Pleurosigma formosum generally has the white dot below; but Mr. Nelson has met with a reverse example. He finds, so far as he can measure it accurately, that the distance between the two dots is fairly constant at 3 λ.

With regard to Mr. Rheinberg's papers, Mr. Nelson is of opinion, after many careful observations, that the white and black dots are exactly superimposed. This seems to be a fatal objection to the trellis-work theory, notwithstanding its interest and ingenuity.

In a paper read before the Quekett last March, Mr. Rheinberg returns to the study of the subject and admits that the two dots are superimposed. He then sums up the possible theories as four, viz.:—

(1) Spherical aberration by reason of the objective acting in zones, each zone having its own focus within certain limits.

(2) A pinhole effect.

(3) Crossing of bands arising from diffraction.

(4) Crossing of bands (or rather cones) formed by reason of the difference of refractive indices of the media, in accordance with the ordinary laws of total reflection beyond the critical angle.

He gives his reasons why the last should be preferred, and also suggests that "critical angle" rather than "trellis-work" theory is the more suitable short title. It has the following six points in its favour:—

(*a*) It will explain the appearances without recourse to other than the most ordinary and generally established optical laws.

(*b*) It accounts for the fact that wide-angled objectives will show the results better than narrow-angled ones; similarly it shows why wide cones are more favourable than narrow ones for the production of the appearances.

(*c*) It allows for the alteration of appearances due to spherical aberration, tube-length, &c. It can also be shown to harmonise with those changes at different foci caused by diffraction.

* Tom. cit. (April 1902) pp. 261–5 (5 figs.).

(*d*) It accounts for the appearances of edges of a transparent object, and of transparent isolated objects, as bacilli, &c.

(*e*) The dimensions of the perforations, particularly the relation of depth to width, account in the simplest way for the fact that sometimes the white dot is seen above and the black below, sometimes *vice versa*. It is simply a matter of an extra reflection at the wall.

(*f*) Different dimensions of the perforations explain the varying vertical distances between the black and white dots seen in different diatoms on the same slide.

(*g*) Lastly, the existence of patches on a diatom showing reverse order of the black and white dots can be accounted for by the difference of refractive index of the gum or other medium in which that portion of the diatom forming the patch is immersed.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Anaerobic Bacteria.†—Dr. Hammerl has elaborated a method for completely eliminating oxygen from anaerobic cultivations, and of obtaining oxygen-free nutrient media. Taking advantage of the fact that solutions of methylen-blue are colourless if every trace of oxygen is removed therefrom, he used this substance as an indicator, and added small quantities to his glucose-formate nutrient media. By prolonged heating in a water-bath or steamer he found he was able to drive off the dissolved oxygen from the depths of the medium in the tubes, although a coloured ring, some 1·5 cm. broad, at the upper part indicated the presence of oxygen at the surface.

On testing the various methods in general use for the production of a condition of anaerobiosis by means of the methylen-blue, all were found to be defective, traces at least of oxygen always being present in the media. He then employed fresh solutions of ammonium sulphate as the deoxidising agent. This substance does not inhibit the growth of bacteria, and if freshly prepared in the manner described by the author, gives highly satisfactory and concordant results.

The method described for preparing the fresh ammonium sulphate is as follows:—Fill 100 to 150 ccm. distilled water into a stoppered measuring cylinder, replace the stopper by a cotton-wool plug, and sterilise in the steamer together with a piece of glass tubing long enough to reach to the bottom of the measure, and some rubber tubing. When cool connect the glass tube to a reservoir of sulphuretted hydrogen gas by means of the rubber tubing, and pass the gas through the sterile water in the measuring cylinder for five or six minutes. Now fill exactly 10 ccm. of the H_2S water into each of several test-tubes (6 or 8), and add to the first tube 2 drops of a 1 p.c. solution of ammonia, to the second 4 drops, and so on, shaking each thoroughly to mix the contents. Finally add 3 drops of a concentrated alcoholic solution of methylen-blue to each tube, and note the length of time required to decolorise the

* 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., 1te Abt., xxx. (1901) pp. 658-64.

mixture. That number of drops of ammonia (probably between 4 and 8) which decolorises the methylen-blue in from $\frac{1}{4}$ to 1 minute is taken as the standard, and the necessary quantity calculated on this basis is added to the remainder of the sterile H_2S water in the measuring cylinder. After thoroughly mixing, this NH_4HS solution is added to each of the tubes of nutrient media in the proportion of 1 : 10.

Isolation of the Typhoid Bacillus.*—Dr. A. Moore recommends a modified Elsner agar medium for isolating the typhoid bacillus. 500 grm. of potato are scraped on a grater, and then macerated in a litre of water for 3 or 4 hours, strained and allowed to stand overnight. Next morning the supernatant fluid is decanted off and the volume made up to 1000 ccm. The liquid is then rendered distinctly alkaline and 20 grm. of agar added. The process is then continued as for ordinary agar. When sterile the medium is distributed into test-tubes, 10 ccm. in each, and immediately before use 0·5 of the following solution is added to each tube:—Potassium iodide 10 grm., water 50 ccm. The agar tubes thus contain 1 p.c. of potassium iodide. Plates made with this medium were sown with mixed cultures of the typhoid and coli bacilli and incubated for 24 hours at 37°. After this interval examination under a low power showed that the typhoid colonies were clear, transparent, with irregular clean-cut margins, while the coli colonies were larger, rounded, and opaque. By this procedure typhoid bacilli were isolated in pure culture from numerous artificial mixtures, from old typhoid dejecta, and from cockles suspected of causing an outbreak of typhoid fever.

The author also describes experiments with W-shaped tubes containing Parietti's serum-gelatin. Though successful for isolating any given strain of colon bacillus the method failed when applied to mixtures of different strains, and though possessing a certain value, was abandoned for the method given above.

Medium for Isolating Typhoid Bacilli.†—V. Drigalski and H. Conradi have constructed the following medium for isolating typhoid bacilli. (1) 3 lb. of beef are macerated in two litres of water for 24 hours. The beef extract is then boiled for an hour, and after having been filtered, 20 grm. pepton, 20 grm. nutrose, and 10 grm. salt are added. The mixture is then boiled for an hour, and after filtration 20 grm. of the best agar are added. After boiling for 3 hours the solution is rendered alkaline, filtered, and boiled for $\frac{1}{2}$ hour.

(2) 260 ccm. of litmus solution (Kubel-Tiemann) are boiled for 10 minutes, and then 30 grm. of chemically pure lactic acid are added. This mixture is boiled for 15 minutes.

(3) The two foregoing solutions, while still quite hot, are mixed together, and having been well shaken, 4 ccm. of a hot sterile solution of 10 per. cent. crystalline soda and 20 ccm. of a freshly prepared solution of 0·1 grm. crystal violet B. Höchst, in 100 ccm. of warm distilled water, are added. Plates are then made in the usual way.

The authors claim that a diagnosis of typhoid can be made by means of this medium always within 24 hours, the typhoid colonies being blue and quite transparent while the coli colonies are red and opaque.

* Brit. Med. Journ., 1902, i. pp. 703–4 (1 fig.).
† Zeitschr. Hyg. u. Infekt., xxxix. (1902) pp. 283–300 (1 fig.).

Adhesion-Cultures.*—P. Lindner describes the following method for examining mixed vegetations in artificial or natural media. A thin layer of the cultivation fluid is spread all over the under side of the cover-glass. The slip is then placed over the hollow of a ground-out slide and ringed round with vaselin.

Should it be desired to cut off or diminish the air-supply to this culture, another cover-slip of slightly less size is put over the film so that the medium is shut in between two glass surfaces. Over the drop culture this method has the special advantage of causing the vegetation to spread out in one plane so that the growth can be readily inspected and photographed.

(2) Preparing Objects.

Fixing and Staining Trypanosoma.†—J. R. Bradford and H. G. Plimmer made films by placing a small drop of the infected blood in one corner of a slide or of a slip, spreading it with a piece of goldbeater's skin, held in a pair of forceps. The edge should be quite straight and the width a little less than that of the slip. The best fixative results were obtained from the vapour of a mixture of equal parts of 2 p.c. osmic acid and glacial acetic acid, though 10 parts formalin with 90 parts absolute alcohol give very good results. Fixation by this latter mixture takes 5–10 minutes, after which the film must be well washed and then dried. The stains used were methylen-blue and erythrosin. The methylen-blue was a 1 p.c. M.B. med. pur. (Höchst) to which 0·5 p.c. potassium carbonate was added and the mixture incubated at 37° for 48 hours. When cold it is filtered and is then ready for use. The erythrosin (tetraiodide of fluorescein) was used in 0·001 p.c. solution with 0·25 p.c. formalin to prevent growth of moulds. When required for use, 20 ccm. of distilled water are put into each of two beakers, to one of which are added 20 drops of the erythrosin solution, and to the other 6 to 8 drops of the methylen-blue solution. The solutions are then mixed and poured into a flat dish in which the slides or slips to be stained have been already placed. In about 20 minutes the preparations are washed in distilled water till no more colour comes away, and are then allowed to dry in the air. No heat must be used for drying, otherwise the red colour will entirely disappear. They are then mounted, preferably in turpentine colophonium.

Method for Fixing Blood-Preparations.‡—Lenoble and Dominici expose the films to the vapour disengaged from a solution composed of perchloride of mercury and iodine, and stain with the Ehrlich triacid mixture. The fixative may be used in two strengths:—(1) Saturated solution of sublimate in 40 grm. of alcohol to which 6 grm. of tincture of iodine are added. (2) Saturated solution of sublimate in 35 grm. of alcohol and 15 grm. of tincture of iodine.

Method for Fixing and Staining Hæmatopoietic Tissue.§ — Dominici fixes the material in a medium which has for its basis a mixture of alcoholic solution of iodine and aqueous solution of sublimate.

* Wochenschr. f. Brauerei, xviii. pp. 512–4. See Centralbl. Bakt., 2te Abt., viii. (1902) p. 286. † Quart. Journ. Micr. Sci., xlv. pp. 449–71 (2 pls.).
‡ C.R. Soc. Biol. de Paris, liv. (1902) pp. 223–5. § Tom. cit., pp. 221–3.

To this stock-fluid may be added formalin, chromic acid, Flemming's fluid, osmic acid, &c.

The stains used are eosin and orange G, 1 grm. each to 200 of distilled water. The preparations are washed in 60 p.c. alcohol, after which they are stained in toluidin-blue, 1 grm. to 200 of water. After decolorising in 60 p.c. alcohol and dehydrating in absolute alcohol, the preparations are mounted in xylol-balsam.

Fixation of Polychæta Embryos.*—A. Soulier when studying the early phases of the embryology of *Serpula*, fixed artificially fecundated ova at various stages of maturation with various fluids. Of those which contain osmic acid, Flemming, Fol's, and Cori's proved to give only moderately successful results. Much more satisfactory were the mixtures known as Gilson's, Roule's, and Ripart et Petit's, Gilson's fluid is composed of nitric acid 78 ccm., glacial acetic acid 22 ccm., sublimate 100 grm., alcohol 60 p.c. 500 ccm., distilled water 4400 ccm. Roule's fluid is a mixture of saturated solution of sublimate 80 ccm., and glacial acetic acid 20 ccm. Ripart et Petit's fluid contains chloride of copper 0·3 grm., acetate of copper 0·3 grm., glacial acetic acid 1 grm., distilled water 150 grm. One volume of any of these fixatives is mixed with three volumes of sea-water containing the ova. Their use does not necessitate a prolonged washing, and they do not interfere with the action of staining solutions.

Examining Nervous System of Sipunculus nudus.†—For examining *Sipunculus nudus* in the fresh condition H. von Mack obtained uncontracted specimens by adding at intervals 75 p.c. alcohol to the sea-water in which the animals were kept. 1 p.c. cocain solution was also very effective. For teasing-out or maceration-preparations Müller's fluid and nitric acid were used. Treatment with the former required several weeks, the tissue being afterwards stained with hæmatoxylin; with the latter in 20 p.c. solution 24 hours were sufficient, the pieces being afterwards washed with distilled water for 24 hours and then, having been mordanted with alum, stained with hæmatoxylin.

For sectioning pieces of tissue 1 cm. long, several fixatives were used, e.g. saturated solution of sublimate in 0·5–0·7 p.c. salt solution (15–20 hours), or Apáthy's sublimate-alcohol (16–24 hours). After either of these, washing in water, then graded alcohols (30 p.c., 50 p.c., 70 p.c.), and Apáthy's alcoholic iodopotassic iodide to 96 p.c. alcohol. This avoids the red precipitate of iodide of mercury which is deposited when the aqueous iodopotassic iodide is employed. Other fixatives used were equal volumes of 1 p.c. osmic acid and the salt-sublimate solution; $\frac{1}{4}$ p.c. osmic acid in sea-water; Flemming's mixture and Tellyesnicky's fluid (acetic acid and bichromate of potassium).

The material was stained *en masse* in very dilute Delafield's hæmatoxylin, in Apáthy's hæmatein solution I.A., and by a combination of the two fluids. The first of these was $\frac{1}{10}$–$\frac{1}{20}$ of the aqueous or alcoholic (30 p.c.) solution of Delafield's hæmatoxylin. Duration 6–8 days, after which distilled water and then dehydration in absolute alcohol. The Apáthy's solution took 5 days; the pieces being afterwards washed in

* Mém. Acad. Sci. et Lett. Montpelier, iii. (1901) pp. 1–7 (4 pls.).
† Arb. Zool. Inst. Wien, xiii. (1902) pp. 237–334 (5 pls.).

distilled water and then dehydrated as quickly as possible in absolute alcohol, as this extracts the colour. The third procedure was to stain first for a few days with Delafield and follow this with Apáthy's hæmatein. The sections were differentiated in 1 per thousand hydrochloric acid-alcohol. The plasma stains used were acid rubin, differentiated or not with acetic acid-alcohol or with picric acid. For double staining, borax-carmine and bleu de Lyon. After fixation with osmic acid the sections are examinable without staining, though safranin was employed in some cases. For differentiating nerve-fibrils Apáthy's gilding method was used.

Preparation of Radulæ.*—K. Diederichs remarks that snails are best killed with boiling water, and after removal of superfluous parts, the head should be boiled in caustic potash solution until the soft tissues can be easily removed from the radula. When thoroughly clean the preparation may be mounted in glycerin or in isinglass jelly. If mounted in balsam the preparation should be stained with some picro-carmin solution, for which the formulæ given in the April number are suitable.†

Fixing and Staining Phycochromaceæ.‡—R. Hegler fixed the material with saturated aqueous sulphurous acid 7 parts; 94 p.c. alcohol 93 parts, and after 12–14 hours washed it in alcohol. If there were much lime, he washed in running water or even fixed with 5 p.c. saturated SO_2 solution, 95 p.c. distilled water.

Formalin-alcohol (40 p.c. formalin 5 p.c. and 94 p.c. alcohol 95 p.c.), afterwards washing with 50 p.c. alcohol, sometimes gave good results.

The fixed material was imbedded in paraffin and sections made, or a small piece was squeezed flat between two cover-glasses. These preparations were placed in 50, 75, and 94 p.c. alcohol, and then after some days the cover-glasses were separated and placed in a mixture of 2 parts absolute alcohol, 1 part glycerin, and 1 part water. A third method was to make cover-glass films and preserve in the above-mentioned mixture.

The following methods gave the sharper staining of the central body :—Dissolve ammonia-alum 75 in water 750, and add glycerin 125, alcohol 100, saturated alcoholic solution of hæmatoxylin 25. Expose to light for several weeks and stain with 10 vols. to 100 vols. 1 p.c. formalin for 24 hours. Wash for 24 hours in running water, and differentiate in saturated alcoholic solution of picric acid 1 vol., water 1 vol., alcohol (94 p.c.) 2 vols. for a few seconds, wash in 75 p.c. alcohol and examine under Microscope. Instead of picric acid, 1 per thousand hydrochloric acid in 60 p.c. alcohol may be used. After differentiation the preparations are washed till they become blue, after which alcohol, toluol, dammar.

Another method is to fix in SO_2 alcohol, immerse for 2–4 hours in 1·5 p.c. iron-alum solution, and then, without rinsing in water, to treat with the following for at least 24 hours:—1 grm. hæmatoxylin, 200 water, 4 ccm. formalin (shake and filter). The preparations are next

* Zeitschr. angew. Mikr., vii. (1901) pp. 29–30 (1 pl.).
† See *ante*, p. 255.
‡ Jahrb. wiss. Bot., xxxvi. (1901) pp. 319–25 (2 pls.).

washed in running water for an hour. Any surface deposit is removed by means of 1 per thousand HCl alcohol. Differentiation with 0·5 p.c. iron-ammonia-alum solution or with hydrochloric and alcohol or picric and alcohol. Next frequent washing, and mounting as before.

Preparing Liver of Mollusca.* — P. Enriques experienced much difficulty in fixing the liver of Mollusca, especially in warm weather. Most of the ordinary fixatives have a solvent action on these organs, so that the cells disappear and the hepatic framework only remains. The most satisfactory fixatives appear to have been, saturated aqueous solution of sublimate in 0·5–1 p.c. NaCl and in 5 p.c. acetic acid; chrom-osmic-acetic acid and Müller's fluid. By partially drying in the air fresh tissue, and then imbedding in gum and glycerin or in syrup and glycerin, decent sections were obtained. If these sections had to be treated with aqueous fluids they were stuck on the slide with a solution of gelatin at 50°–60°. The best staining results were given by hæmalum and thionin.

(3) Cutting, including Imbedding and Microtomes.

Standing's Imbedding Microtome. — This microtome (fig. 89), made by Messrs. R. and J. Beck, consists of a ball of wood surmounted by a tube, in the interior of which the object to be cut is imbedded. Over the tube is screwed a small table which is lowered to the requisite amount to cut the section. In the centre of the ball is a plug, by means of which the specimen is located in a convenient position preparatory to cutting. The whole of the upper portion being removable, the imbedding can be filled in from below.

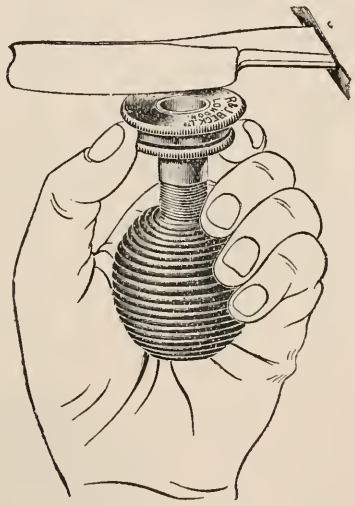


Fig. 89.

Slide-Brake of Jung's Microtome.† — This is an accessory invented by the Heidelberg firm, with the assistance of Prof. Heidenhain, for increasing the stability of the slide-gear. It had been found that, owing to the thickness of the oil-layer or in the case of sections of unusual size or hardness, the section thicknesses were not perfectly uniform and sometimes exhibited variations of 0·5 μ. The contrivance for rectifying this is called the slide-brake (*Schlittenbremse*) and will be understood from the following description:—On each slide-track there is now attached a bar (*a*, fig. 90), and the slide *c* runs along and presses upon this by the interposition of a reel, or roller, *b*. This roller is fastened to the slide, not directly, but in the following way (fig. 91).

* Mittheil. Zool. Stat. Neapel, xv. (1901) pp. 281–407 (3 pls.).
† Zeitschr. f. wiss. Mikr., xviii. (1901) pp. 138–40 (2 figs.).

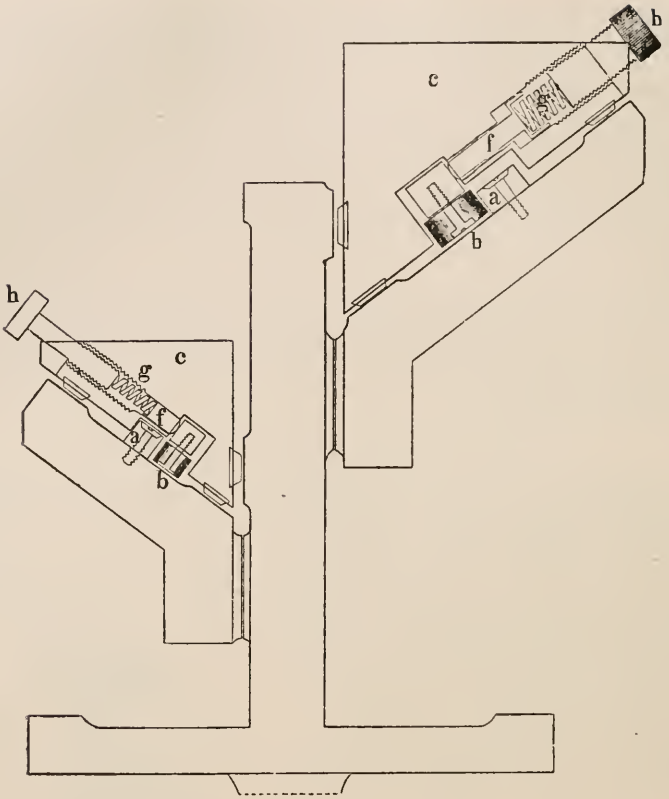


Fig. 90.

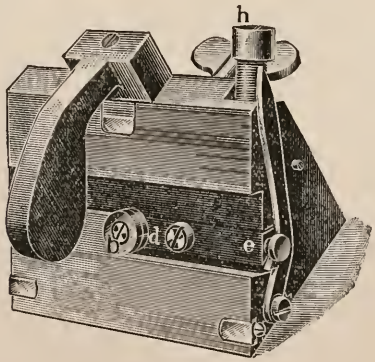


Fig. 91.

A two-armed lever *d e* is secured to the underside of the slide, and to one end of the lever the roller is applied; on the other end (fig. 90) acts, by means of a bolt *f*, a strong spiral spring *g*, which can be tightened or relaxed by a screw (*h*, figs. 90 and 91). Screw, spring, and bolt lie in a perforated canal in the lower massive part of the slide. When the spring is tightened by the screw, the roller can therefore be raised and pressed as tightly as desired against the bar. The effect is to totally deprive the slide of anything like loose play. The spring pressure can obviously be varied at pleasure, and the slide can therefore be regulated as circumstances require. A secondary result is an increased pressure on the micrometer screw, which has therefore needed some strengthening. This slide-brake can be applied to existing microtomes of the Jung type.

Apparatus for Imbedding in Paraffin.*—Dr. P. Meissner describes a useful apparatus for imbedding objects in paraffin. It consists of a tank made of copper with a well sunk in at the top. The well is for the reception of a rectangular bath, and into the latter fits a wire cage in which the paper moulds are placed. Level with the bottom of the well is a pipe which connects by means of rubber tubing with a tank containing cold water. After the specimens have been satisfactorily oriented the paraffin is made to set by letting the cold water flow into the well. This device prevents the formation of air-bubbles. The pan or paraffin bath is then lifted out of the well and hung up outside the bath on the arms of two supports fixed to the top of the tank until the paraffin is completely set.

Rapid Method of making Permanent Preparations of Frozen Sections.†—J. H. Wright makes preparations fully equal to paraffin or celloidin sections by the following procedure:—A piece of tissue not exceeding 5 mm. in thickness is placed for 2 hours or more in 10 p.c. formalin, or may be boiled therein for 2 or 3 minutes. The sections made with a freezing microtome are floated on to a slide, and after the superfluous water has been run off are covered with a piece of cigarette paper. On this is placed a pad of filter paper, moistened with 95 p.c. alcohol, and after pressure has been applied the pad and cigarette paper are removed. The section is then flooded with absolute alcohol, and after this has been drained off a very thin solution of celloidin is allowed to run over the surface of the section to adjacent parts of the slide. After draining off any superfluous celloidin solution, the slide is flooded with 95 p.c. alcohol, and then at once plunged in water for 10 seconds. The section may now be stained by any method. It is then dehydrated in 95 p.c. alcohol, followed by a little absolute alcohol, after which it is cleared with oil of origanum and mounted in balsam. Alcohol or Zenker's fluid may be used for fixing instead of formalin, but then the piece of tissue must be thoroughly washed in water to remove the fixative.

This method not only prevents distortion of the section by dehydrating and clearing agents, but it also saves much time, and a diagnosis may be made within a few minutes after the specimen is received.

* Zeitschr. wiss. Mikr., xviii. (1902) pp. 286–8 (1 fig.).

† Mallory and Wright, Pathological Technique, Philadelphia, 1901, p. 417. See Journ. App. Microscopy, v. (1902) pp. 1670–1.

(4) Staining and Injecting.

Staining Malaria Parasites.*—G. Giemsa contends that methylen-azur is the effective agent in the solutions used for staining malaria parasites, and that the part played by the eosin salts of methylen-blue and methylen-violet has been much overrated. He mixes together 19 ccm. of 0·005 p.c. eosin (Höchst) solution and 1 ccm. of 0·08 p.c. solution of agar. The staining takes only a few minutes, and the preparations only require to be washed in water.

Method for Washing, Staining, and Dehydrating Small Specimens.†—The apparatus used by J. R. Slonaker for dehydrating, washing, or staining small objects consists of a circular board about 12 in. in diameter, on the radii of which are fastened a number of trough-like tin pieces for holding suitable sized vials securely. The wheel is made to revolve slowly (about once or twice a minute) in a vertical plane by any desired method, the writer making use of a water motor for the power, and an old clock gear to reduce the speed.

Intra vitam Staining of Fungi.‡—J. Plato and H. Guth record the appearances observed from *intra vitam* staining of *Penicillium brevicaule* and some *Trichophyta*. The staining solution consisted of neutral red 1 to 50,000—100,000 physiological salt solution; when used so much KHO was added as to impart to the neutral red solution an orange-yellow hue. Pieces cut out of the margin of a 3 to 4 days' old culture were placed in flat capsules containing some of the staining solution. The piece was examined under a low power from time to time, and when the ends of the filaments were found to be stained (10 minutes to 1 hour) the piece of culture was placed on a slide and then a cover-glass applied, some distilled water being run under to prevent the preparation from drying.

New Method for Staining in Bulk.§—A. Spuler uses finely powdered cochineal boiled in distilled water, and after filtering evaporates nearly to dryness. The mass is then treated with alcohol, filtered and evaporated, after which it is dissolved in distilled water. In this solution the pieces are incubated for 24 hours or longer. They are then washed, and mordanted in a dilute iron-alum bath by which the colour is changed from red to black. After having been thoroughly washed the pieces are imbedded and sectioned.

For projection purposes this procedure is extremely suitable as the outlines are well defined and the colour black.

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

Preserving and Mounting Rotifera.‖—C. F. Rousselet first isolates the rotifers, picking them up under a dissecting Microscope with a fine teat-pipette and then placing them in a watch-glass half full of perfectly

* Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 429–30.

† Journ. App. Micr., v. (1902) pp. 1645-6 (1 fig.).

‡ Zeitschr. f. Hygiene u. Infekt., xxxviii. (1901) p. 319. See Centralbl. Bakt., 1te Abt., xxxi. (1902) p. 190.

§ Deutsche Med. Wochenschr., xxvii. (1901) ver.-beil., p. 116.

