Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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FELLOWS OF THE SOCIETY

AND

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

FOR THE YEAR

1904

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, LONDON, W.

OF MESSRS. WILLIAMS & NORGATE, 14 HENRIETTA STREET, LONDON, W.C.

AND OF MESSRS. DULAU & CO., 37 SOHO SQUARE, LONDON, W.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Swift's Simple Dissecting Microscope.†—This is shown in fig. 1, and consists of a metal base and sliding pillar for focussing, with 3-in. and 2-in. lenses.

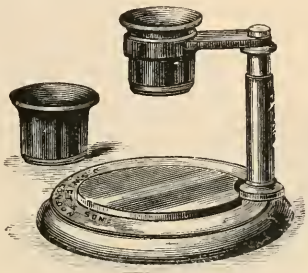

Fig. 1.

Swift's Newly Designed Microscope for Bacteriological Research.‡ This stand (fig. 2) was constructed from suggestions given by Delepine of Manchester. It is fitted with Swift's spiral rack-and-pinion for coarse adjustment. The fitting carrying the optical tube has the same wear-and-tear-preventing device as in the last instrument. The fine adjustment is also the same as in the last instrument. The draw-tube is divided to millimetres ; when fully extended it is 220 mm., when closed 160 mm. The triple nose-piece is perfectly dust-tight. The stage is covered with vulcanite, and is specially large to allow of the free use of the largest size Petri dish ; its right-hand side is divided into squares which answer the purpose of a finder. A full-size improved Abbe condenser, fitted with iris diaphragm and special focussing adjustment for raising or lowering it, is screwed to the under surface of the stage. Flat and concave mirrors are supplied, and a simple ingenious device enables the manipulator to determine when they are in the vertical axis. Three object-glasses are supplied with the instrument, one of them being Swift's $\frac{1}{12}$-in. oil immersion N.A. 1·30. The makers specially guarantee this particular lens to be of the highest possible optical excellence. Another of the objectives is the $\frac{1}{6}$-in., as supplied with the last.

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

† J. Swift & Son's Catalogue, London, 1901, p. 26.

‡ J. Swift & Son's special Catalogue, London.

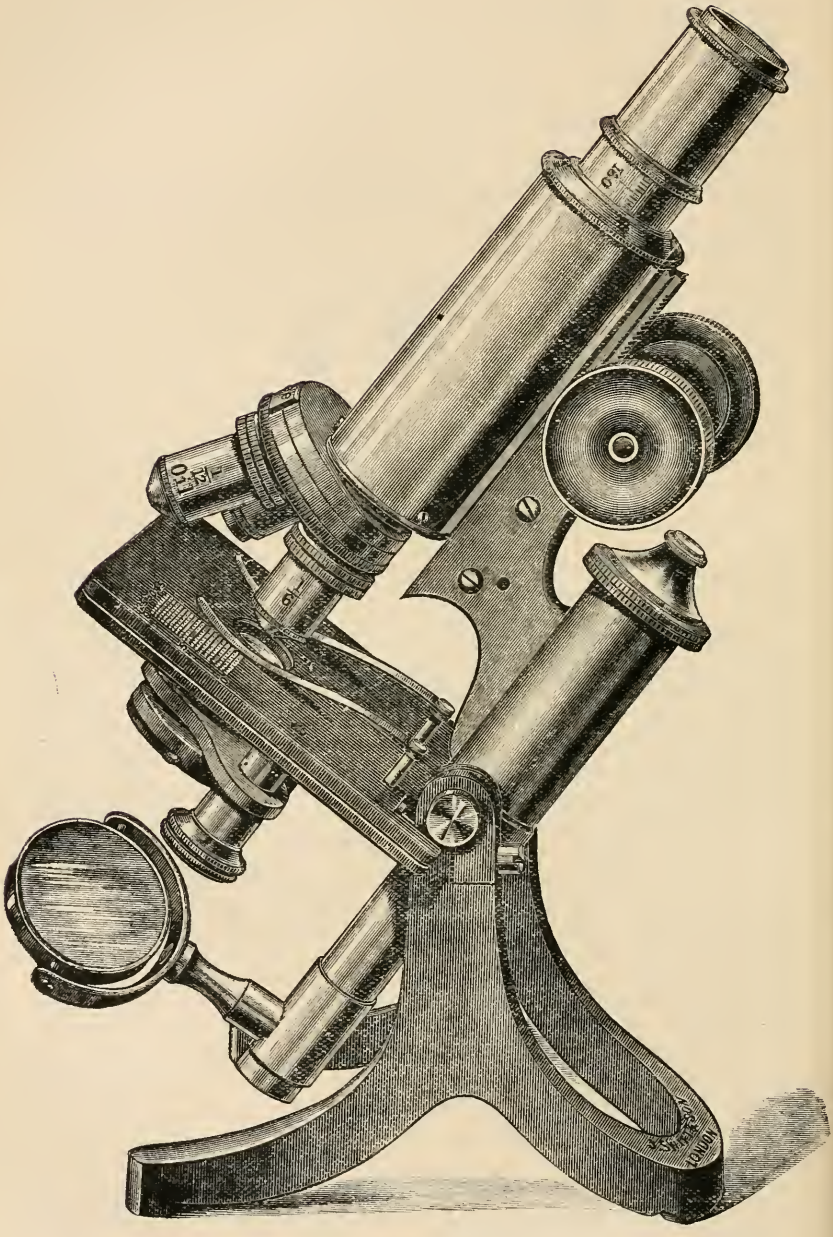

Fig. 2.

Swift's Newly Designed Histological and Physiological Microscope.* — This stand (fig. 3) is fitted with Swift's newly patented

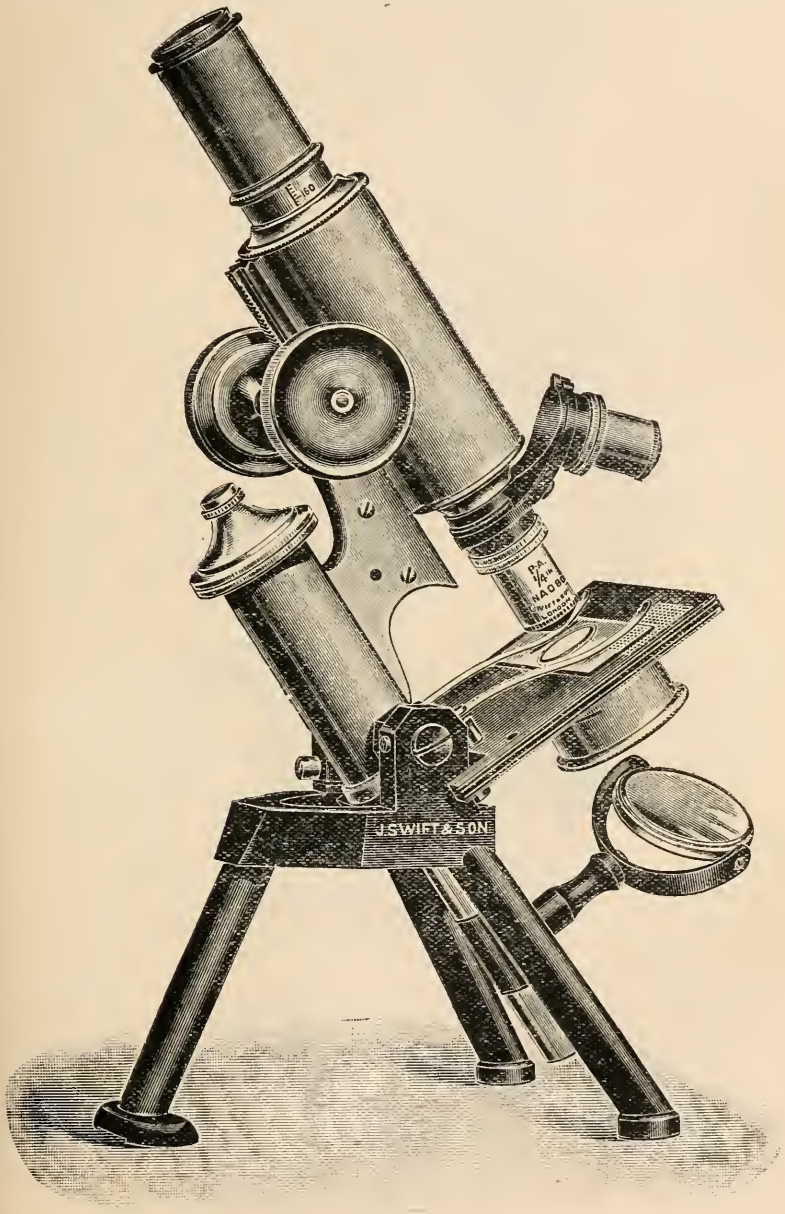

Fig. 3.

* J. Swift & Son's special pamphlet, London.

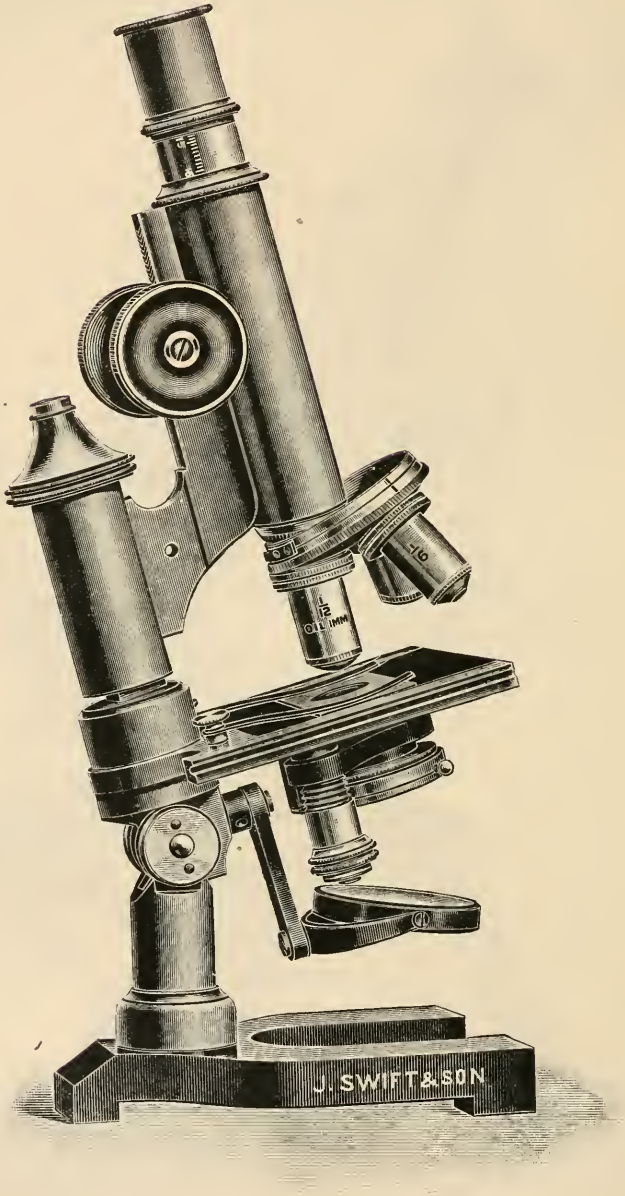

Fig 4.

isolated micrometer screw, whereby side movement is entirely eliminated. The fitting carrying the body or optical tube is new and of a novel construction, such that the wear and tear indispensable to all fittings can be compensated for by means of a simple adjustment effected by three screws fitted to the limb. The coarse adjustment is by means of Swift's patented diagonal rack-and-pinion. The stage is larger than that usually supplied to students' stands, and allows of the free use of a Petri dish. The whole of the instrument, with exception of the tripod and stage, is polished bright, and is of the highest possible mechanical excellence. The $\frac{1}{6}$-in. objective supplied has an exceptionally long working distance for blood examination with the Thoma-Zeiss hæmacytometer.

Swift's Continental Stand.* — The makers have introduced this stand (fig. 4) for the convenience of those who prefer this style. A special plant of machinery has been put down for the manufacture, and the instrument is an absolute réplique of a stand manufactured by one of the most reputed German makers, and is listed at the Continental price. A variation is, however, introduced in the size of the stand, which is much larger than in the original, and allows of the free use of the largest Petri dishes.

Watson and Sons' "Works" Metallurgical Microscope.† — The form and construction of this instrument are shown in fig. 5, and resemble the "Van Heurck" model made by the same firm. The foot is of the tripod pattern, and its front is so shaped that access is freely obtained to the milled heads, which control the movements of the stage and substage. The spread is $9\frac{5}{8}$ in. The instrument can be inclined on the foot in any position from the horizontal to the vertical; a clamping screw being provided for fixing it firmly in position. The stage is mounted on a very substantial bracket which, at the back, is fitted by dove-tailed grooves into a frame in which, by rack-and-pinion, it can be raised or lowered to or from the body of the Microscope. Special attention has been given to affording a sufficient interval between the nose-piece of the Microscope and the surface of the stage, for the use of very low-power objectives. The coarse adjustment afforded by the rack-and-pinion has, in many instances, been supplemented by a fine adjustment, so that the whole focussing of the specimen can be done from the stage instead of with the Microscope body. The stage usually supplied is similar to that of Watson's "Circuit Stage Van Heurck" Microscope with mechanical screws, having a range of motion of one inch in each direction. Complete rotation is provided, so that specimens may be examined under every aspect of illumination. In the illustration it will be seen that a sliding bar is fitted to a recess in the stage; this bar may be instantly removed, and a levelling stage or metal holder may interchange with it. The body is of extra large diameter, and is fitted with two draw-tubes; one having a rackwork, and the other sliding, so that a wide range of body-length may be obtained. There is sufficient range of adjustment for the focussing of the lowest-power lenses. The instrument is recommended by the makers

* J. Swift & Son's special Catalogue, London.

† W. Watson & Sons' Catalogue of Micro-outfits for Metallurgy, pp. 1, 3, 4.

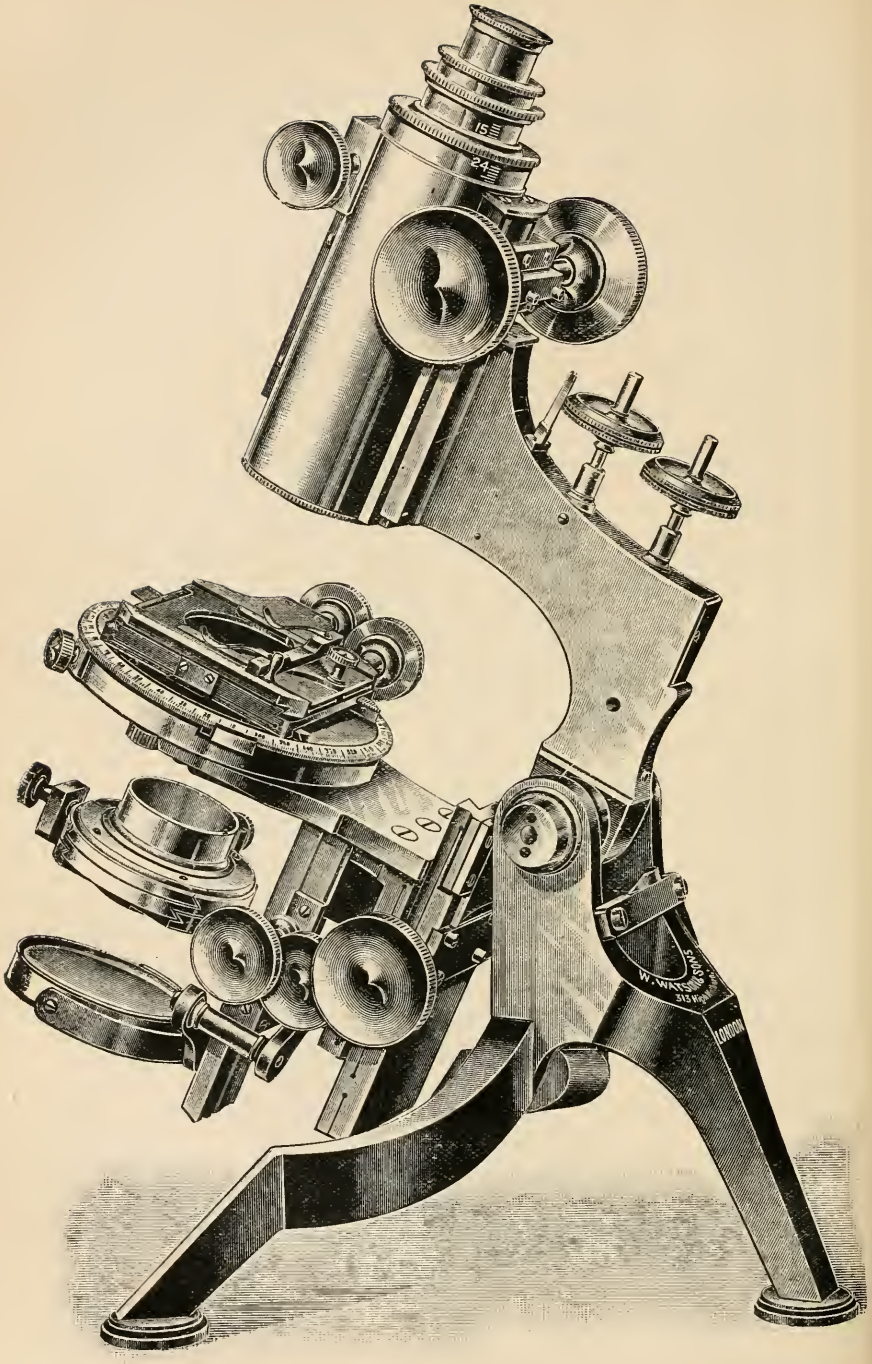

Fig. 5.

as embodying the latest ideas, and maximum of convenience for metallurgical work.

Leach's Oxy-hydrogen Lantern Microscope.*—This instrument (fig. 6), which has been for some time before the public, and has been described in earlier numbers of this Journal,† has received some improvements from its manufacturers, Messrs. Woolley of Manchester, who equip

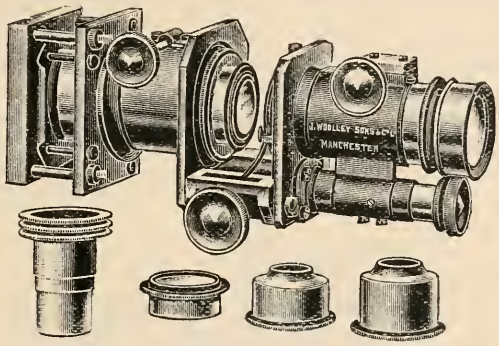

Fig. 6.

it with the highest quality lenses and workmanship. It is fitted to any oxy-hydrogen lantern by screwing it into the flange, which carries the usual lantern objective. In working with this Microscope, all the different parts are mechanically connected. There are no loose parts to get out of position, or to keep in their place after the instrument is set up. Fig. 6 shows the Microscope in its present form.

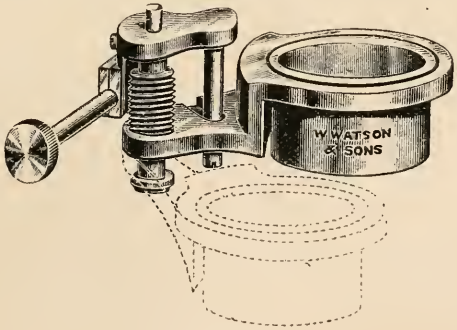

Fig. 7.

Watson's New "Argus" Substage.‡—This substage (fig. 7) can be fitted to almost any Microscope. It is intended to replace the spiral focussing screw so frequently applied to under-fittings of students' Microscopes, and which Messrs. Watson have found so unsatisfactory

* Woolley, Manchester, Special Circular.
† 1887, p. 1019; 1890, p. 803; 1892, p. 105.
‡ W. Watson & Sons' Special Catalogue, p. 7.

that they have determined to discontinue it. The rackwork in the above auxiliary consists of a number of grooves cut on a cylinder, against which a pinion engages, as in the ordinary coarse adjustment of Microscopes. This can be mounted strongly, and to work accurately on almost any Microscope. It is provided with a loose ring, by which it is centred precisely to the Microscope, with which it is to be used, before leaving Messrs. Watson's works, and the ring is then held by screws in position.

Watson's Compound Substage.*—This substage (fig. 8) has spiral rackwork, pinion, coarse adjustment, and centring screws, to enable the apparatus that may be contained on it to be set exactly coincident with the optical axis of the objective.

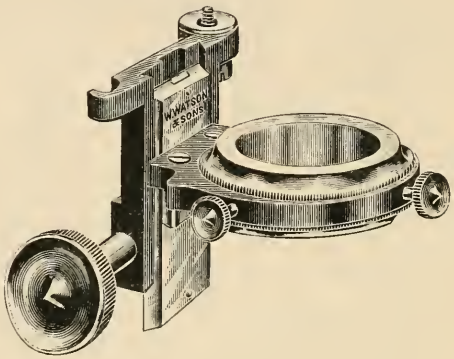

Fig. 8.

Metallurgical Stage.†—W. B. Stokes has devised an appliance, intended to effect a temporary conversion of any Microscope possessing a focussing substage into a stand suited to the needs of metallurgists. When using the "vertical illuminator," a change of object often involves a considerable change in the illumination, but by giving the stage a focussing movement the lighting arrangements remain undisturbed. The aim of the present accessory is to supply this movement to an ordinary Microscope. Taking advantage of the substage movement, it is evident that there is required only a stage-plate fixed to a stem, which fits into a substage adapter in such a way that the stem passes through the ordinary stage aperture.

Pocket-Magnifier.‡—G. C. Karop describes a new pocket-lens (fig. 9) made by Swift and Son. It is a modified Herschelian doublet, made up of a lower inequi-convex 6 : 1 lens, and an upper plano-convex of smaller size, just sufficiently spaced to admit a thin polished

* W. Watson & Sons' Supplemental List, October 1903, p. 7.
† Journ. Quekett Micr. Club, viii. (1903) pp. 549–50 (1 fig.).
‡ Tom. cit. pp. 499–504 (8 figs.).

metal reflector-diaphragm between them. The sizes and focal lengths of the lenses are approximately as follows: Inequi-convex, diameter 1·3; focus 2·1. Plano-convex, diameter ·65; focus 1·75. Focus of combination, diameter 1·95. Of course, all these can be varied in

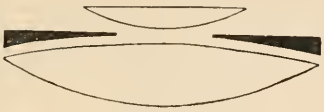

Fig. 9.

relative proportion if required. The three elements are mounted separately, so that, although it is calculated to act as a "system," either lens may be used by itself with or without the speculum.

(2) Eye-pieces and Objectives.

Nelson's Formula Oculars.*—A. A. C. E. Merlin calls attention to the very fine visual results obtained by the employment of E. M. Nelson's new formula Huyghenian eye-pieces when fitted to the telescope. One of these yields a measured power of 160 diameters on a 3·3-in. clear aperture refractor, the object-glass of which was made by Wray. The formula of this description of eye-piece was computed by Mr. Nelson some years ago, and is published in the last edition of Carpenter, but its high qualities when used on an astronomical telescope do not appear to be generally known.

The author is satisfied of the superiority of these oculars for critical microscopical work, over the compensated or ordinary Huyghenian eye-pieces, when working with apochromatic, semi-apochromatic or achromatic objectives.

Lens Calculation.†—"H." in a letter to the *English Mechanic*, compiles the following bibliography of works useful for above purpose.

1. The Perthensis Encyclopædia, vols. xvi. and xxii.
2. Encyclopædia Britannica, third edition.
3. The Telescope, by Herschel.
4. Optical Instruments, by Herschel, in vol. ii. of the Library of Useful Knowledge.
5. Rees' Cyclopædia—very full and complete—vol. xxxv. being the most useful one.
6. Coddington's Optics.
7. Potter's Optics, part ii.
8. Hansen's Dioptrische Untersuchungen.
9. W. Scheibner's Dioptrische Untersuchungen.
10. Steinheil's Handbuch der Angewandten Optik, containing numerous worked out examples and figures.

* English Mechanic, lxxviii. (1903) p. 425.
† Tom. cit., (Nov. 13, 1903) p. 316.

(3) Illuminating and other Apparatus.

Dunning's New Portable Oil-tight Lamp.*—This (figs. 10 and 11) has been constructed to meet the requirements of microscopists exhibiting at societies' meetings and conversazioni. The lamp packs in an oval tin case, $2\frac{3}{4}$ in. by $1\frac{3}{4}$ in. by 8 in., and can be easily carried in the coat-pocket without any risk of leakage. When full it will burn for four hours, and give sufficient light for a large binocular Microscope.

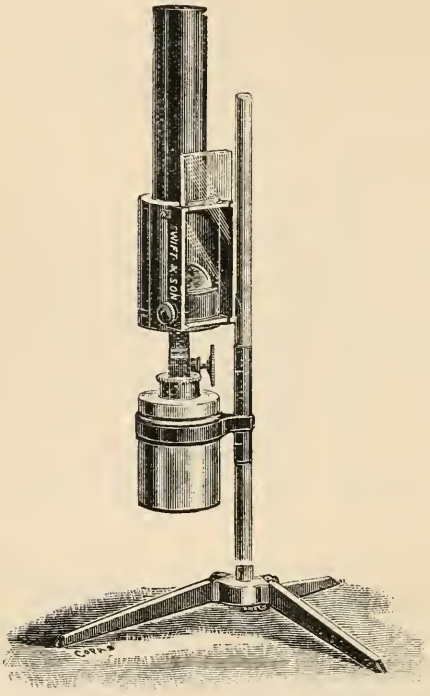

Fig. 10.

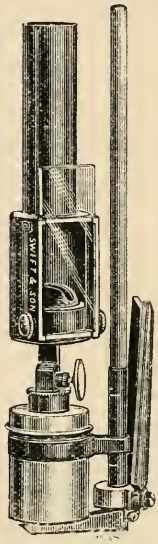

Fig. 11.