‖ Knowledge, xxv. (1902) pp. 68 and 91.

clean water. The animals are now narcotised with (1) 2 p.c. solution of hydrochlorate of cocain 3 parts, alcohol 1 part, water 6 parts; or (2) 1 p.c. aqueous solution of hydrochloride of eucain. The narcotic is added drop by drop until the movements slacken or almost cease, the time varying from 15 minutes to several hours, according to the species. The animals are next killed and fixed with $\frac{1}{4}$ p.c. osmic acid, with Flemming's chrom-aceto-osmic fluid, or with Hermann's platino-aceto-osmic mixture, the preference being given to the last. One drop of the fixative is sufficient. After a few minutes the animals are washed several times in clean water, for marine rotifers sea-water being used. The rotifers are then removed to $2\frac{1}{2}$ p.c. formalin, made by mixing 2·5 ccm. of commercial formaldehyde with 37·5 ccm. of water. In this fluid they may be kept, or mounted therein in ground-out cells or in shallow built-up cells. When mounting, place a drop of the formalin solution in the cell and transfer the rotifers. Place another drop of formalin by the side of the cell, lower the cover-slip on this drop, and then push the slip cautiously and gradually over the cell. The superfluous fluid is removed with blotting-paper and the cell closed with dammar gold-size cement. To do this, first run round a varnish consisting of two-thirds dammar in benzol and one-third gold-size, then two coats of pure shellac dissolved in alcohol, and finally 4 or 5 coats of pure gold-size, with an interval of 24 hours for each coat.

(6) Miscellaneous.

Method of Preserving Museum Specimens.* — H. Galt has found the following solution to give better results than the Kaiserling fluid for preserving museum specimens:—Common salt 5 oz., potassium nitrate 1 oz., chloral hydrate 1 oz., water 100 oz. The preliminary treatment consists in washing the specimen in water, and after properly trimming it immersing it in methylated spirits for a time corresponding to its size. 0·5 p.c. formalin may be added to the spirit.

Method for Demonstrating the Framework of Organs.† — Dr. J. M. Flint describes an extension of Spalteholz's method of demonstrating the framework of organs. The pieces should not exceed 3 mm. in thickness, the other dimensions being immaterial. The tissue from which the piece is taken is first fixed with Van Gehuchten's fluid (glacial acetic acid 10 parts, chloroform 30 parts, absolute alcohol 60 parts), or with graded alcohols. After fixation, the tissue is dehydrated and then transferred to ether, and the fat extracted in a Soxhlet apparatus. When all the free fat has been removed, the tissue is dehydrated in graded alcohols, and then having been again washed with water, is treated with pancreatin. The process of digestion is watched from time to time under the Microscope, and when digestion is complete nothing but the framework remains. When this stage is reached, the tissue is washed in distilled water and cleared with glycerin. The framework can then be studied with the stereoscopic Microscope.

After a study of the framework in the three dimensions, the piece may be cut up for permanent preparations. The glycerin is washed

* Lancet, 1901, ii. pp. 1334–5.

† Johns Hopkins Hosp. Bull., xiii. (1902) pp. 48–52 (1 fig.).

out, and after imbedding in paraffin or celloidin, sections are made. These sections may be stained and mounted in various ways.

Burette for Removing Definite Quantities of Sterile Fluids.*—Dr. St. Epstein describes an apparatus for removing measured quantities of sterile fluids. It consists of a flask A (fig. 92), fitted with a cap C. In the cap are two openings, one for a side tube R plugged at Z with cotton-wool, the other D, melted into the cap, carries a burette B, the lower end of which can be closed at N by means of the rod K. The lower end of the burette is protected by the guard M, and its upper end

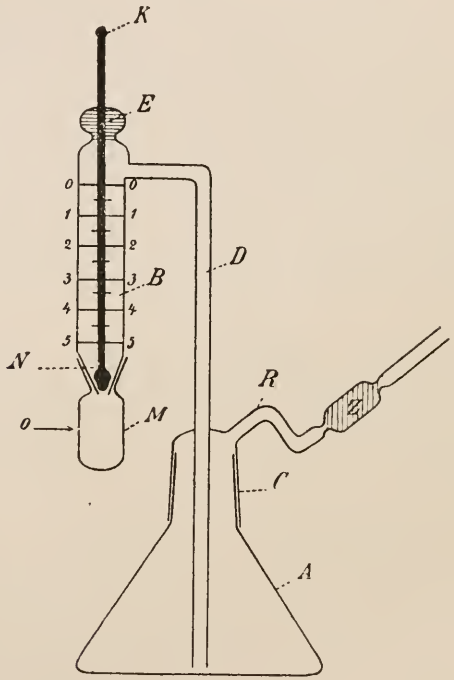


Fig. 92.

is plugged with cotton-wool E. The apparatus may be sterilised with or without fluid. By blowing down the tube R the sterile liquid in A is driven up into the burette B, from which any desired quantity can be removed by raising or turning the rod K. After use the cup-guard M is replaced and pressed against the end of the burette which is vaselined. In M is a minute hole *o* to let the air escape.

"Hanging-Block" Preparation for observing developing Bacteria.†—A. W. Hill cuts a cube of agar from a Petri dish of solidified jelly. The organism to be examined—taken from emulsions, from solid cul-

* Centralbl. Bakt., 1te Abt. Orig., xxxi. (1902) pp. 335–6 (1 fig.).
† Proc. Amer. Soc. Bacteriol. See Journ. App. Micr., v. (1902) p. 1713.

tures, or from a liquid culture—is smeared over the surface of the agar. After drying the cube at 37° for 10 minutes, a cover-glass is applied to the inoculated surface and sealed in place by running a little melted agar round the edges. The block and cover-glass are then placed over the opening in a moist chamber, the block lowermost, and the Microscope focussed upon the bacteria.

Ink for Writing on Glass.*—W. R. Hubbert states that the ink used at the University of Berne for writing on glass is very satisfactory. It consists of a mixture of 3 parts of a 13 p.c. solution of shellac in alcohol in the cold and 5 parts of the same strength solution of borax in distilled water. The solutions are mixed a drop at a time, and if a precipitate form the mixture is heated until clear. Methylen-blue is added to colour it a deep blue.

New Reversible Live-Box.—The live-box (fig. 93) exhibited by Mr. T. D. Ersser at the Meeting on April 16th, is specially intended for showing under the Microscope spiders building their webs; it is also adapted for a lantern-slide, the images being clearly defined when thrown on the screen.

The apparatus consists of two brass plates with a circular box

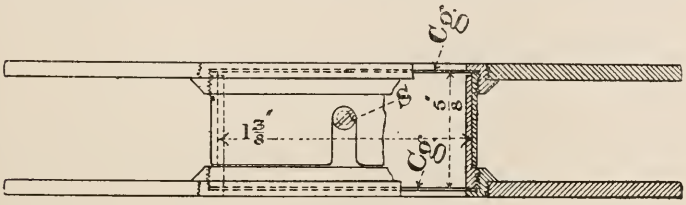


Fig. 93.

attachment to each, the one fitting over the other. A screw S, tapped into the inner box, passes through a slot cut in the outer one, thus keeping the two rings taut and in position. The box attachments when closed in with thin glass form a cell, the diameter of which is $1\frac{3}{8}$ in. and the depth $\frac{5}{8}$ in. They can be unscrewed for the purpose of replacing the cover-glass C*g*.

Cattle Plague.†—M. Nicolle and Adil-Bey, continuing their researches on rinderpest, offer some general observations on the factors concerned in the filtration of fluids containing bacteria, such as the thickness and porosity of the filter bougie, the temperature and pressure at which the operation is conducted, the medium in which the organisms are suspended and the degree of concentration, and also the biological characters of the organisms with respect to size and motility. Under the term *Plasmisation* the authors describe an ingenious method of clearing turbid fluid as a preliminary to filtration. Plasmisation consists of the addition to any turbid fluid of one-tenth of its volume of horse's plasma (obtained by refrigerating the blood), mixing the fluids

* Journ. App. Micr., v. (1902) p. 1680.
† Ann. Inst. Pasteur, xvi. (1902) pp. 56–64.

intimately, and allowing coagulation to take place; the resulting clot carries down the suspended particles and allows the clear fluid to be decanted off.

As the result of their numerous experiments with the filtrates of various infective materials, e.g. brain emulsion, peritoneal fluid, fæces, &c., the authors conclude that the specific micro-organism of rinderpest is "invisible"—that it is too minute to be detected with any of the present combinations of microscopical lenses, or to be demonstrated by any known method of staining; and further, that under ordinary conditions the walls of the porcelain filter candle, Berkfeld or Chamberland, do not offer any resistance to its passage.

The authors further suggest that this organism habitually occurs within the bodies of the leucocytes, and cite the observations of Kolle, who centrifugalised defibrinated virulent blood, and proved that whilst the serum thus obtained was inactive, the deposit remained virulent.

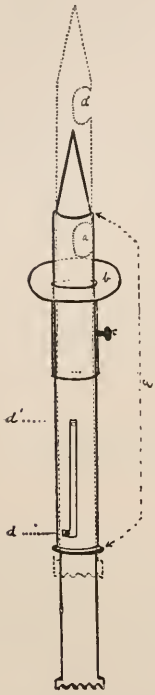


Fig. 94.

Trocar for the Aseptic Collection of Portions of Tumours.*—Dr. Cohn has devised what appears to be an extremely useful instrument for the purpose of removing portions of tumours, &c. for bacteriological examination.

It consists of a metal trocar and cannula (see fig. 94), the former having a small cavity *a* with cutting edges, excavated from the metal just above its point, the cavity being concealed in the cannula *e*, which in turn carries a movable disc *b*. The latter is clamped by the screw *c*, to regulate the depth of penetration of the point of the instrument. Sterilisation is easily effected either by boiling or by hot air. In using the instrument the point is plunged into the tumour, a half-turn of the handle releases a small bayonet-catch *d*, running in a slot in the cannula, and allows the point of the instrument to be protruded beyond the end of the cannula sufficiently to expose the cavity (as indicated by the dotted lines), into which some of the tissue naturally finds its way. Drawing back the handle of the instrument and returning the knob to its original position cuts off the enclosed piece of tissue, and at the same time protects it from accidental contamination when the instrument is finally removed from the tumour.

Properties of Steel Castings.†—J. O. Arnold has undertaken researches to ascertain the best standard composition for steel castings, and gives, by way of instalment, the results of his examination of nearly pure carbon-irons. Many specimens of such steels, as cast and as annealed, were tested. He concludes that pure iron and carbon steel is not a suitable material for fulfilling the modern specifications drafted

* Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 625-6.
† Metallographist, v. (1902) pp. 2-24 (13 figs.).

by engineers for steel castings. With iron and carbon castings the ductility demanded can be ensured with ease, but with such ductility it is impossible to correlate the required tenacity. The latter property, it is true, can be obtained from iron and carbon castings, but at the expense of an almost complete loss of ductility.

Alloys of Copper and Tin.*—W. Campbell, in a paper read before the Institution of Mechanical Engineers,† divides these alloys into seven classes according to their percentage of copper. The paper is illustrated by an excellent series of photographs, from which it appears that the branch *e* in the Roberts-Austen freezing-point curve of copper-tin alloys must be one of change in the solid. When the many and distinct different structures in the series, produced by quenching at different temperatures, and by reheating and then quenching, are considered, it is quite evident that the changes which take place during the cooling of a copper-tin alloy, especially in the neighbourhood of the second eutectic, are even more numerous than those of the carbon-irons.

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Centralbl. Bakt., 2te Abt., VIII. (1902) pp. 370–7 (2 figs.).

* Nature, No. 1685, pp. 354–6 (10 figs.). † December 20, 1901.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Zeiss' Stand for Brain Sections.†—This stand is shown in fig. 95. The upper part is fitted with Berger's micrometer movement and with a very wide external tube. The draw-out tube is worked by hand motion, and has a collar which serves as a handle. The crane-like tube-carrier

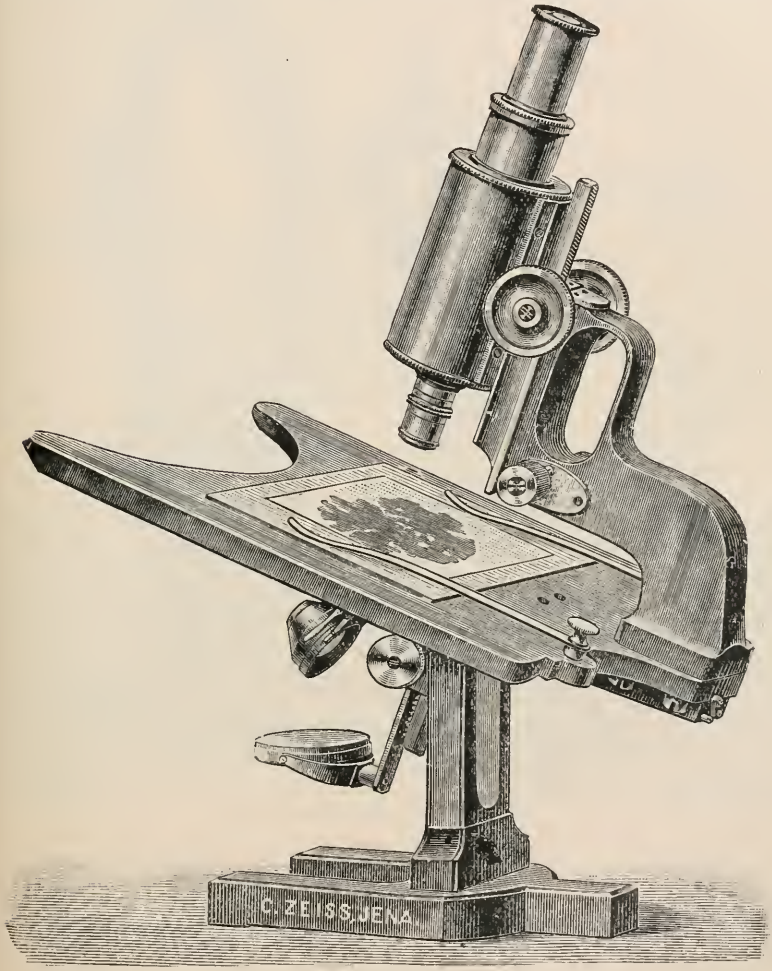

FIG. 95.

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

† Zeiss' Catalogue, 1902, No. 70, fig. 26, p. 56.

is unusually deeply cut out, so that the optical axis of the tube can lie over the centre of a 250 by 250 mm. object-stage. The form of stand especially adapts it for the examination of brain sections or other such extensive preparations.

Czapski's Cornea-Microscope.*—Fig. 96 shows this instrument with its base-plate and Everbusch chin-holder. The Greenhough binocular

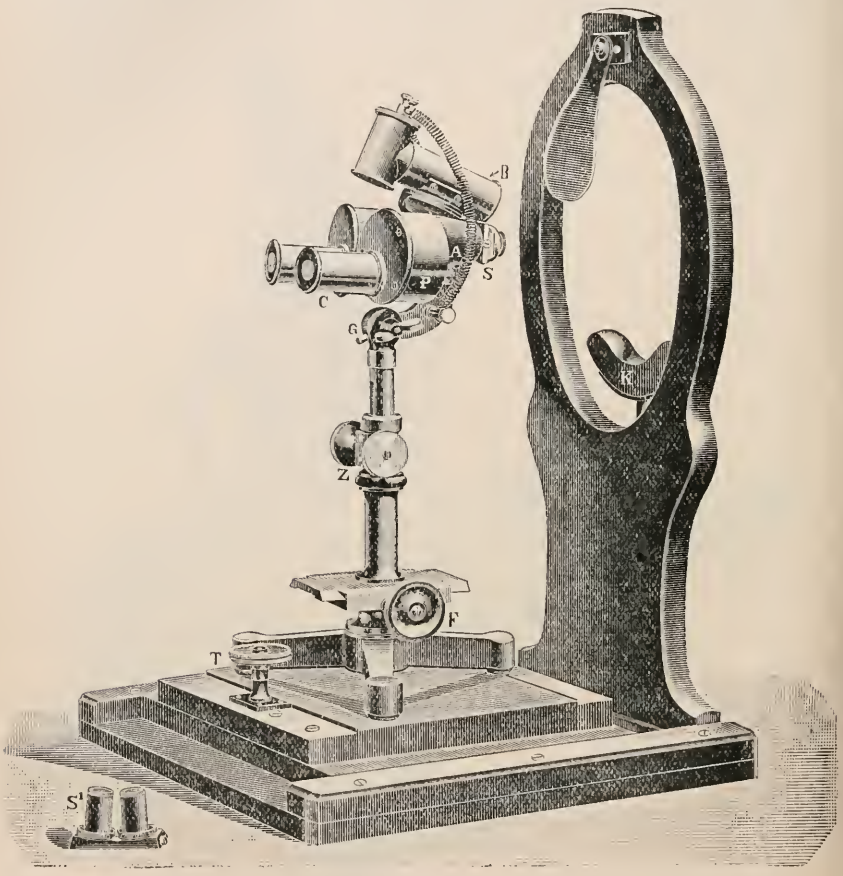

Fig. 96.

is, in this case, provided over the centre line between the double tubes, with an illuminating tube, whose axes converge to the same point as the axes of the two Microscopes. In this tube is an incandescent electric lamp with a two-strand illuminating system so that the most favourable light for the examination of the patient's eye can be found. The whole of the upper part can rotate and be clamped in a vertical plane about a

* Zeiss' Catalogue, 1902, No. 98, fig. 37, p. 76.

horizontal axis formed by a hinge. The instrument is also rotatory about a vertical axis. A rack-and-pinion adjusts the height and a second rack-and-pinion the horizontal distance from the object. The base-plate, on which the whole is mounted, can also be moved in two horizontal directions mutually perpendicular. The movement from front to rear is freehand and from left to right by the milled head T.

Zeiss' Preparation Stand and Drawing Apparatus for Weak Magnifications.* — This apparatus (fig. 97) not only satisfies all the

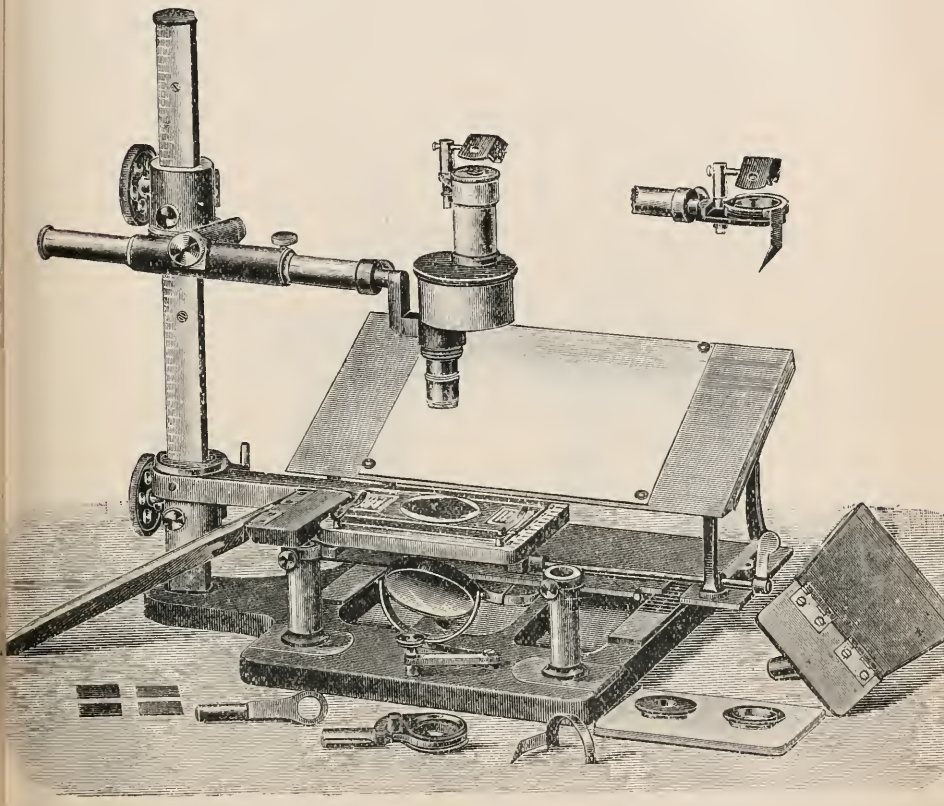

Fig. 97.

requirements of a preparation Microscope, but also serves for the drawing of objects within increased limits of scale-selection. Two horizontal arms are movable up and down on the strong brass pillar to the left. The upper one bears at its extremity a perforation for receiving the various holders for loups, spectacle-glasses, or an erecting Microscope. The lower arm is a frame-shaped object-table for receiving a plate of glass, metal, or wood. Illumination is obtained by transmitted light

* Zeiss' Catalogue, 1902, No. 102, fig. 39, p. 75.

from a mirror set in a universal joint in the base-plate. The drawing-board is pushed up and down on a desk-shaped stand at an angle of 25°. This frame can be slid backwards and forwards in a groove of the base-plate. Scales are set on both sides of the object-table, and, in connection with the scale on the base-plate, have the effect of preserving the same magnification in a drawing of any part of a large preparation. It is also possible to draw in reduced measure, if the preparation is set on the drawing-board and the paper on the object-table.

Photo-measuring Micrometer. — A. Hilger's photo-measuring micrometer (fig. 98), though specially designed for accurate and rapid

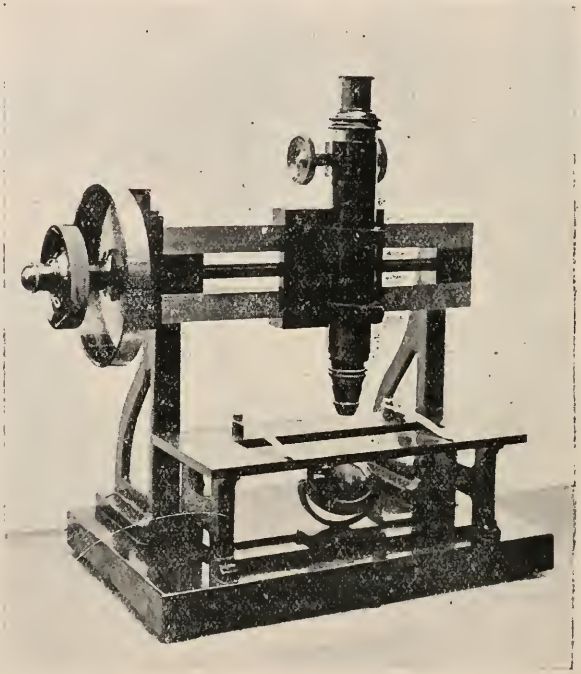

Fig. 98.

measurements of spectrum photographs, is adapted for general laboratory work. The accuracy of the instrument is attained by the careful manufacture of the steel screw, its nut, and the gun-metal Microscope-slide. Its durability is ensured by simplicity of design, by the provision of adequate surface-bearings on the screw and on the Microscope-slide, and by the deep thread of the screw and its substantial diameter of ½ in. As the pitch of the screw is 1 mm., and there is a large divided drum-head, the whole traverse of 6 in. can be rapidly worked over and exceedingly accurate measurements taken. The base of the instrument is of cast iron, and the Microscope-slide is mounted on two cast iron standards.

(2) Eye-pieces and Objectives.

Zeiss' Objectives.*—The Zeiss firm guarantee that their achromats and apochromats may now be classed among durable objectives, and may, without hesitation, be used even under such unfavourable climatic conditions as obtain in maritime and tropical districts.

In the achromats E and F the guaranteed minimum value of the numerical aperture has been raised from 0·85 to 0·90, and in the case of the $\frac{1}{12}$-in. homogeneous-immersion from 1·25 to 1·30.

Demonstration Eye-piece.†—L. Murbach thinks that the well-known difficulty of leading a pupil to identify objects (especially when moving) under the Microscope may be got over by some kind of demonstration eye-piece, whereby both teacher and pupil may view the object at the same time. The principle of his idea is shown in fig. 99. The

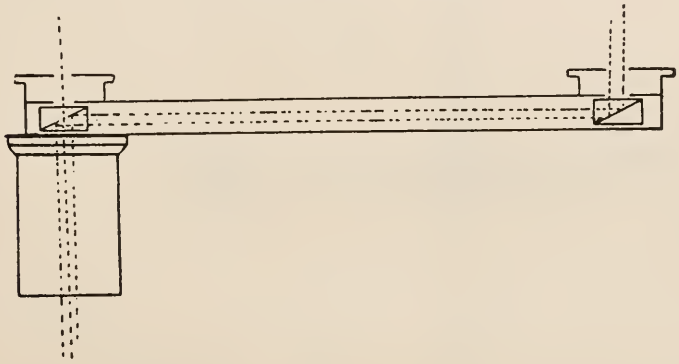

Fig. 99.

device consists of an ordinary eye-piece with cross-hairs for pointing out the object. A prism above the eye-piece is so placed as to reflect the image through a tube at right angles to the eye-piece to another prism at the end of the tube. This prism will reflect the image upward into the eye.

Oculars for General Laboratory Work.‡—J. H. Schaffner says that Microscopes intended for general laboratory work, as for example, the Bausch and Lomb BB4, are usually fitted with the 2-inch and 1-inch eye-pieces; but he recommends that the inch should be replaced by a $\frac{3}{4}$-inch, the 2-inch being retained.

Pulfrich, C.—**Ueber neuere Anwendungen der Stereoskopie und über einen hierfür bestimmten Stereo-Komparator.**

[Discusses, *inter alia*, the principles of the Microscope-Stereoscope.]

Zeit. f. Instrumenkunde, XXII. (1902) pp. 65–81 (4 figs.).

Strehl, K.—**Ueber die Gauss-Bedingung bei Mikroskopobjektiven.**

[Explains the principles on which apochromatic lenses are made, and how the conditions for colour-correction are determined.]

Central-Zeit. f. Opt. u. Mech., XXIII. (1902) pp. 76–7.

* Zeiss' Catalogue, 1902, and special circular.

† Journ. App. Micr., v. (1902) p. 1648 (1 fig.). ‡ Tom. cit., p. 1646.

(3) Illuminating and other Apparatus.

Giltsch's Drawing Stand.*—This simple apparatus (fig. 100) is intended for use with a drawing-prism (camera lucida) or the large Abbe drawing apparatus. Ordinary pocket-loups or spectacle-glasses may be used.

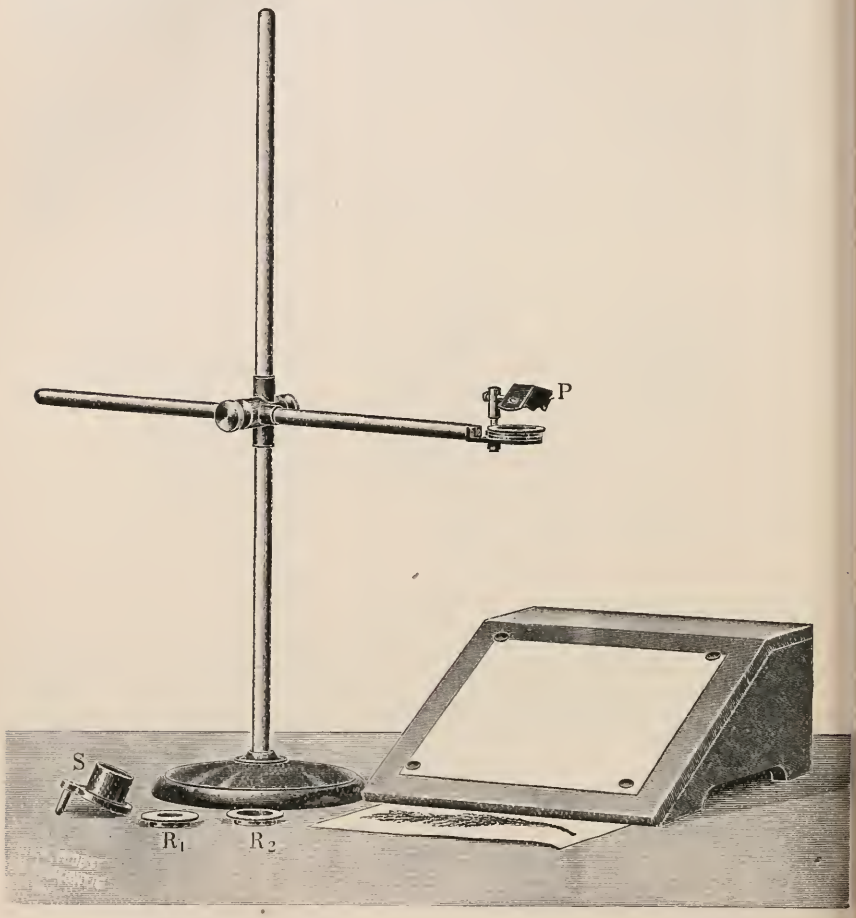

Fig. 100.

The Apertometer and its Use.†—H. F. Angus argues against the neglect of the apertometer and its supposed limited range of usefulness. He also points out that the objection on the score of expense vanishes if either of the two following simple forms be used, and that, except for immersion lenses, these simple instruments are amply sufficient.

* Zeiss' Catalogue, 1902, No. 116, fig. 50, p. 91.

† Journ. Quek. Micr. Club, viii. (1902) pp. 209–15 (1 fig.).

The first, which he calls the protractor apertometer (fig. 101), consists essentially of an ordinary semicircular protractor mounted on a base and supplied with two pointers, easily adjustable to indicate any angle, and an object placed at the centre on which to focus the objective under examination. In practice, a silvered cover-glass mounted on a piece of glass of the thickness of an ordinary slip, with an aperture of about 1 mm., is found the best object on which to focus. The objective is focussed in the usual manner on the edge of the aperture in the silvered surface; the protractor is then moved slightly, so that the edge

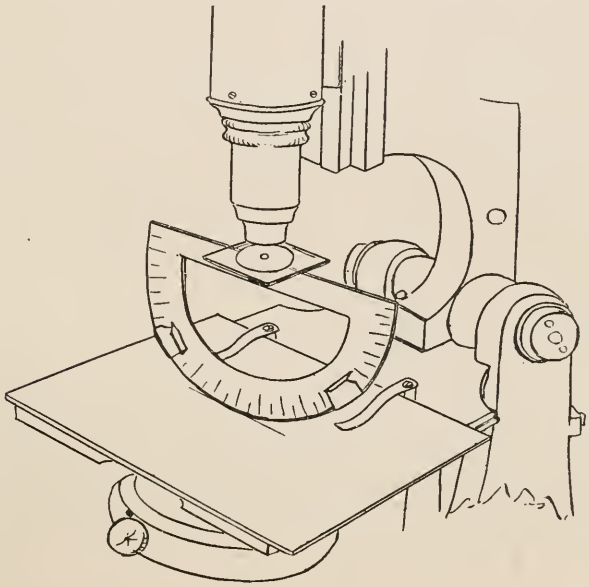

Fig. 101.

on which the focus was obtained moves out of the field, and the centre of aperture in the silver film becomes coincident with the optic axis of the Microscope; then, on removing the eye-piece and looking down the tube, the whole of that part of the protractor which the objective takes in will be found to be visible, and the pointers can be adjusted so as to touch the opposite edges of the field, the reading indicating the angular aperture. Except with very low powers, however, the image of the protractor as seen when looking down the tube is so small that some difficulty will be experienced in adjusting the pointers. To obviate this the draw-tube can be converted into an auxiliary Microscope, thus magnifying the original image. This is effected by replacing the eye-piece and screwing into the lower end of the draw-tube a very low-power objective, such as the posterior half of a 2-in. objective. Having thus obtained a reading of the actual angle embraced by the objective, it can be converted to N.A. by reference to some such table as that in Dallinger's *Carpenter*.

The second simple form is the *substage-scale* apertometer, which was

suggested to the author by F. T. Cheshire, of the Birkbeck Institute. It consists essentially of a glass disc of such diameter that it can be dropped into the stop-carrier of the condenser with which it is used, ruled with equidistant lines (a millimetre scale will be found as suitable as any). To use this piece of apparatus it is first necessary to find the value of the scale when used with any given condenser. This is effected by means of an objective of known aperture in the following manner:—The condenser and objective having been focussed on an object, the disc is inserted below the condenser, the eye-piece removed, and the number of divisions of the scale visible in the field duly noted. As in the case of the protractor apertometer, it will usually be necessary to magnify the image so obtained in order to read the scale with accuracy. When set up in this manner the scale will appear sharply defined right up to the edge of the field, provided that the aperture of the lens measured does not exceed the aplanatic aperture of the condenser. Thus, suppose the objective of known aperture to be a ½-in. of N.A. 0·34, and the condenser to be the Abbe chromatic pattern N.A. 1·20 (this is the total aperture, the aplanatic aperture is, of course, very much less, approximately N.A. 0·50), then, proceeding as above, it will be found that 8½ divisions are visible in the field, and that consequently 1 mm. of the scale with this condenser has a value of N.A. 0·04. If now another objective, say a ¼-in., be taken and 5 divisions be found visible, then the aperture will be N.A. 0·20.

The author gives a number of examples in which the apertometer is used to obtain the conditions for good dark-ground illumination.

Acetylene Gas for the Lantern.—T. D. Ersser states that he has used acetylene gas for lantern purposes for the past two years. He finds that the best apparatus is the Imperial cold generator which when worked on the gasometer principle is perfectly safe. With 20 oz. of the best calcium carbide and an argand burner, a light of over 300 candle-power, free from smoke and smell, and lasting for two hours, can be obtained at a cost of ninepence.

(4) Photomicrography.

New Method of Focussing in Photomicrography.*—Katharine Foot and Ella C. Strobell use a very simple form of vertical camera. The Microscope (an ordinary Continental model with a direct-acting screw fine adjustment) stands upon a base-board, 12 by 12 by ¾ in. thick, to which wooden uprights, which hold a bellows camera, are attached.

In the new focussing method all need for a focussing rod, or other appliance, to carry the movement of the fine adjustment screw to the sensitive plate end of the camera is obviated, neither is it necessary to project the image on to the ground-glass screen, for the correct focus is obtained even before the camera is applied to the Microscope by the simple expedient of using a spectacle lens of a certain negative strength when focussing the instrument.

The powers of the spectacle lenses suitable for given extensions of camera, and other conditions, were experimentally determined and

* Zeitschr. wiss. Mikr., xviii. (1902) pp. 421–6 (1 pl.).

recorded. Thus a Zeiss 2 mm. objective, with projection ocular 4, and a camera length of 29¾ in., measured from the Microscope stage to the sensitive plate, required a − 5 D lens.

Different planes in a thick object are photographed by focussing the Microscope upon the same point in the object, and employing spectacles of various negative strengths.

In illustration of the paper, there is a plate containing nine photomicrographs of one section of an egg of *Allolobophora fœtida*, showing the lower pole of the first maturation spindle, and two and a half of the eleven chromosomes.

The following passage, which is extracted verbatim, throws a curious side light upon the efficiency of the Continental model Microscope, with its direct-acting screw fine adjustment, when used for rough and ready cytological photomicrographic work.

"It is a waste of time to expose the plate unless the stability of the focus is assured, for the slightest change of focus during exposure destroys the sharp outlines of the image, giving that blurred effect so familiar in many photomicrographs. This slipping of the focus we have found the most troublesome factor in photography, and this danger must exist whether the vertical or horizontal camera is used, or with any method of focussing.

"A worn or an imperfect micrometer screw is not the sole cause of this trouble, for we have tested a new Zeiss Microscope and we found the focus changed so radically that after a half hour's wait, the centrosome (on which the test was made) was completely lost sight of. We are inclined to think that changing of the focus is due rather to variations of temperature to which the Microscope may be subjected, for example, in bringing it from a warm part of the laboratory and placing it close to a window, though this would seem hardly adequate to account for all the vagaries of a changing focus. Sometimes a wait of an hour or more is needed to ensure a stable focus, but fortunately these are rare occasions, as a rule ten or fifteen minutes test is all that is needed."

Photomicrographic Device.* — F. E. Ives describes a simple home-made arrangement for securing a photograph of the microscopic image without any readjustment and even without interfering with the inclination of the instrument.

A half-inch mahogany box-lid 10 in. wide and 12 in. long served as a base for the Microscope, which was held securely in place by means of stops against which it was pressed. A small shelf-bracket was fixed on each side of the Microscope so that one of the screw-holes in the bracket came exactly opposite the centre of the Microscope joint. The brackets were so separated as to just sufficiently clear all the working parts of the Microscope. The screw-holes are the points of attachment for the camera device and must occupy such a position in order that the camera may swing from the same centre as the Microscope body, and thus be adjustable by a single movement for any desired inclination. On a double-pillar Microscope the camera attachment could be adapted to swing from the centres on the Microscope itself, and the brackets could be therefore dispensed with. The camera was a simple box with a lens at one end and a plate-holder at the other—the lens of 10-in.

* Journ. Franklin Institute, cliii. (1902) pp. 371–6 (2 figs.).

focus and the distance from lens to plate 10 in. Monochromatic light is recommended. The camera has rack-and-pinion movement on a base-board having two rigidly attached arms extending forward and carrying pins to engage in the screw-holes of the brackets. Slots were cut into the screw-holes so that the pins dropped into place and an automatic lock prevented the pins from being lifted out except when the camera was swung below the horizontal plane. An adjustable telescopic strut

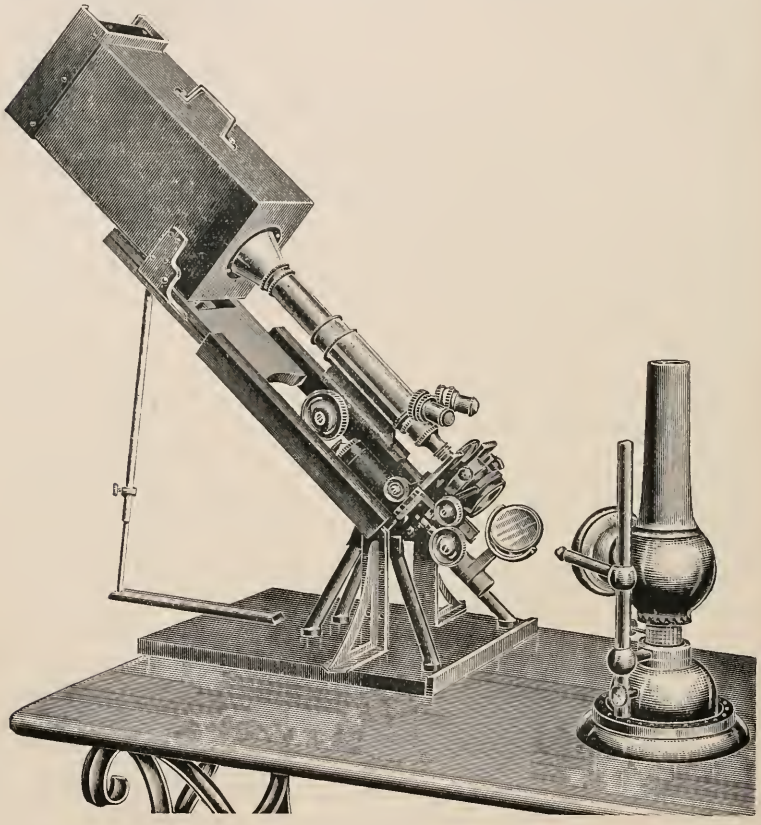

Fig. 102.

and detachable extension to the base-board supported the camera and fixed it at any desired inclination. Fig. 102 shows the device as fitted to a Swift folding Microscope, and the author seems to have been very well pleased with his results.

Photomicrography with Simple Apparatus.*—Katherine E. Golden obtains good results with the following "home-made" apparatus (fig. 103). An inch board about 40 in. long and 12 in. wide carries near the lower

* Journ. App. Micr., v. (1902) pp. 1681–3 (3 figs.).

end a shelf for supporting the Microscope. Near the upper end is a sliding-piece to which is attached the box or bellows of an ordinary camera. Under the shelf another piece of board is fastened to the first at right angles: this assists in supporting the shelf and also serves as a leg to help keep the apparatus in an upright position. The lens of the camera is removed and a washer of felt is glued to the edge of the collar, so as to make a light-tight connection with the eye-piece of the Microscope. A slit is made in the side of the collar, and through this slit is fitted an elliptic-shaped piece of metal having a round opening in one side, the other side being left entire, and also having a piece of the metal projecting on one side of the ellipse to be used as a handle. The elliptic piece is the shutter for admitting or cutting off the light, and is manipulated by the projecting handle. Specimens of the results obtained are given.

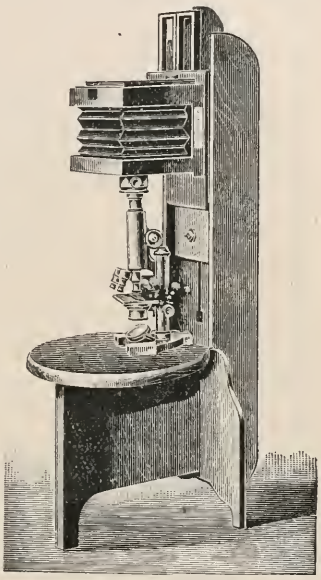

Fig. 103.

Photomicrographs on Gelatino-bromide Films.* — W. Forgan, in a lecture before the Edinburgh Photographic Society, narrates how he cleared up the doubt as to the suitability of collodion or gelatino-bromide plates for photographing eclipses. Microscopical examination showed that the grains of silver in the two plates were of practically equal size, viz. about $\frac{1}{19000}$th of an inch in diameter. The method of preparation, however, of a collodion plate has the effect of covering only the surface with a film of silver; whereas, in the other plate, the silver is thoroughly dispersed throughout the whole medium. This fact seems to account for the superior rapidity of the gelatino-bromide. But the more rapid the action of the plate, the coarser was the granulation. In the ordinary plates the silver grains are in a more scattered form, and the granulation, therefore, finer. Hence, the maker's advice to use ordinary plates wherever possible, is based on sound principles. For astronomical photography, especially for negatives where delicate measurements afterwards require to be made, a slow ordinary plate is an essential requisite.

(5) Microscopical Optics and Manipulation.

Prisms and Plates for showing Dichromatism.† — R. W. Wood describes how to observe the property of dichromatism, i.e. the change of colour of an absorbing medium with increase of thickness. Thus thin

* Eng. Mech., lxxv. (April 18, 1902) p. 203.
† Nature, lxvi. (1902) p. 31.

layers of such a medium might be bright green and thick layers blood-red. The principle is that the medium should transmit two distinct regions of the spectrum, the absorption coefficient for one being greater than for the other. Mr. Wood's method is to boil a quantity of Canada balsam in an evaporating dish until a drop placed on a cold surface becomes quite hard. A dye is made of commercial "brilliant green" but must not be added until the balsam has cooled almost to the point of becoming thick, otherwise it will be decomposed and produce a very muddy green. Enough brilliant green must be dissolved in the balsam to make it appear deep red in layers 1·5 cm. thick. This layer will be found to be blue. It is desirable to add some naphthol yellow in quantity sufficient to change the tint of thin layers from blue to green. A hollow prism is now made by fastening two pieces of thin plate glass between two grooved strips of wood. The base of the prism should be about 2 cm. thick if the strips are 4 cm. long. The plates are warmed with a flame and the coloured balsam poured between them. After the balsam has cooled it is a good plan to run a quantity of melted sealing-wax upon the top of it, which strengthens the prism. An incandescent lamp or gas flame viewed through the prism is seen divided into a green and a red image, the former gradually fading away as the eye is moved towards the base of the prism. If a larger amount of the colouring matter be added to the balsam and the fluid be pressed out between pieces of plate glass, screens can be made which transmit a very good secondary yellow. Through these screens a sodium flame is absolutely invisible, though a gas flame appears of a colour very closely resembling the soda flame. The colour of the transmitted light depends also on the original composition of the light. By a suitable adjustment of the dyes a screen can be made which appears red by lamplight and green by daylight, illustrating very well the peculiarity of the alexandrite crystals.

Stopping Down the Lens of the Human Eye.* — W. Andrews suggests that the optical properties of the human eye may be improved by using a metal plate with a perforation one-fiftieth of an inch in diameter. This acts like a stop in a compound lens and renders unnecessary the use of spectacles.

Gerald Molloy points out that a pair of spectacles on the above principle was made and used by the late Lord Sherbrooke, who was an albino, and had no pigment in his iris. These spectacles consisted of two convex metal cups closely resembling in size and shape the bowl of an ordinary tea-spoon. In the centre of each was a small pin-hole which was the only aperture through which light could enter.

MERLIN, A.—**On the Critical Employment of the Microscope for Ordinary Working Purposes.**

[A very useful paper, full of practical and valuable hints.]

Journ. Quek. Micr. Club, VIII. (1902) pp. 195–209.

(6) Miscellaneous.

Holder for Metallurgical Work.—This apparatus (Fig. 104), made by W. Watson & Sons, consists of two rotating jaws attached to the end

* Nature, lxvi. (1902) pp. 31 and 56.

of screws which work through arms mounted on a base, so as to raise them above the surface of the stage.

It will be seen that the metal substance which is to be examined can be set at any desired angle to the objective and also rotated, thus obviating the necessity of mounting specimens on glass slips, and rendering unnecessary the use of a levelling surface to the stage.

The apparatus shown in the illustration is intended to be used with a Microscope having a large central aperture, but another design is in use for square stages, the outer edges of which are gripped by a frame carrying the screws and jaws.

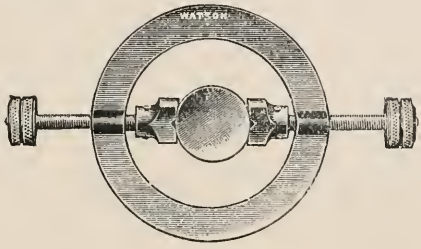

Fig. 104.

Certain Minute Structure observed in some forms of Triceratium.*—A. A. Merlin notes that a variety of *Triceratium parallelum* from the Oamaru deposit, resembling the ordinary form in size, shape, and general appearance, but not identical in detail, has been found to possess a delicate lacework structure apparently covering the whole of the silex composing the upper surface of the valve, and extending to and closely surrounding the primaries. Subsequently a similar but even finer network was observed on the outer surface of a typical *T. parallelum*. This is an excessively faint and difficult object and is close to the limit of visibility with a fine Zeiss 3 mm. apochromat of N.A. 1·426, illuminated by the full cone of Powell's dry adjustable apochromatic condenser. The existence of an identical network has also been noticed on a *T. glandiferum* (Grun), which could only be resolved and held for brief intervals, after long rests to the eyes in the dark, by the employment of the above objective and a solid axial cone of about N.A. 1·3 from Watson's oil-immersion condenser. All the specimens were mounted in styrax, and the author believes the appearances really existent and not ghostly diffraction effects.

Opto-Technics.†—In a paper read before the Society of Arts, Prof. Silvanus Thompson eloquently pleads for the better organisation of optical instruction in all its branches in London. He deprecates the establishment of *poly*-technics, believing that *mono*-technics would be of greater industrial service. Institutions devoted to the culture of special subjects should be developed. Dr. Thompson considers that the Bolt Court Institute, which is exclusively devoted to the technology of the printing trades, is the most successful centre of technical education in

* Journ. Quek. Micr. Club, viii. (1902) p. 267.
† Journ. Soc. Arts, l. (1902) pp. 518-30.

London. In a similar manner an Optotechnical Institute, either at the Northampton Polytechnic in Clerkenwell or elsewhere, should be organised. He sketches a scheme of studies, and dwells upon the importance of the project.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Media for distinguishing B. coli, B. typhosus, and related Species.†—A. S. Grünbaum and E. H. Hume have found that for ordinary working purposes MacConkey's medium with neutral red gives the best results, but for demonstration purposes a medium containing both neutral red and crystal violet gives very striking and instructive pictures. The medium recommended has the following composition:—agar 2 grm.; peptone 2 grm.; water 100 ccm.; made alkaline to the extent of 0·4 ccm. normal NaOH beyond the neutral (litmus) point. To this, when filtered and sterilised, are added, sod. taurocholate 0·5 grm.; lactose 1 grm.; ½ p.c. neutral red solution 1 ccm. The whole is sterilised for 15 minutes. In this medium *B. coli* and other lactose fermenters grow as red colonies; all other similar forms (*B. typhosus*, *B. paracolon*) are white, and impart to the surrounding medium an amber or orange tint. The authors also find that on lactose-agar to which both neutral red and crystal violet (1–100,000) have been added *B. coli* is red and *B. typhosus* blue to purple.

Method for the Detection of the Typhoid Bacillus in the Blood.‡—A. Castellani advocates the use of large quantities of nutrient broth for isolating the typhoid bacillus from blood, on the ground that not only the blood, but also the agglutinins it contained, would be greatly diluted, and at the same time the bactericidal properties of the blood-serum would be weakened. The technique merely consists in obtaining aseptically a few cubic centimetres of blood and at once transferring to large flasks (five or six) each containing at least 300 ccm. of faintly alkaline beef-broth. The flasks are then incubated at blood heat. In practice this method has been found to be very successful, not only by the author, but by several other investigators.

Polythermostats.§ — G. Gabritchewsky advocates the adoption of combining in one apparatus several thermostatic chambers heated to different temperatures by one and the same source of heat. The idea is ingenious, and has been successfully carried out in Moscow, Berlin, and Paris.

Hanging-drop Cultivation.‖—G. C. Karop describes the following convenient method for making hanging-drop cultures. The materials required are millboard, slides, 1 in. square covers, a soup-plate and bell-glass to fit it, white blotting-paper, and a strip or two of perforated zinc.

* 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., 1902, i. pp. 1473-4 (1 fig.).

‡ Centralbl. Bakt., 1te Abt., xxxi. (1902) pp. 477-9.

§ Tom. cit., pp. 814-6.

‖ Journ. Quek. Micr. Club, viii. (1902) pp. 265-7.

Cut the millboard into pieces 1 in. square, and punch out the centres with a $\frac{3}{4}$ or $\frac{5}{8}$ gun-wad punch. Take a strip of perforated zinc 6 in. by $2\frac{1}{2}$ in., and bend down 1 in. of the ends to a right angle to make rests for the slides while in the moist chamber. When required for studying, say, the spores of a coprophilous fungus, place one or more of the punched-out squares of millboard between two pieces of glass, with a weight on top, and soak in water for some hours. According to the size of the drop required take one or more of the squares, and after squeezing out the excess of water place in the centre of a slide. Then take a cover and ring a very thin smear of soft paraffin or vaselin just a shade smaller than the aperture in the millboard. In a clean capsule put a little of the nutrient medium and mix therein the spores; from this remove with a glass rod or dropper sufficient to form a drop and place in the centre of the ring, and then invert over the perforation in the millboard. Next place three or four layers of blotting-paper on the bottom of the soup-plate with sufficient water to saturate them, on these the zinc support, on the latter the slide with the hanging-drop, and over all the bell-jar. The foregoing procedure affords a satisfactory and easy method for studying the growth and development of the lower organisms, more particularly algæ and fungi.

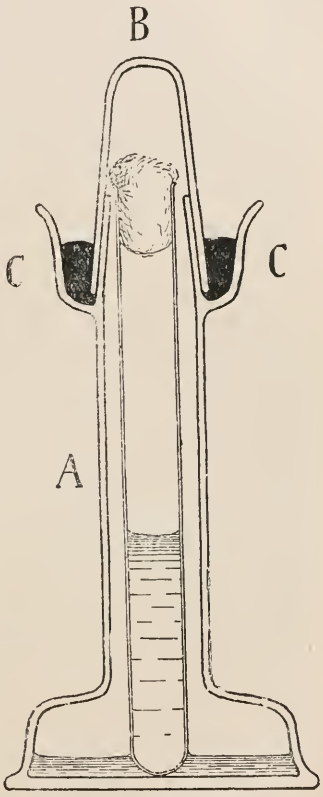

Fig. 105.

Simple Apparatus for Cultivating Anaerobes in Test-tubes.* — W. Omelianski has devised a simple and handy apparatus for anaerobic tube-cultures. It consists of two parts (fig. 105), a cylindriform vessel A and a cap B. The upper end of A is choke-bored, and its base expanded to ensure stability. The height of the whole apparatus is 20 cm.; the diameter of A in the middle is 1·8 cm., and at the base 8 cm. The cap B is ground so as to fit accurately over the narrowed upper end of A. The upturned collar with everted rim C C, which forms a sort of cup or receptacle for mercury, has a diameter of 5·5 cm. When required for use, the ground surface of the cap is smeared with a mixture of 1 part wax and 2 parts vaselin, and then a mixture of 10 ccm. of 12·5 p.c. caustic potash and 10 ccm. of 5 p.c. pyrogallol solution is poured into the bottle. The test-tube (diameter 16 mm., length 16 cm.) containing the culture is then inserted, and the cap put firmly on. The cup C is then filled with mercury in quantity sufficient to

* Centralbl. Bakt., 2te Abt., viii. (1902) pp. 711–3 (1 fig.).

cover the lower end of B. The oxygen is completely absorbed in from 1½ to 2 hours. When the cultivation is finished and it is required to take out the tube, the mercury must be poured off before the cap is removed.

Method for examining Nutrient Media.*—S. Weissbein examined ten different substances with nutrient properties (plasmon, galactogen, Heyden's medium, and others) by the aid of Pappenheim's panoptic triacid solution. Some of the powdered medium was mixed with distilled water, to which ten drops of the staining solution were added. This mixture was then centrifuged for about two minutes and then the stained sediment was examined under the Microscope. To estimate the amount of starch, about two drops of tincture of iodine were added to the sediment, and this again centrifuged. Owing to the selective action of the components and constituents of the media, different stainings of the powdered substances were obtained. As the different colourings indicate different chemical constitution, the method adopted gives much information as to the nature of a nutrient substance and its value as an artificial medium.

(2) Preparing Objects.

Simple Method of Fixing Bacteria to the Slide or Cover-Slip without Drying.†—G. von Wendt takes a loopful of a bacterial culture and mixes it with a drop of water in a watch-glass. If desired, the bacteria may be fixed by using 1–3 p.c. nitric acid or ½–3 p.c. sublimate, &c. instead of pure water. A very thin layer of Meyer's albumen-glycerin is smeared on slides or slips, and the films moistened with a few drops of water. A loopful of the bacterial suspension is then deposited in the water lying on the films. The slide or slip is then covered with a sufficiently large watch-glass. In 20–30 minutes the bacteria will have settled down, and then the covering watch-glass is removed to allow a few drops of water to be deposited on the film. The watch-glass is then replaced, and the whole is placed in an incubator at 75° for 8–10 minutes. In this way the albumen is coagulated and the bacteria fixed to the slide or slip. The watch-glass must fit tight over the slide to prevent evaporation, and must not be removed until the preparation is cooled down sufficiently, after which the films may be stained, passed through graded alcohols, and mounted in balsam.

(3) Cutting, including Imbedding and Microtomes.