Either the flat or edge of the flame may be used by turning the metal chimney, which takes an ordinary 3-in. by 1-in. slip. The flame can be lowered sufficiently for direct illumination. Fig. 10 shows the lamp set up for use. Fig. 11, folded for packing in case.

Swift's Light Modifiers.†—These are light filters, and consist of a metal frame made to carry one or more squares of tinted glass, with adjustments admitting of any position in front of and close to the source of illumination. The modifiers are made in two forms: one

* J. Swift & Son's Catalogue, London, 1901, p. 45.
† Tom. cit., p. 47.

(fig. 12) carries two pieces of cobalt glass of different tints in a telescopic horizontal arm, sliding upon a vertical pillar attached to a heavy base ; the other (fig. 13), has a hinged arm and bull's-eye.

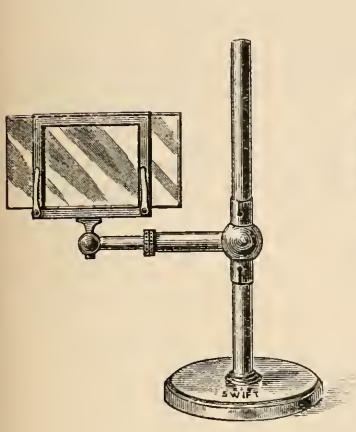

FIG. 12.

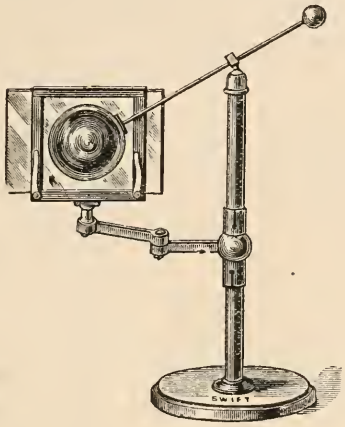

FIG. 13.

Swift's Double-Image Prism for Petrological Microscopes.*— This accessory is shown in fig. 14, and will be found extremely useful for viewing small dichroic crystals. The two images are seen side by side in the field, and one rotates round the other when the prism is turned round the eye lens of the ocular. The images differ according

FIG. 14.

to the nature of the crystal mineral and the direction in which the light passes through it. A thin plate of brass, with a number of small apertures, is inserted in the eye-piece for the purpose of reducing the field to a size smaller than the crystal under observation.

(4) Photomicrography.

ROSE, L. K.—**Photomicrography of Metals.**
[An historical and practical paper.]
Photographic Journ., xliii. (July 1903) pp. 195–9.

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* J. Swift & Son's Catalogue, London, 1901, p. 40.

(5) Microscopical Optics and Manipulation.

LYMAN, T.—**The Prolongation of Spectral Lines.**
[Explains the cause of the streamers observed in the use of a concave grating.]
Proc. Amer. Acad. of Arts and Sciences, xxxix. No. 2 (July 1903) pp. 33–5 (1 pl.).

„ „ **Explanation of False Spectra from Diffraction Gratings.**
[Shows that they seem due to a so-called periodic error in the grating ruling.]
Proc. Amer. Acad. of Arts and Sciences, xxxix. No. 3 (July 1903) pp. 39–47 (1 pl.).

(6) Miscellaneous.

General Principle of some Novel Forms of Geodetical Instruments.*—Sir H. Grubb describes an important simplification in geo-

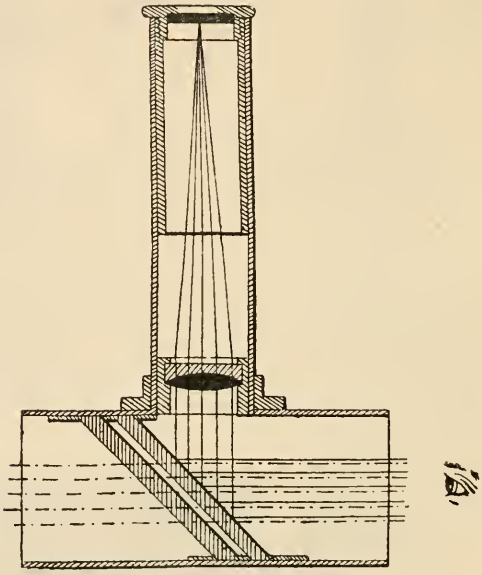

FIG. 15.

detical instruments, which may also be found useful in some departments of microscopy. The half-silvered, half-plain piece of glass generally used in such instruments is replaced by a piece of glass having a thin film of lead sulphide deposited on its surface. This film both reflects and transmits the incident light, and by varying its thickness the proportion of transmitted to reflected light may be varied. The effect is that the images of two objects may be got actually superposed, instead of (as in the prismatic compass) vertically above and below one another. The arrangement will be understood from fig. 15, where the distant object is seen by direct vision through the film, and the near object (after collimation) by reflection. One great advantage is that all the

* Brit. Opt. Journ., iii. (Oct. 1903) pp. 29–31 (4 figs.). Eng. Mech., lxxviii. (Oct. 30, 1903) pp. 263–4.

rays on the observer's eye are parallel, and there is therefore no error due to parallax.

The Collected Treatises of Abbe.*—Dr. S. Czapski has undertaken the welcome task of collecting and publishing in a compact form the various treatises of Prof. Abbe. This, the first volume, is to be followed, in due course, by two or three others, all on mathematical and optical subjects; and a later volume will contain his writings on social and economical topics.

The order adopted is chronological, and treatises originally written in other languages have been translated into German. The task of editing has been performed by Prof. Ambronn.

The following is a translation of the titles of the various papers, and the reference is given when the original was in English. The year of composition is also given.

1. On a spectrum apparatus for the Microscope (1870).
2. On the determination of the light-intensity of optical instruments, with especial reference to the Microscope, and apparatus for light concentration (1871).
3. Contributions to the Theory of the Microscope and of microscopical veracity (1873).
4. On a new illuminating apparatus for the Microscope (1873).
5. Description of the apertometer (1877).†
6. The optical auxiliaries of the Microscope (1878).
7. On micrometric measurement by means of optical images (1878).
8. On the computation of blood corpuscles (1878).
9. On Stephenson's system of homogeneous immersion for Microscope objectives (1879).
10. On new methods for improving spherical correction applied to the construction of wide-angled object-glasses (1879).‡
11. On the conditions of aplanatism of lens-systems (1879).
12. Some remarks on the apertometer (1880).§
13. Description of a new stereoscopic ocular, with general remarks on the conditions of micro-stereoscopic observation (1880).
14. On the limits of geometrical optics, with observations on Altmann's treatise 'On the Theory of Image-formation' (1880).
15. On the conditions of orthoscopic and pseudoscopic effects in the binocular Microscope (1881).‖
16. On the estimation of aperture in the Microscope (1881).¶
17. The relation of aperture and power in the Microscope (1882).**
18. On the mode of vision with objectives of wide aperture (1882).††
19. Note on the proper definition of the amplifying power of a lens or a lens-system (1884).‡‡

* Gesammelte Abhandlungen, von Ernst Abbe, Erster Band, 186 pp., 2 p's., 29 figs. Portrait of author. Published by Fischer, Jena, 1904.

† Journal R.M.S., i. (1878) pp. 19–22.

‡ Op. cit., ii. (1879) pp. 812–24.

§ Op. cit., iii. (1883) pp. 20–31.

‖ Op. cit., i. (1881) pp. 203–11.

¶ Op. cit., i. (1881) pp. 388–423.

** Op. cit., ii. (1882) pp. 300–9, 469–73; iii. (1883) pp. 790–812.

†† Op. cit. iv. (1884) pp. 20–26

‡‡ Op. cit., iv. (1884) pp. 348–51.

20. On improvements of the Microscope by means of new kinds of optical glass (1886).
21. On the effect of illumination by means of wide-angled cones of light (1889).*
22. On the adaptability of fluorite for optical purposes (1890).

Focussing Safeguard.†—In showing microscopic objects to those unacquainted with the use of a Microscope, there is always the risk of accidental injury to either the slides or objectives when the latter are of short focal length. To obviate risk of injury S. E. Dowdy has devised the following contrivance (fig. 16). A B is a metal collar, velvet lined, with a screw at A for clamping on to the objective. D is a fine screw rotating with arm B C, and having a felt-covered circular base, E. In use, the objective should first be accurately

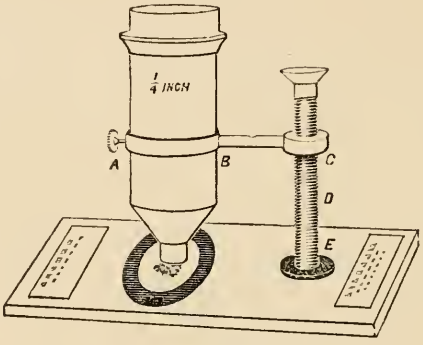

Fig. 16.

focussed, and then by means of the fine adjustment brought within its focal length, with its front lens as near as possible to the cover-glass without touching it.

The screw D is then rotated until the base touches the slide, when it will be obvious that it would be impossible to bring the objective into contact with the cover, though focussing in a safe direction may be effected to any extent.

Ultra-Microscopic Investigation of Colour-matters and their Physiological Significance.‡—A. Birch-Hirschfeld describes how Raehlmann used a new Microscope, introduced by Siedentopf and Zsigmondy, of Jena, which, by means of a brilliant focal, lateral illumination, renders visible the smallest particles (5μ to 10μ) in their natural colour. With this instrument he examined solutions of colouring matter, such as Prussian-blue, carmine, ultramarine, naphthol-yellow, and so forth. The resolution of each of the colouring matters into its component colours

* Journ. R.M.S., ix. (1889) pp.721–4.
† English Mechanic, lxxviii. (1903) p. 291 (1 fig.).
‡ Ophth. Klinik, Aug. 20 and Oct. 5, 1903. See Ophthalmoscope, i. (1903) p. 218.

yields an unsuspected insight into the physical and physiological nature of colour, and is of importance as regards our conception of the mixing of colour. The smallest particles of a pure colouring matter are not only characterised by their colour, but probably also by distinctive form and movements. It therefore follows that colouring matters may be analysed by this method. The composite colours examined showed their smallest component particles either lying alongside each other (physiological mixture of colours), or were seen to consist of particles differing in shape, movement, and colour from those of the components. This condition has been proved by more recent researches—for example, on a mixture of Prussian-blue and naphthol-yellow—to rise from the fact that the particles of one component cluster around those of another, forming, as it were, a kind of sheath. This covering, according to Raehlmann, is formed by electro-magnetic action, minute negatively charged particles collecting around those positively charged, or *vice versâ*. These composite particles may be again separated by the action of electro-magnetism.

Dowdy, S. E.—**Amateur Microscopy.**

[A series of four excellent articles upon this subject, describing a student's Microscope, its apparatus, and the way to use it. The articles are well worth the attention of those intending to purchase a student's Microscope, as well as of those taking up the subject for the first time.]

English Mechanic and World of Science, lxxviii., Nos. 2008-11 (Sept. and Oct. 1903).

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Wright's Collecting Bottle.† — This (fig. 17) contains an improvement by the introduction of an extremely rapid siphon, which is covered with a cylinder of very fine silk, thus preventing the escape of the smallest rotifer during the drawing off of the superfluous water. At the same time the fabric permits the water to be drawn off almost as quickly as it is poured into the bottle. This apparatus will be found invaluable to those collecting pond life, as gallons of water can be rapidly drawn off by means of the siphon without sacrificing a single insect. A cork bung with boxwood top is supplied to the bottle, to save the loss of material collected.

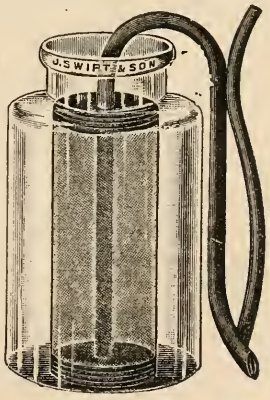

Fig. 17.

* 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.

† J. Swift & Son's Catalogue, London, 1901, p. 42.

Bacteriological Methods in Sanitary Water Analysis.*— C. E. A. Winslow and C. P. Nibecker in an extensive series of water examinations employed the following bacteriological methods: (1) The gelatine plate at 20° C., the count being made after 48 hours. This count was found to roughly correspond to the free ammonia and "oxygen consumed" of chemical analysis, and indicates the amount of organic decomposition in process. A low count is, of course, highly reassuring, but a high one may only mean an exceptional multiplication of certain water forms. (2) The fermentation test, as determined by the gas formula obtained in dextrose-broth tubes after 24 hours, at 37° C. This was found to be especially useful as an indicator of *B. coli*. (3) The litmus-lactose-agar plate after 24 hours, at 37° C. This, by means of the total count and the count of the red colonies, gave a measure of the organisms which thrive at the body temperature, and of those which form acids, which latter are coming to be recognised as intestinal forms.

Technique of the Bacteriology of the Blood.†— R. C. Rosenberger quotes the following procedure adopted by Coplin, who has elaborated and extended Sittmann's method. The middle half of the arm is washed with hot soap and water, and then with sterile water and 60 p.c. alcohol. The arm is then covered with 1 to 1000 sublimate gauze. In 24 hours it is cleaned with alcohol and ether, followed by hot 1 to 1000 perchloride, and lastly with sterile water or normal salt solution. All the solutions should be used hot. The blood is withdrawn from the median vein with a syringe or an aspirating needle. 20 c.cm. of blood should be obtained. From this, plates may be made by passing blood into liquefied agar kept at 45° C., in the proportion of 2 to 3 c.cm. of blood to 6 c.cm. of medium. After thorough mixing, plates are made and incubated at 37° C. Bouillon in flasks should be inoculated; 8 to 10 c.cm. of blood should be divided among flasks each containing 150 c.cm., so that the dilution is from 1 to 75 to 1 to 150. The flasks are well shaken and incubated at 37·5. If the bouillon become cloudy it is plated upon agar. Agar and serum slopes should be inoculated with 1 to 2 c.cm. of blood. Spreads on slides should be made, and animals inoculated with at least 5 c.cm. of blood. A sample of the blood may be incubated as a control or enrichment. Special solid media should be used for certain kinds, as urine agar or blood-serum agar for gonococcus, blood-smeared agar for *Bacillus influenzæ*. The spreads and films should be stained with anilin pigments. The hæmoglobin may be removed by immersion in 5 p.c. acetic acid for ten seconds. The acetic acid is removed by rapid aeration and by exposure to ammonia vapour. The film may then be stained for bacteria, the removal of the hæmoglobin facilitating the search for micro-organisms.

Cultivating Trypanosomes.‡—W. J. McNeal and F. G. Novy have cultivated *Trypanosoma lewisi* in a mixture of defibrinated rabbit's blood and agar. Agar, prepared in the usual way, is sterilised and cooled

* Technology Quarterly, xvi. No. 3 (1903) pp. 227–39.
† Amer. Journ. Med. Sci., cxxvi. (1905) pp. 234–57.
‡ Bull. Inst. Pasteur, i. (1903) p. 602.

down to 50° C. To this, one-third of its bulk of defibrinated rabbit's blood, obtained aseptically, is added, and agar slants made. Loopfuls of trypanosomatous rat's blood were sown in the condensation water, and the tubes incubated at from 34° to 37° C.

(2) Preparing Objects.

New Method of Preparing Superficial Fungi.* — H. H. Whetzel has found the following method very useful for demonstrating the presence of mycelium and pycnidia of fungi: (1) Peel or slice off a piece of the epidermis on which the fungus is growing. (2) Immerse the slice in a 2 to 4 p.c. solution of KHO, and boil in an evaporating dish over a low flame for 20 to 30 minutes. Cook long enough to remove all colour from the tissue of the host. (3) Pour off the potassium hydrate, and wash by letting the material stand for 10 to 20 minutes in each of two or three changes of water. If all the colour be not removed from the host tissue, cook again. Pick away any pieces of sub-epidermal tissue that may cling to the epidermis. (4) Dehydrate in 95 p.c. alcohol. (5) Clear in a mixture of two parts carbolic acid and three parts turpentine. (6) Mount in balsam.

The gist of the process lies in the fact that the pigment of the host-plant is bleached by caustic potash, while that of the parasite is not affected.

Demonstrating the Statocysts of Cephalopods.† — R. Hamlyn-Harris fixed and decalcified the material by immersion in sublimate-acetic acid, though bichromate of potassium and acetic acid answered perfectly well. Heidenham's staining method gave the best results, though other stains were satisfactory. If the Statoliths were not sufficiently decalcified the Statocysts were imbedded in celloidin, and then decalcified with 1 to 2 p.c. hydrochloric acid. The celloidin was afterwards dissolved out, and the preparations imbedded in paraffin.

Detection of Tubercle Bacilli in Organised Sediment by means of Centrifugalising or Simple Sedimentation.‡ — C. Dilg gives the results of a research chiefly on the specific gravity of the sputum in relation to the position of tubercle bacilli in the tube of sputum after centrifugalising, i.e. as to whether these bacteria are present in the upper, middle, or deeper layers, as determined by the use of a capillary pipette. In estimating the specific gravity of the sputum, it was first rendered as air-free as possible by means of the air-pump, and then a modification of the blood method of Hammerschlag employed, an acetone-chloroform mixture being used. The specific gravity of the tubercle bacilli, if in pure culture, was estimated in the same way. If in sputum, it was held that if the bacilli were found copiously in the middle layers of the tube of sputum after centrifugalising, then they and the sputum were of the same specific gravity. By these means the author found that the specific gravity of the sputum varied between

* Journ. Mycol., ix. (1903) pp. 218–9.
† Zool. Jahrb., Abt. f. Morph., xviii. (1903) pp. 327–58 (5 pls.).
‡ Zeitschr. f. angew. Mikr., ix. (1903) pp. 141–55.

0·9290 and 1·2242, while that of tubercle bacilli varied between 1·0110 and 1·0760. The sputum is, therefore, sometimes lighter and sometimes heavier than the bacilli. The author accordingly proposes to ensure its always being heavier by the addition of an equal volume of a 25 p.c. salt solution, a drop of ammonia having previously been added. By this means the bacilli are always found in the surface layers, after centrifugalising, a drop being removed thence by means of a capillary pipette, placed on a slide, dried, and stained in the usual way. The added salt does not cause any difficulty in staining. The author has also devised an instrument which he names a "Sputumdensimeter," for the ready determining of the specific gravity of sputum.

(4) Staining and Injecting.

Modification of Teichmann's Injection Syringe.*—Sieber describes some improvements which he has effected in this syringe (fig. 20). The

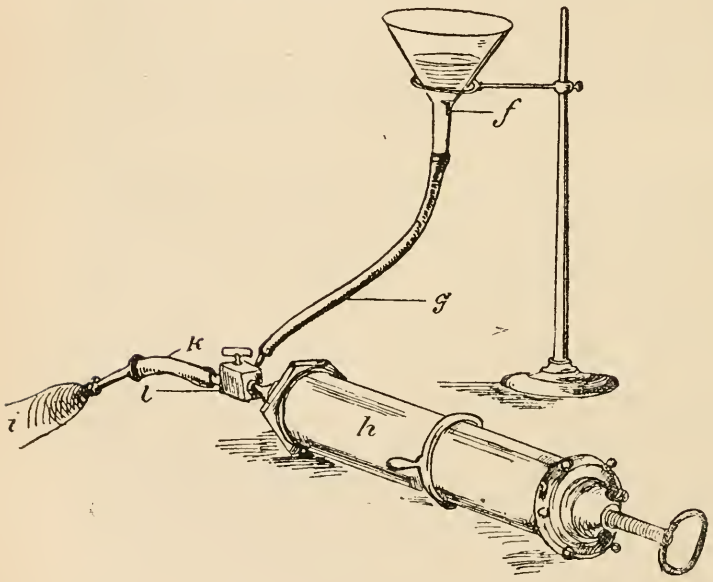

Fig. 18.

end of the piston-rod is grooved, so that, though fixed to the plunger, rotary movement is permitted. The end-cap of the syringe snaps on by means of a bayonet-joint, and this is quite independent of the piston-rod screw. Handles attached to the syringe afford a firm grip of the instrument. A two-way cock (fig. 19) attached to the nozzle allows the syringe to be refilled without disturbing the apparatus or unfasten-

* Anat. Anzeig, xxv. (1903) pp. 7–10 (7 figs.).

ing the parts. A piece of tubing is slipped over the joins of the cannula and nozzle. This pressure-sheath is capable of resisting the pressure of

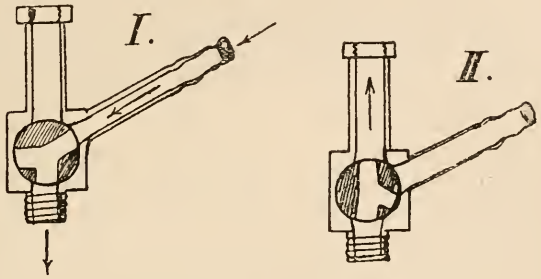

Fig. 19.

two atmospheres, and prevents the cannula from becoming detached from the syringe during manipulation. The illustrations show the syringe (fig. 20), the two-way cock (fig. 19), and the working arrangement (fig. 18).

Vital and Supravital Granule Staining.* J. Arnold has studied the granules in epithelial, endothelial and connective-tissue cells, mast-zellen, leucocytes, etc. Employing the vital method, he either sprinkles the tissue to be examined, e.g. the mesentery, with neutral-red solution, or dusts it with the same substance in powder. If the supravital method is followed, the tissues taken fresh from the animal are placed at once in normal saline solution, containing either ·01 to ·1 p.c. neutral-red or ·0005 p.c. methylen-blue, as the case may be. The granules appear in 10 to 20 minutes. In the epithelium of the frog's bladder he finds a perinuclear arrangement of granules, which he thinks might easily be mistaken for karyokinetic figures. He has compared the effects of vital with those of supravital staining in the case of the tongue of the frog, and finds them identical. The author is of opinion that cell-granules are concerned in the elaboration of fat, iron and bile pigment.

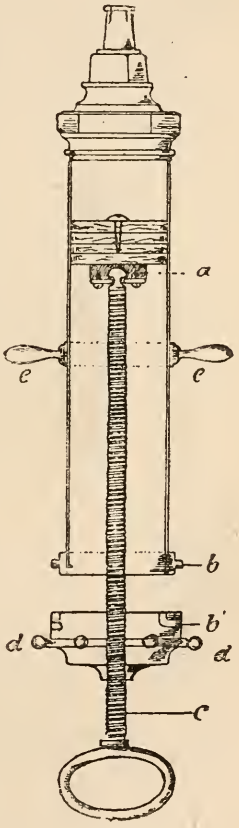

Fig. 20.

Naphthol-Blue as a Reagent for Bacterial Fat.† — A. Meyer, in order to demonstrate this staining reaction, uses organisms known by accurate research to be rich in fat and destitute of volutin, e.g. *B. megatherium*. He mixes a

* Anat. Anzeig., xxiv. (1903) pp. 1–6.
† Centralbl. Bakt. 1te Abt. Orig., xxxiv. (1903) pp. 578–9.

a drop of a filtered 1 p.c. solution of dimethyl-paramethylendiamin (base) on a slide with a trace of a colony of the organism, and then adds to it a single loopful of a solution of α naphthol in 1 p.c. NaOH. If the preparation is examined after a minute the fat granules or drops are found to be stained dark blue. They are decolorised, however, with 1 p.c. H_2SO_4. To show that this reaction is not due to volutin, he uses *B. alvei*, an organism rich in this substance and fat-free. In this, the reaction did not take place.

Gonococci Staining.* — A. Pappenheim advocates the use of a methyl-green and pyronin mixture for the staining of gonococci and for their differentiation from the cell nucleus. The action of this staining mixture depends on the aversion of methyl-green to bacteria, and on its affinity for the cell nucleus, whilst pyronin being a weak stain only affects the nucleus if added in excess. The result is a blue-green nucleus and red cocci. If it is desired to stain also the protoplasm of the cell, an acid stain, such as eosin, may be added to the mixture.

Modification of Gram's Method.† — Nicolle has employed instead of the ordinary Gram's solution, one containing bromine 1 grm., potassium bromide 3 grm., water 100 grm. Over the former it has no advantage, but the results in each case appear to be identical.

Method of Staining the Protozoal Parasites of the Blood.‡—Laveran suggests the following modification of Giemsa's staining method § for the malaria parasite. Cover-glass preparations are stained for ten minutes with eosin (1 : 1000) 2 c.cm., distilled water 8 c.cm., azur (1 : 100) 1 c.cm. A drop of a 5 p.c. solution of tannin is then placed on the film and allowed to act for 2 to 3 minutes. The film is then washed and dried. The author finds this method useful when dealing with material which is not fresh.

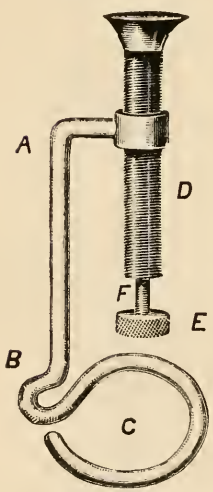

Fig. 21.

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

Improved Mounting Clip.‖—S. E. Dowdy has devised the following form of clip or press by which central pressure, which is completely under control, may be readily obtained (fig. 21).

A B C is a stout piece of wire bent into a circle at right angles to the upright A B at C. D is a screw, having at its end a flat circular metal button at E, which rotates, *independently* of the screw on the pin F. In use, a freshly prepared Canada balsam slide is placed on the circle C, and the screw D rotated until the button or

* Monatshefte f. prakt. Dermat., April, 1903. See also Centralbl. Bakt. 1te Abt. Ref., xxxiv. (1903) pp. 20–1.

† C. R. Soc. Biol., No. 10, 1903. See also Centralbl. Bakt., xxxiv. (1903) pp. 78–9.

‡ Op. cit., No. 9. 1903. See also Centralbl. Bakt. Ref., xxxiv. (1903) p. 78.

§ Centralbl. Bakt., xxxii. p. 307.

‖ English Mechanic, lxxviii. (1903) p. 337 (1 fig.).

pad E presses on the cover-glass. Direct downward pressure without displacement of the cover is then attained by further rotation of the screw.