Simple Method for Making Bone Sections.‡—J. F. Burkholder cuts transverse slices of bone 2–3 mm. thick with a fine saw. One surface is polished on a dry whetstone and then gummed on to a smooth piece of wood 1 by 1 by 2 cm. in size. When thoroughly dry most of the slice may be sawn off, and the rest rubbed down on the wetted whetstone until it is so thin that the grain of the wood can be clearly seen through it. By the aid of a little hot water the bone is easily separated from the wood block. Then place the section on the wetted whetstone and

* Deutsch. Med. Wochenschr., xxviii. (1902) pp. 24–6.
† Centralbl. Bakt. Orig., I^te^ Abt., xxxi. (1902) pp. 671–2.
‡ Journ. App. Micr., v. (1902) p. 1781.

rub to and fro with the ball of the finger until the papillæ are distinctly visible. Then after drying and cleaning by rubbing between the fingers, mount in balsam. Put some very thick balsam on the centre of the slide, and also on the cover-slip, then place the section on the slide and press the slip firmly down.

Improved Method of Sectioning Carbonised Wood.*—L. Wittmack and J. Buchwald saturated the material with Canada balsam or with paraffin, and then made sections of the prepared mass. Some of the sections were incinerated on platinum foil and the ash transferred to xylol or balsam. Their best results were obtained by first incinerating the wood and then working up the ash into microscopical sections. A piece of carbonised wood of suitable size was incinerated, and the residue amalgamated with hot liquid paraffin. The blocks thus obtained were sectioned. The sections, after having been straightened on the slide, were treated with xylol and mounted in balsam.

(4) Staining and Injecting.

Influence of High Temperatures on the Stainability of Bacteria.†—G. Gabritschewsky records some interesting observations on the behaviour of bacterial films to staining solutions at different high temperatures. The first series relates to acid-fast bacteria. After staining for 5 minutes with carbol fuchsin, these bacteria, *B. tuberculosis hominis, avium, piscium, B. möller ii.* (grass), *B. korn* (butter), *B. marpmann* (urine), were decolorised by 5 p.c. sulphuric acid if the preparations had been previously heated to 180° C. They still retained the Gram staining, but lost it at 190°, though up to 200° they would stain by simple solutions. In the second series were *B. anthracis, B. subtilis*, and *B. pseudo-anthracis*. Up to 160° *B. anthracis* with spores stained well with carbol-fuchsin. By Gram's method both bacilli and spores stained up to 180°, but at 190° the spores only retained the dye. In the third series cultures of diphtheria and pseudo-diphtheria showed the Ernst-Neisser granules up to 170°. By Gram's method diphtheria bacilli did not stain at 180°, while the pseudo-diphtheria retained it up to 190°.

New Method of Staining Neuroglia.‡—D. Anglade and C. Morel state that the following method gives sharper details, and is more easily managed, than the ordinary procedures. The material is hardened in a mixture composed of Fol's fluid 3 parts, and sublimate solution 7 p.c. 1 part. The preparations are placed in an autoclave at 37° for 45 hours. On removal they are washed, and then dehydrated in alcohol. After saturating in aceton (24 hours) the material is imbedded in paraffin (3 hours). The sections are stained in warm saturated aqueous solution of Grübler's Victoria-blue and heated until it vaporises. They are next treated with Gram's solution, and afterwards with a mixture of xylol 1 part, anilin oil 2 parts, after which they are imbedded in balsam, or better still, in amber-lac.

* Ber. Deutsch. Bot. Ges., xx. (1902) p. 21. See Zeitschr. wiss. Mikr., xviii. (1902) p. 508. † Centralbl. Bakt., 1te Abt., xxxi. (1902) pp. 813–4.
‡ Rev. Neurol., ix. (1901) pp. 157–8.

Staining the Grey Matter of Spinal Cord after Mordanting with Metallic Salts.*—Kadyi states that after hardening in formalin and mordanting with the acetates of uranium, lead or copper, staining with carmin is very successful. Four variants of the method are given. In the first the grey matter only is stained, the white remaining unstained. After removal from the formalin the pieces are washed and then transferred to a mixture of uranium acetate 1 p.c. and acetic acid 1 p.c., wherein they remain for a few hours to a few days according to their size. The sections are stained in 0·2–0·5 p.c. solution of carminate of soda or in ammoniacal carmin. The second procedure imparts staining to the neuroglia. The sections after having been mordanted in uranium acetate are transferred to a solution of potassium nitrate. By the third method a deep staining of the white matter is obtained, the grey remaining almost colourless. In this case the sections are treated with potassium nitrate before they are mordanted. The fourth imparts a stain to the axis-cylinders only. For this the pieces of spinal cord are hardened in neutral or alkaline formalin solution (distilled water 100; bicarbonate of soda 2; formalin 5). The 1 p.c. copper acetate mordant must not contain any free acetic acid. After the sections have been mordanted they are washed in 2 p.c. potassium nitrate, and after having been stained are differentiated in a solution composed of distilled water 100 parts; carminate of soda 1 part; potassium nitrate 2 parts. When sufficiently decolorised, the sections are washed in 2 p.c. potassium nitrate until the pigment is no longer given off, after which they are treated with absolute alcohol and chloroform and then mounted in balsam.

Staining the Medullary Sheath of Nerve-Fibres.†—W. H. Wynn fixes and hardens the material in 5 p.c. formalin, and sections it on a freezing microtome, using no gum. The sections are mordanted for 24 hours in the cold in 2 p.c. ammonium molybdate, iron-alum or uranium acetate or they may be incubated at 40° C. for a few hours. After washing, they are stained for some hours in acid hæmatoxylin, or for two hours in the incubator. They are again washed and afterwards differentiated by Pal's method: the sections are first placed in potassium permanganate solution and next in Pal's solution, the baths being alternated until the required differentiation is obtained. They are again washed, after which they are mopped up and then transferred to absolute alcohol. After draining off the alcohol they are passed through chloroform and xylol successively and mounted in balsam.

Instead of Pal's solution, Bolton's method may be used for differentiating. This consists in immersing the sections in a moderately dilute solution of ammonia by which the unattached lake is quickly dissolved out, leaving differentiation complete.

Staining the Neuro-fibrils in the Ganglion-cells of the Cerebral Cortex.‡—S. Paton immerses the material for 24 hours in a saturated solution of sublimate containing 5 p.c. acetic acid. It is then transferred to 95 p.c. alcohol which should be changed at least once a day

* Neurol. Centralbl., xx. (1901) pp. 687–8.
† Journ. Anat. Physiol., xiv. (1900) pp. 381–97 (2 pls.).
‡ Journ. Exp. Med., v. (1900–1901) pp. 21–5 (1 pl.).

during the first week and afterwards once a week. It is better to remove the sublimate in this way than to use iodine. The material is then imbedded in paraffin or in celloidin. If paraffin be selected, chloroform must be used as a solvent. When fixed to the slide the sections are treated with tinctura ferri Rademacheri for 1 or 2 hours. The preparations are then washed and stained in Apáthy's hæmatin solution for 24 hours. For differentiation a mixture of anilin oil 1 part and 70 p.c. alcohol 9 parts is used. After having been washed the sections are dehydrated and mounted in chloroform-balsam.

Methods of rendering Golgi-Sublimate Preparations permanent by Platinum Substitution.* — W. F. Robertson and J. H. Macdonald each worked out a separate process for replacing the mercurial deposit in Cox-preparations by platinum.

Robertson's method.—(1) Place the sections in a saturated solution of lithium carbonate for 15 minutes. (2) Wash in water. (3) Place in equal parts of 1 p.c. chloroplatinate of potassium and 10 p.c. citric acid for 1–2 days: keep in the dark. (4) Wash for 1 or 2 hours. (5) Place in equal parts of (*a*) saturated solution of iodine in 1 p.c. potassium iodide, and (*b*) water, for 5 minutes. (6) Wash. (7) Place for 5 minutes in a bowl of water to which 2 or 3 drops of strong ammonia have been added. (8) Wash. (9) Dehydrate in absolute alcohol. (10) Clear in benzol. (11) Mount in benzol-balsam.

Macdonald's method.—Wash the tissue which has previously been treated by Cox's method in a large quantity of water, overnight. Transfer to rectified spirit for half an hour. Cut on a Cathcart's microtome by Coat's method. Transfer the sections to rectified spirit, and when a sufficient number have been obtained proceed as follows:— (1) Transfer to distilled water for a few minutes. (2) Place for 24 hours in (? mixture of) solution i. ♏ 120; solution ii. ♏ 30. Solution i. is 1 p.c. chloroplatinate of potassium. Solution ii. consists of sodium hypophosphite $1\frac{1}{2}$ oz.; sodium sulphite $\frac{3}{4}$ oz.; sodium chloride $\frac{1}{4}$ oz.; water 10 oz.. (3) Transfer to one in eighty hydrochloric acid for 2 minutes and repeat the bath twice. (4) Transfer to solution ii. for 10 minutes. (5) Then to equal parts of (*a*) 1 p.c. iodine in rectified spirit; (*b*) distilled water, until the sections are of the same colour as the solution. (6) Clear, and fix in solution ii. for 10 minutes. (7) Wash for 2 hours. (8) Dehydrate and then clear in benzol and mount in benzol-balsam.

The sections must be manipulated with a brush or quill as metal lifters and needles are inadmissible. For washing the sections and making the solutions distilled water must always be used.

Acid-fuchsin Staining for Degenerated Nerve-Fibres.†—R. Kolster who has made careful investigation as to the value of acid-fuchsin for staining degenerated nerve-fibres, a method invented by Hovén of Copenhagen in 1884, remarks that to obtain good results the material must be exposed to the influence of chromic acid solutions for a long time, e.g. five months in Müller's fluid. The after-hardening in alcohol should not take more than about two weeks. After this the material is imbedded in celloidin and the sections stained with saturated aqueous

* Journ. Mental Sci., xlvii. (1901) pp. 327–30.

† Deutsche Zeitschr. f. Nervenheilk., xx. (1901) pp. 29–34 (1 pl.).

solution of acid-fuchsin (Weigert's) for 1–24 hours. After washing in water they are differentiated in alcoholic solution of caustic potash. The decoloration is continued until the grey substance becomes clearly visible, after which the sections are washed in water, dehydrated, cleared in xylol, and mounted in balsam. The axis-cylinders of the degenerated fibres are clearly traceable by their dark red colour, while the healthy fibres are almost unstained.

The author's results differ somewhat from those obtained by Hovén, possibly owing to slight differences in the composition of the pigments employed.

New Method of Flagella Staining.*—A. J. Kendall describes the following procedure for staining flagella. The bacteria are properly diluted on the cover-glass by adding to a tube containing 5 ccm. of sterile water enough of an 18–24 hours agar culture to produce a faint turbidity in the upper half of the water. The tube is then placed in an incubator run at the optimum temperature for the particular species for one hour. Two or three drops are then placed on a cover-glass and allowed to dry spontaneously at the temperature of incubator. The film is fixed in the flame and stained by Pitfield's method. Pitfield's mordant consists of 10 p.c. aqueous solution of tannic acid 10 ccm., saturated aqueous solution of corrosive sublimate 5 ccm., saturated aqueous solution of alum 5 ccm., carbol fuchsin 5 ccm. The stain is composed of saturated aqueous solution of alum 10 ccm., saturated aqueous solution of gentian-violet 2 ccm. The film is hot-mordanted for about a minute, after which it is washed, then hot-stained, dried, and mounted.

Staining Mast-Cells and the Chromatin of Malaria Parasites.†—L. B. Goldhorn gives three methods for staining mast-cells. (1) Saturate wood-alcohol with dahlia or methylen-blue and pour the solution on a freshly made blood-smear without previous fixation. (2) Methylen-blue is rendered polychrome and then acidulated with glacial acetic acid. The polychrome solution is made by dissolving 4 grm. of the pigment and 4 grm. of lithium carbonate in 300 ccm. of warm water and heating for 15 minutes in a water-bath. The solution is poured into a bottle and after a lapse of several days is rendered faintly alkaline by adding some 4–5 p.c. acetic acid. Next add 5 p.c. eosin solution, and then filter. Dry the mass on filter in a hot-air oven, and then dissolve in wood-alcohol. (3) Saturate wood-alcohol with methylen-blue, and stain the film for about 15 seconds. Wash in water, and stain in 0·1 p.c. aqueous eosin for from 15 to 30 seconds.

The author also gives a method for staining the malaria parasite. Dry the films and fix in methyl-alcohol for 15 seconds, wash. Stain in 0·1–0·2 p.c. aqueous solution of eosin for 7–30 seconds, wash. Stain in polychrome methylen-blue solution for 30 seconds to 2 minutes, wash thoroughly. Dry in air.

(6) Miscellaneous.

Improved Method of Making Collodion Sacs.‡—N. M. Harris describes a method of making collodion sacs which is an improvement on

* Journ. App. Micr., v. (1902) p. 1836. † Tom. cit., pp. 1635 and 1867.
‡ Bull. Johns Hopkins Hosp., xiii. (1902) pp. 112–5 (3 figs.).

those of Trudeau and McCrae. The materials employed are empty gelatin capsules, glass tubing, celloidin or collodion solution, a drying rack, blow-pipe flame, and a small file.

The end of the glass tubing is heated in the burner and while still hot is passed through the lid of the capsule. When cool the capsule is plunged in the celloidin solution and afterwards placed on the rack to dry. The coated capsule is then filled with broth by means of a Pasteur pipette and then immersed, glass tube end downwards, in a broth culture tube and autoclaved at 1 atmosphere for 5 minutes at 120°. By this procedure the gelatin becomes dissolved in the broth. The gelatin may, however, be removed by washing out the sac with hot water.

After inoculating the medium in the sac by the aid of a Pasteur pipette the glass tube is sealed up, a procedure requiring considerable care and skill.

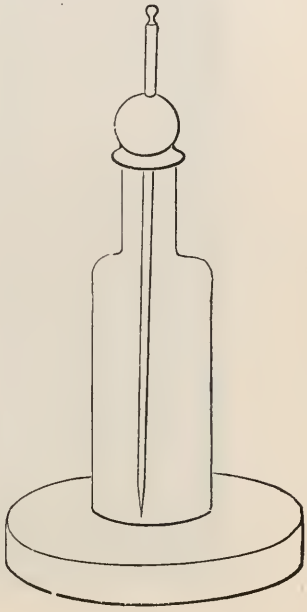

Fig. 106.

Method for Cleaning Slides.* — L. Jones recommends a washing powder known as "Gold Dust" for cleaning old and dirty slides. A strong solution is heated to boiling and then removed from the fire. As many slides as the vessel will hold are at once dumped in and left there for half an hour or so, but should be moved about occasionally. On removing the slides they should be washed in water and then dried or passed through alcohol and then wiped. Usually one bath is quite sufficient.

Bottle for Cedar-Wood Oil.—F. Tiessen, of Breslau, makes a bottle for cedar-wood oil, which has some useful features. An ordinary glass phial (fig. 106) is fixed to a circular leaden base: this ensures stability. The stopper is a sphere of hard rubber or vulcanite. This ball is perforated to allow the passage of a long stem, the upper end of which serves as a handle and the lower end as the dropper. As the stem is not fixed in the ball it can be pushed up and down so as to regulate the length for the quantity of oil in the bottle.

Germ- and Water-tight Stopper for Flasks.†—Dr. H. Schottmüller describes a stopper which is air- and water-tight and also prevents the entrance of germs. The stopper proper is fixed to the inside of a cap which goes over the neck of the bottle. The outer surface of the stopper and the inner surface of the neck are ground to fit accurately. The neck of the bottle has a double lip to prevent the layer of cotton-wool which is wound round the neck from getting wetted when fluid is poured out.

* Journ. App. Micr., v. (1902) p. 1781.

† Centralbl. Bakt., 1te Abt., xxx. (1901) pp. 875–7 (3 figs.).

The layer of cotton-wool prevents the entry of germs from without. The apparatus is sterilised in the usual way (figs. 107–109).

Fig. 107.

Fig. 108.

Fig. 109.

Micro-Crystalline Structure of Platinum.*—T. Andrews obtained a satisfactorily developed crystalline structure of a polished platinum ingot after boiling it for 45 seconds in aqua regia composed of 4 parts of hydrochloric acid (sp. gr. 1·2) to 1 part of nitric acid (sp. gr. 1·42). The general micro-crystalline structure was observed to be allotriomorphic in character, and derived from a system of interfering cubes and octahedra, the cubic and hexagonal forms being frequently noticeable. The size of the large crystal grains varied from 0·002 in. to 0·04 in. in size, and the smaller crystals ranged from about 0·0002 in. to about 0·007 in. There were indications that the smaller crystals

* Proc. Roy. Soc., lxix. (1902) pp. 433–5 (1 pl. of 6 photos).

were each built up of even more minute crystalline ramifications. The crystalline structure of platinum appears to generally resemble that of gold and silver.

HOUGHTON, S. A.—**The Microscopic Structure of Metals.**

[Two interesting lectures before the Institute of Marine Engineers.]

Shipping Gazette and Lloyd's List, March 6 and 13, 1902.

„ „ **The Internal Structure of Iron and Steel, with special reference to defective material.**

[A lecture before the Institute of Marine Engineers, April 21, 1902. The author gives a very complete *résumé* of our present knowledge on this subject, but avoids the discussion of controversial points. More than thirty of the photographs are original, and deal with cases of failure in metalwork.]

Shipping Gazette and Lloyd's List, April 24, 1902; also as a pamphlet issued by the Institute of Marine Engineers.

STEAD, J. E.—**Metallic Alloys.**

[A lecture before the Cleveland Institution of Engineers, Dec. 10, 1900. A full investigation of the subject.]

Metallographist, v. (1902) pp. 110–44 (19 figs.).

Nomenclature of Metallography.

[A preliminary glossary of technical terms, with their French and German equivalents, has been drawn up for the consideration of the International Committee of Metallurgists, which has been appointed to consider this question.] *Metallographist*, v. (1902) pp. 145–65.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Zeiss' Smaller Mechanical Stage.†—In this apparatus, the leading idea of which was first worked out by a Fellow of the Society, the late

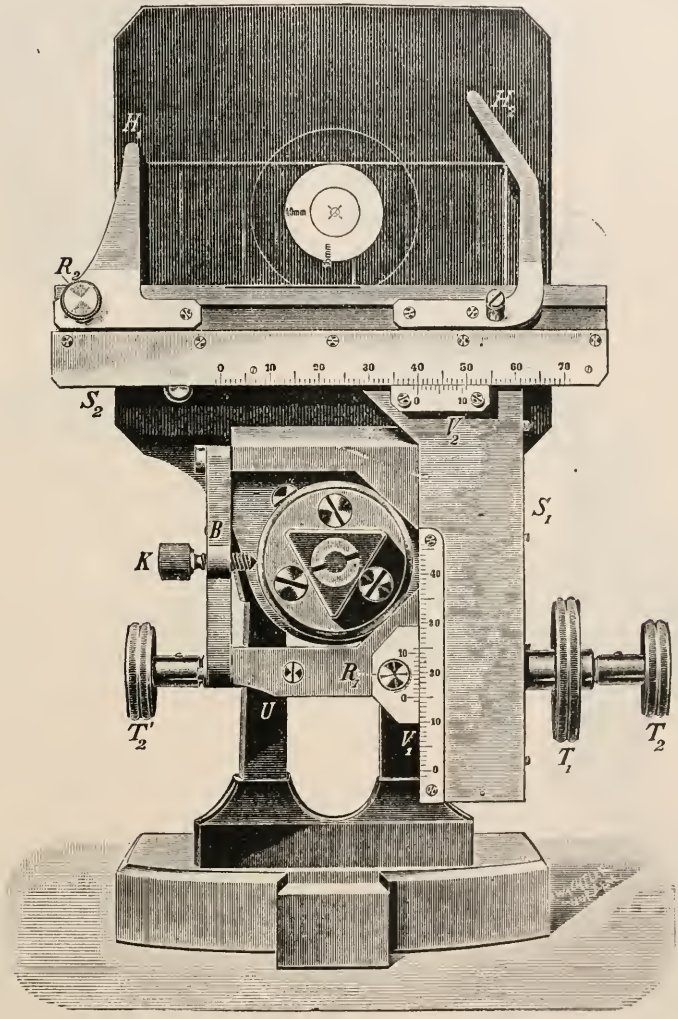

FIG. 110.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous. † Zeiss' Cat., 1902, No. 47, fig. 18.

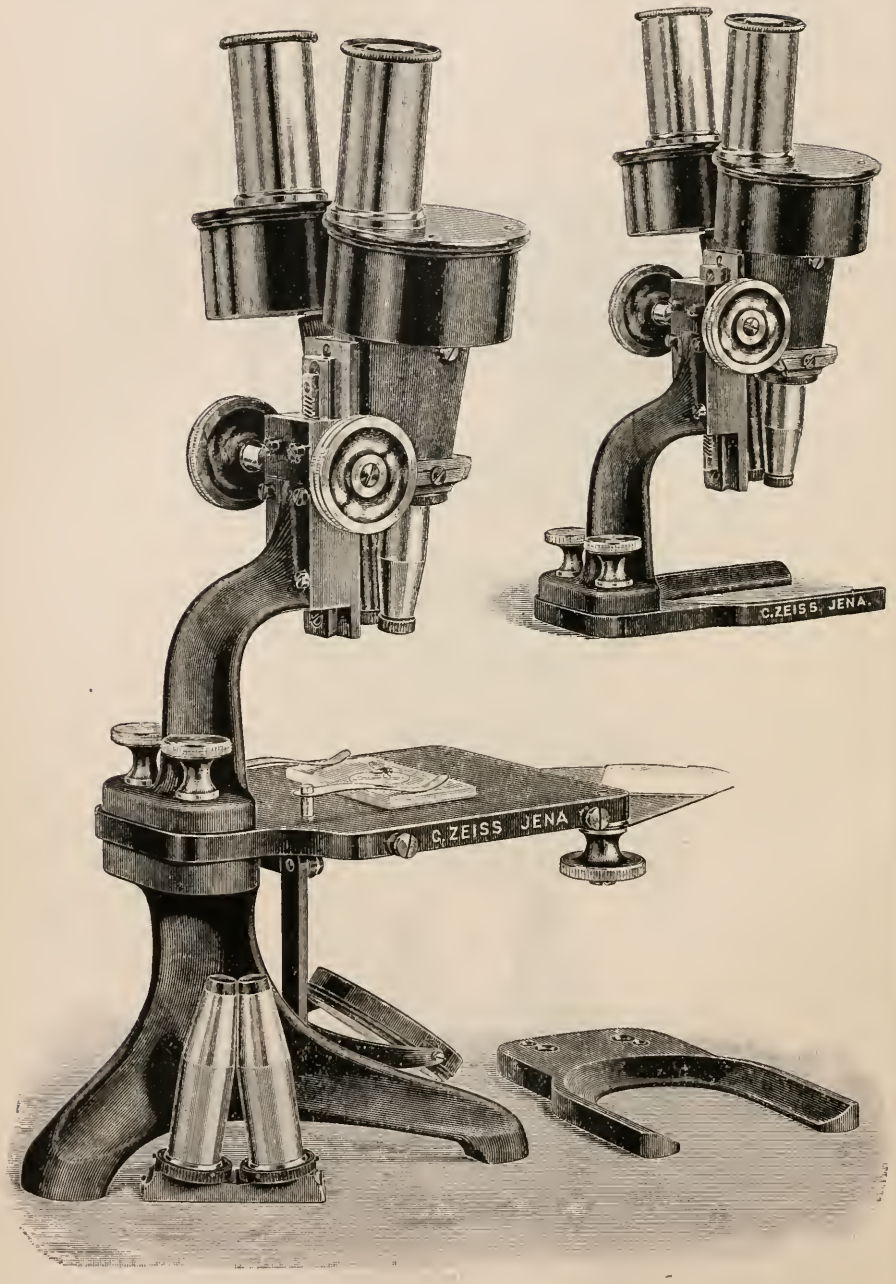

Fig 111.

Mr. J. Mayall, jun.,* some improvements have been recently introduced. The milled heads for the movements of the two slides are set co-axially, and preserve their position during rotation. The horizontal movement can be effected by either the right or the left hand. The range of the movements has been slightly increased and now extends to 60 by 30 mm. An accurately gauged centring glass, on which are engraved the distances of the cross-strokes from two edges of the object-carrier, is supplied with each stage. Fig. 110 shows the stage as applied to Stand IV*a*.

Greenough's Binocular.†—The Zeiss firm now make the upper part of this instrument with the double tube removable; after the removal of this upper portion the stand can be replaced by a vulcanite fork to which the tube-carrier is screwed (fig. 111). Thus a portable instrument is formed which can be applied to the examination of objects of any kind: it may, for instance, be used as a dermatoscope for skin investigations.

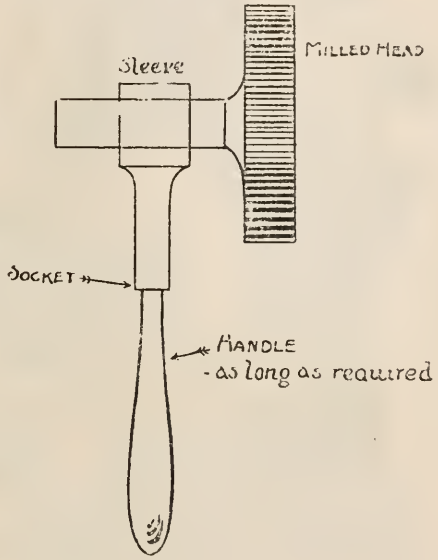

Fig. 112.

Microscope Adjustment.‡—A correspondent, "Treadle," to the *English Mechanic*, after noticing the tendency of Microscope makers to reduce cost by omitting the fine and by improving the coarse adjustment, suggests a revival of the following old device (fig. 112) in use some forty years ago, but now apparently forgotten. It consists of a sleeve fitting loosely on the shank of either of the coarse-adjustment milled heads, with a socket attached into which can be fitted a handle of

* This Journal, 1885, p. 122.
† Zeiss' Catalogue, 1902, No. 95, fig. 35*b*, p. 73.
‡ Eng. Mech., lxxv. (1902) pp. 207-8 (1 fig.).