GRIBBON, W.—**Mounting Clip.**

English Mechanic, lxxviii. (1904) p. 491 (1 fig.).

VILLAGIO.—**Modern Mounting Methods.**

Tom. cit., p. 490.

(6) Miscellaneous.

Waterproof Cement for Glass.*—The following preparations, which are unaffected by water, will be found suitable for cementing glass, repairing troughs, etc. :—

(1) Dissolve 5 to 10 parts gelatin in 100 parts of water; add 10 p.c. of saturated bichromate of potassium solution; mix thoroughly and keep in a dark place. After using the cement the articles are exposed to sunlight, by the action of which the medium is rendered unaffected by water. (2) Quicklime, 4 parts: litharge, 6 parts; linseed-oil varnish, 1 part.

Mounting Medium Bottle.†—S. E. Dowdy gives the following directions for fitting up a bottle for holding balsam. Obtain a 1 oz. or 1½ oz. wide-mouthed metal screw-stoppered bottle, and bore a circular hole through the lid large enough for a thin glass rod to pass through with plenty of room to spare. Thread the rod on a medium sized cork several diameters larger than the hole in the metal lid, and the thing is finished. Pour the balsam into the bottle, after removing the lid. The length of the rod can be easily altered to suit the depth of the medium.

Gelatin Plates as Substitute for Glass Light-filters.‡—K. Diederichs describes a procedure for making light-filters for microscopical and photomicrographical purposes. A solution of the best gelatin, such as is used for making dry plates, is made in the usual way, the proportion to the water being as 1 to 200. To the filtered solution 3 c.cm. of 1 to 50 aqueous solution of alum are added.

The films are made by pouring the gelatin on a glass plate placed on a levelling stand. When quite dry the gelatin is overlaid with a film of collodion stained with some anilin dye.

Red plates may be made as follows :—Dissolve (1) 2 grm. aurantia in 40 c.cm. absolute alcohol, (2) 5 grm. rose Bengal in 20 c.cm. methyl alcohol. Then mix 20 c.cm. of (1) with 10 c.cm. of (2), and add 90 c.cm. of 4 p.c. collodion. Yellow plates can be made by adding 20 c.cm. of a saturated alcoholic solution of aurantia to 80 c.cm. 4 p.c. collodion. The gelatin plates may be doubled so as to strengthen the film, or one may be placed on either side of the coloured layer.

Method of taking Internal Casts of Foraminifera.§—H. J. Quilter obtains perfect specimens by the following method. The shells having been cleaned by boiling in caustic potash, in order to remove all traces

* Scientific American. See Knowledge, xxvi. (1903) p. 285.
† English Mechanic, lxxviii. (1903) p. 401 (1 fig.).
‡ Zeitsch. angew. Mikr., ix. (1903) pp. 197–8.
§ Journ. Quekett Micr. Club, viii. (1903) pp. 551-2.

of sarcode, are soaked in benzole to extract most of the air and prepare the surface of the shell for the wax. They are then transferred to melted paraffin wax, the wax being cooled and heated several times in order to expel the air. After the air-bubbles have disappeared a little melted wax is put on the centre of a slide placed on a warm stage. To the melted wax the shells are transferred, and arranged so that there is a clear space around each. The slide is then allowed to cool. When the wax has become hard the wax above and around the shells is removed by means of a brush dipped in benzole. After this the preparations are brushed with soap and water, and then immersed in a beaker filled with water. To this hydrochloric acid is added until effervescence takes place. When effervescence ceases the slide is washed, dried and mounted.

Silicate of Soda (Water Glass) as an Injection Medium for Macroscopic Preparations.* — S. Jachtchinsky recommends a saturated solution of silicate of soda, to which is added a little powdered chalk stained with cinnabar or ultramarine, for injecting the vascular system of animals. The advantages claimed are that it is used cold, does not set too quickly, does not block the syringe, has no disagreeable odour, and when once dry the preparations keep excellently.

New Small Shaking Apparatus.†—H. Zikes has devised the following shaking apparatus for use in fermentation work (fig. 22). A

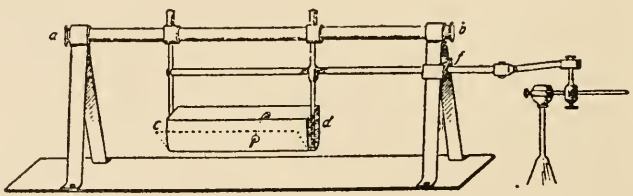

Fig. 22.

steel bar *a b* is supported at each end by a rigid metal stand. From this bar hangs the shaking trough *c d* by two short brass rods. These rods can glide on the steel bar and are firmly joined to a pushing rod, which by means of a projecting end *f* is able to move the trough to and fro in one direction. This projecting end articulates with a connecting rod, through which the movement is given by means of a turbine or electro-motor. The shaking trough is a half cylinder, closed at the ends, open at the top, and having a flap along one of its sides. The fixing of the vessel to be shaken is accomplished by means of a steel peg attached to the flap on one side, and fitting into one of a series of holes on the other, according to the size of the vessel.

Bacteriological Tests for Show Butters.‡ — D. Houston, in a bacteriological examination of butters exhibited at the winter show of the Royal Dublin Society, employed the following method: ·1 grm. of

* Anat. Anzeig., xxiv. (1903) pp. 204-5.
† Centralbl. Bakt., 2te Abt., xi. (1903) pp. 107-8 (1 fig.).
‡ Proc. Roy. Dublin Soc., i. (1902) pp. 179-88.

the butter sample was placed in 10 c.cm. sterile water and kept at 25° C. This was then thoroughly mixed and allowed to cool. The fat having separated, ·1 c.cm. was taken and mixed with nutrient gelatin, usually 2 p.c. lactose gelatin, and plated out in the usual way. The colonies were then counted, and subcultures made in different media. For the more ready estimation of gas-forming organisms, the solidified inoculated gelatin in the Petri dish was covered with a thin layer of sterile gelatin. The little gas-bubbles were then easily seen. The author found that undesirable flavours and aromas were in most cases due to the action of micro-organisms, working either in the ripening cream or in the made-up butter. Such organisms may be either bacteria, yeasts or moulds. A good-flavoured butter containing undesirable contaminations will soon become objectionable. The bacteriological tests were not found to agree with the judge's awards.

Metallography, etc.

Dichroiscope.*—This instrument (fig. 23), made by Swift & Son, is for the accurate comparison of the different colours of dichroic minerals. It is extremely useful for distinguishing coloured gems from glass imitations.

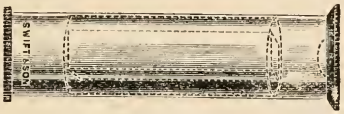

Fig. 23.

Petrological Examination of Paving Sets.†—J. Joly gives the following method for determining the proportions of hard and soft constituents in rock. The thin rock-section is placed in the Microscope, and using a low power and low eye-piece the image of the field is projected into a ground-glass screen above the eye-piece, any of the usual photographic apparatus being used. The ground glass is turned rough side up. Upon this is placed a transparent divided scale prepared as follows. A piece of logarithmic paper (divided to square millimetres, or square tenths of inches) is placed in contact with a sensitive plate in a photographic printing frame, and printed off by contact in the usual manner. The result is a negative, having the divisions appearing as clear lines on a dark background. This negative may be used, or a positive printed from it. The transparent divided scale is placed *face downwards* upon the ground-glass. We now have an image of the field traversed by the lines upon the scale. On the back of this scale, the outline of any particular constituent is traced by an ordinary writing pen and ink. This done, the divided plate is lifted off, and holding it up to the light the number of square millimetres, or square centimetres, are estimated as contained within the ink outlines. The whole circular

* Swift's Catalogue, 1901, p. 40.
† Proc. Roy. Dublin Soc., x. (1903) pp. 62-92 (4 pls.).

area of the field in square centimetres is $\frac{\pi D^2}{4}$; hence the area occupied by the mineral can be estimated as a percentage of the area of the field. This is done for several fields, and an average taken. In most cases this method is quite accurate, but in exceptional instances, e.g. where mica plates appear edge-on in the field, certain allowances must be made, otherwise the quantity of the constituent would be underestimated.

Microscopic Study of the Prehistoric Bronzes of the Charente.* M. G. Chesneau has microscopically examined the metal of two prehistoric bronze axe-heads. One head was provided with a socket; the other merely heeled. It is admitted that the former is the more recent type of weapon. Micrographic analysis reveals that, at any rate in the Charente district, axes were used rough from the mould at the beginning of the Bronze Age, but that later on the methods of manufacture were improved, and the axe, after casting, was submitted to numerous reheatings and hammerings at high temperatures to increase the hardness of the material.

Surface Structure of Solids.†—G. T. Beilby seems to succeed in proving the following important propositions by means of his series of photomicrographs of metallic films:

(1) The operations of cutting, filing, grinding or polishing, produce on the surface of solids a thin film, which is in many respects essentially different to the general body underneath it.

(2) This surface film results from a certain mobility, which is conferred on a thin layer of molecules by the tool or polishing agent moving over the surface.

(3) While it is in the mobile condition, the film of solid molecules behaves like a liquid, and is subject to the action of surface tension.

(4) If these propositions are established it will follow that a truly polished surface is one in which, for a certain minute depth, the substance has been liquefied and then smoothed by the action of surface tension.

(5) Heat and solvents can confer on the molecules of solids sufficient mobility to enable their films or other minute portions of the solid to behave like a liquid.

(6) In the aggregation of solids from their molecules there is a certain size of the aggregate up to which its form is controlled by surface tension, and only after this point is passed can crystallic force come into play.

(7) The metals are the most opaque bodies we know, but their substance is nevertheless intrinsically transparent.

(8) The "spicular" appearance frequently to be seen by the Microscope on the surface of metals, and other solids under obliquely-reflected light is due to a granular texture in the thin translucent film with which the surface is covered.

(9) This granular texture results wholly or in part from the action of surface tension on the surface layer of molecules, while it is in the mobile condition.

* Comptes Rendus, cxxxvii. (1903) pp. 930–2 (2 figs.).

† Third Hunter Memorial Lecture, Glasgow; 1903, 55 pp., 42 photomicros.

Contributions to the Study of Alloys of Aluminium and Silicon.* Vigouroux and Arrivault find that the lack of durability often met with in vessels made of commercial aluminium is due to the presence of minute crystals of silicon, or of the eutectic silicon alloy. The two elements act as the poles of a battery, and set up rapid corrosion.

Primary and Secondary Devitrification in Glassy Igneous Rocks.† T. G. Bonney and J. Parkinson point out analogies between these phenomena and those observed in the micro-chemistry of alloys. Just as important changes take place after solidification in copper-tin alloys, so that the structures and compounds produced at earlier stages of consolidation disappear, to be replaced by later products; so not improbably similar changes would be found to have taken place in many rocks.

Metallography of Nickel Steels.‡—L. Guillet has made a very complete set of observations on steels containing nickel varying in amount from zero to 90 p.c. The observations included :—

(1) Microstructure of cast steels. (2) Microstructure of quenched steels. (3) Microstructure of reheated steels. (4) Microstructure of cold-worked steels. (5) Microstructure of steels cooled below atmospheric temperature. (6) Cementation and decarbonisation of nickel steels. (7) Research on the regeneration of quenched steels. (8) Conclusions.

His conclusions are that the constituents of nickel steel are :—

(1) Ferrite, pearlite, and, of course, troostite and sorbite. (2) Martensite. (3) Acicular crystals, which appear after etching, sometimes white, sometimes black, although the reason for this phenomena is not known. (4) Polyhedric grains, undoubtedly corresponding to Mr. Osmond's iron.

The acicular crystals are probably hardenite, another form of martensite.

Ashe, A.—**Photography of Cavities in Minerals and the Determination of the Condensation Points of the Enclosed Gases.**
Journ. Quekett Micro. Club, viii. (1903) pp. 545-8 (1 pl.).

Beck, W. T.—**Preparation of Samples for Microscopic Analysis, as followed by the Westinghouse Ele tric and Manufacturing Company.**
Proc. of Engineers' Soc. of Western Pennsylvania, Dec. 1902.
Metallographist, vi. (Oct. 1903) pp. 320-2.

Lau, F. C.—**Tests on Finishing and Annealing Heats.**
Sparks from the Anvil, Oct. 1902.
Metallographist, vi. (Oct. 1903) pp. 322-7 (6 figs.).

Woodworth, J. V.—**Hardening, Tempering, Annealing, and Forging of Steel.**
[Favourably reviewed by J. O. Arnold in *Nature*, lxix. No. 1780 (Dec. 10, 1903) p. 124.] Constable & Co., 288 pp.

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* Procès-Verbaux des Séances de la Soc. des Sciences de Bordeaux, 1901-2, pp. 20-3, 3 plates f 6 photomicros.

† Quart. Journ. Geol. Soc., lix. (Nov. 1903) pp. 428-44, 1 plate of 6 photomicros.

‡ Bull. de la Soc. d'Encouragement, May 31, 1903; Metallographist, vi. (Oct. 1903) pp. 274-302 (40 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Ross' Improved No. 2 "Standard" Microscope.† — This instrument (fig. 24) is constructed upon the basis of the original Oberhauser-Hartnack model, and claims to have important improvements not

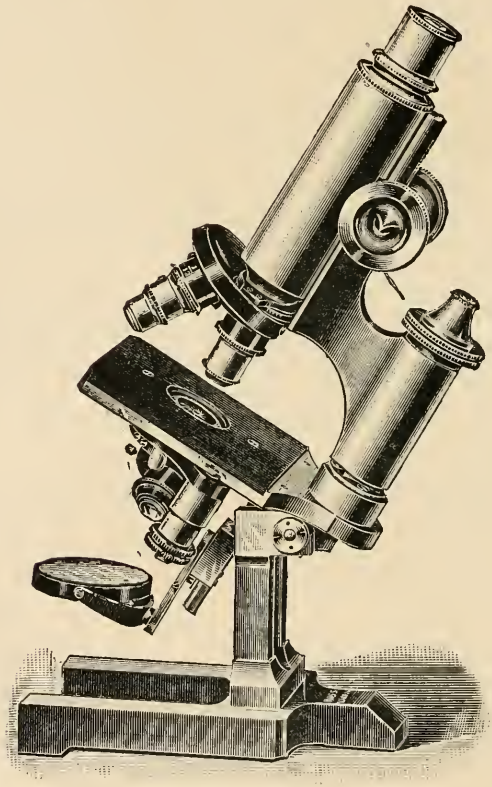


Fig. 24.

embodied in any other instrument. The very best workmanship has been introduced throughout, and special care has been bestowed upon

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

† Ross' Catalogue of Latest Improvements in Microscope Construction, 1903.

the exact fitting and working of the wearing parts, so as to secure perfection of alignment in the optical parts. When the Microscope is used vertically, the stage is extremely rigid under manipulation even with the highest objectives, and in this position the stage rests upon the step-like supports of the pillars. The mirrors are mounted with a swinging bar on an exceptionally strong focussed slide-bearing, the swinging bar being provided with a "clock" for indicating central illumi-

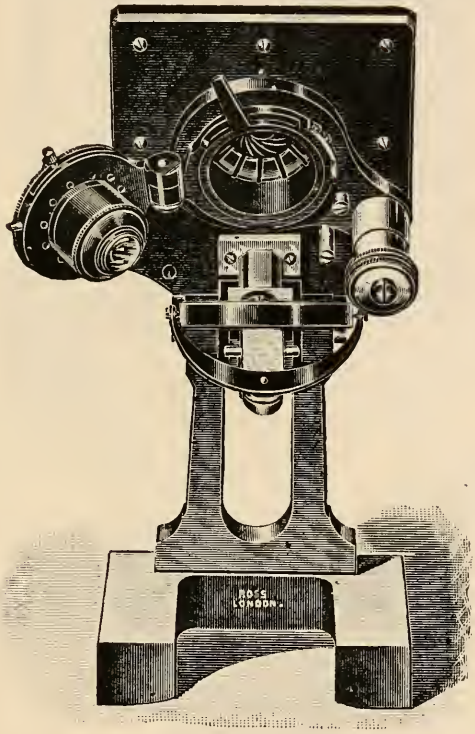


Fig. 25.

nation. For facilitating rapid work of a variable nature, such as occurs in general medical work, a special and unique substage fitting (fig. 25) can be supplied, the condenser being hinged to the mounting of the upper dome-shaped iris diaphragm, so that it can be instantly swung downwards, leaving this iris *in situ*, the distance of this diaphragm from the stage being readily varied by the substage screw. The condenser can be immediately reinserted by a single movement without disturbing the position of the instrument, and thus altering the lighting.

The mechanical stage can be attached or removed in a few seconds, and is so constructed that it will always register to the exact position it previously occupied, in order that an object can be

readily found by means of the vernier. Both rectangular movements are attained by smoothly-working diagonal racks-and-pinions of superior workmanship. The pinion-boxes are automatically self-adjusting to

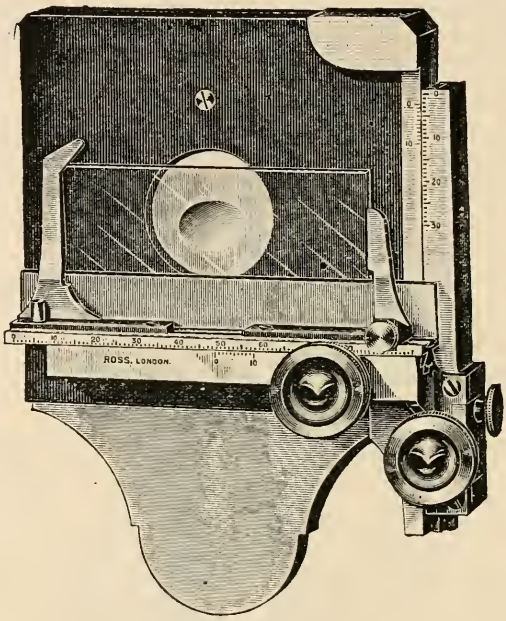


Fig. 26.

take up wear. The range is sufficient to allow the systematic search of a very large slide, and the fixed stage itself is of corresponding dimensions. The milled heads are extra large, to secure perfect control

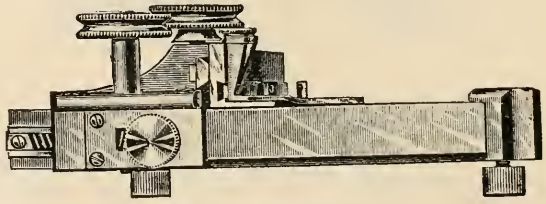


Fig. 27.

over the movements with high-power objectives. Fig. 26 shows the general view of the mechanical stage, and fig. 27 gives a side view.

Watson and Sons' New "Argus" Microscope.*—This instrument has a tripod foot with a spread of $6\frac{3}{4}$ in. The coarse adjustment is

* W. Watson & Sons' Supplemental Catalogue, Oct 1903.

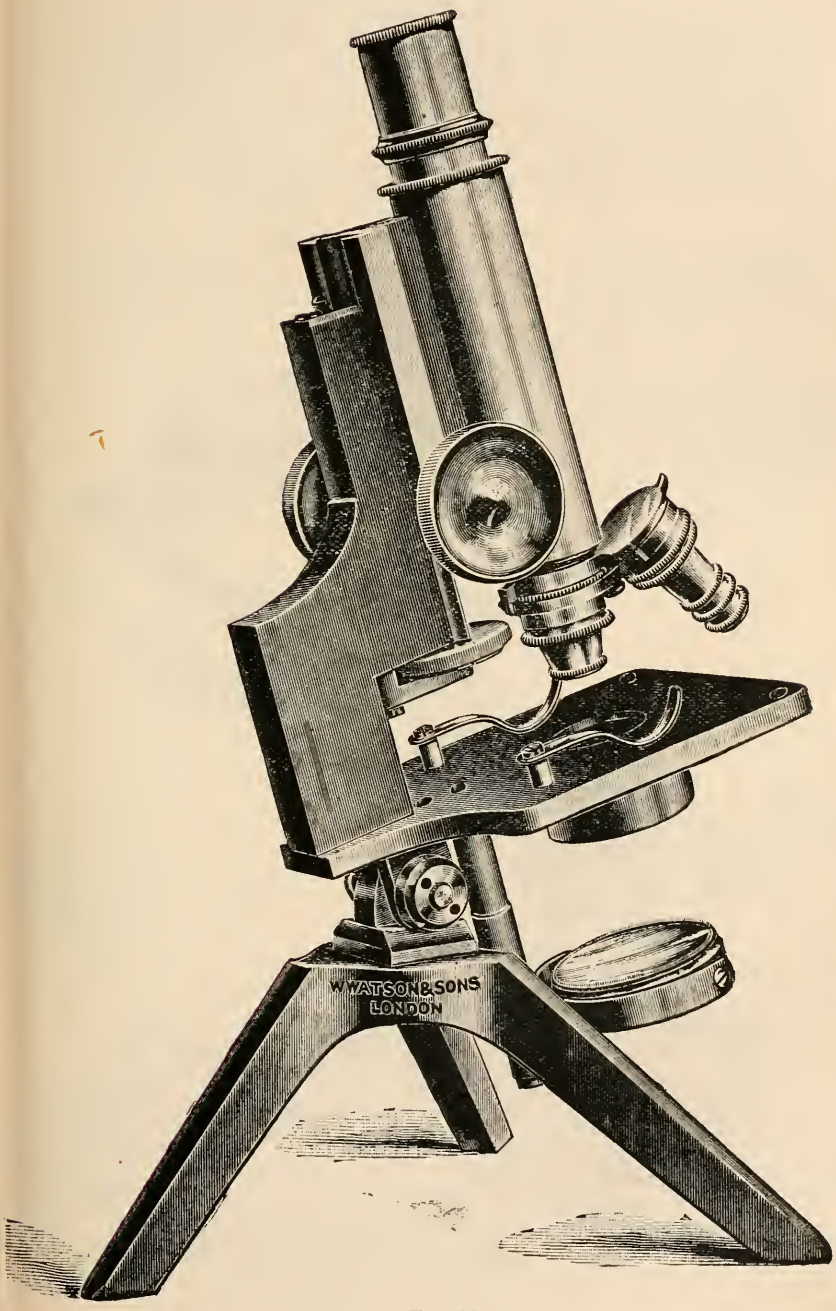


Fig 28.

effected by means of a helical rackwork and pinion of a new design, and the fine adjustment by the rotation of a direct-acting screw. The stage and body are of brass, and the height of the instrument when placed vertically is 10¾ in. All the fittings are of the universal size, and compensating screws enabling the working parts to be adjusted are provided (fig. 28).

HITCHCOCK, R.—**The ideal projecting Microscope.**
Journ. New York Micr. Soc. Annual, 1902 (1904) pp. 19–23.

(3) Illuminating and other Apparatus.

Heele's Heliostats.*—These are shown in the accompanying illustrations. Fig. 29 is of Silbermann's construction with accurate clock-

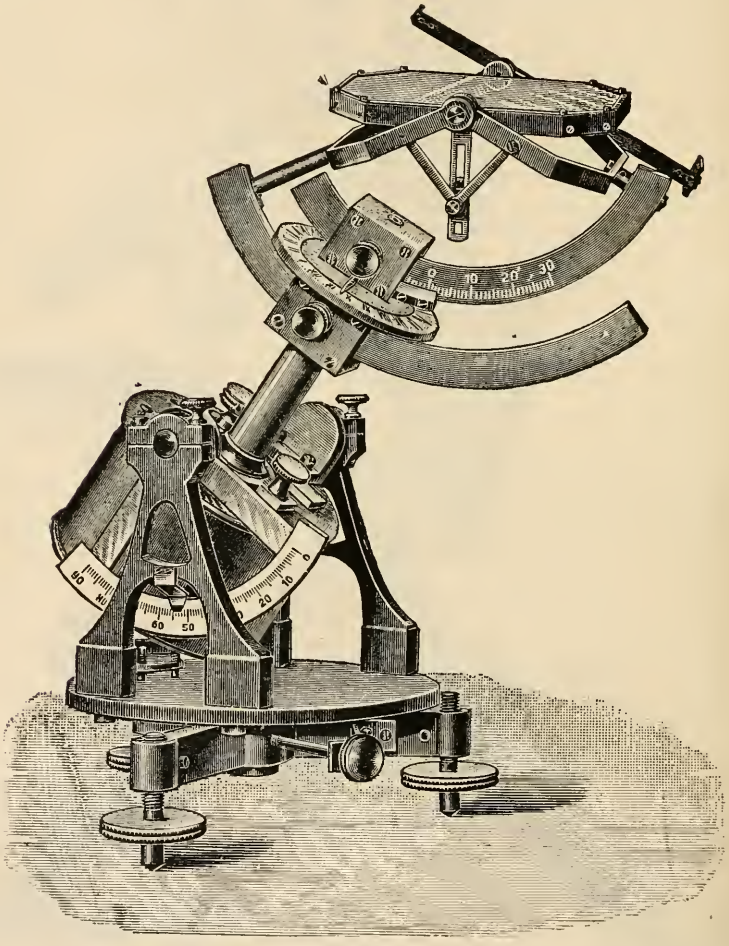


FIG. 29.

* Catalogue, pp. 21–3, Nos. 83–6.

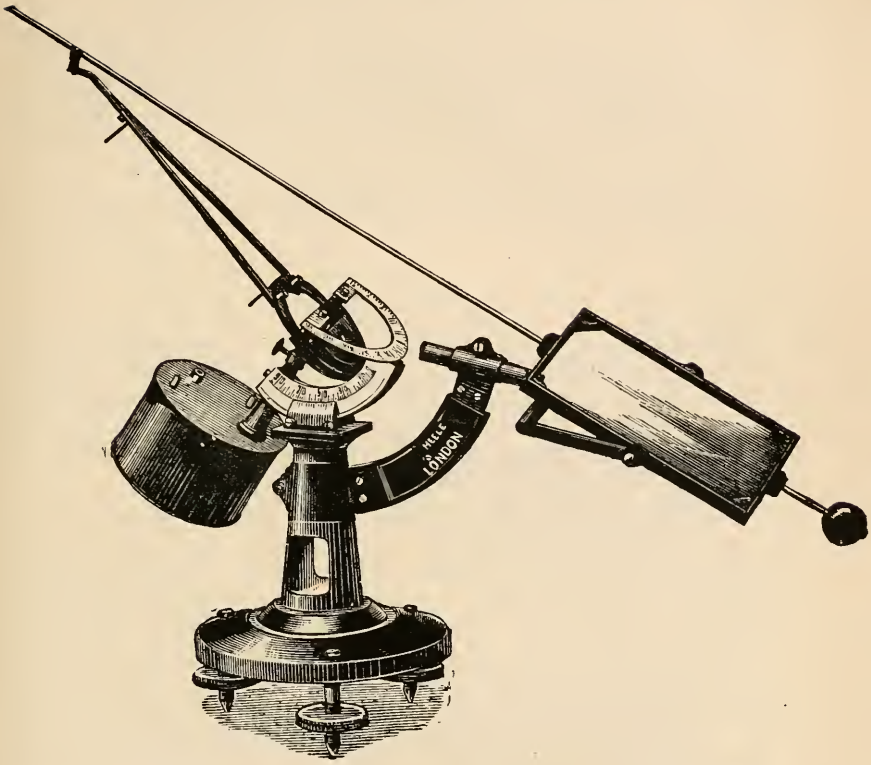


FIG. 30.

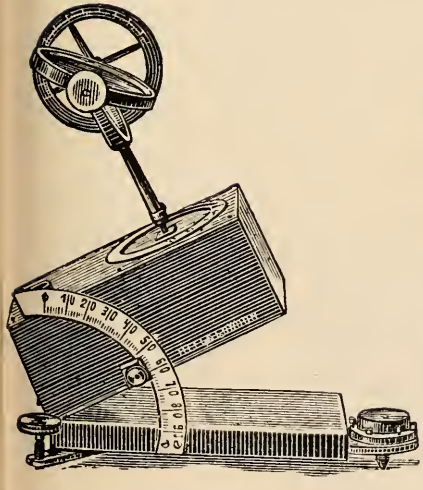


FIG. 31.

FIG. 32.

work, escapement and compensation balance. The size of the mirror is $2\frac{1}{2}$ by 4 in. Fig. 30 is an instrument with Heele's modifications. The size of the mirror is 3 by 5 in. Fig. 31 is of simpler form. The clockwork is contained in a mahogany case. The instrument is fitted with spirit-level and levelling screws. Fig. 32 is of still simpler construction.

Dowdy, S. E.—**Microscope condenser fitting.**
[Describes how an effective condenser can be cheaply improvised.]
English Mechanic, lxxix. (1904) p. 59.

(4) Photomicrography.

Photographing Microscopic Crystals.* — W. Bagshaw shows that a combination of transmitted and reflected light is necessary to throw objects like microscopic crystals into relief and impart a pleasing and faithful representation. The transmitted light, subdued so as not to dominate the reflected light, ensures the outlines in their finest ramifications, whilst the reflected light casts the shadows.

The How and Why of the Lippmann Colour Process.† — T. A. O'Donohoe reminds his readers that the Lippmann film is usually a very thin transparent film of gelatin containing a very small proportion of perfectly emulsified silver bromide. The glass support must be between the film and the lens, and the film must be backed by mercury to form the reflecting surface. Suppose fig. 33 to represent a section of the film; A B the glass surface in contact with the film, and C D the mercury, also in contact with the film. Let R be a ray of monochromatic light passing through the film in a sinuous unbroken line, and impinging at right angles on the surface of the mercury. At the moment of reflection it loses half a wave-length, and according to Young its phase is reversed, so that it returns in the form of the dotted sinuous line, interfering more or less in its course with the entering wave. The two systems of waves are now, as it were, locked up in the film, and are called "stationary waves," because they have lost their forward motion and can only move up and down within the film. They rise and fall with incredible rapidity and act chemically, all the time producing the greatest effect where their motion is greatest, and the least or no effect in the nodal planes where the two waves intersect. In the figure the planes of highest chemical activity are represented by lines *max*, and from these to the shorter lines *min*, where there is no chemical effect, there is a gradual waning of actinic power. There are thus alternate planes parallel to the mercury, showing the maxima and minima of chemical action, and should the theory be correct, a transverse section of such a film should, after development and fixation, show these maxima and minima by alternate bands of black, where the deposit of silver bromide is greatest, and of white bands, where the deposit of silver bromide is little or none. Other colours of the spectrum will,

* Amateur Photographer, xxxix. (1904) p. 69 (4 figs.).
† Photogram, x. (Sept. 1903) pp. 271–4 (6 figs.).

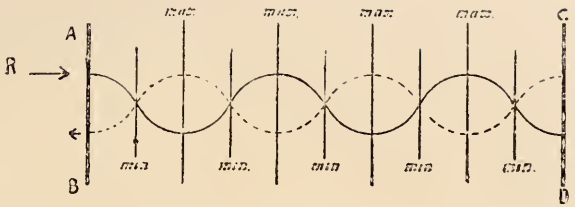
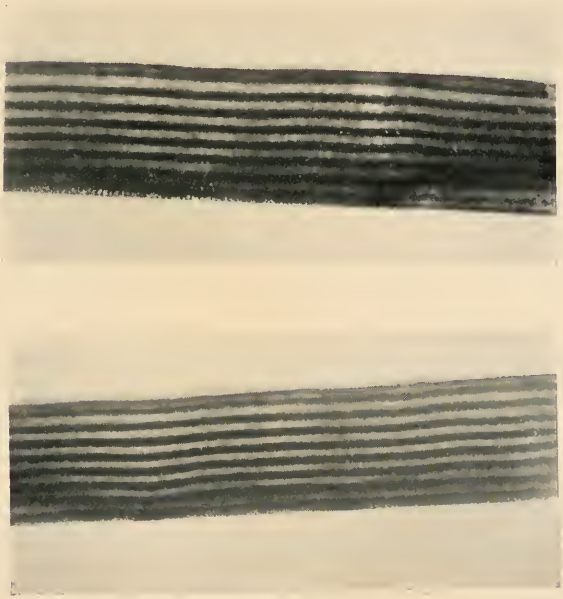


Fig. 33.



Figs. 34, 35. × 1000.

Fig. 36. × 1000.

[To face p. 242.

of course, be acting similarly. The action, moreover, is continuous during exposure, the red waves impressing their forms in the film at the rate of 38,000 to the inch, and the blue at 52,000 to the inch. Prof. Lippmann did not advance beyond the theory, but last year E. Senior photographed a spectrum, and by the aid of collodion stripped the film from the glass support. W. B. Randles imbedded this film in paraffin and after cutting sections mounted them in Canada balsam. Figs. 34 and 35 show the results under high-power magnification, and are photo-micrograms of the red part of the spectrum in which the alternate bands are distinctly visible through the entire thickness of the film. Fig. 36 is a photo-microgram of the blue part of the spectrum under the same magnification. The portion of the film acted on by the blue light was not quite so thick as that of the red owing to the difficulty of making a perfectly plane film. The strata of the blue are, as they should be according to theory, much closer together than the strata in the red. Thus it will be understood that, after development and fixation, each part of the film will reflect only the light whose wave-lengths exactly coincide with the impressions already made in the film.

(6) Miscellaneous.

Ultra-microscopic Objects.*—A. Cotton and H. Mouton, in repeating the experiments of Siedentopf and Zsigmondy on the visibilty of finely-divided particles in certain media, have found the following arrangements very convenient for studying liquids. A very oblique beam of light, diagrammatically represented in fig. 37, is projected on

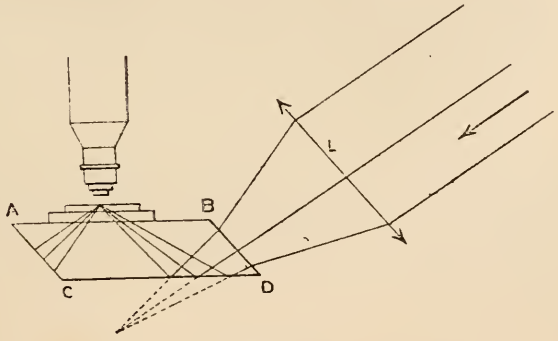


Fig. 37.

to one of the sides of an oblique parallelopiped A B C D with rectangular top and bottom faces, and reflected upwards from the base through the object-slide and cover-slip. A thin layer of the liquid to be examined

* Revue Générale des Sciences, xxiii. (Dec. 15, 1903) pp. 1184–91 (6 figs.).

is placed between the slide and cover-slip, and the under surface of the slide is moistened with a drop of liquid of same refraction-index as the glass. If the angle of incidence of the beam is suitably chosen, the interior beam meets the cover-slip at the angle of total reflexion, and throws no light on to the objective. Any ultra-microscopic particles present in the liquid become, however, diffractive, and therefore self-luminous. The effect on the objective is to render these bodies visible on a dark ground. In the figure the angle of the parallelopiped was about 51°.

The authors consider that their method has the great advantage of using a large percentage of the light emitted from the source. The experiments must be conducted in a darkened room. A view of the actual apparatus is given in fig. 38, where it will be noticed that the light issuing from the condenser of a small inclined lantern is con-

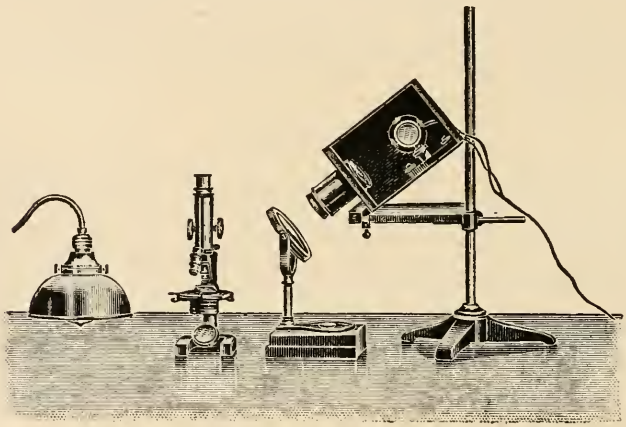


Fig. 38.

centrated by a lens on to the parallelopiped. The lamp on the left is used when it is desired to view the liquid as a transparent object.

The examination of Lippmann's films liquefied showed that the ultra-microscopic particles of silver bromide are in a state of Brownian movement. The authors suggest that this fact may have a bearing on photography in colours. A thin solution of Chinese ink behaved similarly. A preparation of ferrocyanide of copper was examined as a specimen of a colloid, and highly exhibited the Brownian movement; but, when a minute quantity of alum solution was added, the motile particles instantaneously disappeared, and granular masses of ordinary precipitated ferrocyanide of copper were produced. The property possessed by colloids of diffusing light is probably due to the presence of very minute particles, and the authors think that their experiments are very suggestive to biologists who wish to study the action of saline

solutions and diastases on the numerous colloids found in living organisms. It would seem that the minuteness of many bacteria is an insufficient test of their identification, and that more difficult characters, such as peculiar motility, tactism, agglutination, must be looked for: possibly sensitiveness to different kinds of coloured illumination may be found. In the examination of a living culture in bouillon of the microbe of a bovine peripneumonia totally reflected light revealed numerous brilliant corpuscles animated by a movement indistinguishable from Brownian. Great care was taken to ensure that the observations were not tainted by any accidental inequalities or defects in the glass used.

Horder's Clinical Case.—Fig. 39 shows an improved form of the clinical case exhibited at the November meeting.* The modification consists in an alteration in the size of the case, which now measures

Fig. 39

141 mm. by 100 mm. by 31 mm. The increased capacity of the case allows the inclusion of additional requisites such as pipettes, hæmacytometer counting chamber, rack for drying cover-glasses, and some other additional articles.

* See this Journal, 1903, p. 782.

Heele's Miniature Spectroscopes.*—One form of these instruments, catalogued as No. 32, is shown in fig. 40. It has a symmetrical adjust-

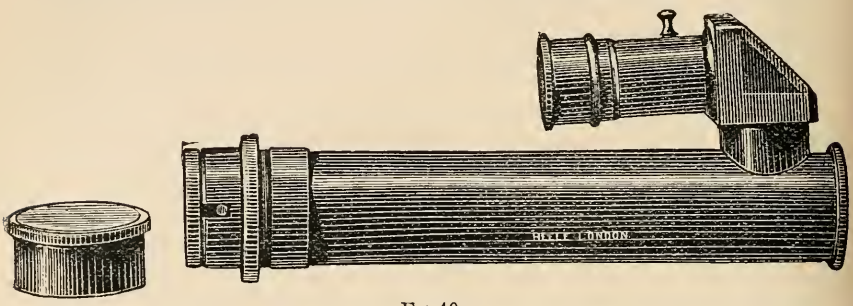


FIG. 40.

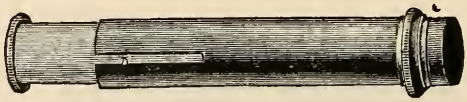


FIG. 41.

able slit, comparison prism, achromatic lens and photographic micrometer scale for determining the position of the lines. The same instrument, in a simpler form, with adjustable slit and achromatic lens, is shown in fig. 41.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Simple Method for Clearing Nutrient Agar without Filtration.‡ H. Fischer recommends the following plan: A glass funnel of suitable size is plugged with a cork just where the cone joins the tube, and placed in an iron ring. Into this the boiling hot agar solution is poured. It is then covered and placed in the cool. After some hours the mass is found to be hardened, and all the turbidity is quite at the bottom of the glass. The funnel is then inverted, and the agar with a little help falls out. It is caught in the hand or a dish, and the turbid part at the apex of the cone removed with a knife. The rest is then remelted and poured into culture tubes. The method is not suitable for gelatin.

Blood Cultures in Typhoid Fever.§—L. M. Warfield takes 10 to 15 c.cm. of blood in the usual manner from the arm, and distributes it among four or five flasks containing 250 c.cm. of bouillon each, and two or three containing the same quantity of litmus milk. The flasks

* Catalogue (pp. 8–9), Peter Heele, London.

† 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., xxxv. (1904) p. 527.

§ Bull. Ayer. Clin. Lab. Pa. Hosp., 1903, No. 1, pp. 77–80.

are incubated at 37·5° C. If organisms be present, a clouding of the bouillon and blackish discoloration of the blood at the bottom of the flask gives evidence of their growth within 24 to 48 hours. Occasionally the signs of growth do not appear for four or five days. The bacilli are afterwards identified on the ordinary media and by the agglutination test. Cultures made early in the disease give a much higher percentage of positive results than those made during the third or fourth week.

Method of Concentrating Plankton without Net or Filter.*—B. L. Seawell describes the following procedure for concentrating plankton. The samples are collected by dipping or by the use of a plankton pump without the filter. A measured quantity, say 500 c.cm., is placed in a conical flask of, say 750 c.cm. capacity, 5 c.cm. of 40 p.c. formaldehyde added, and the two well mixed at once. The planktonts soon die and settle at the bottom. After about a week the supernatant fluid is siphoned off till only 150 c.cm. remain. The residue is poured into a conical flask of about 150 c.cm. capacity, and allowed to settle for another week. The siphoning is repeated and the residue poured into a 75 c.cm. flask. This flask has a base so small in diameter that all but about 20 c.cm. can be safely siphoned off, and this last sediment filled into two 10 c.cm. phials. If kept for future study it may be advisable to add a small quantity of glycerin.

(2) Preparing Objects.

Bleaching Reagents.†—S. E. Dowdy remarks that hydrogen peroxide when used as a bleaching agent should be employed fresh and of full strength. Chlorinated lime in freshly prepared solution, to which a drop or two of dilute acid is added, makes a much more satisfactory bleacher.

Formol-sublimate Fixing Fluids.‡—R. Pearl recommends the fluids devised by D. C. Worcester for fixing and killing. One of these is a saturated solution of sublimate in 10 p.c. formalin. The other consists of nine parts of the foregoing and one part of glacial acetic acid. The first fluid is especially adapted for fixing and killing Protozoa; the second for fixing teleost eggs, and embryological material in general.

(3) Cutting, including Imbedding and Microtomes.

Pleuel Microtome.§—In this instrument which has been improved by Kaplan, the movement is given to the knife-carrier through the continuous turning of a handle, to the crank of which a connecting rod is attached in the desired degree of eccentricity. This rod is at its other end connected with a sliding block, to which it gives a to-and-fro movement. The sliding block is joined to a metal band, which in its turn is loosely connected to the knife-carrier by means of a double-hinge joint. The extent of the to-and-fro movement of the knife-

* Trans. Amer. Micr. Soc., xxiv. (1903) pp. 17–19.
† English Mechanic, lxxix. (1904) p. 63).
‡ Journ. Applied Micr., vi. (1903) pp. 2451.
§ P. Thate's Catalogue, Berlin, 1903.

carrier thus varies directly with the degree of eccentricity of the attachment of the connecting rod. The working of the micrometer-screw is automatic and can be adjusted by means of a peg on the knife-carrrier. The advantages claimed are :

1. Mechanically ensured movement of the knife-carrier exclusively in the course of the sliding track.
2. Simplicity of construction without cogged wheels.
3. Variability in the extent of the movement of the knife-carrier.
4. Automatic working of the micrometer-screw.
5. Adaptability of the apparatus to other sliding microtomes.

Rotation Microtome.*—P. Krefft has devised a microtome, named by him "Herzberge," of which the knife (fig. 42) is the special feature. This is semicircular in form with an outer cutting edge, and it rotates eccentrically round a selected point lying somewhere in its diameter. During such an eccentric rotation the distance becomes constantly and gradually increased between the rotation point and the cutting point of the advancing edge, which advances to just double the extent of the eccentricity. The knife is fixed to a holder on the top of a vertical axis, on the head of which is a millimeter scale for the setting of the knife to the required eccentricity, which should be equal to half the broadest diameter of the preparation to be cut through. The knife-holder grasps the whole back of the knife, and so any elastic spring is avoided. Across this axis passes a rod which can become fixed in the required position and serves for the regulation of the automatic block-raising apparatus : during the half of the revolution, in which the semicircular knife runs free, i.e. does not cut, a lever fixed to the chief axis pushes the rod to one side, and at the same time by means of a catch takes hold of and moves the toothed micrometer-screw, and so causes the block to be raised. During the second half of the revolution, in which the knife cuts, the lever is out of reach of the rod. The whole is worked by a handle, which by means of a cogged wheel acts on the chief axis.

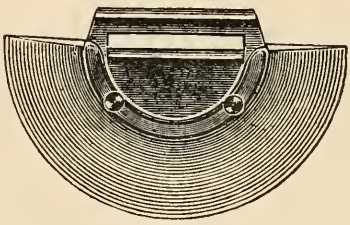


Fig. 42.

For the cutting of paraffin ribbons a straight-edged knife can be substituted for the semicircular one. The advantages claimed for this microtome are :

1. The absence of elastic spring.
2. The course of the knife is uniform and sure.
3. The manipulation is easy.
4. The sections are uniformly regular.

Stebbins, J. H.—**New and cheap Hæmatoxylin Stain.** *Journ. New York Micr. Soc. Annual*, 1902, pp. 1–6.

„ „ **Goldhorne's Double One-dip Bloodstain.** *Tom. cit.*, pp. 6–7.

* Zeitsch. wiss. Mikr., xx. (1903) pp. 7–11 (2 figs.).

(4) Staining and Injecting.

New Modification of the Romanowsky-Ruge Method for Staining Blood-Spores.* Berestneff recommends the following. Stain No. 1 : 0·5 p.c. watery solution methylen-blue (med. puriss.). Stain No. 2 : 1 p.c. watery solution methylen-blue and 0·3 p.c. crystalline soda, heated for three hours in a water bath and then filtered. Stain No. 3 : 0·5 p.c. watery solution eosin (extra B.A.). Four parts of No. 1 are mixed with one part of No. 2, and to 5 c.cm. of this 2·25 c.cm. of No. 3 are added. The preparation is fixed in absolute alcohol, and then stained for 10 to 30 minutes (crescents require at least 35 minutes). The preparation is then dried with filter-paper, or quickly washed with water, differentiated in a mixture of 100 parts alcohol and 2 parts 5 p.c. acetic acid for a few seconds, washed quickly in water and dried.

Demonstrating Presence of Cilia in Bacteria.†—D. Ellis used ordinary agar, "spirillum agar," and peptone-beef broth, and his method was to keep on continually transferring the organism to a fresh medium as soon as growth was perceptible. He was successful in demonstrating cilia in all these species. The following staining method was employed :—Three small drops of water were placed on an absolutely clean slide. A portion of the material was then, with a platinum loop, mixed with the first drop. A loopful of this drop was then mixed with the second, and, lastly, a loopful of the second with the third. From the third drop the cover-glass preparations were made. The smears were then fixed by being kept at 37° C. for 4 minutes, then mordanted for 3½–7 minutes with—

10 c.cm. of a 20 p.c. sol. of Tannin,
8 c.cm. of a cold sat. sol. $FeSO_4$,
1 c.cm. of a sat. sol. of Fuchsin in Abs. Alc. ;

and, lastly, stained for 5 minutes with—

1 grm. Säure violett (Grübler & Co. 6 B),
75 c.cm. Absolute Alcohol,
75 c.cm. water.

Resistance of Tubercle and other Acid-fast Bacilli to Decolorising Agents.‡—C. A. Coles submitted the bacilli of tubercle, smegma, Timothy grass, grass bacillus ii. and mist bacillus to various decolorising agents, after staining with Ziehl-Nielsen for seven minutes. The most important results are that tubercle bacilli can resist 25 p.c. sulphuric acid for 72 hours, while pseudo-tubercle bacilli are decolorised in 16 hours or less. Tubercle bacilli resist Pappenheim's solution [1 part corallin (rosolic acid) in 100 parts of absolute alcohol, to which methylen-blue is added to saturation ; this mixture is further treated with 20 parts of glycerin] for 52 hours, while pseudo-tubercle bacilli are decolorised at the end of four hours.

The author suggests a modification of Pappenheim's solution, finding

* Centralbl. Bakt., 1te Abt. Ref., xxxiv. (1904) p. 296.
† See *ante*, p. 232.
‡ Repr. from Journ. State Med., Feb. and March, 1904, 20 pp.

that the omission of methylen-blue gives better pictures. The films are afterwards contrast stained for a minute or so in weak aqueous solution of methylen-blue.

For differential diagnosis it is advised to immerse the stained slide in the decoloriser for not less than four and not longer than twelve hours. If 25 p.c. sulphuric acid be used, the slides should be left in the acid for at least sixteen and not more than twenty-four hours, and after thoroughly washing with water they are contrast stained with aqueous methylen-blue, dried and mounted.

(5) Mounting, including Slides, Preservative Fluids, etc.

VILLAGIO—**Modern Mounting Methods, continued.**
English Mechanic, lxxix. (1904) pp. 13, 14, 83–4.

(6) Miscellaneous.

Iodine-Calcium Nitrate, a new reagent for Cellulose.* — E. L. Seeliger recommends the following for the recognition of woody material in paper: Iodine 0·1; potassium iodide 0·5; calcium nitrate ($Ca(NO_3)_2 + 4H_2O$) 30·0, and water 50·0. By this, cellulose in its purity is stained light to dark blue, linen dark red, and woody material and woody fibres (as jute) yellow brown. By this reagent, also, can be distinguished the cellulose of conifers from that of other trees—the former staining reddish, and the latter blue. The cellulose of conifers, if bleached, takes on a violet tinge, and if unbleached, a yellowish one.

The Agglutinoscope, an Apparatus for facilitating the Macroscopic observation of Agglutination in the Test-tube.†—H. Jaeger has devised the following apparatus. Three boards of wood are taken, and two of them are joined to the ends of the third by hinges. These two meet in the form of a roof-edge, but one of them is made to overtop the other by a hand's breadth, the latter resting on a ledge on the former. This arrangement screens the daylight from the observer, as he works desk-wise at the lower board. Extending transversely across this, is a slit 3 mm. wide, and about the length of a test-tube. Underneath the slit-opening is fixed an elliptical electric lamp, the long axis of which is parallel with the slit, and through which it sends a very bright beam of light. The test-tube containing the solution to be studied is held by a clamp almost horizontally above the slit, being thereby brightly illumined, and the observer, by means of lens fixed to the board, can readily see even the smallest clumps.

Prevention of Pedetic or Brownian Movements.‡—For the purpose of photography, or for measurement and counting, it is very objectionable to have minute particles in constant motion. For preventing this movement, J. H. Gage uses a 10 p.c. solution of gelatin, filtered through

* Zeitsch. angew. Mikrosk., ix. (1903) pp. 249–50.
† Centralbl. Bakt. 1te Abt. Orig., xxxv. (1904) pp. 521–3.
‡ Trans. Amer. Micr. Soc., xxiv. (1903) p. 21.

filter-paper. A drop of the solution and a drop of milk are placed on a slide and thoroughly mixed. A cover-glass is put on and squeezed down, and then the gelatin is set by putting the slide on ice. This method, which is quite suitable for other liquids containing particles in suspension, gives very satisfactory results.

Cover-glass Cleaner.*—S. E. Dowdy describes an appliance for cleaning cover-glasses as follows. Procure a 1 oz. wooden pill-box, a small piece of thick felt and a strip of chamois leather. Cut or punch out a sufficient number of circular discs of the felt to fill up the bottom part of the box, which should be first smeared inside with seccotine to hold the discs in position. Now line the inner part of the box-lid with a piece of chamois leather in the same way, taking care to get it tightly stretched across, free from creases. The thickness of felt and leather must be so arranged that when the lid is fitted on the box their surfaces just touch. In use, place the cover-glass flat on the felt surface, put on the box-lid, and, holding the box sidewise, rotate its two portions in opposite directions. In this way the thinnest cover-glass may be cleaned without risk of breaking. As a rule, fresh cover-glasses are easily freed from the thin film of adherent grease by soaking them in a little dilute ammonia, afterwards rinsing in distilled water, and either drying at once on a piece of silk or placing them in absolute alcohol, which removes the water and is itself got rid of by evaporation.