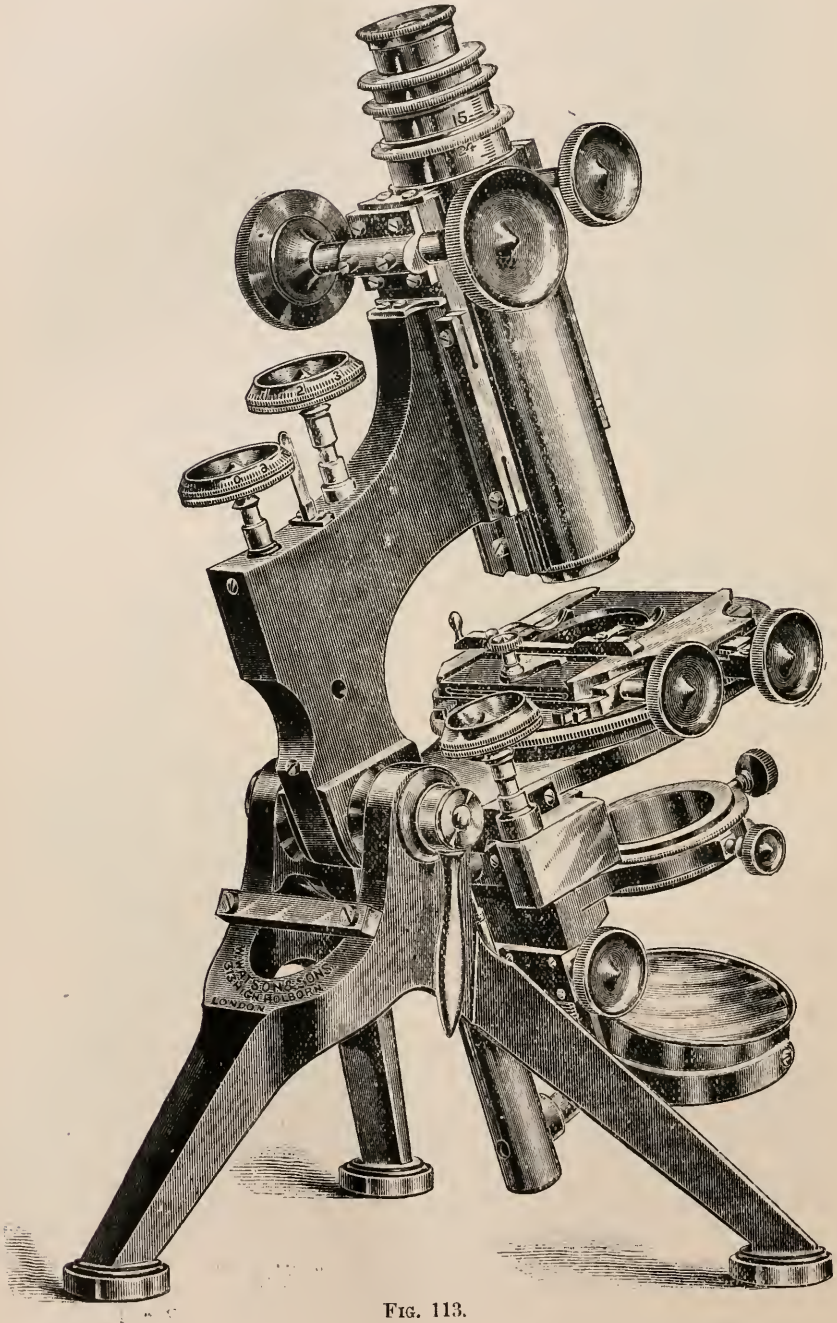

Fig. 113.

any convenient length. By moving the handle sideways the sleeve is made to seize upon the shank of the milled head, and the long handle allows of a very delicate motion being imparted to the pinion. With a well-cut rack the author finds even high-power objectives can be satisfactorily focussed.

This form of fine adjustment by means of a loose lever attached to the coarse adjustment pinion, was described by Messrs. Smith and Beck at the Microscopical Society of London on October 9th, 1861.* A very similar construction by Ladd is also figured in the third edition of *Carpenter*, p. 81, fig. 27 (1862). Mr. Beck states in a foot-note that Mr. Brookes (Charles Brooke?) was the first to recommend this kind of slow motion.

Males-Watson Two-speed Fine Adjustment.—The essential feature in this new two-speed fine adjustment is a lever similar to that regularly

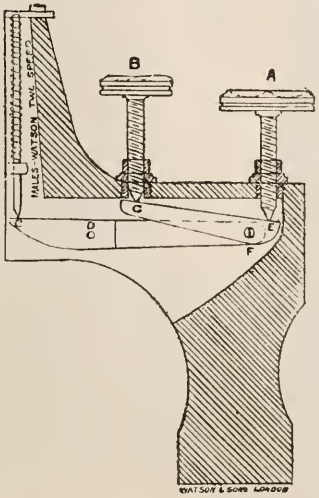

Fig. 114.

fitted to Watson's Microscopes. The fulcrum of this is at D, and the lever is worked by the milled head A on the point E. By using a coarse thread for the screw a speed of $\frac{1}{150}$th of an inch for each complete rotation is produced. The second and slower speed is obtained by another lever fitted to the first at the point F, which is acted on by the screw B at the point G. A somewhat finer screw is used for this, and the combination of the levers yields a movement as slow as $\frac{1}{4500}$th of an inch for each complete turn of the milled head. Any desired ratio of speed can be obtained by altering the pitch of the threads of the micrometer screws. Fig. 113 shows the adjustment fitted to a Watson's Van Heurck Microscope, and Fig. 114 gives a sectional view of the working parts.

* Trans. Mic. Soc., x. (1862) p. 11, pl. 5.

Berger's Fine Adjustment. — Fig. 115, from Messrs. Zeiss'* new Catalogue, shows the action of this fine adjustment more clearly than the illustration previously published in the *Journal* for 1898, p. 585, fig. 99.

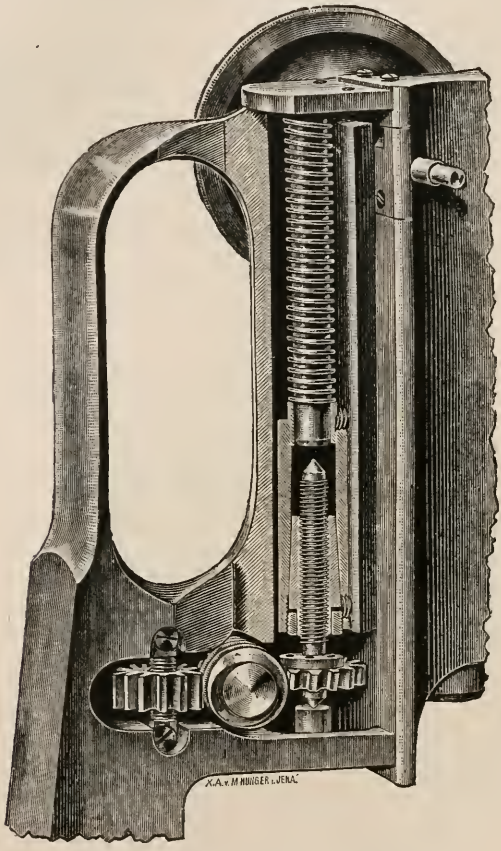

Fig. 115.

Zeiss' Small Mineralogical Stand.† — This model (fig. 116) is numbered IX^{b} in the Catalogue; it is not inclinable, and possesses rack-and-pinion coarse adjustment. The tube, which is not provided with draw-tube, carries on its upper extremity a divided circle and a removable analyser. At the lower end are two sliding carriers and a centring appliance. One of these carriers bears a second analyser, while the other is available for a quartz or other crystal plate for insertion above the objective. The polariser is combined in a sliding sleeve with a condenser system of 1·0 N.A. The upper lens of this

* Fig. 19, p. 44, of Zeiss' Catalogue.
† Catalogue, English edition, 1902, pp. 68–71, fig. 34.

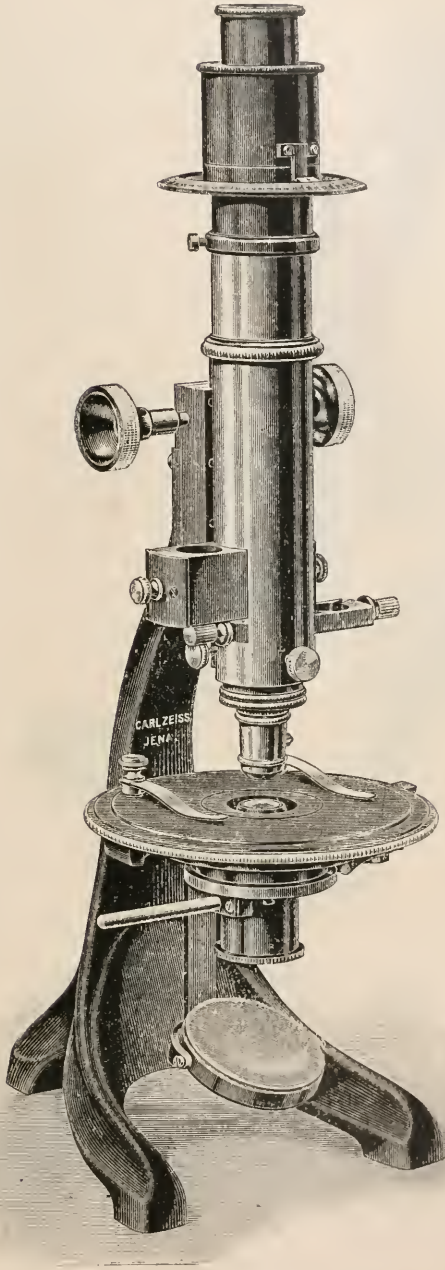

Fig. 116.

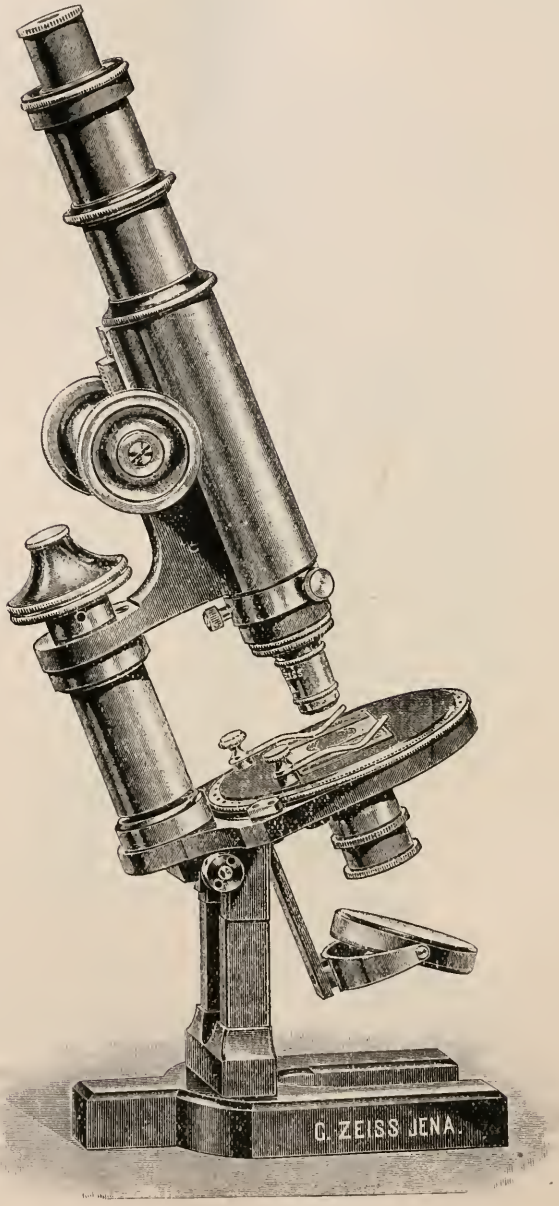

Fig. 117.

condenser is easily removable, as, when using low magnifications, it is advisable to work with the lower condenser lens only. A sliding sleeve, within which the polariser may be revolved by means of a lever, is situated below the revolving and graduated stage.

Zeiss' Small Model Polarising Microscope.*—This stand (fig. 117), indexed as VI^b, is one of Zeiss' smaller models adapted for work with polarising apparatus. It bears a revolving stage (diam. 80 mm.) with a graduated peripheral scale. A centring appliance for objectives is situated on the lower extremity of the tube. Objectives of the highest power can be used, and the stage can be completely rotated.

Messter's Attachable Mechanical Stage.†—M. Marpmann highly praises this accessory for its cheapness and convenience. The object-slide, which fits into a space of suitable size, is secured by two clamps. The stage itself is easily attached to any Microscope: the upper screw fits into a hole of the table and the trigger-shaped part on the right is secured to the pillar, so that the stage is rigid in all positions. Of the two screws which control the stage motions the lower imparts a perpendicular movement from front to rear within limits of 30 mm., and the front one a lateral movement within a range of 50 mm. These dimensions serve for preparations of large size. Positions are noted by means of two scales which are easily read to 0·1 mm.

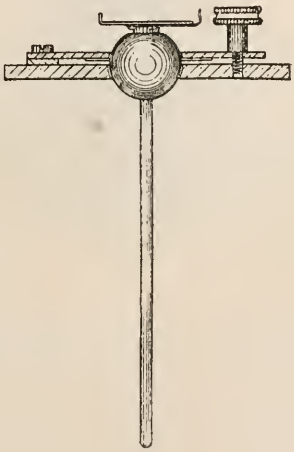

Fig. 118.

Huntingdon's Tilting-stage for Holding and Adjusting Minerals.—This apparatus (fig. 118), made by Messrs. R. and J. Beck, consists of a pair of brass plates which grip a ball, held in two circular holes cut in the plates. The ball is surmounted by a small stage, and from its inferior aspect projects a rod by which the specimen is oriented. By

* Catalogue, English edition, 1902, pp. 62–5.
† Zeitsch. f. angew. Mikr., ii. (1901) pp. 230–4 (1 fig.).

means of a screw-clamp the pressure on the ball may be adjusted. The tilting-stage is placed on the Microscope-stage, and the specimen, roughly mounted on a glass plate 1 in. wide, is placed in the holder. The apparatus is then adjusted so that the surface to be examined is exactly at right angles to the optic axis.

When the Microscope upon which it is used has a mechanical stop, an adjustable plate may be placed at the base of the Microscope, so that it may be used for temporarily fixing the long rod. In this case the ordinary movements of the mechanical stage form a fine adjustment for levelling the object. When the object is levelled the plate may be released, and then the stage-movements are used in the usual manner for moving the object.

(2) Eye-pieces and Objectives.

Zeiss' A* Objective.*—This useful objective, in which there is an arrangement for separating its component lenses by rotating a collar, for the purpose of increasing its magnifying power, has had its mechanism altered, so that now it is in its original form.

When it was first introduced, the rotation of the collar caused the

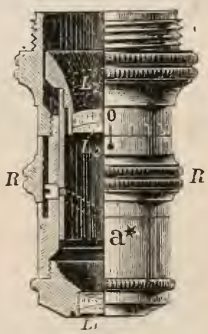

Fig. 119.

back positive lens to move away from the front negative lens, which was fixed; but in 1880 the motion was changed, so as to make the front lens move while the back remained fixed.† The reason for this was, that the back lens, in its excursion up the tube, should not foul the diaphragm, usually placed by Messrs. Zeiss at the end of their draw-tubes. Fig. 119, which is taken from this year's catalogue, shows that Messrs. Zeiss have reverted to their original form in making the back lens the movable one.

An interesting account of the theory of this lens will be found in the *Journal* for 1884, p. 450.

Assorted Pairs of Objectives for Binocular Microscopes.‡—These are now supplied by Zeiss in a special form of setting, and mounted in pairs on slides, and are well adapted for Greenough's binocular. They

* Catalogue, English edition, p. 14, fig. 6. † Journ. R.M.S., 1880, p. 524.
‡ Catalogue, English edition, 1902, p. 18.

are designated (55), (a_0), (a_2), (a_3), and (Pl), and are respectively of working distances 70, 54, 40, 30, 35 mm. The combination (Pl) is recommended as a plankton searcher.

Zeiss' Orthomorphic Eye-piece.*—A Ramsden eye-piece is made by the Jena firm specially for use with Greenough's binocular Microscopes. The name "orthomorphic" is applied to it because of the original design of combining it with small diaphragms in the region of the upper microscopic nodal point in order to satisfy Mr. Greenough's "orthomorphic" requirements. The magnifications obtained by combinations of this eye-piece and any of the objectives in last paragraph, range between 15 and 72 diameters.

(3) Illuminating and other Apparatus.

Zeiss' Centring Apparatus for Microscope Objectives when used as Condensers.†—In many instances it appears desirable to use achromatic, or apochromatic, objectives as illuminators instead of ordinary condensers. For this purpose a sliding sleeve is supplied with centring

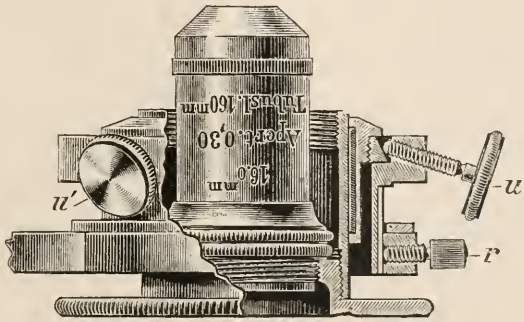

Fig. 120.

collar into which such objectives may be screwed, and which fits into the sleeve of the illuminating apparatus. The arrangement is seen in fig. 120, where *u u'* are the centring screws, and *r* the screw for clamping the condenser in the sliding sleeve.

Solar Projection Apparatus and its Adjustment.‡—A. H. Cole recommends a solar projection apparatus fitted with a porte-lumière, instead of a heliostat, as being a cheap, manageable, and effective arrangement. A porte-lumière and a heliostat are both intended for reflecting sunlight: but the porte-lumière is hand-regulated, whereas the other is clockwork-regulated. The author mounts his apparatus on a wide board of sufficient length to exactly fit into any desired window. The window-sash should be raised, the board then placed *in situ*, and the sash then drawn down close on to the board. Any supplementary fixing

* Catalogue, English edition, 1902, pp. 19 and 72.
† Tom. cit., p. 32 and fig. p. 31.
‡ Journ. Applied Microscopy, v. (1902) pp. 1795-7 (1 fig.).

should be added as required. The board is perforated by a hole large enough for the mirror and base rods to be passed through, but smaller than the brass plate to which the water-cell and mirror-adjuster are attached. This plate is firmly screwed to the board. The various items of apparatus slide on the base rods, and ordinary objectives are used. A sufficient darkening of the room is obtained by very dark opaque blinds on spring-rollers, their edges being boxed up.

(4) Photomicrography.

Observing Prism for Photomicrography.—This apparatus, fig. 121, devised and made by Messrs. R. and J. Beck, consists of a right-angle prism fitted in a tube of the same length as and at right angles to the

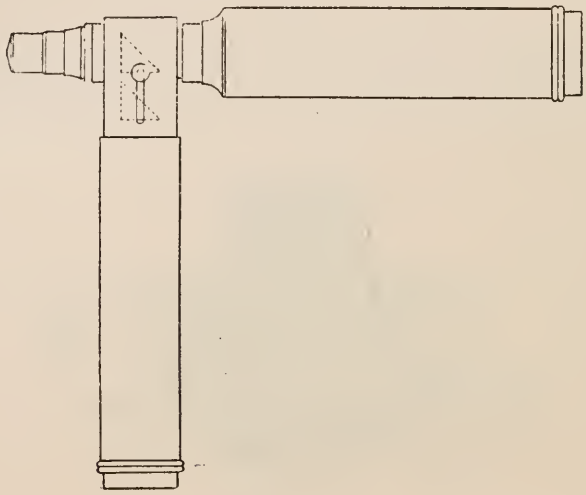

Fig. 121.

ordinary Microscope-body. The tube screws on to the object-glass end of the instrument. When the Microscope is in a horizontal position the tube may be connected with the photomicrographic camera and all the observing done through the supplementary body through the observing prism. To take a photograph, the prism may be instantly displaced by pressing a milled head, and the light then passes directly up the Microscope-tube into the camera. So accurately are the parts constructed and adjusted that there is no loss of definition and *Amphipleura pellucida* can be perfectly resolved.

Photomicrography.* — F. M. Duncan's *First Steps in Photomicrography*, which only claims to be a handbook for novices, consists of a simple and almost non-technical account of the methods and apparatus employed in the production of photomicrographs. It deals with low, medium, and high-power work, developing, printing, preparation of

* London, Hazell, Watson & Viney, 1902, 104 pp., with illustrations.

suitable objects, and with stereo-photomicrography.' The booklet, which forms one of a series ("Amateur Photographer's Library") should have a ready vogue.

(5) Microscopical Optics and Manipulation.

GULLSTRAND, A.—**Allgemeine Theorie der monochromatischen Aberrationen und ihre nächsten Ergebnisse für die Ophthalmologie.**

[Very fully discusses the general mathematical questions involved in passage of light-rays through the eye, and deduces their special applications in ophthalmology.] *Nova Acta Reg. Soc. Sci. Upsaliensis*, XX. fasc. 1 (1901) 204 pp. and 51 figs.

(6) Miscellaneous.

Zeiss' Crystal Films and Plates for Double Refraction.* — (i.) *Selenite and Mica Films.* These are now supplied in four different thicknesses which, when placed between crossed Nicol prisms, show red of the i., ii., iii., and iv. orders; there are also four different mica films, which are graduated so as to produce differences of phase equal to $\frac{1}{8}\lambda$, $\frac{1}{4}\lambda$, $\frac{3}{8}\lambda$, $\frac{1}{2}\lambda$. These eight films compose the set of selenite and mica films originally proposed by H. v. Mohl for the examination of plant cells in polarised light.

(ii.) *Bravais' Double Selenite Film.* In this case two semicircular films for red of the i. order are so arranged side by side that the equal angles of optical elasticity are at right angles to each other, and form angles of 45° to the boundary line.

(iii.) *Biot-Klein's Quartz Plate.* This is a plate of quartz 3·75 mm. thick, and cut perfectly perpendicularly to the axis.

(iv.) *Bertrand's Quadruple Quartz Plate.* Four quadrant-shaped quartz plates, cut perpendicularly to the axis, are cemented together so that their dividing lines form the shape of a cross. Two of the plates are composed of quartz with rotatory power directed to the right, the other two of crystals having the opposite rotation.

(v.) *Stauroscopic Calc-spar Plate.* This is a plate of calc-spar, cut perpendicularly to the axis, mounted so as to be readily inserted between eye-piece and analyser.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Flask for Storing Culture Media.‡—A. Robin describes a simple device for storing fluid culture media. It consists of a flask A plugged with cotton-wool and sealed with a mixture of equal parts of paraffin and vaselin, a bent tube *d*, and a siphon tube *a b c* (fig. 122). The end of the tube *d* is loosely filled with cotton. The whole is sterilised, and then the plug is pushed down the neck, leaving about one-half inch space from the brim. The surface is dusted with powdered sulphate of copper, and then the space in the neck above the stopper is filled in with a

* Catalogue, English edition, 1902, pp. 104–5.

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

‡ Journ. Applied Microscopy, v. (1902) pp. 1876–7 (1 fig.).

mixture of paraffin and vaselin. The siphon is started by blowing through the tube *d*. Once started the flask is inclined in the direction opposite the outlet, when the fluid will run back into the tube *b*. The level of the fluid in *b* will be the same as in A. The end of *c* is then sealed as well as the end of *d*. To pour out the medium, the end of *c*, after careful flaming, is broken off at one of the narrowed points, and the flask inclined in the direction of *c*. The rapidity of the flow can be made to vary from a drop to a stream according to the inclination of the flask. Hence this flask is suitable not only for storage purposes, but may be used as a dropping-bottle or used in the bacteriological examination of water when fractions of a cubic centimetre are required.

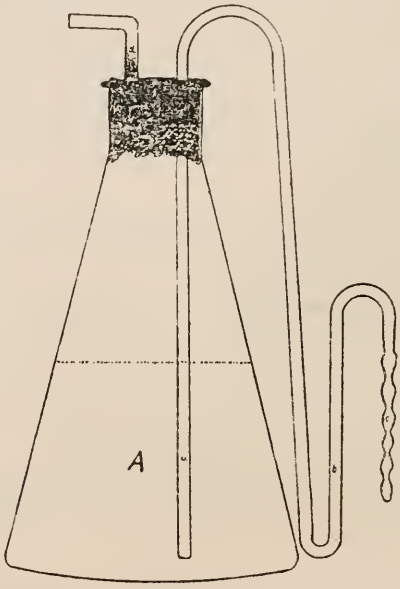

FIG. 122.

New Method of Cultivating Tetanus Bacillus.*—L. Debrand, who had previously demonstrated the identity of the toxin produced in anaerobic cultures of the tetanus bacillus and the toxin found in air-cultures of *B. tetanus* associated with *B. subtilis*, has recently made experiments which tend to show that with the toxin obtained from the symbiosis of these bacilli cultivated aerobically there can be produced a serum just as active as with the toxin raised by the ordinary methods. This new cultivation method may replace the old procedure for preparing anti-tetanus serum.

Cultivation of Nitrite-formers on Paper Disks.†—W. Omelianski sews numerous pieces of filter paper together and fits them in the bottom

* Ann. Inst. Pasteur. xvi. (1902) pp. 427–32.
† Centralbl. Bakt., 1te Abt., xxxi. (1902) pp. 785–7 (1 pl.).

of a Petri's capsule. Some carbonate of magnesia is sprinkled over the bottom underneath the filter-paper. The usual inorganic solution for cultivating nitrite-formers is then poured in, care being taken that the fluid does not reach the topmost layer. The fluid should reach about half up the clump of paper disks. The capsule is then sterilised, and when cool inoculated. When the nitrification process is set up, the fluid is tested for ammonia and nitrous acid. When all the ammonia has disappeared a few drops of sterilised 10 p.c. ammonium sulphate are introduced. Colonies are just visible to the eye by the 10th to 15th day as yellowish points, which gradually become brown.

(2) Preparing Objects.

Methods for Use in the Study of Infusoria.*—A. W. Peters obtains clean specimens of many kinds of Infusoria by the following "yarn-siphon" method. From the culture-jar a quantity of the liquid is removed with a pipette to a Stender dish. The organisms are distributed by sucking up the liquid into, and forcing it out of, the pipette a few times. A few pieces of woollen yarn about 10 cm. long are then laid parallel in a single strand, held in water and pressed together until thoroughly wet. This yarn-siphon is then placed with one end in the Stender dish, the other hanging over into a receiving vessel. Ciliated organisms soon pass over the siphon into the receiving-vessel. From time to time fresh water is added to replace that lost by siphoning.

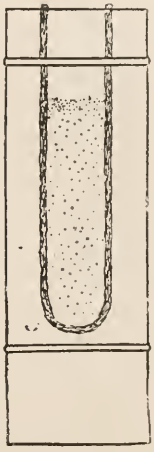

Fig. 123.

To concentrate the organisms in a small amount of water, to remove the culture, or to change the medium, the author devised an apparatus termed a "tube-filter." One end of a short piece of wide glass tubing is closed by a piece of filter-paper held in position by a rubber band. The process essentially depends on the quality and area of the filter-paper employed; for rapid work with about 50 ccm. of fluid a tube of about 3 cm. in diameter and 6 cm. in length is used. The tube is held in a vertical position on a ring-stand, and under it is placed a Stender dish or other vessel containing the organisms. The tube is lowered until its paper diaphragm comes within a few millimetres of the bottom of the dish. In the tube is hung a filled glass siphon with the lower end of the outer arm bent upwards to prevent its running empty. As the water rises through the filter-paper and into the tube, it is removed by the siphon. More culture-water with organisms or fluid desired as medium may be added from time to time. The process of upward filtration leaves nearly all the organisms in the dish when the tube is removed.

Another device, called the U-cell, serves much the same purpose as the tube-filter, but on a smaller scale. To make this U-cell (fig. 123) there are necessary two slides, some rubber bands, and coarse, tough darning-cotton. A piece of the cotton one-and-a-half times the length of the slides is saturated with water and then laid upon a slide in the form

* Amer. Natural., xxxv. (1901) pp. 553-9 (2 figs.)

of a U, the two ends only just projecting beyond the edge of the slide. The other slide is laid on top, and the pair are secured by means of rubber bands. This arrangement constitutes the U-cell. It is filled by standing it in a nearly vertical position, and then injecting the fluid containing the organisms with a pipette through the open end of the U. Or it may be filled by siphoning by means of a piece of woollen yarn thrust through the U-aperture to a depth of 5–10 mm.