Metallography, etc.

Watson and Sons' Metallurgical Auxiliaries.†—1. *Universal Metal-holder* (fig. 43).—This combines in itself a metal-holder with the means of levelling the specimen. Two clamps with rotating jaws grip

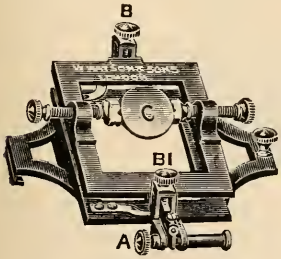


Fig. 43.

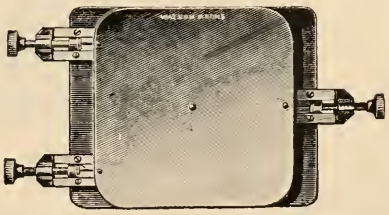


Fig. 44.

the specimen C, and if its plane is not at right angles to the objective, it can be tilted exactly to the desired position by means of the adjusting screws A and B, B′. This fitting is usually made to interchange with the levelling stage plate on the main stage of the Microscope, and for rapid and precise work is of great importance and convenience.

* English Mechanic, lxxix. (1904) p. 14.

† W. Watson & Sons' Catalogue of Micro-Outfits for Metallurgy, pp. 8, 9, 11.

2. *Levelling Superstage* (fig. 44).—It has hitherto been usual for this superstage to be made with levelling screws working from the upper surface, but it will be seen that this new and improved form works from the sides by means of screws operating on wedge-shaped pieces of brass, which, slowly tilting, cause the upper part to tilt, and reaction is obtained by springs attached to the lower plate and grasping the lower one on its upper surface.

3. *Scōp Bullseye Stand Condenser* (fig. 45).—This is fitted with centring adjustments and iris diaphragm. The lens is $2\frac{1}{8}$ in. diameter,

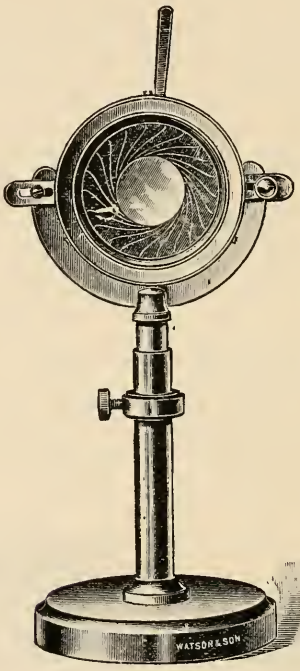


Fig. 45.

and is of a suitable power for work with a vertical illuminator. With it a very small point of light of intense brilliance can be secured.

4. *Scōp Bullseye with Mechanical Adjustments* (fig. 46).—When examining metal specimens, constant necessity arises for the minutest possible alteration of the position of the bullseye lens, sometimes laterally, sometimes vertically. Messrs. Watson have specially constructed this bullseye, which optically is the same as the preceding, to meet this inconvenience. It is mounted upon a pillar, on which is a rackwork, with which adjustments can be made to the finest point by turning the pinion milled head. Laterally, similar slight movements can be effected

by means of a spiral screw. The foot is an exceedingly substantial flat tripod.

Elastic Limit of Metals.*—T. K. R., in an abstract of M. Frémont's carefully-reasoned article, contributed to the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*,† describes the author's chief experiments and results as obtained by microscopic methods. He states that M. Frémont has proved :—

1. That the *theoretical elastic limit* is the mean charge per unit of section on which the real elastic limit is locally attained at a point of the piece tried. It is not the elastic limit of the metal, but of the particular piece of metal under the special conditions employed.

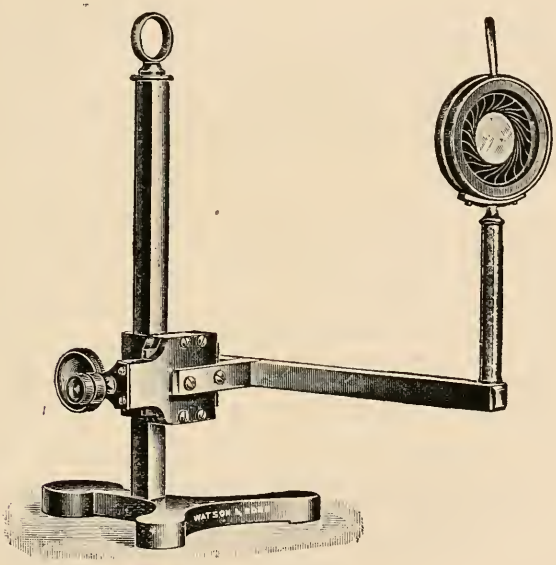


Fig. 46.

2. That the *proportional elastic limit* is still more fortuitous. Owing to compensating error, the line showing the relation between stress and strain may continue to be fairly straight even above the theoretical limit.

3. That the apparent limit is the mean charge per unit of section when the real elastic limit is reached in all regions where it had not previously been reached.

4. Finally, that there is only one elastic limit of a metal, the "real elastic limit," as determined by the method he indicates. The real limit alone has the characters of a physical constant. The other so-called limits depend upon the appearance of discontinuous deformations, the

* Nature, No. 1786 (Jan. 21, 1904) pp. 276–7. † September, 1903

presence of which is almost inevitable in practice, although their cause is purely accidental.

Influence of Sulphur and Manganese on Steel.* — J. O. Arnold and G. P. Waterhouse conclude :—

(1) That sulphide of iron is deadly in its effect upon steel, whilst sulphide of manganese is comparatively harmless.

(2) That the above facts are due to the fusibility, the high contraction coefficient, and the tendency of sulphide of iron to form cell-walls or enveloping membranes surrounding cells of ferrite, whilst sulphide of manganese is much less fusible, segregates whilst the iron is at a high temperature, and so collects into rough globules and very seldom into meshes.

(3) That manganese retards the segregation of iron and hardenite, and that what is called pearlite in a normally cooled manganese steel is really a mixture of granular pearlite and unsegregated ferrite.

(4) That the complete segregation of the ferrite in a manganiferous steel can be brought about by very slow cooling, but that such annealing injures the mechanical properties of the steel by lowering the maximum stress, and the reduction of area per cent. registered by the unannealed steel.

Segregatory and Migratory Habit of Solids in Alloys and in Steel below the critical points.†—J. E. Stead concludes :—

1. That at certain temperatures near to, but below the eutectic point of the iron-phosphorus eutectic, the two constituents when quite solid are capable of migrating from one part to another.

2. That there is evidence that the large crystalline masses in solids have an attractive force for the smaller particles of the same kind, and under suitable conditions draw them to themselves ("crystallic attraction").

3. That in the ordinary or primary eutectic referred to, if the whole mass is of eutectic composition—the constituents being equally distributed and in juxtaposition—the attractions are balanced, and as long as the condition of equilibrium is maintained there is no segregation, at least not during heating for 48 hours to a point just below the eutectic melting point.

4. That active secondary segregation occurs when the eutectic exists in isolated areas, and is surrounded by masses of substance of the same kind as one of its constituents. As there is no equilibrium or balance of the crystallic attractions between the particles of a like kind, both constituents draw together or segregate, and cease to be eutectic in character.

5. That in the secondary eutectic pearlite, at temperatures below the eutectic point, there is the same tendency for the constituents to migrate and segregate.

6. That in annealing steel the main softening effect takes place in the zone 690° C. to 670° C. It is, however, in this zone that the elastic limit of the steel is most rapidly reduced.

* Journ. Iron and Steel Inst., ii. (1901) p. 234 *et seq.* ; Metallographist, vi. (Oct. 1903) pp. 302-13 (9 figs.).

† Iron and Steel Metallurgist, vii. (Feb. 1904) pp. 139-59 (10 figs.).

Recent Investigations in Cast Iron.*—A. E. Outerbridge, jun., has investigated the changes in volume produced by the repeated heating and cooling of cast iron. In some cases the expansion amounted to as much as 40·98 of the original volume. He thinks that these changes must be connected with the mobility of the molecules of the cast iron.

HALL, J. L.—**The Microscope in Engineering: its widening use in studying the Structure of Metals.**

[An interesting, historical and practical paper.]

Iron and Steel Metallurgist, vii. (Jan. 1904), pp. 45–55 (7 figs.).

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* Journ. Franklin. Inst., clvii. (Feb. 1904) pp. 121–40 (3 pls. of six figs.).

VII.—*On a Microscope with Geometric Slides.*

By Keith Lucas.

[*Read February 17th*, 1904.)

The instrument with which this paper deals represents an attempt to replace the usual planed slides of the Microscope by geometric slides. The application can hardly be considered new, since geometric slides are commonly used on measuring Microscopes, yet I am not aware of the existence of any other Microscope suitable for biological work in which such slides are used.

The arrangement of geometric slide which has been found most suitable for the focussing movements is a tube, concentric with the optic axis of objective and eye-piece, sliding in two V-guides placed near its extreme ends. This arrangement has the advantage of ensuring that rotation of the tube within its V-guides shall not displace the optic axis; consequently the means adopted for preventing this rotation may be of the roughest nature, may, in fact, be only sufficient to prevent such a degree of rotation as would damage the focussing mechanism. Unfortunately the necessity of conforming to the proportions of Microscopes commonly in use has rendered such an arrangement impossible in the case of the slide which carries the condensing lenses. In this case the axis of rotation of the guide-tube has been considerably displaced from the optic axis.

The photograph reproduced in fig. 49 will serve to indicate the general arrangement of the instrument.

The main casting, or limb (A, figs. 49–53), is carried further forward than is usual, so as to partially embrace the large body-tube (B, figs. 49, 50, 51), and carries four projections, two at its upper, and two at its lower end, which form the V-guides, in which that tube slides. This slide forms the coarse adjustment. The means adopted to hold the tube against its four guides, and to prevent it from rotating about the optic axis, will be considered later. The large body-tube carries two rings, one (C, figs. 50, 51) inside its upper, and one (C′, fig. 51) inside its lower end. Each of these rings has two projections upon it, against which the long narrow inner tube (D, figs. 49, 50, 51) is held. Thus are formed the V-guides of the coarse adjustment.

The two upper guides of the fine adjustment, and of the coarse adjustment, and the two concentric tubes which slide in these guides, are shown in fig. 50. The substage is carried by a long stout tube

(E, figs. 49, 52), which passes up inside the limb, and has two guides at the level of the stage, and two, consisting of adjustable screws (F, figs. 49, 52, 53), at a higher level.

The detailed arrangement of the body tubes and focussing mechanism is shown in fig. 51, which is a vertical section passing through the limb and tubes. The long coarse-adjustment tube (D) passes right through the shorter and wider fine-adjustment tube (B). At each end of the latter there is a ring (C, C'), which carries the guides of the coarse-adjustment tube. Between the two tubes there lies a long leaf-spring (G), whose middle point presses back-

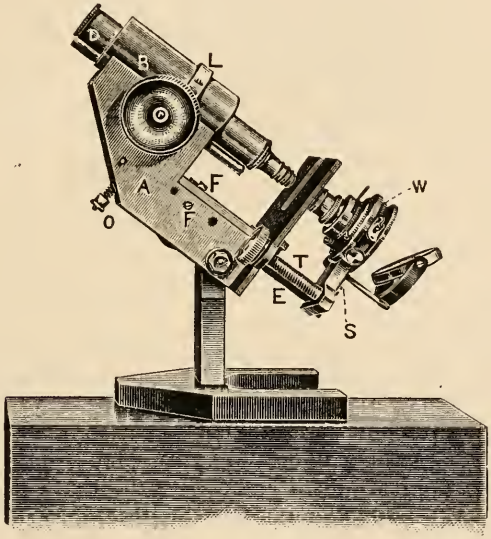

Fig. 49.—Side Elevation of Microscope.

A, limb; B, fine-adjustment tube; D, coarse-adjustment tube; E, guide-tube of substage; F, aligning screws of substage; L, ring carrying bearings of coarse-adjustment barrel; O, nut retaining fine-adjustment tube against guides; S, substage bracket; T, focussing screw of substage; W, spring retaining substage ring against centring screws.

wards upon the coarse-adjustment tube, holding it firmly against its four guides. A piece of smaller tube (H), fixed parallel to the back of the coarse-adjustment tube, and passing through a slot in the upper bearing-ring, prevents the tube from rotating about its long axis.

The next point for consideration is the means adopted for moving the coarse-adjustment tube to obtain focus. This is effected by means of a wire and barrel (J and K, fig. 51). The two ends of the wire are anchored to the extreme ends of the coarse-adjustment

tube, and lie inside the two small tubes which are attached to the back of that tube. The upper one of these small tubes has already been mentioned as the guide which prevents rotation of the coarse-adjustment tube. The lower end of the wire is fixed rigidly, the upper through a spring held in tension. At about its middle point the wire takes one turn round the cylindrical barrel. The barrel has its bearings in a ring (L, fig. 51), which embraces the large fine-adjustment tube. To the outer ends of the barrel are screwed the milled heads of the coarse adjustment. The friction of the wire upon the barrel is sufficient to cause the coarse-adjustment tube to move up or down when the barrel is rotated. The reasons for adopting this device in preference to the usual rack-and-pinion are two: first, the relatively small cost of manufacture, and, secondly, the fact that its action upon the tube is only a direct pull in the direction of the desired movement. It exerts no side thrust, such as is caused by a rack-and-pinion. The absence of teeth causes the motion to be extremely smooth and regular. The wire is made of hardened steel, silver-plated, and is protected, when the instrument is put together, by the small tubes in which it lies.

The four guides in the limb, in which the fine-adjustment tube slides, have been already described. It remains only to deal with the means by which the tube is held against those guides, and prevented from rotating about its long axis. Both these ends are secured by means of a rod (M, fig. 51), hinged to the ring which surrounds the fine-adjustment tube, and passing backwards through a hole in the back part of the limb. A spring (N, fig. 51), held in compression between the limb and a nut (O, figs. 51, 53) screwed on to the end of the rod, pulls the fine-adjustment tube against its four guides. The hinged joint, whose axis is horizontal, allows the fine-adjustment tube to move up and down through a small distance, moving the rod in or out of the hole in the limb as it moves; at the same time it does not allow rotation of the tube against its long axis.

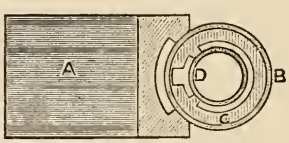

Fig. 50.—Section through Upper Part of Limb and Body Tubes.

C, ring carrying guides of coarse-adjustment tube.
Other letters as in fig. 49.

There is a spring (P, fig. 51) in tension between the upper part of the fine-adjustment tube and the more remote end of the rod. This spring performs two functions. In the first place, it ensures

that the upper part of the tube shall be firmly held against its guides, and, secondly, it pulls the whole tube downwards against the end of the lever by which it is moved.

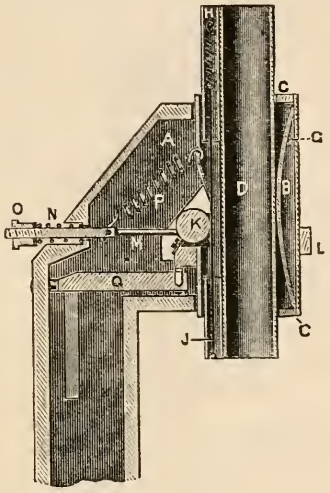

Fig. 51.—Section through Limb and Body Tubes.

C C′, rings carrying guides of coarse-adjustment tubes; G, leaf spring retaining coarse-adjustment tube against guides; H, small tube which prevents tube D from rotating; J, wire of coarse-adjustment; K, barrel; L, ring carrying bearings of K; M, rod, and N, spring retaining tube B against its guides; P, spring forcing tube B downwards against the fine-adjustment lever; Q, fine-adjustment lever. Other letters as in figs. 49, 50.

This lever (Q, figs. 51, 52), which transmits the motion of the fine-adjustment screw to the body-tube, is of the bell-crank type, with its axis of rotation running from back to front of the limb. It is moved by a fine-threaded screw (R, figs. 52, 53), which passes through the left-hand side of the limb, a short distance above the stage. The arrangement of the lever is partially seen in fig. 51 and partially in fig. 52, which is a section passing through the back part of the limb, viewed from the front.

The essential parts of the substage are: a long tube (E, fig. 52), sliding in geometric guides inside the limb, and a bracket (S, fig. 52) attached to this tube, extended laterally to encounter the focussing screw (T, figs. 52, 53), and forwards to carry the centring ring, into which the condenser is fitted. The lateral extension also carries a rod (U, fig. 52), mounted parallel to the tube, and preventing rotation about the long axis of the latter. The whole substage is forced upwards, against its focussing screw, by a long spiral spring (V, fig. 52), anchored to the limb at its upper end, and passing down

inside the tube (E, fig. 52), to which it is attached at its lower end. Since the upward pull of the spring and the downward pressure of the focussing screw are not in the same line, there results a couple, tending to rotate the whole substage and tube in a vertical plane

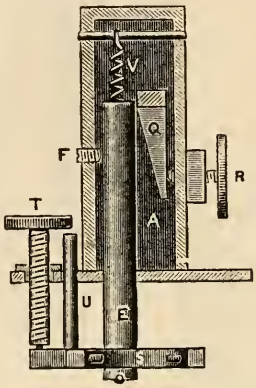

FIG. 52.—PART SECTION THROUGH LOWER PART OF LIMB, SHOWING SUBSTAGE, VIEWED FROM FRONT.

R, fine-adjustment screw; S, bracket of substage; T, focussing screw of substage; U, rod which prevents rotation of E; V, spring of substage. Other letters as in figs. 49, 50, 51.

about the lower end of the focussing screw. Advantage is taken of this couple to hold the tube against its geometric guides, the upper and lower pairs of guides being placed on opposite sides of the tube. The upper pair of guides is formed by two adjustable screws (one shown at F, figs. 52, 53), which serve to procure perfect alignment of the substage slide with the slides of the body-tube. By this device it is possible to secure the alignment of the body-tube optically instead of mechanically, so that far greater accuracy is obtainable.

As has already been pointed out, rotation of the guide-tube of the substage about its long axis is prevented by means of a rod, which passes through a hole in the stage. This rod makes no attempt to fit in the hole through which it passes, but presses on one side of it only. The rod is prevented from leaving this side of the hole by the device of winding up the long spring (V, fig. 52), which lies inside the guide-tube. This spring has, consequently, a tendency to rotate the substage about the long axis of the tube, in such a direction as to hold the rod against the side of the hole.

The long spiral spring, enclosed within the guide-tube, is thus seen to be the key to the whole substage mechanism. It causes the substage to follow its focussing screw without backlash, holds the tube against its four guides, prevents rotation of the tube about its long axis, and allows of the alignment of the substage slide with the body-tubes.

A few other points about the substage demand attention. The position of the focussing screw (T, fig. 53), above the stage on the right-hand side, is a very convenient one. Moreover, since the nut in which the screw works is fixed to the stage, and the connection between the screw and substage is flexible—being effected by a long pointed pin which passes up inside the screw—alterations of focus can be obtained without fear of any other derangement of the illumination.

The substage bracket is not a complete ring, as is the usual practice, but a fork (S, fig. 52), open at the front. This enables the centring ring to be readily removed. When in place, this ring is held against its two centring screws by a spiral spring (W, fig. 49), stretched between the two prongs of the fork.

The range of the substage movement is amply sufficient to enable it to take condensers of either the substage or understage pattern. The absence of milled heads and slides below the stage renders the condenser accessible from every side.

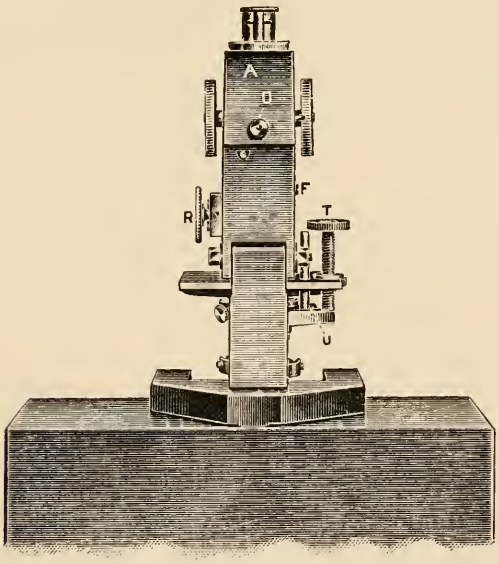

Fig. 53.—Elevation: Microscope in Vertical Position.

Lettering as in figs. 49, 50, 51, 52.

The advantages claimed for the instrument are the following:—(1) Cheapness of manufacture, the turning of the tubes, and the filing of the guides being less expensive work than the planing of dovetailed slides. The alignment of the various slides also involves very little expense, being obtained without careful workmanship.

(2) It is impossible for the movements to become shaky from wear, since every movement is held up by a spring. (3) The alignment of the several slides is obtained optically.

These are the essential advantages. There are also some incidental points, namely, easy removal of the fine-adjustment tube for cleaning; possibility of replacement of any part without the need of special fitting—for example, it would be possible to replace a fine-adjustment tube, which carried a sliding coarse adjustment, by one carrying a mechanical movement, without skilled work; convenient position of the substage focussing screw; accessibility of the condenser; and the shape of the limb, which enables it to be finished entirely by machinery.

Of all these points, those which make for cheapness appear to me to be of the greatest importance. This was the primary object with which the instrument was designed.

The particular instrument from which the photographs reproduced with this paper were taken, was made throughout with the roughest of workmanship. In spite of this, the movements all worked smoothly, and without shake, a result which could certainly not have been obtained with similar workmanship in a Microscope of the usual pattern. This fact affords the strongest proof of the superiority of the geometric slide.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Old Microscope by Bate.—This Microscope (fig. 55) by Bate, kindly presented to the Society by Mr. Stringer, was exhibited at the February Meeting of the present year. It is apparently a late form of

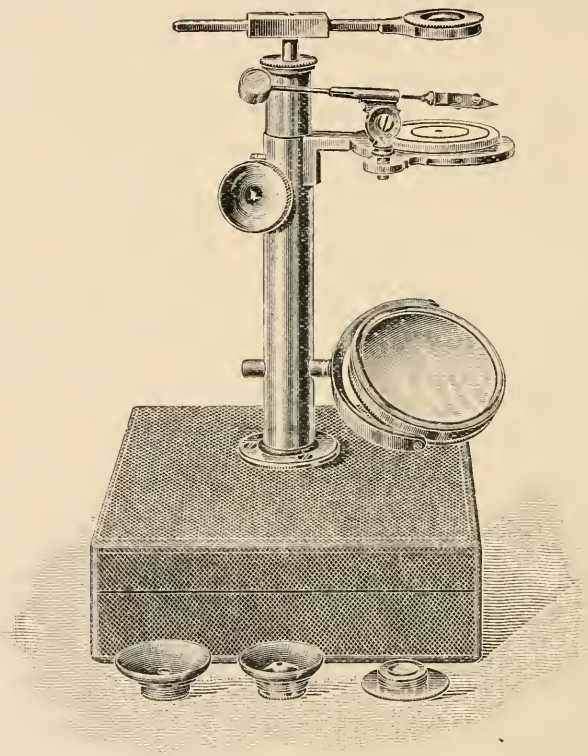

Fig. 55.

Ellis's Aquatic Microscope, described by Adams in his *Essays on the Microscope*, published in 1787.

Adams says, "In the representation of this Microscope the pin D is delineated as passing through a socket at one side (really the back) of the pillar A, whereas it is usual at present to make it pass down a hole bored through the middle of the pillar."

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

Further on he says, "These Microscopes are sometimes fitted up with a toothed rack and pinion for the more ready adjustment of the glasses to their proper focus."

These two modifications constitute the principal differences between the Bate Microscope and the one named after John Ellis, and used by him in 1752–4 when preparing his work, *An Essay towards a Natural History of Corralines*. Ellis there says the Microscope was made by Cuff, and he gives a figure and description. The figure was used by Adams in his Essays, and on a reduced scale may be found in Dallinger's edition of *Carpenter on the Microscope*.

Cuff's Microscope is evidently the forerunner of many modern dissecting Microscopes.

The date of this (Bate) Microscope is doubtful, but there is reason to believe that Bate's instruments were produced somewhere about the early part of the last century.

It scarcely requires any further description, beyond mentioning that there are four lenses, the two higher powers being provided with Lieberkühns.

Old Microscope by Plössl, of Vienna.—This Microscope, which was exhibited at the Society's Meeting on January 20, and is represented in fig. 56, resembles in general character the old Microscope by Schiek, figured by Quekett in his *Practical Treatise on the Use of the Microscope*, 2nd ed. 1852, fig. 50, p. 102.

It is an early example of a Continental Achromatic Microscope, and its date may be given approximately as 1845.

The brass body, 10½ in. long, is supported on a short curved piece, which slides on a triangular steel bar by rack-and-pinion movement. The teeth of the rack are let in on the under surface of the steel bar, and the latter is fixed by a compass joint to a solid, upright brass pillar, which stands on a folding tripod with levelling screws at each end. Three brass discs are provided, on which the sharp points of the levelling screws rest.

The stage is movable, for fine adjustment focussing, on the same triangular bar by means of a fine screw fixed at the end of the bar. Another screw at the back serves to clamp the stage in any position.

The stage has mechanical motion in two directions; a fine screw on the right gives lateral motion to the extent of about ⅔ in. On the left lower side a screw, acting on a lever, and with the stage plate pressing against a spring at the top of the stage, gives up-and-down motion. A horse-shoe shaped piece on the stage holds the object slide, and can be lifted by pressing against a spring below the stage.

In addition to these movements there is on the right side a large drum micrometer screw, with divisions reading to 0·00001 of a Vienna inch, and also some divisions on silver at the bottom of the stage. The screw works against a spiral spring enclosed in a small brass cylinder on the other side of the stage.