The U-cell may also be used for a circulating medium, as shown in fig. 124. The cells are placed at an angle in a glass dish, and lean against an inner vessel placed in the centre of the first. The dimensions of the two vessels should be so selected that the upper ends of the

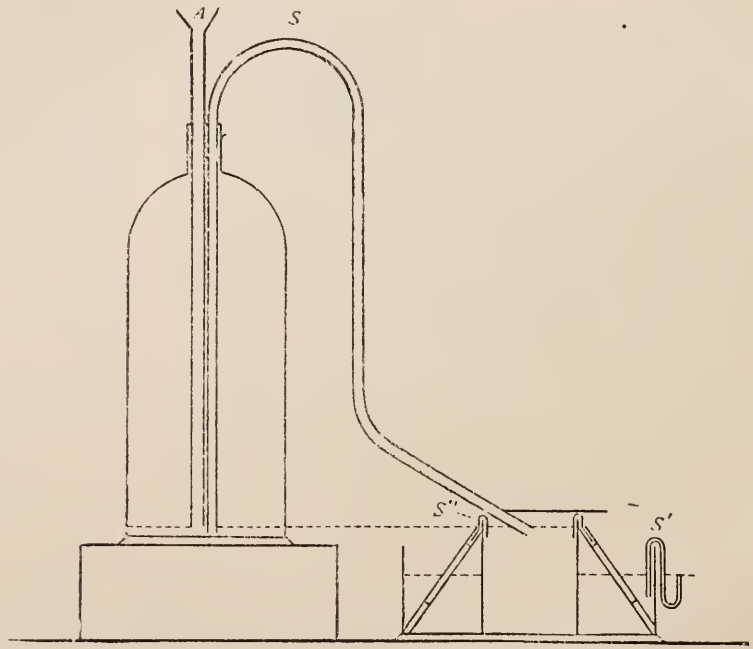

Fig. 124.

cells come in contact with the inner vessel at about 5 mm. below its upper end. From the inner vessel water is led by cotton-yarn siphons S″ into the cells. A constant-level siphon S′ is hung over the wall of the outer vessel. The inner vessel is supplied from a bottle fitted with an air-tube A and a siphon-tube S. The inner vessel and its yarn-siphons should be protected from dust by a glass plate, the edge of which is notched to admit the siphon-tube. Woollen yarn is used when a rapid flow is desired, cotton for a slower rate.

In the preparation of microscopical specimens requiring change of fluids under the cover-glass, the author uses cotton-wool. A small quantity of dry absorbent wool is placed on a slide and moistened with

a drop or two of water containing Infusoria. The cotton is then spread out into a thin layer about the size of the cover-glass to be used. The cover is then placed on the cotton layer and secured in position by means of rubber bands. The slide is placed in a sloping position, and the fluids introduced by adding them in drops at the top side of the slip. The excess fluid streams out on the lower side, or may be guided down by strips of filter-paper.

When the latter device is adopted, the rubber bands may, if desired, be removed after the passage of the fixing fluid. The cotton acts as a mechanical obstruction, the organisms being caught in the meshes. The procedure is safe and rapid, and also convenient, as the preparations may be inspected at any stage or stored up for future examination.

Preparation of Metal Specimens for the Microscope.* — In preparing specimens of metal, the principal object, says M. I. Cross, is to obtain a perfectly level surface, free from all scratches and marks, with the highest degree of polish. The surface of the sample is first carefully filed or ground. The marks made by this procedure are then taken out with a very smooth file or with emery cloth, the coarseness of the cloth being gradually diminished until the finest grade is reached. From this stage the polishing must be done on parchment or chamois leather stretched very tightly on wood; the leather being sprinkled with fine crocus powder or rouge moistened with a little water. At this stage the metal should be frequently examined under the Microscope. This is easily done by clamping it in a metal-holder. When the requisite degree of polish is attained the preparation is ready to be etched, by which process the structure is further developed. Etching is effected by various reagents, such as dilute mineral acids, but best by infusion of liquorice root and tincture of iodine. The method of applying the reagent is as follows: the specimen is either coated with some protective varnish,—leaving the surface to be acted on free,—and immersing the whole in a bath; or a few drops may be applied to the surface and then spread by means of a glass dipping rod. The solution should be allowed to act, say, for 20 seconds; the specimen is then carefully washed in methylated spirit, the surface being gently rubbed with the little finger, after which it is washed in water and then dried with a soft piece of linen. If the etching be not satisfactory, the process should be repeated. Owing to the advent of the metal-holder it is no longer necessary to fix the piece of metal to a glass slide, as this apparatus is fitted with jaws which grip the preparation tightly and allow it to be set in any plane.

(3) Cutting, including Imbedding and Microtomes.

Born and Peter's Orientation Plate.†—This appliance, named after its inventors, is made by Messrs. Zeiss, and is designed to mark the position of objects contained in hardening paraffin, and at the same time to impress so-called lines of direction upon the paraffin blocks. For the latter purpose one side of the plate has several parallel grooves, of equal width and with sharp edges, cut into it. A pair of glass set-squares is generally supplied with the instrument.

* Knowledge, xxv. (1902) pp. 189-90.

† Catalogue, English edition, 1902, p. 114.

(4) Staining and Injecting.

Staining Biliary Canaliculi.*—St. Ciechanowski recommends Weigert's nerve-staining method for demonstrating biliary canaliculi. Small pieces of liver are fixed for not less than 24 hours in 2–4 p.c. formalin, and after-hardened in alcohol. The sections are mordanted in 0·5 p.c. chromic acid solution for 2 hours, and then stained in Weigert's hæmatoxylin solution. When sufficiently stained the sections are differentiated in the ferridcyanide solution, and having been thoroughly washed are mounted in the usual way.

Glycogen Staining.†—Best publishes a method for staining glycogen in the liver, tumours, &c., by means of lithium-carmin. The procedure is as follows. The sections are first stained with Delafield's or Böhmer's hæmatoxylin, and after having been washed in water are immersed for 15–20 minutes in a freshly made mixture consisting of carmin solution 2, liq. ammon. caust. 3, and methyl-alcohol 6.

The carmin solution is prepared by boiling a mixture of carmin 1, ammon. chloratum 2, lithium carbonicum 0·5, and 50 water. To this, when cold, 20 ccm. of liq. ammon. caustici are added. After the carmin staining the preparations are decolorised in the following mixture, frequently renewed:—methyl-alcohol 2, absolute alcohol 4, water 5, or in liq. ammon. caustic. 1, absolute alcohol 2. Dehydration in 80 p.c. and 100 p.c. alcohol, oil, balsam.

The tissue should be fixed in absolute alcohol and imbedded in celloidin.

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

Sodium Silicate as a Mounting Medium for Microscopical Preparations.‡—Schürhoft recommends silicate of sodium mixed with 10 p.c. glycerin and 10 p.c. water for mounting microscopical preparations. 80 parts of commercial silicate of sodium solution are added to a mixture of 10 parts glycerin and 10 parts previously mixed. The medium hardens well in the course of a few hours.

Simple Method for Preserving Urinary and other Deposits.§—R. Rohnstein says that the deposit or sediment from secretions or discharges may be preserved in the following simple manner. In the case of urine the sediment is first treated with an equal bulk of 2 p.c. formalin, and the deposit therefrom mixed with an equal volume of the following solution:—formalin 20, glycerin 125, distilled water up to 200. When the material to be preserved is of a more solid character such as vomit or fæces, it is thoroughly mixed with an equal bulk of the solution.

(6) Miscellaneous.

Micrometer Gauge.‖—This micrometer gauge (fig. 125), made by Elliott Brothers, is excellently adapted for ascertaining the thickness of cover-glasses. The instrument is fitted with a ratchet head to prevent

* Anat. Anzeig., xxi (1902) pp. 426–30.
† Deutsch. Med. Wochenschr., 1902, No. 5, Vereins-Beil., p. 36.
‡ Deutsch. Apoth.-Zeit. See Zeitschr. angew. Mikr., viii. (1902) p. 54.
§ Fortschr. d. Med., xx. (1902) pp. 41–4.
‖ Elliott Bros.' Catalogue, 1902, p. 18, fig. 3550.

undue straining of the contact points, and is made in sizes to take $\frac{1}{4}$ in. to 1 in. measurement in steps of $\frac{1}{1000}$ in. The pitch of the screw-shaft is 50 to the inch, and the circumference of the cylinder carried by the shaft is divided into 20 parts, so that each division on the cylinder equals

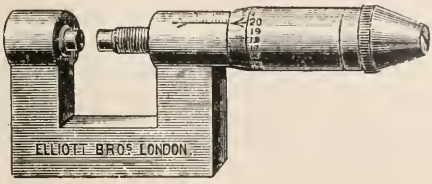

Fig. 125.

0·001 in. By slightly enlarging the cylinder, a reading of $\frac{1}{10000}$ in. is obtained by subdividing the 20 divisions into 10 parts. These gauges are also made to read in metric measure to 0·01 and 0·001 mm.

Lee and Henneguy's Histological Technique.* — The well-known treatise on the technique of microscopical anatomy by Bolles Lee and Henneguy has reached its third edition. In the present issue the work has been practically recast and is considerably enlarged. While numerous obsolete methods have been omitted, fifty pages of entirely new matter have been added. The additions include chapters on the theory of fixation, setting of microtome knives, principles of histological staining, methods for making series of sections, &c. The chapters on coal-tar colours and on cytological methods have been practically re-written, and that on neurological methods has not only been entirely recast but has been remodelled on a scheme suggested by van Gehuchten. The authors acknowledge also assistance from P. Mayer in the selection of new matter in the chapters on zoological methods.

Dictionary of Photography.† — E. J. Wall's *Dictionary of Photography* has just reached its eighth edition. The present issue, enlarged to 656 pages, has been revised and brought up to date by T. Bolas. Nearly 100 pages of new matter and many diagrams have been added, but owing to concentration and elimination the bulk of the volume is not unduly increased. The work presents the same general features as have rendered its success so marked.

Re-crystallisation of Platinum.‡ — W. Rosenhain points out that platinum, when used as foil or as crucible, is in a condition of severe strain, having been bent, drawn, rolled, &c. either in the cold or at temperatures far below its annealing temperature. When submitted to a prolonged exposure at a high temperature it undergoes re-crystallisation, and then becomes brittle.

* Traité des Méthodes techniques de l'Anatomie Microscopique, Histologie, Embryologie et Zoologie, par A. Bolles Lee et L. F. Henneguy, avec une préface par Prof. L. Ranvier, 3me édition, Paris, Octave Doin, 1902, ix. and 553 pp.

† Hazell, Watson and Viney, London, 1902, 656 pp.

‡ Proc. Roy. Soc., lxx. No. 462 (1902) pp. 252-4 (1 fig.).

Microscopic Effects of Stress on Platinum.*—Messrs. T. Andrews and C. R. Andrews prepared an ingot of pure platinum, carefully machined into a cube 0·30 in. square. This was microscopically polished and subjected to a compression stress of 12·82 tons per square inch, thereby reducing its height by 10 p.c. of the original dimension. The result was to produce a great number of "slip-bands," roughly inclined at an angle of 45° to the line of the compression force on the crystal sectional facets. The experiment is confirmatory of the observations of Ewing and others, that stress alone, without etching, sometimes renders manifest the lines of inter-crystalline junction of the large or primary crystal grains of a stressed metal, providing that the stress is of sufficient intensity.

RICHARDS, B. R.—**System of Recording Cultures of Bacteria genealogically for Laboratory Purposes.**

[This system furnishes a convenient means of recording all data relating to the study of individual laboratory cultures of bacteria.]

Journ. Applied Microscopy, 1902, pp. 1877-83.

SPARROW, F. W., R.N.—**Principles of Simple Photography.**

[A manual embodying the ruling principles of elementary photography.]

London, Hazell, Watson & Viney, 1902, 130 pp., with illustrations by the author.

* Proc. Roy. Soc., lxx. No. 462 (1902) pp. 250-2 (3 figs.).

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER 1902.

TRANSACTIONS OF THE SOCIETY.

X.—*Electrical Method of Taking Microscope Measurements.*

By Philip E. Shaw, B.A., D.Sc.

(*Read November 19th*, 1902.)

Two years ago* I described a method of taking very small measurements by a new process, that of electric touch. Since then considerable advance has been made on the same lines, and now it is possible to measure one-millionth of a mm. with accuracy, and the method has been used in a variety of physical problems.†

By simplifying the original instrument a small apparatus, called the Simple Electric Micrometer, has been produced giving measurements of one-thousandth of mm. or less. It has a great number of uses in the physical laboratory, including one application to the Microscope about to be described.

This method of measuring is novel in two respects. Firstly, it is electrical; secondly, it is a direct method, which is in its favour.

Description.—In the diagram (fig. 126) the essential parts for the measurement are shown.

The slide *sl* is mounted on the stage *s*, *o* being the Microscope objective. A screw *sc* is brought up to nearly touch the edge of the slide. This screw is carried by a nut *n*, and has a graduated disc *d* and milled head *m* attached to it. If the screw have two threads to a mm., and the graduated disc have 500 divisions, then a movement of the screw-disc by one division corresponds to a movement of the screw-point *t* by one-thousandth of a mm. (i.e. 1 micron). The micrometer-screw is supported on a stand quite separate from the Microscope, so that it can be removed and packed in a separate box for preservation. There is a universal joint *j* between the screw and the stand, so that we can raise or lower the screw, point it in any direction whatever, and then rigidly clamp it there. Suppose the screw and stage are brought

* Phil. Mag., Dec. 1900.

† Phil. Mag., March 1901; Electrician, March 1901 and March 1902.

into contact, an electric circuit is completed through a battery *b*, a resistance *r*, a telephone receiver *te*, a nut *n*, and thence through the screw *sc* and the stage *s* to the battery. At each make or break of circuit at the point *t* the telephone "speaks."

In order to measure any object seen in the Microscope slide, move the stage by the rack-and-pinion or other adjustment, till the cross-wire is on one side of the object. Bring the screw *sc* into contact with stage *s*, and when the telephone speaks observe the

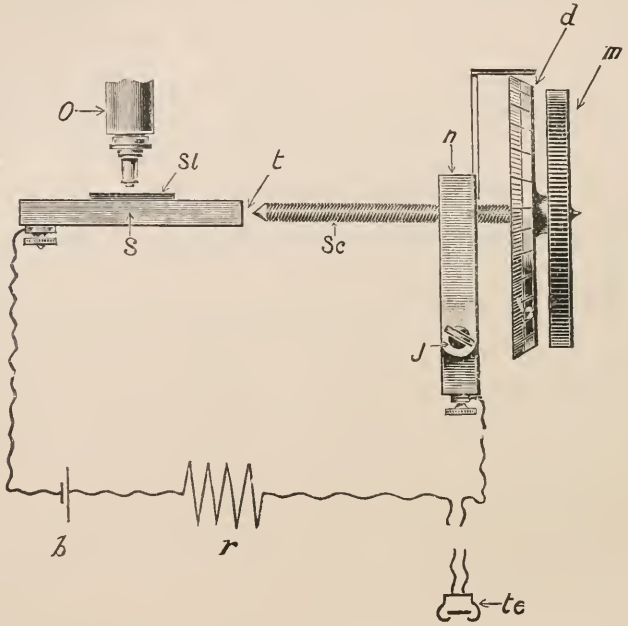

Fig. 126.

reading R_1 of the disc *d*. Now move the stage till the other side of the object coincides with the cross-wire. Bring the screw into contact again, and obtain a new reading R_2 of the disc *d*. Then the diameter of the object is $(R_2 - R_1)$.

As an example, three sets of readings were taken for *Bacillus tuberculosis*, and were as follows :—

R_1.	R_2.	Length $= R_2 - R_1$.	
411	414	3 microns	mean 3·1 microns
410·7	414	3·3 „	
411	414	3 „	

As an instance of another class of measurement the following is given. If it be desired to accurately measure the number of lines in a diffraction grating used to produce a normal spectrum, place the grating on the stage and proceed as before. A table of results is given.

EVERY 50 LINES IN A DIFFRACTION GRATING.

Micrometer Reading.	Difference in Term of μ.
225	
	454
679	
	455
1134	
	459
1593	
	453
2040	
	458
2498	
	455
2953	
	457
3410	

Mean 456 μ for 50 lines.

Fig. 127 shows the micrometer by itself.

Fig. 128 shows the whole apparatus for Microscope measurements.

Details.—This method of measuring by electric contact has been exhaustively tested for several years and is quite reliable. Consistent results can be obtained if two conditions are observed:—(1) Both the contact surfaces of the screw and the stage must be metallically clean; fine emery cloth should be used on them till they are quite free from lacquer, oil, &c. (2) Vibrations should be avoided. Mount the apparatus on a steady table not subject to vibrations, and handle the screw delicately when taking a measurement. Any cell will do for the circuit, and any telephone receiver will act, though a "loud speaker" is most convenient. For resistance I have used a few hundred ohms. The object in having resistance is to keep the current small, but it is not an essential. In completing the circuit through the Microscope, I have used any spare screw on the Microscope and brought the joining wire to it. If there is no screw convenient, the wire may be simply lashed firmly on the instrument, but of course to an unlacquered surface. It should be observed that the method works equally well whether immersion is adopted or not.

Other Methods of Measuring.—(1) *The Ramsden Eye-piece Micrometer.*—This is a convenient and sensitive method, but every measurement taken by it has to be divided by the magnifying power of the objective, a quantity which is only known to a certain degree of accuracy. Hence, besides the error due to the micrometer reading, a second one is introduced into the measurement. Moreover, the magnifying power must be known for every objective. Again, in most cases the Ramsden eye-piece is mounted in the tube of the Microscope, so that movement and oscillations of the tube take place each time the Microscope is handled, thus introducing errors. To avoid this, the eye-piece should be on a separate stand.

(2) Less sensitive than the former is the *Jackson eye-piece*

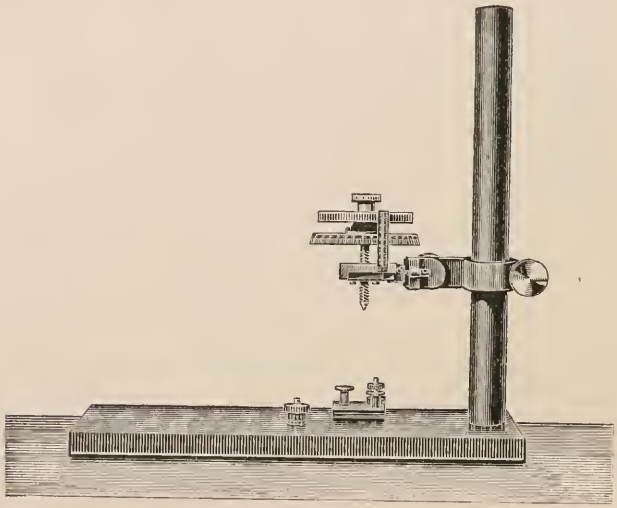

Fig. 127.

micrometer. It is convenient, as with it the eye-piece is not handled, and the difficulty in the Ramsden form is avoided. But it labours under the other disadvantages mentioned.

(3) *The stage micrometer* method.—Whilst the ruled scale is the standard of length it cannot be used directly on the object to be measured, but either we (*a*) use the camera lucida method of sketching, which is clumsy, or (*b*) calibrate the eye-piece micrometer by means of the ruled surface, and then proceed henceforward to use the eye-piece micrometer. The stage micrometer rulings are not perfectly uniform.* Thus the methods in common use at present are all *indirect*, for at least two steps have to be

* See Carpenter's book on the Microscope, 7th edition, p. 231.

taken in any measurement made. Each step involves errors and expenditure of time.

On the other hand, the electric micrometer is a direct method; only one measurement is required, thus making for accuracy, whilst at the same time the instrument used is very sensitive.

If one specially wishes to work by means of an eye-piece micrometer, it is easy to see how the electric method can be used in place of the stage micrometer to give a very accurate calibration of the eye-piece. But this does not seem a desirable course.

(4) Some modern Microscope stages are moved by a screw which has a graduated head. In this way a measurement may be taken directly (as with the electrical method). In principle this micrometer is good, but in practice it has three disqualifications:—

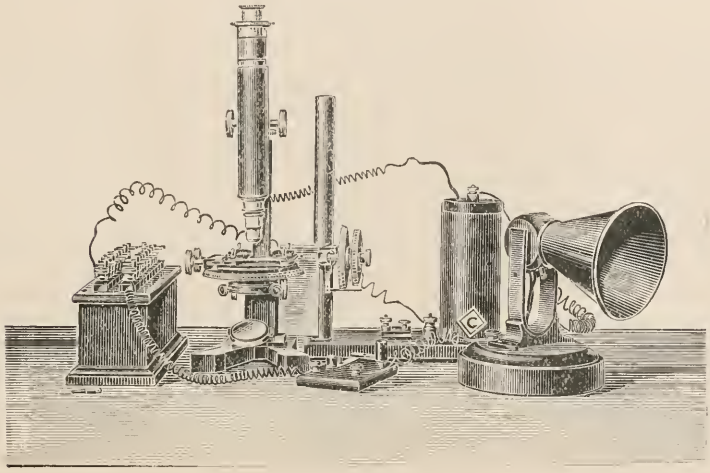

Fig. 128.

(i.) The measuring-screw is given the work of carrying the stage with it when it turns; supposing no looseness or backlash occur at first, these will probably be set up in time from the wearing action, and so errors will arise. (ii.) It is inconvenient to have such a large graduated disc attached near the stage as will give readings of 1 micron; but the disc is generally small, and hence the readings cannot be very fine or the instrument delicate. (iii.) The micrometer screw being fixed on the stage will be liable to be knocked and damaged, and so spoiled for accurate measurement. Any fine measuring-screw should be put away when not in use.

The Electric Micrometer is like the above in being direct-acting, but it does not suffer from the disqualifications mentioned. It can be used with any Microscope having a movable stage (and

if a movable stage does not exist a temporary one could be easily made by having a brass plate moved by the screw itself), no other micrometer at all being needed.

I have used it on two laboratory Microscopes for a variety of measurements. It takes only a minute or two to set up the apparatus.

Given delicacy of touch, measurements can be made of anything visible. I have found no difficulty in reading to $\frac{1}{4}$ micron.

If a capstan-pin be inserted into the edge of the milled head of the screw, a more delicate angular movement may be given to the screw, and readings of $\frac{1}{10}$ micron obtained.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Swift's "Ariston" Fine Adjustment.—J. Swift and Son claim that their new fine adjustment (fig. 129) entirely eliminates the side-movement which occurs in so many instruments when the micrometer-screw is put in motion. The accompanying illustration, which gives a sectional view, shows how the principle of the apparatus has been worked out. The milled head of the screw is isolated and supported on an independent tube fixed to the base-piece. The only point of contact of the micrometer-screw is its fine point bearing upon the top of the fine adjustment. The advantages claimed for the Ariston fine adustment are that even with a coarse screw a very slow rate of speed and extremely delicate focussing are obtained; that it is practically impossible for it to get out of order, and that the micrometer-screw is entirely disconnected from any of the fittings likely to produce movement when the milled head is touched.

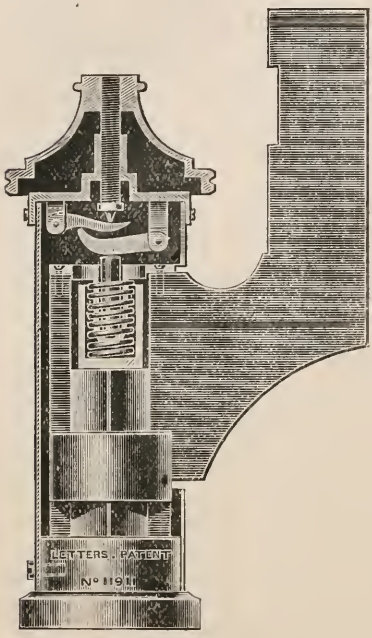

Fig. 129.

Scheffer, W.—**Mikroskope.**
[A popular introduction to the instrument.]
Forms Bändchen 35 of the series "Aus Natur und Geisteswelt," B. G. Teubner, Leipzig.

(2) Eye-pieces and Objectives.

Berger's Stereoscopic Loups.†—E. Berger has arranged a combination of stereoscopic loups which seems likely to be of considerable service to miniature painters, lithographers, microscopists, watchmakers, and others who are interested in delicate handicraft. The author thinks it offers many advantages over the present watchmaker's lens. In the construction two of Berger's decentric lenses inclined to one another in the horizontal meridian are used. The inclination is so arranged that the light rays do not fall at too great an angle on the strongly prismatic

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

† Central. Zeit. f. Opt. u. Mech., xxiii. (1902) pp. 145-6 (3 figs.).

parts of the lenses. The loups are fitted up in a sort of camera, which may be worn over the eyes and secured by a band behind the head.

Zeiss' Improved Algascope.*—A "No. 1 Combination Lens" is fitted to a sliding sleeve, to which a small stage with spring object-holders is attached. In this form the lens is known as the "improved Algascope."

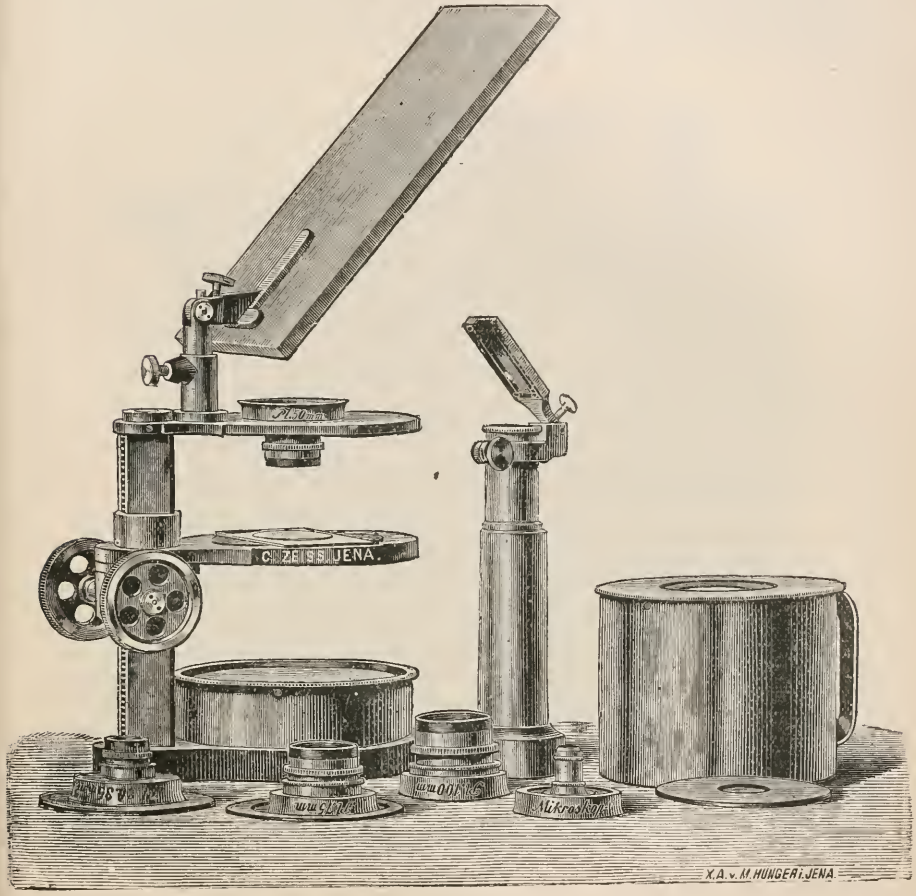

Fig. 130.

The "combination lens" consists of three achromatic lenses combined with an achromatic dispersion lens, which also serves as an eye-piece. The magnifications obtainable from different members of the series vary between 11 and 100 diameters.

(3) Illuminating and other Apparatus.

Zeiss' Epidiascope.†—This is an apparatus for the projection of objects lying in a horizontal position. It employs reflected light in

* Catalogue, English edition, 1902, p. 23. † Special Catalogue.

the case of opaque, and transmitted light with transparent (or at least translucent) objects. As compared with Zeiss' projection apparatus with an optical bench (Catalogue, No. 249) it possesses the following characteristic advantages:—(1) Greater latitude in the shape and size of objects; (2) when reflected light is used, the illumination is more perfect; (3) transition from operation with reflected to transmitted light is effected with greater speed and convenience; (4) the apparatus is easily adjusted for projection obliquely upwards; (5) the several com-

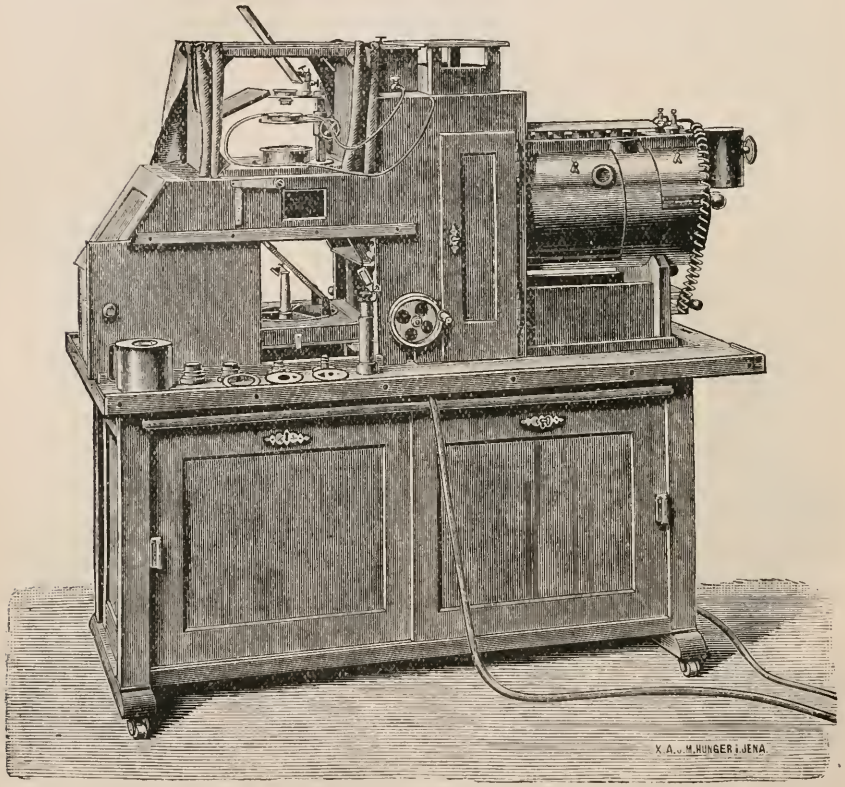

Fig. 131.

ponent parts are better protected against dust and improper usage. On the other hand, owing to the absence of the optical bench, the epidiascope lacks somewhat the manysidedness of application so characteristic of Zeiss' other projection apparatus. The epidiascope is about 4 ft. 11 in. in length, 2 ft. 6 in. in width, and about 4 ft. 11 in. high. The height is so calculated that a person standing on the floor at the side of the apparatus may be able to work it with ease and comfort. The source of light used is a search-light lamp adjusted for a current of 30 or 50 amperes. The objective supplied cannot be exchanged for one of differ-

ent focus without special adaptation. Hence the degree of magnification can only be varied by altering the distance between the apparatus (which is placed on casters) and the screen. With the small search-light the magnification of a uniformly illuminated area of 9 sq. in. is magnified 9 diameters; but smaller objects may be magnified up to 25 diameters. With the larger lamp the magnification varies from 14 to 37 diameters. An opaque screen is recommended for the projection and may be prepared as follows:—A wall space, or a paper or linen screen, is painted

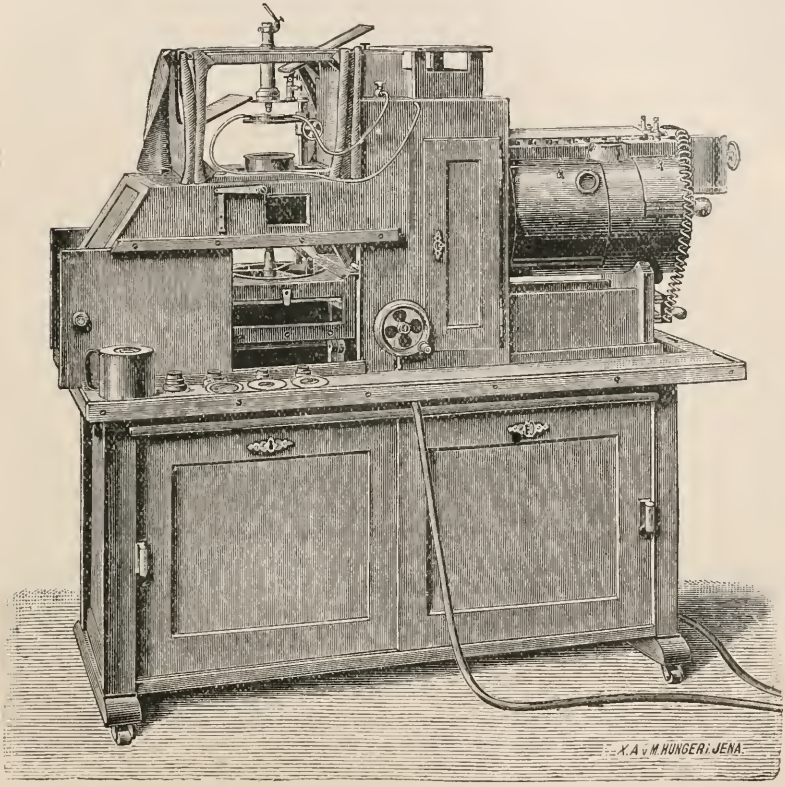

Fig. 132.

with white zinc, prepared with water and size, and dusted over with powdered chalk just before the coat of paint becomes dry. Such a colouring can be easily renewed when necessary.

When reflected light is used the light emitted by the crater of the positive carbon falls upon the parabolic mirror of the lamp and is thence reflected in the shape of a nearly cylindrical pencil. It next passes through the cooling chamber (which is filled with water and performs the function of absorbing heat rays), then strikes a mirror and is by it reflected obliquely through the diaphragm and upon the object imme-

diately below. From the object the light is diffusely reflected upwards. Of the reflected rays, only those which are confined in their passage to the space marked off by the dotted lines reach the objective. The cone of rays travelling upwards through the objective meets the erecting mirror and is finally reflected upon the screen.

When transmitted light is used the mirror previously employed is turned back so as to allow the pencil of rays to pass to a second mirror. From there it is reflected obliquely downwards upon a third mirror, which again reflects it vertically upwards into the condensing lens situated below the object-stage. On leaving the condenser, the rays of light pass through the transparent object and form a reduced image of the search-light reflector near the projection objective. They next pass through the objective and meet the erecting mirror. The latter is fitted with a regulator. The position of the mirror is that required for projecting the picture obliquely upwards.

Fig. 130 represents the simplified Microscope with a planar lens in use. Fig. 131 shows the whole epidiascope and the simplified Microscope attached to it when used with a planar lens. Fig. 132 gives the epidiascope with the simplified Microscope provided with an ordinary microscopical objective and ocular.

Projection Microscopes using Electric Arc or Oxyhydrogen Light.*—A. H. Cole points out that the utility of projection Microscopes depends upon the degree of success with which three practical problems are solved:—(1) A light of intense brilliancy must be produced and kept in the optical axis; (2) the system of condensers must collect the largest possible percentage of light rays from the luminous point and deliver them at the proper angle of convergence for each of the objectives used; (3) the apparatus must not be too cumbersome or complicated, or too expensive for ordinary use. Fig. 133 shows the author's attempt to solve these problems, the body being rotated upwards on the top of the plate and held in position by a slender support so as to give a clear view of the 90° arc lamp and electrical connections. The baseboard is cut away under the lamp so as to permit the use of long vertical carbons. At the rear end and right side of the board is placed the switch in the most convenient position for use. On the opposite side of the board is the fuse-block. At the right of the fuse-block, as seen in the illustration, are two binding-posts connected with the fuse-block by two twisted flexible wire cables. From the other end of the fuse-block two similar cables connect with the binding-posts of the knife-switch. When the electricity is turned into the lamp by closing the switch, it passes to each carbon through the cables connected with the right-hand binding-posts of the switch. The arc is formed between the proximate ends of the carbons, which are shown on an alternating current of 110 volts, and in about the proper adjustment to develop the maximum power of the lamp. The carbons are fed together or singly by turning both feed-wheels at the end of the horizontal shaft below the horizontal carbon at the same time, or either one alone, as needed. The entire lamp may be elevated, or lowered, and rotated to the right or left, and moved along the base-rods and clamped in any position.

* Journ. App. Micr., v. (1902) pp. 1892-3, 2012-3 (1 fig.).

The available light is derived from the end of the horizontal carbon and falls directly into condenser number one, then passes through condenser number two, both of which are in the condenser-cell attached to the front of the plate. The light next passes through the water-tank, then through condenser number three, which is attached to the tank, then passes to the substage condenser if high-power objectives are being used, next through the object mounted on the stage of the Microscope, then through the objective, and, lastly, through the amplifier and falls upon the screen. The substage condenser is not used with low-power objectives, as it produces a cone of rays with too wide an angle. The amplifier is a single plano-concave lens of 5 or 6 in. focal length and may be used with any objective to increase the magnification of the

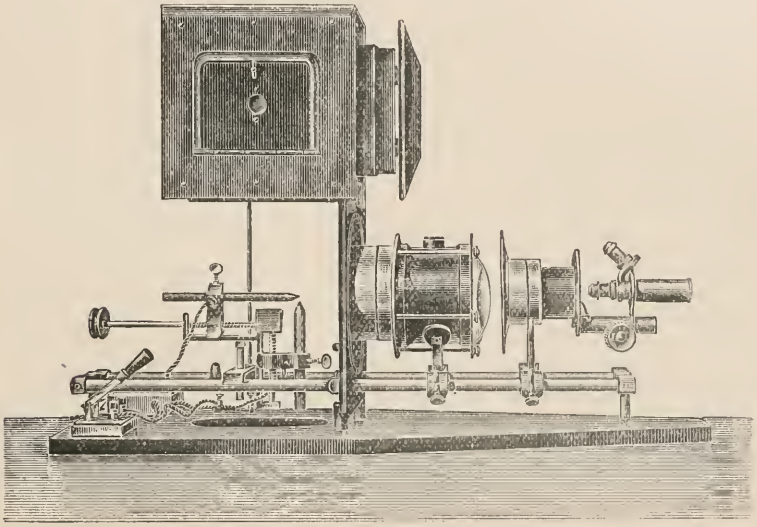

Fig. 133.

image on the screen. It is preferable to a regular microscopic ocular, as it intercepts less light.

In working with high-power objectives it is necessary to bear in mind that the field is sometimes only one-fiftieth of an inch in diameter, and that perfectly uniform illumination is essential for successful work. By observing an arc through smoked glass, or through a combination of two plates of deep ruby and blue glasses, it is readily seen that the arc creeps about on the ends of the carbons as they are slowly consumed. The luminous point consequently varies in position. This difficulty may be overcome in three ways:—(1) By using soft-cored carbons; (2) by using as small a horizontal carbon as possible in combination with a larger vertical carbon; (3) by moving the luminous point into the optical axis by a slight vertical or lateral movement of the arc. To accomplish the last, the vertical supporting rod of the lamp should not

be clamped rigidly, and a slight lateral push on the feed-wheels will rotate the lamp on its support. Small carbons burn away more rapidly than large ones, and the feed requires more frequent attention. The carbons shown in the engraving are $\frac{7}{16}$ and $\frac{9}{16}$ in. in diameter, "Nürnberg soft-cored Electra brand." In the highest power work which the author has done with the electric light, a very steady light was obtained by using a $\frac{9}{16}$ in. cored vertical and a $\frac{5}{16}$ in. solid horizontal carbon. The light from a 110-volt alternating incandescent current was sufficient to give a strong picture of a stained transverse section of an earthworm having a magnification of 8800 diameters by measurement. The objective used was a B and C $\frac{1}{12}$-in. oil-immersion in connection with an amplifier. The conditions just described will indicate the reason for the use of hand-fed 90° arc lamp rather than for other types of hand-fed lamps or for any of the automatic-fed. The automatic-fed lamp is convenient in very low power and lantern slide projection, but here also the 90° lamp gives as good results. Concerning the field of illumination on the screen, it should be noted that, if the Microscope is pushed too close to the lamp, the field will be blue and will not give satisfactory results. As the Microscope is moved to a greater distance from the lamp, the centre of the field will be strongly illuminated, and at a still greater distance the entire field will be evenly illuminated, and this is the best position for all objects except ths most difficult, which may require the strong central illumination. The system of condensers is of the utmost importance, and the best combination consists of three plano-convex condensers, each $4\frac{1}{2}$ in. in diameter, and arranged as follows:—No. 1, a plano-convex lens of about 5 in. focal length with its plane side next to the light; No. 2, a plano-convex lens of $6\frac{1}{2}$ in. focal length with its convex side facing the convex side of No. 1, and enclosed in the same cell with it; No. 3, a plano-convex lens of about 11 in. focal length and attached to the water-tank with its convex side facing the Microscope. A simple plano-convex substage condenser of $\frac{13}{16}$ in. focal length is a necessity in high-power work with the above condensers, but its efficiency varies with its distance from the object. The correct distance for each objective should be determined by experiment and recorded for reference. All the above directions for the electric light apply equally well to the oxyhydrogen, in which the luminous point is constant: but the less intense light materially reduces the available magnification.

Method of Measuring Objects in the Microscope.* — F. E. Ives proposes a simple arrangement for stage measurement. In fig. 134, A represents the foot of the Microscope; B is a block of wood notched to fit against the foot and project in a particular direction; C is a rider with set-screw and a post, and spring-clamp D to hold a jeweller's saw having sixty-four teeth to the inch; E is the Welsbach light diffused by a ground-glass chimney and shielded from the eyes by a hood open only on the side towards the Microscope. The source of light being on a level with the Microscope, the jeweller's saw is supported in a vertical plane directly between the light and the Microscope mirror, and in this position its image can be focussed in the field of the Micro-

* Journ. Franklin Inst., cliv. (1902) pp. 73–6 (3 figs.).

scope by slightly racking back the condenser. The image of the saw-teeth constitutes the measuring scale which can be given any desired value, within limits, by adjusting its distance from the Microscope mirror and comparing the focussed image with the scale on a stage micrometer. When the scale is not wanted the block is pushed aside and can be replaced in an instant. An engraved scale on glass, or celluloid, could be substituted for the saw.*

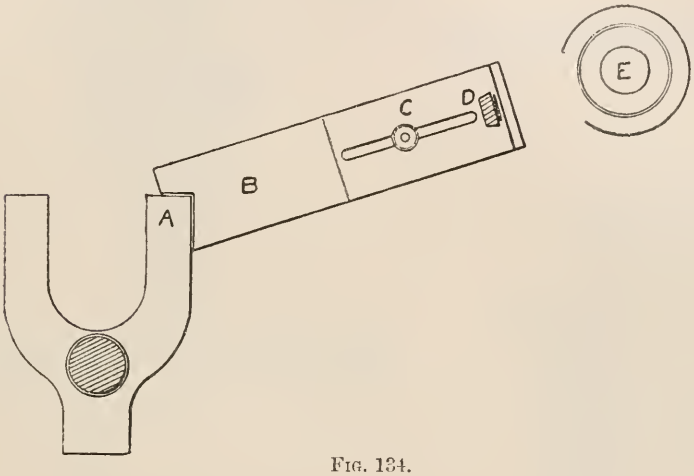

Fig. 134.

Form of Vertical Camera and its Uses.† — J. Reighard has arranged an apparatus for photographing such objects as the eggs of *Amia*, which are some 2 mm. in diameter, spherical and opaque, and must be photographed under liquid with a vertical camera. He used Zeiss' larger photomicrographic camera, which is made in two sections so that the front section alone may be employed where a short bellows is desired. The camera was attached by means of clamps to an iron frame consisting of two iron rods held together by cross bars at the ends and middle, and the length of the bellows could be varied by the adjustment of the clamps. The frame could be slid backwards and forwards in four grooved supports screwed to the top of an iron stand: this top was a heavy I-shaped casting bolted to the rest of the stand. A fine adjustment was secured by the following device:—Alongside the camera frame (on the left) at a distance of 5 cm. from it runs a vertical wooden rod 3 to 4 cm. in diameter (fig. 135); this rod is pivoted at its upper end to the ceiling near the first pulley wheel, and at its lower end it is pivoted on a wooden bracket which extends from the wall just below the board to which the iron base-plate is attached; the rod is thus within easy reach of a person focussing the camera, and turns freely; its upper end for about 6 cm. is formed into a spool and

* This is a variant of the ghost micrometer described by Dr. Goring in 'Micrographia,' 1837, p. 51. It has since been re-invented many times.

† Journ. App. Micr., v. (1902) pp. 1782–90 (7 figs.).

about it the rope running to the counterpoise makes one turn; the remainder of the rod is octagonal; by turning the rod with the hand the camera may be moved up or down with great delicacy, while the rod offers no hindrance to the direct and more rapid movement of the camera by hand.

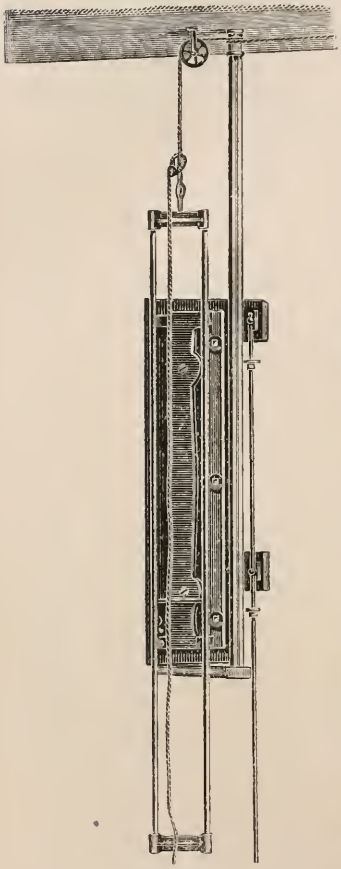

Fig 135.

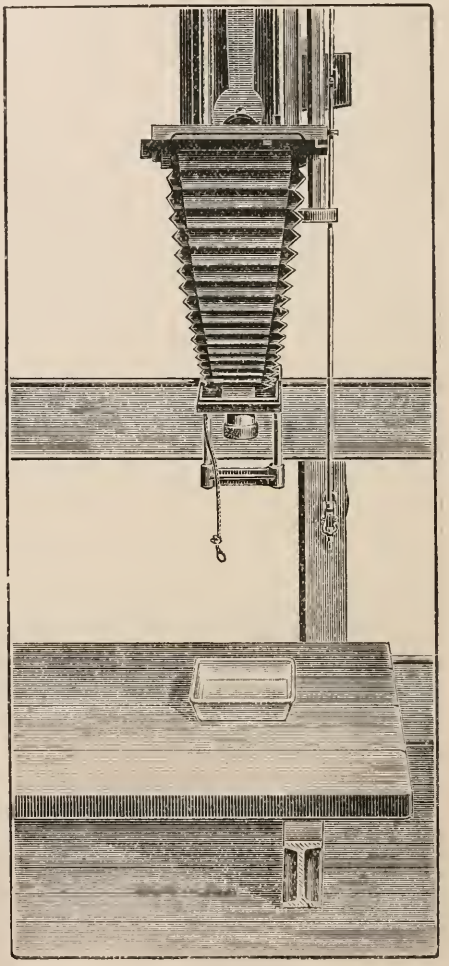

Fig. 136.

Fig. 137 shows the apparatus fitted to the Microscope, the illumination being provided in this case by a Thomson 90° arc lamp, lantern-condenser, and alum-cell. The Microscope must be attached to a levelling plate which is a cast-iron slab 17 by 25 mm. and 6 mm. thick,

with truncated rectangular pyramidal feet 8 mm. high at the corners; these feet are pierced by levelling screws. The slab is provided with ear-like projections extending from either end through which the plate may be screwed to small iron plates set into the floor. The upper surface of the levelling plate is provided with stops against which the base of the Microscope fits, with felt pads for the instrument to rest on; it has also a binding-screw by means of which a metal strip is clamped across the base of the Microscope to hold it to the plate (fig. 138). To the end of the plate at the back of the Microscope is attached a socket from which rises an iron rod 12 mm. in diameter, and vertically adjustable by a thumb-screw in the socket. At the top of this rod is a cross bar for bearing a pair of pulley-wheels, which may be set at any point on the backwardly projecting limb of the cross bar. An iron rod 11 cm. long and 5 mm. in diameter is attached to one end of the axis of the pulley by means of a Hooke's joint. Supported from the wall by two brackets alongside the camera is a vertical metal rod which extends from the level of the coarse-adjustment screws to the uppermost camera support (fig. 137). This rod is provided with two adjustable milled heads, which may be set at any point so as to be within easy reach. At the lower end of the vertical rod is a third bracket which supports a bevel gear whose cog-wheels are each about 3 cm. in diameter (fig. 138). The upper wheel is attached to the vertical rod, while to the lower is attached, by means of a Hooke's joint, an iron rod like that attached to the axis of the pulley-wheel, but only 3 cm. in length. When the levelling plate is in position these two iron rods may be united by means of a brass sleeve in which there are two screws (fig. 138). The Hooke's joints give this connection a certain degree of flexibility, and so permit of considerable movement of the levelling plate and of adjustment of the pulley-wheels on the cross bar. When the connections have been made, the coarse adjustment of the

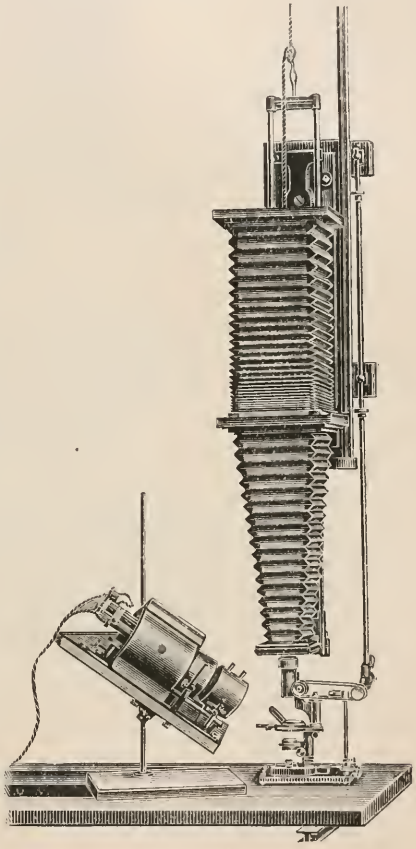

Fig. 137.

Microscope may be manipulated by an operator looking at the ground glass of the fully extended camera. The coarse adjustment is to be

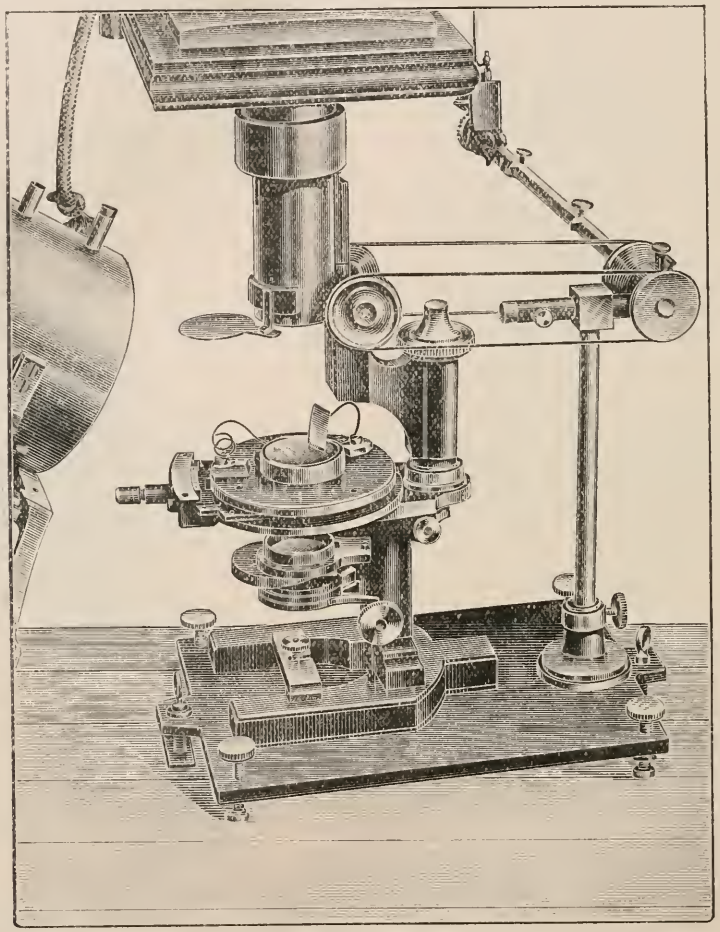

Fig. 138.

Fig. 139.

preferred for all work with very low powers. If high powers are to be used the focussing rod and Hooke's joint may be attached to the limb

of the cross bar, opposite that which carries the pulleys, and by means of these the fine adjustment may be turned from a distance.

A flat opaque object, such as a chick blastoderm, may be brought into the focal plane of the objective by the following device (figs. 138 and 139):—To the centre of a brass plate of the size and form of the Microscope stage is soldered a flat brass ring 40 mm. in diameter and 9 to 10 mm. high, thus forming a shallow pan in the centre of the brass plate; to the centre of one face of a small brass disc 30 mm. in diameter, a brass ball of about 6 mm. in diameter is attached by a stem 2 mm. long; this ball is received into a socket between the lower face of the brass pan and a small brass disc screwed to it, and this socket is packed with oiled leather; the small metal plate then forms a sort of false adjustable bottom within the pan, which is filled with alcohol and placed on the Microscope stage; the specimen is then placed on the false bottom which is tilted until the specimen lies as nearly as possible in the focal plane of the objective. The brass plate may be provided with holes by means of which it may be attached by pins inserted into the clip-holes of the Microscope stage.

(4) Photomicrography.

Bagshaw, W.—**Elementary Photomicrography.** London, 1902, 70 pp. and 6 pls.

Marktanner-Turneretscher, G.—**Wichtigere Fortschritte auf dem Gebiete der Mikrophotographie und des Projektionswesens.**

[Gives a very complete *résumé* of international progress in photomicrography.]

Jahrb. f. Photographie und Reproductionstechnik für das Jahr 1902, Halle; also in pamphlet form, 21 pp. and 5 figs.

(5) Microscopical Optics and Manipulation.