The single mirror on a swivel, fixed to the steel bar, is concave, and provided with blackened brass diaphragms to partly cover the mirror when less light is desired.

There are four Huyghenian eye-pieces and one large positive eye-piece, having two large plano-convex lenses, the convex sides turned

towards each other. The six object glasses all screw together, one on the top of the other; they are intended to be used singly or in combinations of two or three, as indicated by the table of magnifications.

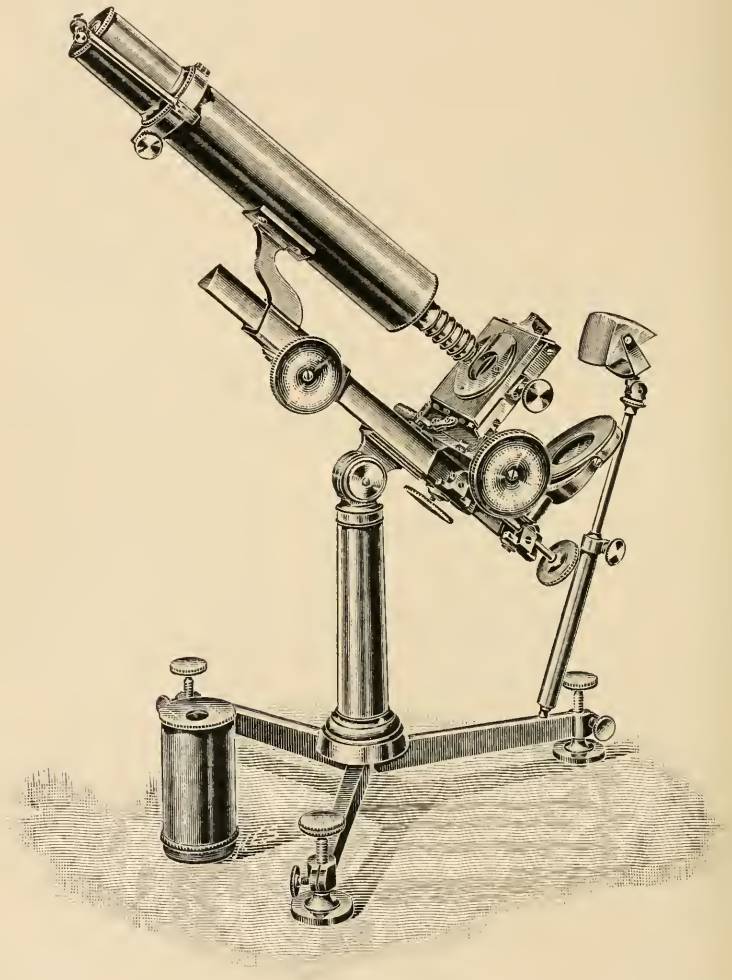

Fig 56.

A bull's-eye condenser is provided, and also a rectangular condensing prism with two convex surfaces, mounted on an extending rod with compass joint, to be fixed on the front leg for illumination above the stage.

The following table of magnifications, compiled by the makers, accompanies the instrument :—

Objectives.	Eye-pieces.				
	Apl.	I.	II.	III.	IV.
No. 1	11	24	36	..	..
1 + 2	26	54	89	..	..
1 + 2 + 3	41	84	126	..	..
2 + 3 + 4	51	108	160	..	..
3 + 4 + 5	68	134	205	450	..
4 + 5 + 6	103	206	300	720	1080

Baker's Diagnostic Microscope No. 1.*—This instrument (fig. 57) is a modification of the one designed at the suggestion of Major Ronald

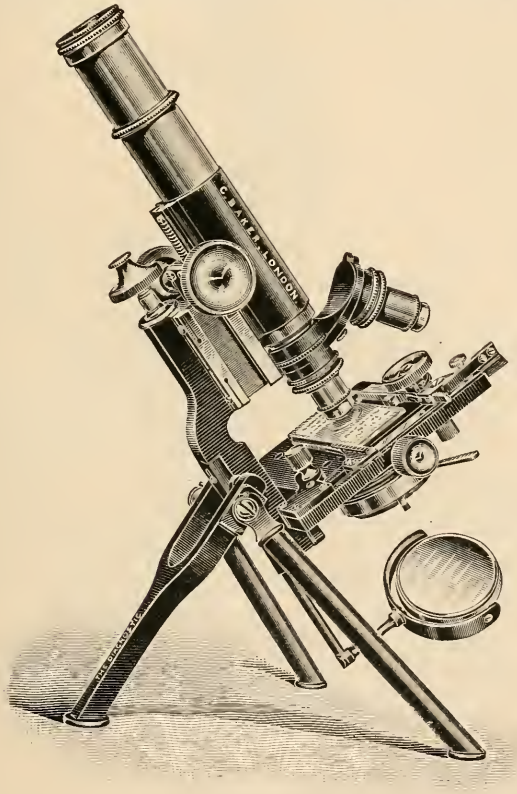

Fig. 57.

Ross, F.R.S., for the special use of officers of the Indian Army Medical Department for the diagnosis of malarial fever, etc.

* See this Journal, 1902, p. 98.

It has diagonal rack-and-pinion coarse movement, micrometer screw fine adjustment and draw tube, as in the original instrument, but a larger stage, $3\frac{1}{4}$ in. by $2\frac{3}{4}$ in., which folds to facilitate packing, and is held in position by a strong clamp screw, a substage fitting of $1\frac{1}{2}$ in. diameter carrying a full size Abbe condenser and iris diaphragm, and larger plane and concave mirrors, viz. $1\frac{1}{2}$ in. diameter, have been added.

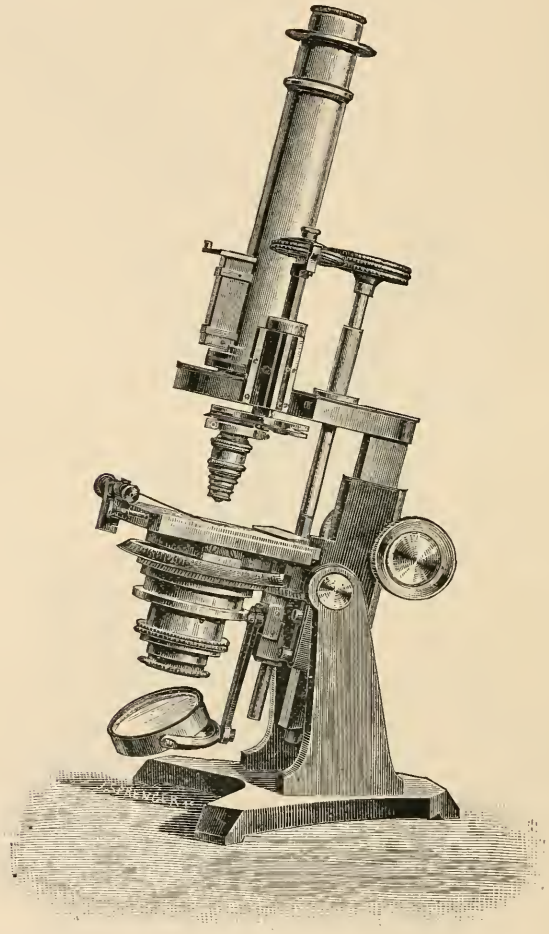

Fig. 58.

A removable mechanical stage with 1 in. movement in both directions has also been fitted, as this greatly facilitates the examination of blood spreads, etc.

It is mounted on a folding tripod foot, and is supplied in a solid leather case. The size of case is $10\frac{1}{2}$ in. by $5\frac{1}{2}$ in. by 3 in., and it will carry the following apparatus :—Microscope stand, two eye-pieces, three

objectives, bottles for stains, Horder's storage box for cover-glass preparations, and the special aluminium frame to carry the latter.

Mineralogical Microscope.* — This is shown in fig. 58, and is a strongly constructed model, inclinable, with a stage 85 mm. square. The Nicol's prisms have rectangular surfaces; the polariser can be removed, and the analyser behind the objective inside the tube can be easily slipped to one side. The object under examination does not turn: the Nicol's prisms being turned together by means of cog-wheels worked by a screw-button; this arrangement is something like the Allan-Dick model made by Swift. A graduated circle, with a vernier reading to one minute, indicates the position of the polariser with regard to the object. Rapid change of parallel light into converging light is effected by lenses mounted on a slide. The variation of the focus produced by the Nicol's prism is corrected by a lens. There is an opening behind the objective for the introduction of mica or quartz lamellæ, etc.

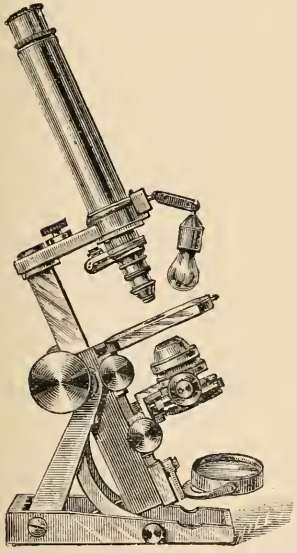

FIG. 59.

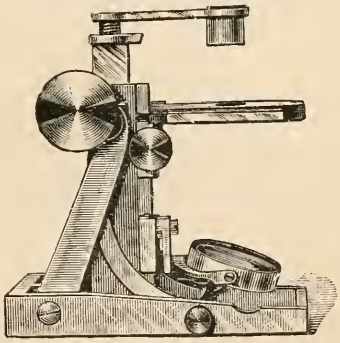

FIG. 59A.

The instrument has the quick-changing nose-pieces. The position of the oculars with respect to the Nicols is determined by shades.

The lenses for this series of Microscopes are all supplied by Messrs. Seibert and Kraft, of Wetzlar.

Travelling Microscope.†—This is shown in fig. 59. It is described as "large size," but is reduced to a small bulk by the easy dismounting of its component parts. The instrument can also be used as a simple Microscope for dissection (fig. 59A). The present form seems an improvement on the earlier model, which was described in this Journal.‡

* Catalogue Soc. Génévoise pour la construction d'instruments, de physique et de mécanique, No. 2485 (1900) p. 102.

† Op. cit., No. 2430 (1900) p. 101. ‡ Journal R.M.S., 1884, p. 437.

Leitz' New Binocular Loup.*—This instrument, which was exhibited at the December meeting (1898) of the Royal Microscopical Society, is shown in fig. 60. The usual principle of the ordinary binocular Microscope is not adopted, inasmuch as that principle involves a partition of the beam of light proceeding from an object, and a consequent diminution of the brightness of the image. But this instrument consists of two independent Microscopes, just as an opera-glass is formed of two separate telescopes, and the two images are combined by a mental process. The arrangement allows a greater freedom in the choice of objectives than in the ordinary binocular Microscope. The instrument contains two of Brücke's loups, whose fields of view accurately superpose. The eye-distance from the preparation-plane is about 250 mm., the field is large and flat, and the magnification about four diameters. The binocular loup admits of horizontal and vertical adjustment, and can be secured in any position by clamping-screws. The fine adjustment is by rack-and-pinion.

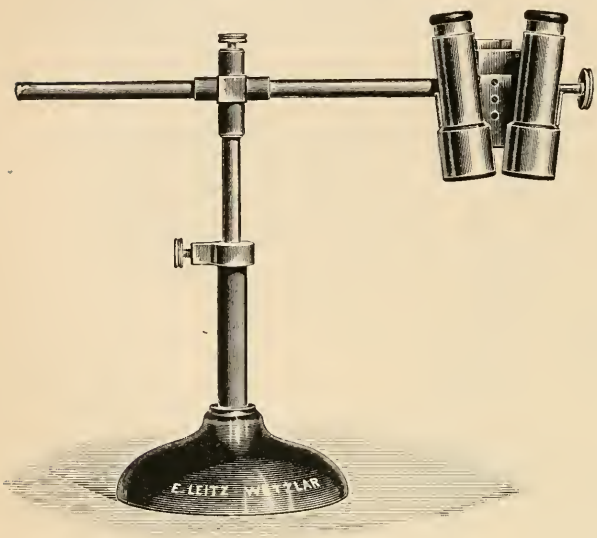

Fig. 60.

Dowdy, S. E.—**Sliding Stage for the Microscope.**
English Mechanic, lxxix. (1904) p. 218 (1 fig.).

(4) Photomicrography.

Dowdy, S. E.—**Amateur Photomicrography.**
English Mechanic, lxxix. (1904) p. 172–4 (5 figs.).

(5) Microscopical Optics and Manipulation.

Absorption and Emission of Air and its Ingredients for Light of Wave-lengths from 250 μ to 100 μ.†—After describing a photographic vacuum Spectroscope designed and made by himself, with lenses and prism of fluor-spar, and with arrangements for maintaining the same pressure throughout the body of the instrument, as in the Geissler tube (used end on), V. Schaudinn states his results.

* Zeitsch. f. Ang. Mikr., ix. (Feb. 1904) pp. 291–2 (1 fig.).

† Smithsonian Contributions to Knowledge, xxxix. (1903) No. 1413, 30 pp., 4 pls. and 10 figs. in text.

Photographs of the ultra-violet spectra, beyond 185 μ, of the following substances were made :—Nitrogen ; Oxygen ; Water ; Carbon monoxide ; Carbon dioxide ; Hydrogen.

Nitrogen.—Emission spectrum : beyond 185 μ no bands. Absorption spectrum : very transparent, even beyond 162 μ, but absorbed particular wave-lengths energetically.

Oxygen.—Emission spectrum : three continuous maxima at about 185 μ. Absorption spectrum : rays absorbed in the neighbourhood of 185 μ in a series of well-defined groups, fourteen in number.

Hydrogen.—The author states that none of the spectra beyond 185 μ with which he is acquainted emits such a wealth of lines or extends so far as this. Hydrogen reaches its highest photographic efficiency at 162 μ, and extends to approximately 120 μ ; but as such wave-lengths have not yet been measured, it is impossible to give the exact limit. A single plate of fluor-spar at the lower limit reduced the photographic effect to one-half. Hydrogen is extremely transparent.

Air.—The absorption effect of strata of the following thicknesses was tried : 15, 14, 4, 3, 2, 1, 0·5, 0·25, 0·1 mm. With the same time of exposure and same width of slit, the greater thicknesses stopped the spectrum entirely at 178 μ, but a stratum of 4 mm. allowed the first band at 170 μ to appear. With a stratum of 0·5 mm. the spectrum runs to the end of the plate, corresponding to 163 μ, and with the lesser thicknesses of air still further. Attention is drawn to the profound effect caused by introducing such a thin layer of air at atmospheric pressure into the path of the rays.

The paper is throughout illustrated by photographs of spectra.

In connection with V. Schaudinn's interesting experiments, J. W. Gifford observes that, with fluor-spar and the melted quartz now available, there is no doubt that object-glasses could be made, and a vacuum Microscope constructed for use with these very remote rays. In which case, the present resolving power of the Microscope (other things being equal) would be increased, roughly speaking, sevenfold. This means that objects could be separated when the interval between them was no greater than one nine-hundred-thousandth of an inch = ·0282 μ.

Note on the Diffraction Theory of the Microscope as applied to the Case when the Object is in Motion.* — According to the Abbe theory of microscopic vision, says R. T. Glazebrook, when a grating is placed on the stage of a Microscope and illuminated by plane-waves, diffraction images are formed in the focal-plane of the object-glass, and the images in the view-plane result from these—and this is undoubtedly true. The following difficulty has, however, been raised : if the grating be moved in its own plane in a direction perpendicular to the ruling, the diffraction images do not change ; those seen in the view-plane move : how then can the latter images be due to the former ? The answer lies in the fact that in the above argument the effect of the differences of phase among the diffracted images has been neglected. The diffracted images are not all in the same phase, their

* Proc. Physical Soc., 1904, p. 162.

relative phases are altered by shifting the grating, and the image pattern in the view-field is altered in consequence. A simple case is considered in the paper, and it is proved that the image in the view-plane may change without an alteration in the *position* of the diffracted images.

Light Waves and their Uses.* — Although this work is of little assistance to us in solving those intricate microscopical problems which depend on the wave theory of light, it is nevertheless a most fascinating book. More than this, it will be useful to those of our Fellows, who, not having studied physical optics, are desirous to understand something about the fundamental principles by which the Microscope image is formed.

The drawback to all books on this subject is, that if they are worth anything at all, they are crammed full of mathematics, and, therefore, intelligible only to those acquainted with that form of hieroglyphic writing ; if, on the other hand, the treatment is popular, they are generally so inaccurate as to be valueless.

Here we have a book by one of the highest authorities, written with hardly a mathematical symbol, and in a peculiarly pleasant style.

The author, A. A. Michelson, speaking of wave-motion, says that it "is one of the most fascinating, not only of the department of science, but of human knowledge. If a poet could at the same time be a physicist, he might convey to others the pleasure, the satisfaction, almost the reverence, which the subject inspires."

The chapter succeeding that upon Wave Motion and Interference, deals with the Resolving Limits for the eye, the Telescope and the Microscope. It is shown that the resolving power of the eye is about $\frac{1}{250}$ in. at 10 in., and that this amount is augmented five-hundredfold by a 5 in. telescope and four-hundredfold by a Microscope.

The larger part of the book is occupied by showing how quantities (linear and angular), far smaller than any that can be dealt with either by the telescope or Microscope, can be measured by means of the Interferometer—an instrument, as its name suggests, for measuring interference phenomena.

Those who have studied mathematical instruments will be much interested in the description of the *harmonic analyser*, as well as in the woodcut showing some of the wonderful curves it has drawn.

Some idea of the accuracy gained in measurements made by the Interferometer may be obtained from the following example.

A standard metre, measured by three different observers at different times, separated by whole months, was found to be equal in length to 310678·48 red waves of light. The greatest difference between the three measurements was only one-fifth of a single wave-length.

There are three plates giving excellent coloured representations of spectra, and the book is well illustrated by woodcuts throughout.

Simple Method for the Observation of Ultra-Microscopic Particles.†—E. S. London demonstrated to the Microbiological Society of Petersburg (November 8, 1903) a new apparatus of Siedentopf and

* Decennial Publications of the University of Chicago. University of Chicago Press, 1903, 8vo, 166 pp , 3 pls. and 108 figs.

† Centralbl. Bakt., Ref., xxxiv. (1904) pp. 433-4.

Zsigmondy for ultra-microscopic observations. Its constituent parts were (1) a carbon arc light, (2) a condenser, (3) a vessel filled with alum solution for the absorption of the heat rays, (4) a diaphragm, (5) a Microscope, and (6) a specially constructed camera. The first four were taken from the large microphotographic apparatus of Zeiss. The Microscope was also by Zeiss. The special camera was a four-sided metal receptacle, 2 cm. by 0·8 cm. by 1·8 cm., in which there were five round openings 0·3 cm. in diameter. The opening in each of the smaller surfaces was prolonged into a metal tube. The openings in the narrow surfaces were placed opposite each other. The fifth opening occupied the middle of the broad upper surface. The middle point of the three last lay in one plane. The light passing through the condenser, the alum-containing vessel and the diaphragm, entered the anterior opening of the camera, which latter was placed on the Microscope object-wise. The illuminated contents of the camera can then be studied through the upper opening. By means of this apparatus various objects were demonstrated, and among them the *Bacillus dysenteriæ* (Shiga) in normal saline solution, with a magnification of only 31 diameters.

Filtration of Ultra-Violet Rays through a Selection of Jena Optical Glasses.*—H. A. Krüss has investigated this subject in connection with samples of glass supplied him by Schott and Co. These samples represented the kinds of glass most frequently used in optical instruments, and comprised the catalogue numbers 3094, 2900, 2990, 3046, 1800, 2572, 3111, 3013, 2563, 2625. Each sample was, moreover, supplied in the three thicknesses. The results are tabulated in the following manner: for glass of 1 mm., $\lambda = 309$ to 384 $\mu\mu$; for glass of 10 mm., $\lambda = 309$ to 434 $\mu\mu$; for glass of 100 mm., $\lambda = 309$ to 480 $\mu\mu$. A full account of the method, apparatus and theory is given, as well as an introductory bibliography.

Optical Properties of Vitreous Silica.†—J. W. Gifford and W. A. Shenstone point out that the properties of vitreous silica suggest that it is not unlikely to play an important part in optical work. Its composition is definite, that is to say, it is not liable to those minute variations which make it impossible to produce with certainty two meltings of glass, which exhibit no sensible difference in their optical properties when tested by a first-rate spectrometer. Hardly any corrosive fumes, except those of fluorine and hydrogen fluoride, attack silica, and it is indifferent to most ordinary solvents. It is as transparent to ultra-violet radiations as quartz, but is not doubly refracting like that substance. Although it is a little difficult to prepare vitreous silica in large masses, this difficulty can be surmounted, and the supply of the substance is not limited like that of fluorite. In short, vitreous silica places at our disposal a really standard glass. Its refractive index is low, and its dispersive power is sensibly greater than that of quartz.

The authors describe the method of manufacture, which involved a

* Zeit. f. Instrumentenkunde, xxiii., July 1903, pp. 197 207; August 1903 pp. 229–39 (7 figs.).

† Proc. Roy. Soc., lxxiii., No. 491, pp. 201–8 (3 figs.).

prolonged use of the oxy-hydrogen gas furnace, and the satisfactory results from the testing of a series of prisms. They give tables of :

1. The refractive indices of vitreous silica.

2. The focal lengths in metres of a compound lens of fluorite and vitreous silica, achromatised for wave-lengths 7950 and 1852.

3. Partial and proportional dispersions of fluorite and vitreous silica.

The second of these is quoted below *in extenso*.

Radii :—R = 0·38733; S = 0·20351; R′ = S; S′ = ∞.
R, S, R′, S′ refer to the surfaces of the two lenses.

Wave-length.	Focal Length.	Wave-length.	Focal Length.	Wave-length.	Focal Length.
7950	1·00000	3962 H′	0·99743	2194	0·99120
7682 A′	1·00010	3611	0·99653	2144	0·99151
7066 B′	1·00045	3303	0·99558	2099	0·99174
6563 C	1·00070	3054	0·99409	2062	0·99205
5893 D	1·00086	2749	0·99250	2024	0·99258
5607	1·00059	2573	0·99143	1988	0·99360
5270 E	1·00017	2446	0 99054	1933	0·99490
4861 F	0·99983	2313	0·99055	1852	1·00000
4341 G′	0·99874	2265	0·99078		

Theories of the Resolving Power of a Microscope.*—Geometrical optics in its relation to instruments has, says R. T. G.,† been studied to great advantage abroad ; we in England have of recent years somewhat neglected the subject, with the result that only a small share in the recent advance in lens construction has been ours. The books and papers under review tell us of the advance.

It was in 1878, in his report on the London International Exhibition of Scientific Apparatus, that Prof. Abbe first directed attention to the fact that the further perfection of the Microscope as an optical instrument depended on the advance of the art of glass making. With the glasses then at their disposal it was not possible for opticians to get rid of the secondary spectrum of their object glasses ; while a glass could be made achromatic for two wave-lengths, the differences in the relative dispersion of the two ends of the spectrum were such that there was an outstanding amount of colour which prevented the attainment of the highest perfection of the image. It was to this fact that the establishment of the now celebrated firm of Schott and Company was due, and the results of Abbe's own work on Microscope lenses are summed up in the first volume of his collected papers, which has recently appeared.

* 'Gesammelte Abhandlungen.' Von Ernst Abbe.
'Das Zeisswerk und die Karl Zeiss-Stiftung in Jena.'
'Zur Theorie der Mikroskopischen Bild-erzeugung.' By Victor Grunberg.
'The Helmholtz Theory of the Microscope.' By J. W. Gordon.
'The Theory of Optical Images.' By Lord Rayleigh (Journ. R.M.S., 1903).

† Nature, lxix. (1904) pp. 497–8.

The well-known paper, *Contributions to the Theory of the Microscope and of Microscopic Perception*, which forms the basis of his work, is here reprinted, and it will be interesting to consider some of the points it raises.

But first let us contrast what is now possible so far as achromatic correction is concerned with what was possible, say twenty years ago. In those days the ordinary flint and crown glasses only were available. In the case of a telescope object glass with a focal length of one metre for the D line, the variation in focal length will, with such glasses, amount to 1·4 mm. for A′ and 2·2 mm. for G′. In an object glass using modern glass, such as that designed by Mr. H. D. Taylor, these errors are reduced respectively to −0·1 mm. and +0·3 mm.

These figures are enough to show how much the optician owes to the art of the glass maker.

Turning now to some theoretical matters connected with the microscope which are dealt with by Abbe in his papers, let us consider first the term "numerical aperture" in its relation to the resolving power of the instrument. We owe to Abbe the introduction of this term, and the realisation of its importance as defining, in certain circumstances, the resolving power of the instrument. By numerical aperture is meant the value of the quantity $\mu \sin \alpha$, where μ is the refractive index of the medium in which the object is placed, 2α the vertical angle of the cone subtended at the object glass by the point in which the axis of the instrument meets the object. Let us suppose, then, that an object is on the stage viewed by transmitted light, and to simplify matters let us suppose the source of light at some distance.

Then, according to Abbe* and his followers, in considering the image formed in the focal plane of the eye-piece, we are not to start from the object as a self-luminous source and consider where the image of such a source would be if formed by the laws of geometrical optics; we are to start from the source itself, to consider its image formed in the focal plane of the object-glass, and to treat this image as a self-luminous source of light in the microscope tube from which arises the image we see.

If the object be small, the focal image will be modified by diffraction due to the object, and according to the views enunciated in the paper before us, it is on the nature of the diffraction images and the number of them which are formed that the definition depends.

We will return later to the question whether it is necessary thus to consider our problem.

At present let us develop it and examine whether it affords us a satisfactory solution of the problem of resolving power.

Suppose, now, the Microscope has been focussed on some object on the stage and then this object has been removed; the parallel rays from the source are brought to a focus in the focal plane of the object glass, forming there a circular patch of light; rays diverge from each point of this, and reaching the eye produce the sensation of a uniform luminous field.

Now let the field in the focal plane be limited by diaphragms

* It was stated recently by Dr. Czapski (Proc. R.M.S. August, 1903, p. 569) that it would be a mistake to suppose that Prof. Abbe had merely given a grating theory of the Microscope; he has treated the matter more fully.

pierced with a series of small apertures. The distribution of light in the focal plane of the eye lens, the view plane, will no longer be uniform ; we shall see the diffraction pattern formed there by the apertures.

If, for example, there be but one aperture, a single narrow slit, the field will still be uniform ; light diverges from the slit uniformly in all directions, and no structure is seen.

If we have a number of equidistant slits the view plane will be crossed by a series of equidistant dark and light bars. The distance between these bars and the distribution of light between them will depend on the distance between the slits of the diaphragm and the distribution of luminosity among the slits. If this be known, the distribution of light in the view plane can be calculated. If, for example, the distance between the slits be doubled, the distance between the maxima in the view plane will be halved, that is to say, the number of bright bars in a given interval will be doubled. The distribution in the view plane depends on that in the focal plane, and can be calculated from it ; this is quite certain.

But now, instead of producing a variable distribution in the focal plane of the object glass by means of diaphragms, we can do it by means of the diffraction effects of small objects on the stage.

Thus, if we put on the stage a grating consisting of a series of equidistant spaces, and if e be the grating distance, then, taking homogeneous light, a series of narrow bands of light, the diffraction images of the source, will be produced in the focal plane with darkness between them ; the central image will be on the axis, and if $\theta_1\ \theta_2\ \ldots$ be the angular distances between the images, then $\sin\theta_1 = \lambda/e$, $\sin\theta_2 = 2\lambda/e$, etc.

It may be shown that the image in the view plane produced by this series of diffracted images is the ordinary geometrical image of the grating. It should be observed that in this proof there is no discussion of the distribution of light in the interspaces between the maxima, and it is on this distribution that the question of resolving power depends. It is clear, of course, that if we modify the number of spectra in the focal plane we modify the image, and this is done in an ingenious way in some of the experiments arranged by Prof. Abbe's pupils to illustrate the theory.

If we cut out all but the central image the view field is uniform, no structure is visible ; if we allow the first image on either side of the central one to become effective, the bands appear in the field in their proper positions, and so on. It is said to be the fundamental result of Abbe's theory that the object, the grating, can be fully resolved if one diffraction image is formed on either side of the central one. It is clear that in this case there will be variations of intensity in the view plane ; we shall see later what they amount to.

Now the number of spectra is limited by the fact that some of the diffracted light may be so obliquely diffracted as not to enter the object glass. If $2a$ be the angular aperture of the object glass measured from the axial point of the stage, then the nth diffracted image will not appear if $\sin\theta_n$ is $>\sin a$, but $\sin\theta_n = n\lambda/e$.

Hence, for the nth image to be excluded, $n\lambda/e$ must be greater than $\sin a$, but according to Abbe, for resolution the first diffracted image must appear, and hence resolution is just possible if λ/e is equal to $\sin\theta$.

It has been assumed that air is the medium on either side of the object glass ; if on the object side we have a medium of refractive index μ, then it is easy to show that we must replace $\sin\theta$ by $\mu\sin\theta$, and the condition of resolution is that e should be equal to $\lambda/\mu\sin\theta$, or introducing the term numerical aperture for the quantity $\mu\sin\theta$, we have the result that a grating is resolvable if the space between the lines is not less than the result found by dividing the wave-length of light by the numerical aperature.

Now, while the truth of this result can in certain cases be established, the reasoning given in the books under consideration is insufficient to prove it.

In order to decide if the grating can be resolved we must establish the law of variation of intensity in the view plane, and then consider whether these variations are such that they can be detected by the eye. This has been done by Lord Rayleigh. The images formed in a Microscope are, like all other images, produced by interference ; in considering resolving power we have to consider diffraction effects, it is true, but the diffraction which concerns us mainly is that due to the aperture of the object glass, and only indirectly that due to the object viewed.

Neither is it necessary, if we know completely the distribution of the light over the stage, to go back to the source in our consideration of the problem ; having given the distribution over the stage both in amplitude and phase, we are potentially able to determine that in the view plane without reference to the source. Difficulties of calculation may stop us, it is true, but that is another matter.

Let us take, again, the case of a grating illuminated by plane waves, their plane being parallel to that of the grating ; we have to consider the effect due to a series of equidistant lines of light ; these differ, however, from a series of independent equidistant linear sources in that, with the grating, the phases of the various sources are the same ; we have therefore to remember that interference will take place between the light from the different lines, while with a series of independent lines there is no relation between the phases ; we can calculate the intensity due to each source separately, and superpose the whole.

Lord Rayleigh's solution of the problem, which is presented when a narrow double line in a spectrum is viewed through a telescope, or when the attempt is made to resolve two close double stars, is better known than his equally valid solution of the grating problem, and as it is simpler it will be useful to indicate it first.

The intensity in the view plane for a single linear source, assuming for the moment that we are dealing with a telescope with a rectangular aperture, is given by a certain curve. If we assume a second independent source parallel to the first we get a similar curve alongside the first. The resultant intensity is found by adding the corresponding ordinates of the two curves, and the lines will appear as double when the drop in the resultant intensity curve is sufficient to be detected by the eye.

Lord Rayleigh suggested that in his case the drop would be just distinguishable when the maximum of intensity due to the second curve was superposed on the first minimum due to the first, and experiment has borne this out. In this case the two halves of the aperture send light in opposite phases to the first minimum, and the angular deflection of the minimum is the angle subtended by the wave-length of light at the distance of the breadth of the aperture. Two lines which subtend a greater angle than this can be resolved.

Similar methods were applied by Lord Rayleigh in 1896 to the Microscope, and additional results have been given in his recent communication to the Royal Microscopical Society, which follows Mr. Gordon's interesting paper on Helmholtz's theory of resolving power in the *Journal* of the Society. In his paper Mr. Gordon discusses in detail Helmholtz's theory, and points out how far it is from fully explaining all the difficulties of Microscopic vision.

In Lord Rayleigh's earlier paper he deals with (1) two independent linear sources viewed through a Microscope, and shows that they can be resolved if the distance between them is half that given by Abbe's theory; (2) two sources which are always in the same phase; in this case resolution is impossible if the distance is that given by the theory.

If, instead of having *two* sources, either cophasal or independent, we have a long series, the problem is more complex, but the method is the same. An expression is found for the variations of intensity in the view plane, and the question is considered whether or no these variations are sufficient to be noticed by the eye.

In the paper the question of the visibility of a dark bar on a uniform field is dealt with, and here again a distinction must be drawn between the case in which the field is self-luminous and that in which it is due to a distant source. In the latter case it appears that the image of the bar would be marked by a perceptible darkening across the field, even when the breadth of the bar was but $\frac{1}{3\frac{1}{2}}$ of that given by Abbe's theory, though the breadth of this shadow would not be a measure of that of the bar; in the former case the fall in intensity over the geometrical image is only one-half of what it is in the latter. Moreover, we are certain to arrive at erroneous consequences if we apply results obtained from the case of a grating of a large number of parallel slits to a case such as that of a single small aperture through which light is coming or a single small obstacle obstructing the light; the diffraction pattern due to such an obstacle is entirely different from that due to a grating, and the conditions of resolution will be different also.

It appears, then, that while Abbe's theory of Microscopic vision is undoubtedly correct in that a small object or objects on the stage produce diffraction patterns in the focal plane of the object glass, and the illumination in the view plane can be inferred from these diffraction images, still this method of regarding the question is not the only possible one, neither is it necessary to go back to the original source if we know the distribution in the object plane. By proceeding, however, in the way indicated by Lord Rayleigh, we can evaluate the distribution of intensity in the view plane, at any rate in certain cases, and obtain thus a numerical estimate of the resolvability.

(6) Miscellaneous.

Gage's Microscopy.*—S. H. Gage's *The Microscope: an Introduction to Microscopic Methods and to Histology* has recently passed into the ninth edition, and while retaining all its previous excellent features and well-known characteristics it has been revised throughout, and important changes have been effected in certain parts, e.g. those relating to serial sections and to micro-chemistry. The chapter on the Projection Microscope has been entirely re-written and much more fully illustrated.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

New Culture Medium made with Helix Pomatia.‡—Della Rovere has employed the following culture medium for the purpose of determining whether certain micro-organisms retained longer on it their virulence and reproductive power, than when grown on horse-liver or horse-flesh bouillon, a medium considered the best for their growth. 300 grm. snails, freed from their shells and finely minced, are set in 1000 c.cm. of water, and to this are added 10 grm. Witte's peptone and 5 grm. sodium chloride. From this bouillon or agar is prepared. The author concludes that such bouillon is the most suitable for *B. coli*, *B. icteroides* and *B. murisepticus*. He found that the virulence of *B. coli* remained for a long time, and that the reproductive power of *B. coli*, *B. icteroides*, *B. murisepticus* and *B. anthracis* remained for a longer time than in cultures in horse-flesh bouillon. He holds that the characteristic of his bouillon is due to the fact that it contains an important quantity of grape sugar developed through a natural reduction of glycogen.

Bacterial Diagnosis of Typhoid by means of the v. Drigalski-Conradi Medium and Agglutination.§—B. Lipschütz, from the results of an experimental research on this subject, comes to the following conclusions:

1. The v. Drigalski-Conradi medium simplifies the cultivation of typhoid bacilli from fæces, urine, etc., but the characteristic behaviour of the typhoid bacillus on this medium, and the identification of the suspected colonies by means of agglutination, do not furnish a certain guarantee for the accuracy of the bacterial diagnosis, and therefore a wider cultural investigation is advisable.

2. It is desirable in the investigation of suspected colonies by means of agglutination to employ the so-called 'end-dilution' (*Wassermann*). If there is suspicion of para-typhoid (or dysentery) the

* Comstock Publishing Company, Ithaca, New York, 1904, vi. and 299 pp., 230 figs.

† 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.

‡ Gazetta degli Ospedali e della Cliniche, 1904, No. 139. See also Centralbl. Bakt., Orig., xxxiv. (1904) p. 562.

§ Centralbl. Bakt., 1te Abt., xxxv. (1904) pp. 798–811.

agglutination of the colonies in question must be investigated with the specific serum of this disease.

3. Agglutinin and agglutinating substances are not bodies of constant composition and nature ; they appear rather as biological products to differ within certain limits, and this renders desirable the special judging of agglutination results in each case.

4. The immobilising in the agglutination of typhoid or coli bacilli, depends on the nature of the specific serum as well as on that of the employed bacteria.

Capsule Formation by Diplococcus Pneumoniæ in Culture.* — M. H. Gordon demonstrates the capsules by the following procedure :

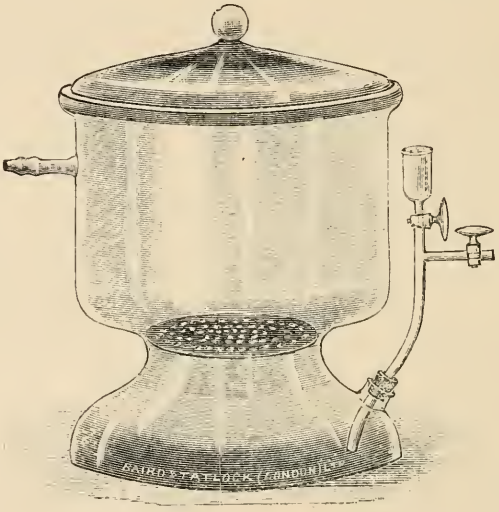

Fig. 61.

Boil for 30 minutes, 1 lb. of minced beef in 1 litre of distilled water. Filter and add 12 p.c. of *yellow gold table* gelatin, 1 p.c. pepton and ½ p.c. salt. Make faintly alkaline to litmus paper with liquor potassæ (B.P.). Add white of egg, and steam for 30 minutes. Filter, pour into tubes, and sterilise in the steamer for 30 minutes on two successive days.

A drop of the fluid gelatin culture, after incubation at 37°, is removed with a loop and spread over a cover-glass, dried over the flame, allowed to stand in alcohol for a minute, and then without drying transferred, film downwards, to a watch-glass containing Ziehl-Neelsen's carbol-fuchsin. After staining for 1 to 3 minutes the cover-glass is dipped lightly in water. The moisture is then removed from the upper side, and the preparation is then examined in water.

Permanent specimens showing the capsules are difficult to obtain by

* Brit. Med. Journ. (1904) i. p. 659 (1 fig.).

this method, unless the film be deeply stained and washed very slightly in water.

New Anærobic Apparatus.*—A. R. Laing has devised an apparatus which consists of a glass jar (fig. 61) with a constriction near the base, and surmounted with a closely fitting lid. Near the top is a short tube for connection with an exhaust pump. Below the constriction is another opening, through which passes a glass tube kept tight by means of a rubber cork. The upper end of the tube has two arms, one having a reservoir for caustic potash, the other leading to the hydrogen supply. Both arms are furnished with stop-cocks.

To work the apparatus, a sufficiency of pyrogallic acid is first put into the reservoir below the constriction; upon the latter is placed a perforated porcelain plate, on which the cultivation vessels rest. The glass lid is smeared with vaselin and pressed firmly down, and the gap between the lid and the jar filled with paraffin soap. The air is then exhausted and the apparatus filled with hydrogen, this process being repeated six times to ensure a complete hydrogen atmosphere. A little of the hydrogen is removed by means of the exhaust, in order to have slight negative pressure within the vessel. Potash solution is then run in.

W.J.S.—**Collecting and preparing Diatoms.** *English Mechanic*, lxxix. (1904) p. 84.

(2) Preparing Objects.

Preparing Small Dried Insects for Microscopical Examination.† G. Enderlein claims good results from the following treatment of such dried material. The insect is placed carefully in a mixture of 1 part moderately strong caustic potash solution and 8 to 10 parts water. If winged, these appendages are best first removed. If, however, the insect is a very delicate one, the wings may be left on, and a weaker solution of the alkali employed. According to the size and delicacy of the object, it remains in this solution from 10 minutes to 1 hour, until indeed the natural form has been regained. It is then placed in water, being carefully watched the while, lest undue swelling take place. The larger air-bubbles are now removed with a fine brush, and the object again placed for a short time in dilute caustic potash, transferred to water, and then taken gradually into 96 p.c. alcohol, when the remaining air-bubbles are removed as before. In 96 p.c. alcohol it can be kept. If a microscopic preparation is desired, as much as possible of the body contents are removed by pressure with a fine brush. The object is then arranged suitably, passed through absolute alcohol and cedar oil, and mounted in Canada balsam. If one is dealing with very thin chitinous structures, e.g. delicate abdominal walls, it is well to mount the specimen in glycerin directly after water.

The author makes permanent glycerin preparations by fixing the cover-glass, on which no glycerin should be allowed to flow over, to the slide by means of a ring of wax. This being done, Canada balsam or

* Lancet, i. (1904) p. 515 (1 fig.).

† Zool. Anz., xxvii. (1904) pp 479–80.

other cement is applied to the edges. In many cases it is worth while to preserve a dry wing between cover and slide, a simple ring of wax being sufficient. Except with larger and more markedly chitinous insects, such as beetles, heating of the caustic potash solution is not advised.

Demonstrating the Structure of Corpus luteum of Sheep.*—F. H. A. Marshall placed freshly excised uterus and ovaries in 10 p.c. formalin, and after six days at least pieces of the uterine wall were excised. These were then washed in water for about twelve hours, and afterwards passed through alcohols of increasing strength. Sections, made by the paraffin method, were stained with hæmatoxylin and iron-alum, hæmatoxylin and eosin, anilin-blue and borax-carmin. The ovaries were generally treated in the same way, but sometimes were fixed with sublimate.

Demonstrating Presence of Seed-Fungus in Darnel.†—E. M. Freeman placed the grains in a germinating chamber, and dissected out the embryos or seedlings at various stages. The fixatives used were Flemming's fluid and chromic acid (1 p.c. and ½ p.c.). Anilin-water safranin and Heidenhain's hæmatoxylin were found to be the most effective stains. In some cases chloral hydrate, potassium hydrate, and lactic acid were used. For demonstrating the starchy endosperm the sections were made with an ether-freezing microtome.

Fixation of Infusoria.‡—P. de Beauchamp recommends the following procedure for fixing in the extended condition contractile animalcules, especially Vorticellæ. The principal feature of the method consists in slowly anæsthetising the animals, placed between a slide and cover-glass. The use of the cover-glass prevents a too hasty action of the reagent and avoids diffusion currents. The preparation is supported on a couple of wedges placed inside a glass vessel containing a little alcohol. The duration of the anæsthesia varies from ¼ to ¾ of an hour, according to circumstances. The animals are then fixed by running a drop of the fixative under the cover-glass. The author used only saturated solution of sublimate for fixing, which requires copious and prolonged washing in order to get rid of it, but suggests that osmic acid would act equally well. The preparations may now be stained say with picrocarmin, and afterwards mounted in glycerin.

Demonstrating the Tubular Reticulum in the Cytoplasm of nervous and epithelial Cells of the Earthworm.§—S. Ramón y Cajal, after calling attention to the existence of a tubuliform apparatus in the cytoplasm of the nervous and epithelial cells of the earthworm, gives the following method for demonstrating the reticulum. The pieces of earthworm, which should not exceed 3 to 4 mm. in thickness, are incubated for two to five days at 35° to 40°C. in 1·5 p.c. solution of silver nitrate in distilled water. In certain cases stronger or weaker solutions may be used with advantage, but it is always advisable to employ a large quantity. When removed from the silver solution, the pieces should

* Phil. Trans., cxcvi. (1904) p. 55. † Tom. cit., pp. 3–4.
‡ Bull. Soc. Zool. de France, xxix. (1904) pp. 26–7.
§ Bol. Soc. Española Hist. Nat. iii. (1903) pp. 395–8 (2 figs.).

be washed for a few seconds in distilled water, and then transferred to the following reducing medium :—Pyrogallic acid 1 grm. ; formalin 5 to 10 grm ; distilled water 100 grm., for 24 hours. After a rapid wash the pieces are placed at first in 36 p.c. alcohol and then in absolute, previous to imbedding in celloidin or paraffin.

The author * adopts the same procedure for staining nerve-fibrils.

Preparing Planarian Worms.†—G. Marpmann places the worm on a slide by means of a pipette, and then narcotises it with 0·5 p.c. eucain. When it no longer responds to the stimulus of a needle, it is killed by pouring over it the following solution :—Sublimate 1 ; salt 1 ; glacial acetic acid 5 ; water 100. The specimen may be stained with picro-carmin and then cleaned up in pure carbolic acid, the latter being removed by means of xylol previous to mounting in balsam. These worms are well adapted for showing nerve ramifications when stained by appropriate methods.

Demonstrating the Structure of Cardiac Fibres.‡—In his researches on the structure and development of the cardiac fibres in the Vertebrata, F. Marceau fixed the tissue in acetic acid sublimate, using chiefly Zenker's fluid. After from 4 to 24 hours, according to the size of the heart or of the pieces taken, the tissue was transferred to alcohols (30, 50, 70, 80 p.c.) for 2 to 6 hours, and then paraffin sections made. The sections were usually stained with iron hæmatoxylin, and afterwards contrast-stained with eosin or Bordeaux red. It was found advisable to mordant the sections for 12 to 24 hours in iron alum. In reference to the after-staining with eosin, the writer notes that it is better to use a weak solution and employ it when the iron staining is halfway through, and finish off the iron staining afterwards.

Heidenhain's hæmatoxylin and vanadate of ammonia method was also used, but only in a few instances, as there are many difficulties connected with it. The hæmatoxylin and chloride of vanadium method recommended by Wolters was found to be far more easy ; the results were good, but did not differ materially from those of iron hæmatoxylin.

In order to obtain good preparations of heart-muscle of birds and mammals, it was found better not to fix the material until three-quarters of an hour had elapsed after the animal was killed.

For teasing out the fibres 20 p.c. nitric acid was far superior to caustic potash or chromic acid ; the fibres were easily dissociated, and when washed in water, alcohol and glycerin would make excellent permanent preparations.

(3) Cutting, including Imbedding and Microtomes.

New Method for Sticking Celloidin Sections to the Slide.§—R. Fischel recommends linimentum exsiccans for sticking celloidin sections to the slide. This adhesive is composed of 5 parts tragacanth, 2 parts glycerin, to 100 parts distilled water, and is put up in collapsible tubes.

* C. R. Soc. Biol. de Paris, lv. (1903) pp. 1565-8.
† Zeitschr. angew. Mikrosk., ix. (1903) pp. 328-9.
‡ Ann. Sci. Nat. Zool., xix. (1904) pp. 235-9.
§ Zeitsch. wiss. Mikr., xx. (1904) pp. 288-91.

A piece about the size of a pea is placed between two slides ; by squeezing these together two thin even films are produced. Upon the films are arranged the celloidin sections. Upon these are placed several folds of blotting paper, and firm but gentle pressure applied.

Instead of the foregoing procedure, some of the liniment may be mixed with distilled water to a syrupy consistence, and a film made on the slide with a camel's-hair brush. In any case, it is always necessary to make the smears immediately before arranging the sections, as the linimentum dries very quickly.

The slides covered with sections are then placed in a vessel containing 96 p.c. alcohol for a quarter to half an hour before they are exposed to any after-treatment, such as staining or mounting.

If it be desired to remove the celloidin, the slides are immersed in a solution of equal parts of alcohol and ether for half an hour or more, and then transferred to 96 p.c. alcohol.

Method for Sticking Paraffin Sections to the Slide.*—H. Michaelis places the section in warm water (45°) and removes it thereform on a slide. After removing the superfluous water with blotting-paper, a piece of smooth writing-paper is pressed firmly on the section. On carefully lifting the paper the section is removed along with it. The paper is then cut off all round the section, care being taken not to have any piece projecting beyond the edge of the section. A slide is now covered with a layer of glycerin albumen, and upon this the section is laid, paper side uppermost. After pressing the section firmly down, the albumen is coagulated in the flame. When the paraffin is dissolved out in xylol the paper falls off.

(4) Staining and Injecting.

New Method of Staining with Iron Hæmatoxylin.†—A. Paine, in a communication made to the Pathological Society of London, recommended the use of iron and hæmatoxylin in *one* solution, not in separate and consecutive solutions as in the methods of Heidenhain and Benda, and without subsequent decolorisation. Such a solution he prepares by adding in certain proportions a 5 p.c. solution of hæmatoxylin (Grübler) in absolute alcohol, to a weak solution of perchloride of iron, e.g. 1 to 1000 of the B.P. liq. ferri perchlor. fort. Convenient proportions were found to be 5 to 10 drops of the former to 10 c.cm. of the latter solution. This stain can be used after alcohol, mercury or bichromate fixation, but the best results followed fixation in 3 p.c. potassium bichromate and 5 p.c. glacial acetic acid added at the time of using.

Staining of Bacteria difficult to Stain (Glanders and Typhoid Bacilli, Gonococci, etc.) in Sections of Skin and other Organs.‡—K. Zieler recommends for sections, to be stained with polychrome methylen-blue, a preliminary staining with acid orcëin solution. By

* Centralbl. allgem. Pathol. au. pathol. Anat., xiv. (1903) pp. 264–5.

† Lancet, i. (1904) pp. 435–6.

‡ Centralb. allg. Path., xiv. (1903) p. 561. See also Centralbl. Bakt., xxxiv. (1904) p. 462.

this a considerable alcoholic firmness is obtained, and also a differentiation of the nuclear and protoplasmic structure, and a staining of the elastic fibres. Glanders bacilli appear dark on an unstained ground, and typhoid bacilli intensely red-violet. The proceeding is as follows: (1) Fixing and hardening, best in Müller-formalin, and embedding in paraffin or celloidin. (2) Sections are stained overnight in orcëin D (Grübler), 0·1; officinal nitric acid, 2·0; 70 p.c. alcohol, 100·0. (3) A short washing in 70 p.c. alcohol. (4) Water. (5) Staining in polychrome methylen-blue for 10 minutes to 2 hours. (6) Distilled water. (7) Differentiation in glycerin-ether mixture, 1; water, 2 to 5, until the sections appear bright blue. (8) Distilled water, 70 p.c. alcohol, absolute alcohol, xylol, balsam.

Is there a "Vital" Staining?—Under this heading R. Krause* discusses the question as to whether vital staining is really possible, meaning thereby a staining of the cell organs while the cells themselves suffer no loss of function, or whether such staining is not merely staining *intra vitam*, and associated with loss of function and approaching death of the stained tissue elements. The author inclines to the former supposition from the results of observations on the ciliated cells lining the vestibule of the labyrinth in *Petromyzon*, their function being of course observable microscopically. He injected into the heart or posterior cardinal vein of the living animal a few cubic centimetres of a 2 p.c. solution of crystallised, chemically pure methylen-blue (Höchst) in normal saline solution. At the end of the injection the auditory capsule was laid bare, and then by means of a good knife horizontal or vertical sections were cut. These were studied in normal saline solution. The cells at first appeared unaffected, but soon their constituent parts underwent a differential staining, the continued unchanged movement of the cilia contra-indicating any impairment in the functional activity of the cells.

Staining Trypanosoma.†—W. E. Musgrave and M. T. Clegg approve of Woolley's method of staining Trypanosoma. The blood films are fixed for 10 minutes in absolute alcohol, and then stained with the following solution:—(A) Eosin, 1 grm.; distilled water, 1000 c.cm. (B) Polychrome methylen-blue, Unna's formula. (C) Methylen-blue, 1 grm.; distilled water, 100 c.cm. (D) Solution B, 2 parts; solution C, 1 part. 1 c.cm. of A is mixed with 4·5 c.cm. of D. The preparations are stained for 20 to 40 minutes, are then washed, and afterwards stained with solution A for 2 to 5 seconds.