Kraft, C.—**Études expérimentales sur l'échelle des couleurs d'interférence.**

[The author describes the mapping out of the colours of various spectra in connection with the corresponding wave-lengths.]

Bull. Int. Acad. Sci. Cracovie, No. 5 (1902) pp. 310–53 (4 pls.).

(6) Miscellaneous.

Chambers and Inskeep's Improved Ophthalmometer.* — This instrument, for measuring the curvature of the cornea, possesses, as its special characteristics, stationary and luminous mires and adjustable prisms. These features give it, say its inventors, a distinct superiority over other forms of ophthalmometer.

Fig. 140 gives a rear side view of the instrument, and shows the adjustments for focussing, for perpendicular adjustment, and for moving the prisms. Fig. 141 presents the stationary mires and head-rest. The construction will be understood from fig. 142, which is a vertical section of the instrument. *d* is the outer tube mounted to rotate in sleeve or collar *s*, supported by standard *t*, the standard being swivelled in tubular support *g*; *k* is a diaphragm; 10 is the eye-piece, with suitable lenses *a* and *b*; *n* is a stationary disc borne on collar *s*, graduated to indicate angles of meridional deviation of plane of mires; *i* is a

* Chambers, Inskeep & Co.'s Special Catalogue.

pointer, or index finger, carried on angular bridge q of telescope-tube to point out angle on graduated scale; u is a black concave disc rotating with the tube d; $w\,w$ are the mires, made of translucent material; 12, 12 are hemispherical shells containing the light, connected with

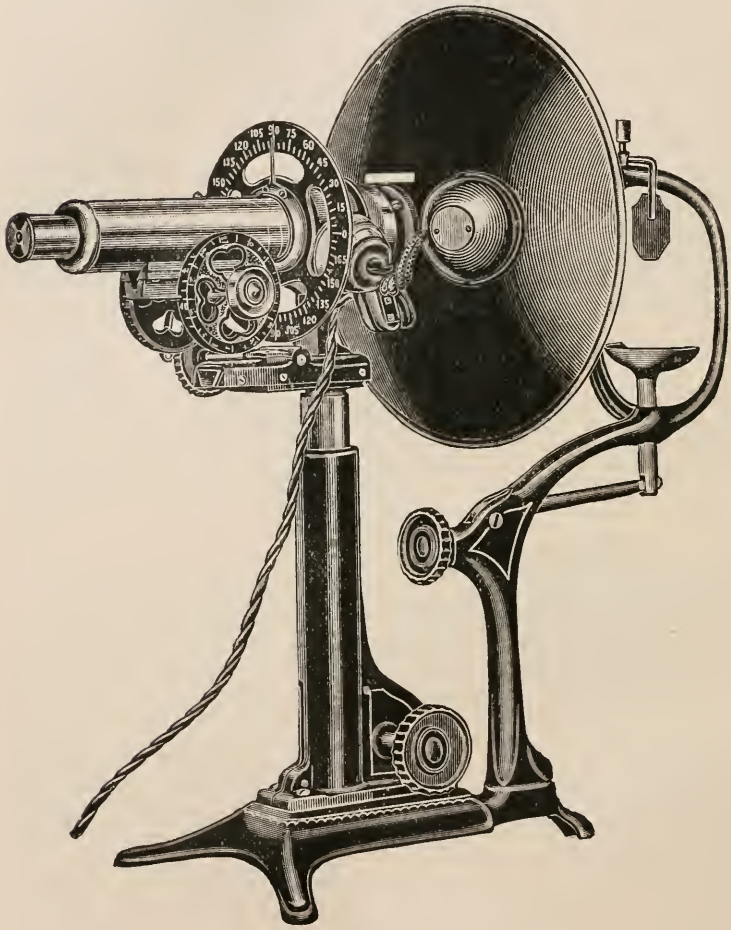

Fig. 140.

wires running from insulated rings in the hollow stem t; f is the inner or sliding tube of telescope, carrying a prism $h\,h$, whose refractive plane is in the plane of the mires: this tube has a rack o attached thereto for moving it; this rack projects through a slot m, and is engaged by a pinion p, by which the inner tube is carried back and

forth in the outer tube. On the axis of the pinion is a milled head, for turning the pinion and discs in duplicate, graduated on outer edge and face with a scale in millimetres of radii and their equivalent in dioptres. The effect of moving the prisms longitudinally is to approximate or separate the images of the mires as seen on the cornea.

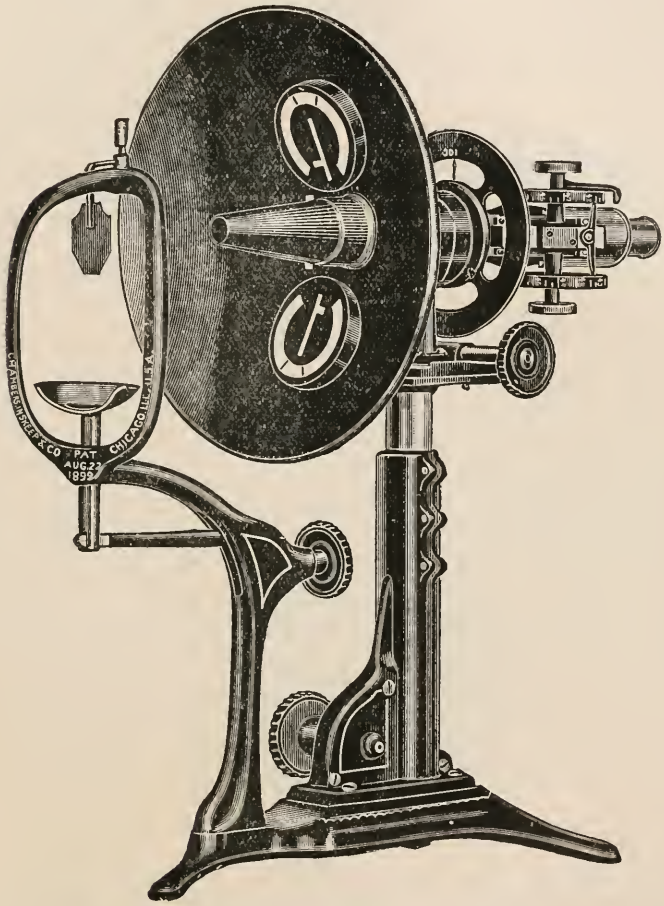

Fig. 141.

In using the ophthalmometer, the operator, after the necessary adjustments for height, obtains a clear image in the patient's eye of the mires by the focussing adjustment. He then turns the tube horizontally slightly to right or left until two images of the mires are seen in close proximity (fig. 143). An outer image may be seen on either side of the field of view, but these are always widely separated from the inner ones,

and are to be disregarded. The instrument is now revolved until the long meridian lines of the images show a single straight and unbroken one. If there is no astigmatism this condition will be seen at all axial

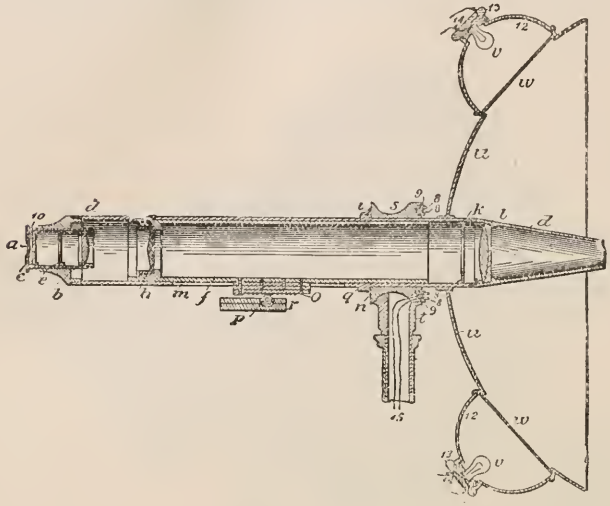

Fig. 142.

positions; if astigmatism, at but two positions. Directions are given for reading the variation of cornea curvature in dioptres and fractions.

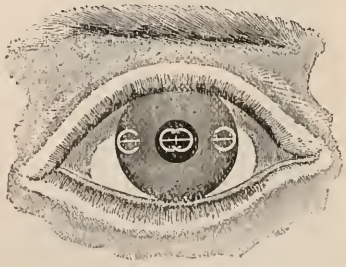

Fig. 143.

Interesting Extracts from Borelli. — The following passages, of which a literal translation is subjoined, occur in Borelli's Treatise on the Telescope and other magnifying glasses, viz. *De vero Telescopii inventore cum brevi omnium Conspiciliorum Historia. Authore Petro Borello. Hagæ-Comitum*, 1655. The copy of this work in our library is in fair condition, though two pages, including the portrait of the author, are wanting.

Book i. p. 10:—"And lastly the Microscope, or the fly or flea spy-glass, by which the flea and the fly rise to (the size of) the camel and the elephant, is made of two glasses inclosed in a tube; the glass nearest

the eye is convex, and made out of a minute segment of a spherule, the diameter of which should be two inches; the other is a flat glass: it may also be made out of two convex (glasses), and this is better."

Book ii. p. 43:—"The third kind of tube is the Microscope for greatly increasing the size of small objects, as fleas, &c. This consists of two glasses and a tube of one inch (? long) or thereabouts, in which small bodies are placed. One glass, that nearest the eye, is convex (and) ground out of a minute segment of a sphere, the diameter of which is at most equal to two inches; the lower one near the bottom, on which the things to be looked at are placed, is merely a simple piece o lass flat on both sides.

"Or Microscopes are made of two convex glasses, reduced to the shape of the tube; one, which is directed towards the things to be looked at, is highly convex, and should be made from the segment of a small sphere; the other, which is applied to the eye, is somewhat flatter; of course the proportion to the things to be seen in it must be carefully considered."

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Physical Properties of Gelatin, in reference to its use in Culture Media.†—G. C. Whipple made experiments which show that the character of the gelatin used in culture media has a most important influence upon quantitative and qualitative bacteriological work, and that for different observers to obtain results which may be fairly comparable, it will be necessary to use culture media made from one and the same lot of gelatin. It will be necessary also to follow a most rigid system in the preparation, sterilisation, and use of nutrient gelatin, in order that its physical condition may be the same in all cases. The chemical characteristics of different gelatins with reference to their use in culture media are not discussed, as investigations in that direction are not completed, but the effect of the physical condition of the culture medium on bacterial growth is pointed out. The viscosity, melting-point, and spissitude (jelly strength) of gelatin solutions are described, and a new form of spissimeter and a new method of stating the results of spissitude measurements are suggested.

Method of Cultivating Anaerobic Bacteria.‡—F. C. Harrison describes a method of growing anaerobes which is a combination of the pyrogallol method and a vacuum. Plates or tubes are placed in a bell-jar with stopcock at the top (fig. 144), and this connected with a vacuum pump. The bell-jar is sealed to the dish with paraffin. Pyrogallic acid is placed on the floor of the dish, and the apparatus shown in fig. 145 is inserted after having been filled with KOH or NaOH. The vacuum

* 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.

† Technol. Quart., xv. (1902) pp. 127–60 (14 figs.).

‡ Journ. App. Micr., v. (1902) p. 1974 (2 figs.).

causes the NaOH in the tube to siphon off, and the last remaining trace of oxygen is absorbed.

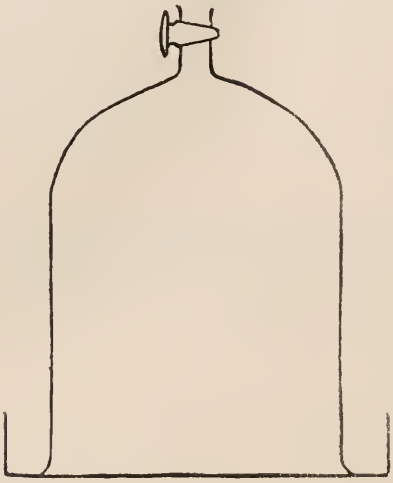

Fig. 144.

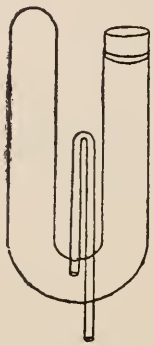

Fig. 145.

Eggs as a Medium for the Cultivation of Bacillus tuberculosis.* M. Dorset finds that coagulated egg-albumen is an excellent medium for cultivating the tubercle bacillus. The white and yolk are mixed together and then distributed in tubes. The tubes are incubated at 70° C. for two successive days for four hours and simultaneously sterilised. A couple of drops of sterilised water are poured into each tube, and then the surface of the slope is inoculated with the tuberculous material. The cotton-wool plugs are saturated with paraffin, and the ends of the tubes filled in with paraffin.

Apparatus for Removing Pieces of Tissue for Microscopical Examination.†—T. L. Webb has devised an apparatus for removing pieces of tissue for histological examination by means of suction. The apparatus consists of a glass tube about $\frac{3}{8}$ in. in diameter, which is attached to an aspirator. When the aspirator is turned on some tissue is drawn up into the tube and then it is easy to snip off a piece.

(2) Preparing Objects.

Simple Method of Preparing Bone Sections.‡—H. G. Rosenberger first cuts rough sections with a saw and then inserts them in a cavity hollowed out of a piece of soft pine. The block is then held against a revolving grindstone, so that wood and bone are ground down together. As soon as the first side is well smoothed, the section is turned and the

* Amer. Med., iii. (1902) pp. 555-6. See Centralbl. Bakt., 1te Abt. Ref., xxxii. (1902) p. 114.

† Journ. Brit. Dental Assoc., xxiii. (1902) pp. 438-40 (1 fig.).

‡ Journ. App. Micr., v. (1902) p. 1996.

other side ground until the desired thickness is nearly reached. The section is then removed and finished off on an oilstone or hone, and finally mounted in thick balsam.

Neurological Technique.*—A monograph containing the approved methods of examining nervous tissue has long been a desideratum. This want has been supplied by Irving Hardesty, whose work entitled *Neurological Technique* will be found of the greatest service by those who are engaged in studying or in teaching the histology of the nervous system. The sub-title (Some special histological methods employed for the study of the nervous system, together with a laboratory outline for the dissection of the central nervous system and the neurological nomenclature (BNA) arranged in a classified list) more closely indicates the general scope of this useful work.

The first part of the work deals with general considerations as to the need and action of reagents, and with general instructions in procedure. Then come fifteen methods for demonstrating the histological appearances of the central nervous system. These are followed by two methods for museum preparations, after which is a chapter on the fixation and preservation of human embryos and fœtuses. The last two chapters deal with the application of formalin and with the dissection of the central nervous system. There is an adequate index.

(3) Cutting, including Imbedding and Microtomes.

Marble Blocks for Celloidin Tissues.†—E. C. Streeter recommends marble blocks instead of wood or cork for celloidin masses. He has given them a year's trial and is satisfied that they are very advantageous.

SLONAKER, J. R.—**An Attachment to the Minot Microtome for cutting Sections of 1 micron thickness.** *Journ. App. Micr.*, V. (1902) pp. 1994–6 (4 figs.).

(4) Staining and Injecting.

Rapid Method of Staining the Morphotic Elements of Blood.‡—Marino uses two solutions:—(i.) A saturated solution of acid fuchsin; (ii.) Brilliant kresyl-blue 1 to 1000–4000 water, or kresyl-blue 1, absolute alcohol 200. The preparations are stained for one minute in the acid-fuchsin solution, and then having been washed with water are treated for 15–20 minutes with the kresyl-blue.

Staining Axis-Cylinders of Fresh Spinal Cord.§ — H. L. Osborn finds that spinal cord may be stained sufficiently well for demonstration purposes by placing a small piece in 30 p.c. alcohol and incubating at 56° for six hours. Small pieces are teased out in distilled water on a slide and irrigated with an aqueous solution of acid-violet.

New Alcoholic Carmin Solution.‖—N. Loewenthal prepares a carmin solution in the following way. The first step is to make a sodium

* University of Chicago Press, Chicago, and Wesley and Son, London, 1902, xii. and 183 pp. and 4 figs. † Journ. App. Micr., v. (1902) p. 1970.
‡ C.R. Soc. Biol. de Paris, liv. (1902) p. 457.
§ Journ. App. Micr., v. (1902) p. 1987 (1 fig.).
‖ Zeitschr. wiss. Mikr., xix. (1902) pp. 56–60.

picro-carmin mixture by heating together 0·4 grm. carmin, 100 ccm. water, and 0·8 ccm. 10 p.c. caustic soda. While still hot, 25 ccm. of 0·5 p.c. aqueous solution of picric acid are added gradually. When cold this sodium picro-carmin is mixed with half its bulk of 1 p.c. HCl. The red precipitate which forms is then washed until the water is no longer yellow. The dark red deposit on the filter is then dissolved in 70 p.c. alcohol acidulated with HCl (about 1 p.c.). The solution is quite clear and gives good results after any method of fixation. The immersion time is from a half to several hours. The after treatment is simple and consists of changes of alcohol from 70 p.c. up to absolute. The author states that the solution is an effective nuclear stain, that by its use aqueous media can be avoided, and that it does not colour celloidin.

Flagella Staining.*—W. Kuntze describes the procedure he adopts for staining flagella. The medium recommended for cultivating the bacteria is the ordinary 1 p.c. meat-pepton-agar but without salt. The tubes need not be fresh. The cultures used for inoculating should be from a few days to several weeks old and have been kept at the room temperature for some time. The freshly sown tubes are incubated and are ready for use in from 8 to 10 hours. An essential for success is that the cover-slip should be perfectly clean, and though a decent result may be attained by wiping, washing in ether and flaming, it is safer to follow the procedures of van Ermengem and Hinterberger. On the clean cover-slip is placed a drop of tap-water. This is effected by means of a loop $\frac{1}{2}$–$\frac{3}{4}$ mm. in diameter and made by bending a piece of glass rod. From this drop of water a droplet about the size of a pin's head is removed and placed on another cover-glass. To the latter is added a minute trace of the bacterial culture and the suspension distributed into a thin layer by means of the glass loop-rod. This must be performed without rubbing or pressing lest the flagella be torn off or damaged. The film should dry in a few seconds; it is then fixed in the flame in the usual way. When the film has cooled it is mordanted with van Ermengem's fluid made about a week before. The mordant consists of 1 vol. 2 p.c. osmic acid and 2 vols. 25 p.c. tannic acid with four drops of acetic acid to 100 ccm. The mordanting takes from $\frac{1}{2}$ to $\frac{3}{4}$ hour according to the temperature of the room. As it is important that the preparations should not come in contact with metallic substances, the cover-slips are held in glass-bladed forceps during the rest of the manipulation. The films are next washed with distilled water, and while still damp some 1 p.c. alcoholic solution of silver nitrate is dropped on. After a few seconds they are treated with the developer (5 grm. gallic acid, 3 grm. tannin, 10 grm. acetate of soda, 350 grm. distilled water). After a short action, silver nitrate solution is again dropped on until the black precipitate, which forms at first, is washed away. The films are then washed with distilled water, and if it be found that they are clean and free from precipitate may be at once passed through absolute alcohol and dried in the flame. If, however, any precipitate still remain they must be treated with gold chloride solution (1–2000 or 3000). Should it be necessary to use gold chloride the

* Centralbl. Bakt., 1te Abt. Orig., xxxii. (1902) pp. 555–60 (1 fig.).

preparation should be previously exposed to the light for a short time, and in any case the treatment must be of short duration. If, after using gold chloride, the resulting picture is found to be good, it is advisable to expose the preparation to the light for a few days, as gold is reduced much more slowly than silver.

Staining Sections of Spinal Cord with Cœruleïn S.*—B. Rawitz recommends Cœruleïn S (Höchst) for staining sections of spinal cord. The following solution gives good results:—Cœruleïn S 0·1 grm., potassio-tartrate of antimony 1·0 grm., distilled water 100 ccm. The potassio-tartrate is dissolved in lukewarm water, the pigment is then added, and the mixture boiled in a sand-bath. When cold, the clear dark-green fluid is decanted off and kept as stock. When required for use, one part of the stock solution is mixed with ten to twenty times its volume of distilled water. The time required is 24–48 hours, and it may be necessary to incubate at 37°–40°. The sections are afterwards washed in distilled water, dehydrated in 96 p.c. alcohol, and after clearing in bergamot oil mounted in balsam.

Simplified Method of Staining with Polychrome Methylen-Blue.† B. Rawitz gets excellent results by means of the following simplified procedure. The sections are placed for 24–48 hours in dilute polychrome blue (1–50 Aq dest.)., and then after a short washing with water are immersed for 24, 48–72 hours in 96 p.c. alcohol or until they become quite light blue. They are then cleared up in dark-green bergamot oil (the yellow is too acid) and mounted in xylol.

Staining the Reticulum of Spinal Ganglion-cells.‡ — F. Kopsch demonstrates the reticulum in ganglion-cells of the spinal cord in the following manner. Not more than six ganglia are immersed in 2 ccm. of 2 p.c. osmic acid solution for about eight days. The acid must be renewed if there be any reduction. The reticulum begins to stain about the fifth day, but does not attain its maximum till the eighth or even later. Though this method is not successful with cells of the central nervous system it gives good results with cells from other regions, e.g. salivary gland.

Zangger, H.—**Histologisch-Färbetechnische Erfahrungen im allgemeinen und speziell über die Möglichkeit einer morphologischer Darstellung der Zell-Narkose (vitale Färbung).** (A discussion on histological staining technique and intra vitam staining.)
Vierteljahrschrift Naturf. Ges. Zürich, XVII. (1902) pp. 43–72.

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

Double Mounting for Whole Objects.§ — H. F. Perkins suggests the following device for mounting objects to be studied from both surfaces. The object is mounted on a large cover-glass with a smaller slip for cover. The larger slip is then laid on an ordinary slide and one end fixed by means of gummed paper or sticking-plaster. This

* Anat. Anzeig., xxi. (1902) pp. 554–5. † Tom. cit., p. 555.
‡ S.B. Königl. Preuss. Akad. Wiss. Berlin, xxxix. (1902) pp. 929–35 (1 fig.).
§ Journ. App. Micr., v. (1902) p. 1926 (1 fig.).

acts as a hinge and allows the large slip to be turned over. A small wire clip is used to hold the covers firmly to the slide in either position.

(6) Miscellaneous.

New Counting Apparatus for Plate Cultures.* — R. Thiele describes a counting apparatus which is intended to avoid counting the colonies twice over. It consists of a tripod stand having a loup attached to the upper end of the pillar. This loup has a diameter of 10 cm., gives a magnification of six to eight, and can be used with both eyes. The plate is borne on a carrier which can be moved up and down the pillar. The carrier is marked out in squares or in sextants. The distance between the loup and the carrier is such that a pencil can be used to indicate the colonies.

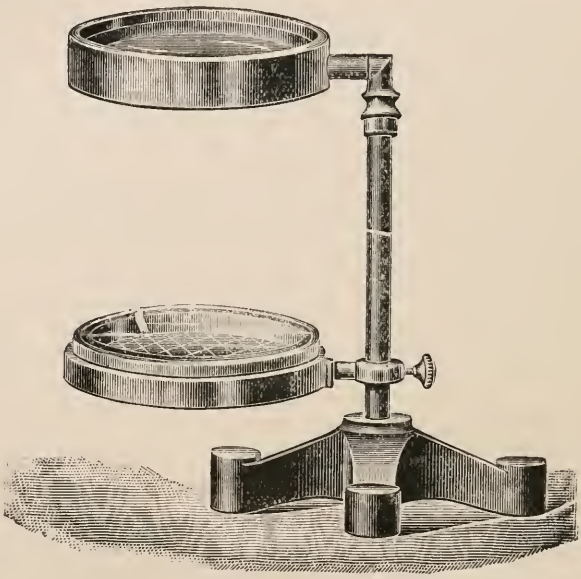

Fig. 146.

Effect of Reheating upon Overheated Steel.† — K. F. Göransson concludes that the destruction of the coarse network of cementite is caused by its carbon being dissolved in the martensite, and that the network surrounding the new grains is formed by the expulsion of cementite from the martensite as it is being cooled.

Steel Rails: Relation between their Structure and Durability.‡ R. Job has undertaken a long series of microscopic observations on

* Centralbl. Bakt., 2te Abt., ix. (1902) pp. 332–3 (1 fig.).
† Metallographist, v. (1902) pp. 216–28.
‡ Tom. cit., pp. 177–91 (13 microphotos).

steel rails which have fractured or duly worn in use, as well as on other rails which have shown especial durability. His conclusions are corroborative of other investigators' results and show the importance of giving to steel rails a fine-grained structure throughout—not merely as a surface layer. The rail should be fine-grained even at the centre of the head, and practically amorphous at the surface. Reliance upon chemical analysis is quite untrustworthy.

S. S. Martin's * experiments point to the same conclusion, and he argues that since no change of structure can result from finishing below the critical point, a rail must be rolled as near the critical point as possible to get the best structure, or in the case of rail steel between 700° C. and 725° C.

A. Sauveur,† after discussing theories of present methods, points out that, in order to confer a fine-grained structure upon steel rails, there seem to be three courses of manufacture open:—(1) To shorten the crystallising period, i.e. the time during which the rail is allowed to cool undisturbedly above the critical temperature (say about 700° C.). (2) To cause a part of the crystallising period to occur previous to the final pass through the mill. (3) To finish the rail at the temperature most desirable for easiness and speed of manipulation in rolling, and then to reheat it to a temperature slightly above the critical, a treatment which would result in the breaking up of the pre-existing coarse structure and replacing it by a much finer one.

S. S. Martin ‡ also shows by the comparison of fine micro-sections the difference between hot and cold sawing upon steel. It follows that in studying the structure of rails care should be taken that the polished sections are sufficiently removed from the hot sawn side to be unaffected by the action of the saw; otherwise seriously misleading observations might result: a coarsely crystalline rail might be made to appear fine-grained.

Effects of Strain on the Crystalline Structure of Lead.§— J. C. W. Humfrey experimented with some exceptionally favourable lead crystals. The effect of tensile strain was to produce slip-bands, and it appeared that, when a slip had been produced in any part, there was a tendency for it to continue there rather than in other parts of the specimen. Thus the effect was rather to localise the strain. If the originally uniformly oriented crystal showed signs of recrystallisation after straining, it was found that moderate heating (up to 100° C.) very much facilitated the process. Experiments were specially carried out to determine whether the recrystallisation, which is apparent immediately after re-etching a severely strained crystal, is a direct and instantaneous effect of the strain, or is a growth which occurs during the interval of time that has elapsed during the straining and the examination. The author's opinion is clearly in favour of the latter hypothesis, and he considers it ought to be classed with the progressive growth demonstrated by Ewing and Rosenhain in their observations on the crystals of ordinary lead after straining.

* Tom. cit., pp. 191–6 (4 microphotos); and Iron Age, Dec. 26, 1901.
† Tom. cit., *supra*, pp. 197–202.
‡ Tom. cit., pp. 245–7 (5 microphotos).
§ Proc. Roy. Soc., lxx. (1902) pp. 462–4.

Structure of Copper-Antimony Alloys.* — J. E. Stead contributes a microphotograph showing the value of the "superposing" method for the preparation of alloys to be studied under the Microscope. The method consists of first melting the metal of highest specific gravity and then pouring on top of this, in a molten condition, the other, lighter metal. The two metals will alloy in such a manner that a vertical cross-section will show crystals of a pure metal at one end and crystals of the other metal at the other end, while between these the metals will be found alloyed in all proportions.

C. H.—**The Microscope and the Metallurgy of Steel.**
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