Method for Intra-vitam Staining of the Protoplasmic Granules of the Cornea.‡—G. Colombo makes a saturated solution of Bismarck brown in 92 p.c. sodium chloride. This is filtered while hot and afterwards when cold. The solution is sterilised in a water bath and then dropped into the conjunctival sac of a frog. About 5 drops are instilled four times a day. In 3 or 4 days the cornea becomes yellowish brown. A piece of the excised membrane may now be examined in physiological salt solution.

* Anat. Anzeig., xxiv. (1904) pp. 400–3.
† Publications of Dep. Int. Bur. Govt. Lab., Manila, 1903.
‡ Zeitschr. wiss. Mikrosk., xx. (1904) pp. 282–8 (1 pl.).

In order to fix the pigment granules *in situ* the whole eye should be immersed for about eight hours in the following solution. Saturated solution of sublimate in 1 p.c. sodium chloride, 2 c.cm.; 1 p.c. solution of osmic acid, 2 c.cm.; 1 p.c. acetic acid, 1 c.cm. The eye is then transferred to Müller's fluid for 16 hours, after which the cornea is excised and washed in running water for 1 or 2 days. The material may then be dehydrated in absolute alcohol, and, having been cleared in origanum oil, examined on the flat, or sections may be made by the paraffin or celloidin methods.

Triple Staining of Vegetable Tissue.* — L. Petit stains sections of vegetable tissue with iron chloride and ferrocyanide of potash, whereby the cellulose and collenchyme are coloured blue. The cork and cuticula are stained with alkanna and woody tissue by means of an aqueous or alcoholic solution of iodine green. In this way a triple staining is obtained.

Vital Staining of Corethra plumicornis.†—W. Kolmer, after trying to stain the larvæ of *Corethra plumicornis* with methylen-blue but without success, hit on the following ingenious device. In the fluid containing the larvæ and the methylen-blue he placed a colony of *Stentor cæruleus*. The infusoria soon perished, and methylen-blue granules were freely deposited on their bodies. These were greedily eaten by the larvæ, the stain passing from the alimentary canal to other parts of their anatomy, so that the structure of the animals was easily observed.

New form of Section-Lifter.‡—S. E. Dowdy bends a piece of wire gauze to the shape of a funnel. A circular cover-glass is placed inside the hopper. After the funnel is immersed in the fluid the section is washed off into it. On raising the funnel, the section is left stranded on the cover-glass. The latter is then easily removed. By this procedure thin and delicate sections may be secured and mounted without risk of injury.

Dowdy, S. E.—**Thickness of cover-glasses.**
English Mechanic, lxxix. (1904) p. 81.

„ „ Ditto. *Tom. cit.*, p. 123.

F.R.M.S.—Ditto. *Tom. cit.*, p. 104.

Gribbon, W.—Ditto. *Tom. cit.*, p. 194.

Holmes, Edwin—Ditto. *Tom. cit.*, p. 104.

Mieter, Millie—Ditto. *Tom. cit.*, p. 123.

Treadle—Ditto. *Tom. cit.*, p. 240.

Verinder, A.—**Mechanical finger.**
English Mechanic, lxxix. (1904) pp. 88, 153 (1 fig.).
(See this Journal, 1879, pp. 951-3.)

Villagio—**Modern Mounting Methods—continued.**
English Mechanic, lxxix. (1904) pp. 13, 83, 149, 240; lxxviii. (1904) p. 534.

* Proc. Soc. Amis Sci. Nat. de Rouen, 1903.
† Biol. Centralbl., xxiv. (1904) pp. 221-3.
‡ Pharmaceut. Journ., lxxii. (1904) p. 263 (1 fig.).

(6) Miscellaneous.

Mounting Diatoms.*—J. G. R. Powell gives the following method for mounting filamentous diatoms so as to display them in that beauty of pattern which they lose by boiling. They are mounted between two thin covers, so that they can be examined either as transparent or opaque objects. The slips for this purpose are made of card, wood slips being more costly.

Cut 3 in. by 1 in. blanks, in one set punch $\frac{5}{8}$ in., in the other about $\frac{1}{2}$ in., and gum together. When thoroughly dry ring the hole with black sealing-wax varnish, and cement in a $\frac{5}{8}$ cover, ringing on a varnish cell of about $\frac{1}{2}$ in. These slips, with their cells, are best prepared at odd moments in advance. The filamentous diatoms are found as waving chocolate-coloured wisps in running streams, ditches, drains, and springs. They should be lifted carefully out into a small, wide-mouthed bottle with distilled water, and brought home with as little skake as possible. Transfer them gently to a saucer of distilled water, have ready some clean covers (say $\frac{9}{16}$ No. 2), each cover with a drop of distilled water on it. Cut off a tiny portion of the filament, and let it settle on a cover in the drop, removing the superfluous water when it has settled. Dry the covers thoroughly, and then burn them. Place these diatoms upward on a flat slip of platinum or a bit of very thin tin, and gently lower them into the flame of a Bunsen burner till all vegetable matter is destroyed. Now very lightly retouch one of the prepared cells with cement, and lay on the cover diatoms downward, sealing down after a few hours. This last is a ticklish job, as the cement has a tendency to run in and spoil the mount. The cement should be thick, and only just touched. Brown's cement is good for the first layers. Slides so mounted are glorious objects under incident light, one side being best for this purpose; and the other, on which the diatoms are in optical contact with the cover, is better for transmitted light. But this method obstructs the light for Lieberkuhn and paraboloid. The burnt cover may be mounted on a ring of Canada balsam or dammar in chloroform. These gums, separate or mixed, dry quickly, are not so liable to run in, and do not obstruct the light. If the diatoms on the cover are rather crowded, the cover may be fastened to a slip, diatoms upward, with a tiny drop of ordinary balsam, heated till not quite hard, and then the cover gently melted down. Then a tin ring of proper size can be cemented just outside it, and a $\frac{5}{8}$ or $\frac{3}{4}$ cover put on, One or two mounts of the burnt covers should be put up in the ordinary balsam method. Run a drop of spirit of turpentine on to the diatoms, followed by a tiny drop of ordinary balsam, and give them time to mix. Then lay the cover on the thin slip, balsam upwards, heat gently over say a benzoline lamp till the balsam when cool is not hard. Care is needed to avoid bubbles. Centre a glass slip with an ink dot, touch the other side with a very little fresh balsam, lay the cover balsam downward, and warm gently till the two balsams mix, and run under the whole cover. If the mounter has been successful, the cover when cool will stand rubbing, and no finishing is required. Label with plain inch

* English Mechanic, lxxix. (1904) p. 123.

squares of note paper, letting the writing run the long way of the slide. Card shoes require no labels, and can be stacked one on the other. Suitable cells may be cut of any depth from compo gas piping, and fastened with marine glue.

Beck's Safety Cedar Wood Oil-Bottle. — In shape this bottle (fig. 62) resembles a cone. The metal cap is fitted with a flexible wire looped at the end for holding a drop of the oil. The central tube is ground into the main bottle to form a good joint. The bottle is filled by removing the tube.

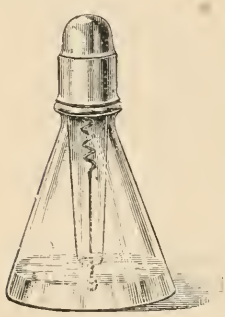

Fig. 62.

New Method for neutralising Carmin Injection-Masses.* — P. Konaschko states that he is able to get good injection masses by the following method. Ammonia carmin is added to gelatin solution in the ordinary way. The neutral reaction is determined, as usual, by the disappearance of the odour of ammonia, and then any trace of ammonia is detected by means of dialysing the mass through animal membrane. If the carmin mass will not diffuse through such a membrane, it will not permeate blood vessels. The membrane used is the septum cisternæ of the Frog. The membrane is taken up with a forceps, the blades of which are flat and perforated. On one side of the membrane is placed a drop of the warm mass, on the other side a piece of writing paper moistened with physiological salt solution. If the mass is sufficiently neutralised the paper remains unstained after one to two minutes. As it is possible to oversaturate the mass with acetic acid, which would precipitate the carmin, it is advisable after each addition of acid to examine the injection-mass under the Microscope.

Metallography, etc.

Microscopic Analysis of Metals.† — The metallographic work of Floris Osmond is so well known and so universally appreciated, that the appearance of a text-book by him on the microscopic analysis of metals will be welcomed by all who are interested in this aspect of the subject. The volume is edited, and presumably englished, by J. E. Stead, a fact which affords an additional recommendation. The style is most lucid, and the illustrations copious and excellent.

In the first part metallography is considered as a method of assay. Under this heading the author deals with the subject in three subdivisions : the anatomical, or the identification of individual constituents ; the biological, or the transformations which occur in the life of metals and alloys under the influence of heat and pressure ; the pathological, or

* Zeitschr. wiss. Mikrosk., xx. (1904) pp. 280–1.

† London, Charles Griffin & Co., Ltd., 1904, x. and 178 pp., with diagrams and 90 photographic illustrations.

the diseases of metals, represented by incipient fractures, slag inclusions, planes of weakness, and metals in which weakness has been produced by improper treatment.

The second part contains the general methods for the micrographic analysis of carbon steels. The first two chapters are devoted to the technique for obtaining suitable surfaces for microscopical examination. The next chapter describes the primary constituents of carbon steels, and the fourth is occupied with the micrographic identification of the various constituents. Then follows a detailed examination of selected steels, and the influence of annealing and quenching. The last chapter gives the author's theoretical and practical conclusions.

To this English edition are added two special appendices, one on the apparatus and the method for photographing the metallic surfaces, the other on the relative softness of austenite.

The volume is well got up, and the index sufficient.

Influence of Structure upon Strength under Sudden Stresses.§—R. Job gives an interesting instance of a driving-wheel tyre which fractured in service, while in apparent good condition as to size and extent of wear, and without any indications of internal flaws. Neither analysis nor tensile tests suggested any faults, but microscopic examination of an etched surface from a central section revealed that the structure was excessively coarse and open, thus proving that thorough working of the steel had ceased while the metal was at a high temperature. The material was therefore capable of but relatively small resistance under sudden stress.

Notes on the Structure of an Alloy which on Freezing Separates into Solid Solutions and a Eutectic.‖—J. E. Stead reproduces a large scale photograph used by Sir William Roberts-Austen in his "James Forrest" lecture, before the Institution of Civil Engineers, April 23, 1902, on the structure of phosphorus and iron compounds. Dark octahedral spines represent the unsaturated portions which first solidified and merged into the saturated or white parts surrounding the "land-locked" eutectic itself.

* Iron and Steel Metallurgist, vii., March 1904, pp. 324–5 (1 fig.).
† Tom. cit. pp. 258–9 (1 fig.).

reached. If continued further, a new line makes its appearance on the one side just as the line on the other is going to disappear. Now when we have a grating on the stage, it can be shown that in the image the diffraction patterns, due to neighbouring lines in the object, overlap, and interference occurs in such a way that as any image line loses in brightness from one object line, it gains in brightness in just the same proportion from the neighbouring object line. Thus the brightness as seen remains constant, and so far as appearance goes it is the same line which travels right across the field.

My intention this evening was only to bring some visual evidence in connection with the interesting matter which Prof. Everett has brought to our notice. I fear I have been explaining my experiment at too great length; if so, my excuse is that I was desirous to bring out not only the points of similarity, but also the points of dissimilarity which may result from creating difference of phase amongst the spectra by different means.

When the above note was written, I thought the experiment was an entirely new one, but I have since found that a somewhat similar one was made by Abbe, and referred to in a catalogue of optical measuring instruments issued by the firm of Carl Zeiss in 1893.

In Abbe's experiment the chief maximum is blocked out, and a phase difference created between the two maxima of the first order, and it is pointed out that, under these circumstances, the number of lines in the image is doubled, and that the striæ wander.

An Attachment for reading the lines in a direct-vision Spectroscope.

By E. B. Stringer, B.A., F.R.M.S.

This attachment (fig. 63) may, perhaps, be of interest to the Society, since an arrangement of the same kind might easily be made for a micro-spectroscope. It affords a more accurate means of reading the lines than the reflected scale which is generally used, whilst it is even more convenient, as the scale does not require independent illumination.

It consists of a light and rigid arc of phosphor bronze, of about 40 degrees, and $6\frac{1}{4}$ in. radius, cast in one piece with the broad ring by which it is firmly clamped to the body of the instrument. The arc carries a millimetre scale, which is divided in white upon a

black ground, so that it may easily be read in a dim light. A vernier reading to tenths is carried above the scale by the telescope itself, and immediately beneath the eye-piece is a magnifying lens, which follows the vernier in its movement, and through which the scale and vernier may be read with the greatest ease, without any change of the observer's position. The eye-piece has cross wires of the usual kind.

It will be seen that the radius of the arc is much greater than that of the table in most table spectroscopes, so that much finer readings are possible; also, that as the vernier is carried by the telescope itself instead of by a separate arm, there is less chance of inaccuracy.

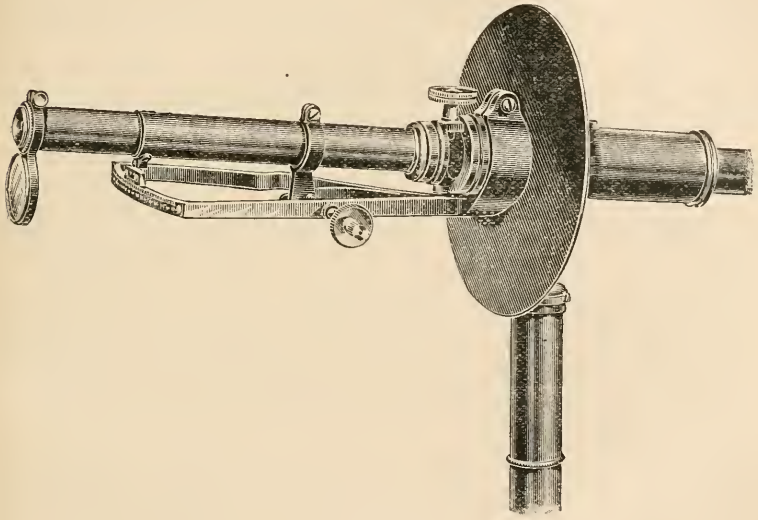

Fig. 63.

The telescope is carried round by means of a screw, which bears against a lug clipped upon the tube, and works through a small boss cast on one arm of the arc, the opposing spring being attached to the opposite arm and bearing on the opposite side of the lug, an arrangement which altogether relieves the telescope from any lateral strain. The screw has two milled heads; the smaller is rapidly rotated between the finger and thumb in order to move the telescope quickly through a large distance to another part of the spectrum, whilst the larger is for exact adjustment upon any line it may be desired to read. A blackened screen of sheet metal protects the eyes from direct light.

The instrument itself was made by Browning.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Draw-Tube Stop.† — S. Gelblum discusses the general conditions which a draw-tube stop should fulfil; he suggests the best practical means for arriving at the result. He considers that, inasmuch as the stop would have to be applicable to objectives of different lengths as well as to preparations of different thicknesses, it would be best to attach the stop to the objective itself. He recommends that the objective mount should be provided with a small cincture to which could be

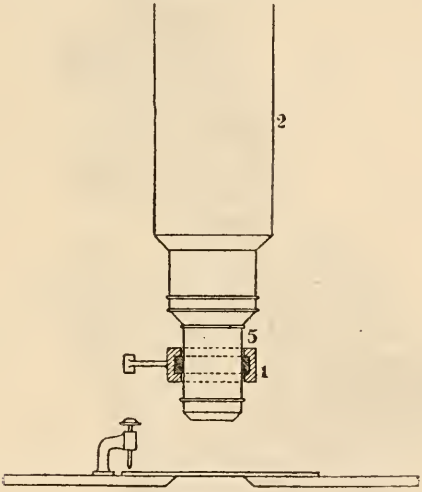

Fig. 64.

attached a removable band of brass (fig. 64). From this band a small arm terminating in a kind of button would project; this button would, on lowering the tube, come into contact with an adjustable button on the stage, and so prevent the tube from being lowered beyond safety distance. This stage button would, in reality, be the head of a screw working in a small right-angled arm attached to the stage. The screw could be adjusted at various heights, as required.

Beck's London Petrological Microscope.‡—This instrument (fig. 65) embodies the principle invented by Allan B. Dick,§ but numerous im-

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

† Zeitschr. wiss. Mikr., xx. (1903) pp. 129–32 (3 figs.).

‡ R. and J. Beck, Special Catalogue, 1904.

§ See this Journal, 1889, p. 432, fig. 57.

provements suggested by Dr. Flett, of H.M. Geological Survey and Museum, have been introduced. The base is heavier and more solid, while the general arrangement of the parts allows freer access to the

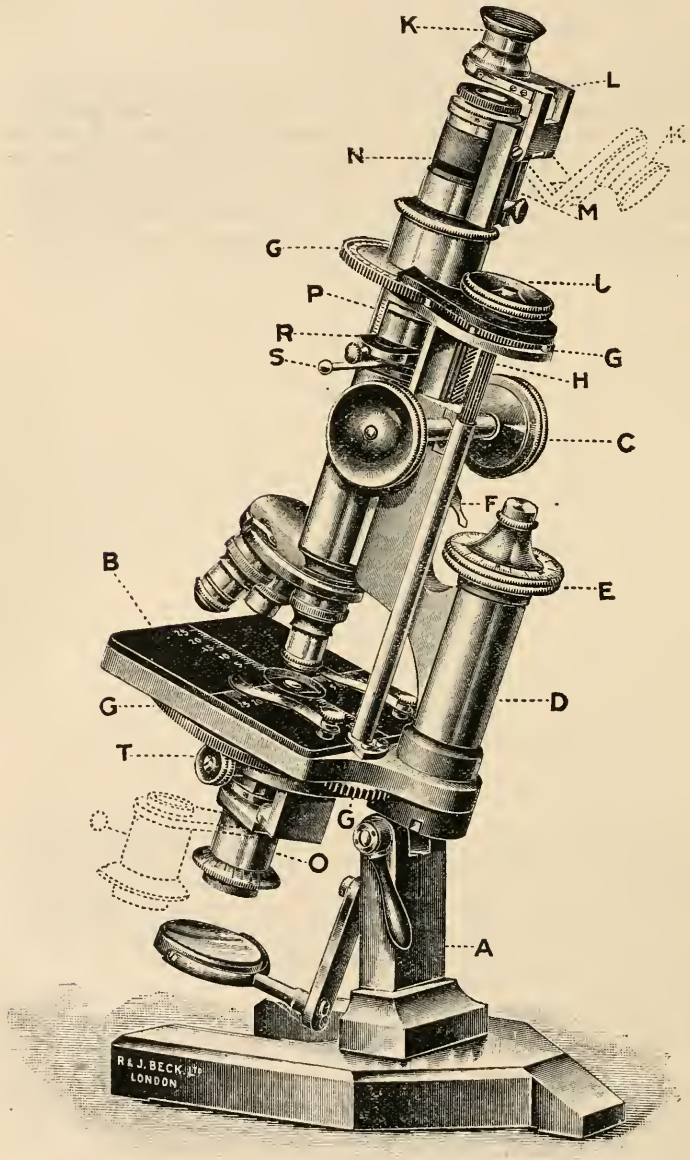

Fig. 65.

apparatus above and below the stage. The stage is covered with vulcanite and measures 4 by 4 in. The analyser and polariser are simultaneously rotated by means of cogwheels connected by a shaft H, so placed that it does not interfere with the use of the stage: there is a distance of 2 in. from the centre of the stage and the edge of the slow-motion pedestal, and the cogwheel shaft is 1·8 in. from the centre of the stage. The analyser K is carried on a swinging bracket L, and is usually supplied on a sliding dovetail M, so that its height can be adjusted to the eye-point of the Microscope, and the slide is provided with a clamp to fix the analyser in any position.

Within the body-tube is a slot P, through which an inner tube carrying a Bertrand lens can be slid up and down. Below the Bertrand lens is an iris diaphragm S.

Two kinds of condensers are supplied, the simpler form (fig. 66)

Fig. 67.

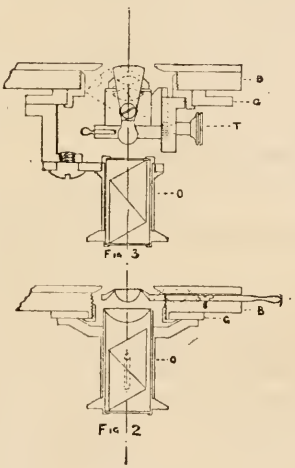

Fig. 66.

consisting of a couple of lenses placed above the polariser. The more complete form (fig. 67) consists of an achromatic and aplanatic condenser 1·0 N.A., or semi-apochromatic condenser 1·2 N.A., and has a pivoted top lens which can be swung out of the optic axis by means of a handle below the stage. An iris diaphragm is affixed to the condenser to reduce the aperture when necessary.

The top lenses of the eye-pieces have a special adjustment to enable either the micrometer or the cobwebs to be focussed. The principal cobweb of the crossed pair is marked by a V.

Zeiss' Rotary Projection Slide Carrier.* — E. Richter describes this apparatus, whose general nature is that of a square rotary drum with its axis transversely in the axis of the optical lantern. It is placed between the illuminating apparatus and the objective. When

* Zeitschr. wiss. Mikr., xx. (1903) pp. 132–7 (2 figs.).

the carrier is in its initial position the slide is placed horizontally in a sort of recess prepared for it at the top of the drum, which is then rotated backwards through 90°, so as to bring the slide in front of the condensing lens: it is now in the proper position for projection. A second slide is now put in at the top and the drum rotated through a further 90°. The first slide is now horizontally at the bottom of the drum, and automatically falls out on to a soft surface suitable for its reception; the second slide has now come into the projection position. The fourth side of the drum, viz. that opposite the slide displayed, is always clear and therefore offers no obstacle to the free passage of the light. A suitable arrangement of bars ensures that the apparatus shall stop accurately in the proper positions. The foot has been designed for attachment to the prismatic bar of an optical bench, but could, of course, be modified for other applications.

Bergmann—**Das Trichinoskop.** *Zeitschr. Fleisch u. Milchyg.*, xiii. (1903) p. 111.

Dowdy, S. E.—**Attachable Object-finder.**
English Mechanic, lxxix. (1904) p. 410 (1 fig.).

Hitchcock, R.—**The Ideal Projecting Microscope.**
Journ. New York. Micr. Soc., Annual of 1902, pp. 19–23.

Ives, F. E.—**Ein neues Binocularmikroskop.**
Centralzeitg. Opt. u. Mechan., xxiv. (1903) p. 38.

„ „ **Französische Mikroskop.** *Op. cit.*, xxiii. (1902) p. 98.

Köhler, A.—**Das Zeiss 'sche Trichinoskop.**
Zeitschr. Fleisch u. Milchyg., xiii. (1903) p. 107.

Leitz, E.—**Ein neues Mikroskopstativ und seine feine Einstellung.**
Zeitschr. Instrumentenk., xxiii. (1903) p. 79.

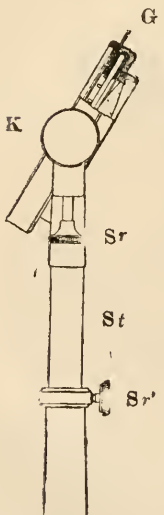

Fig. 68.

(2) Eye-pieces and Objectives.

Zeiss' Compound Lens with Iris Diaphragm.* This is shown, one-third full size, in fig. 68. The lens having an aperture of about 6 cm. with a focal length of about 12·5 cm., is secured in a ring, which carries an iris diaghragm of aperture 3 to 6 cm. The desired aperture is attained by means of the lever G. The ring hangs in a semi-circular sleeve, and is rotated by means of the knob K, about a horizontal axis capable of being clamped by the screw S*r*. The sleeve is screwed on to a rod S*t*, which a clamping screw S*r*^{1} grips inside a rider or cylindrical foot. The lens is primarily useful for illumination in photomicrography, in case light sources with enlarged surface, such as incandescent gas and petroleum light, are used; it can be applied to the upright or sloping Microscope. With transparent light it must be used in conjunction with a condenser. With reflected light it can be used either alone or with a vertical illuminator. The instrument can be also used for ordinary microscopic work.

* Deutsche Mechaniker-Zeitung, No. 3 (Feb. 1, 1904) p. 28 (1 fig.).

(3) Illuminating and other Apparatus.

Watson and Sons' New Objective Changer. — This apparatus (fig. 69) was exhibited at the May meeting, and is fully described in the Proceedings of the Society (see *ante*, p. 382).

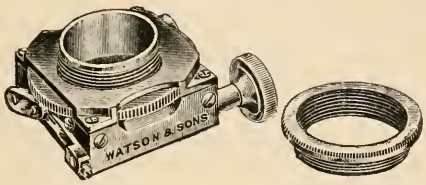

FIG. 69.

FEDOROW, E. VON—**Einige neue Hülfsapparate für das polarisationsmikroskop.**
Ann. Géol. et Minér. de Russie, iv. (1901), p. 142 ;
Zeitschr. Krystallogr., xxxvii. (1903) p. 413.

METCALF, M. M.—**An electric lamp for Microscope illumination.**
Science Notes, xv. (1902) p. 937.

PATTERSON, W. L.—**A new changing nose-piece.**
Journ. Applied Micros., vi. (1903) p. 2162.

SCHMIDT, H.—**Ueber projections-und Vergrösserungsapparate.**
Centralzeitg. Opt. u. Mechan., xxiii. (1902) pp. 253, 265.

(4) Photomicrography.

Photomicrography of Rock Sections.* — This is one of the most interesting applications of the Microscope, says W. Forgan, and one to which, so far as can be learned, not much attention has been paid in photographic literature. The sections of rocks are so varied in their character that to very few of them can the same mode of lighting and illumination be applied. It may be stated generally that granite and its three components, quartz, felspar and mica, form the basis of all rocks. Many other chemical substances assist in giving character and variation in a greater or less degree ; but the three components of granite are the ruling features in the whole of them. The chief use of the photography of rock sections may be said to be the production of lantern slides for teaching purposes. A good negative when reproduced in this way most materially assists in the illustration of a geological lecture. In fact, to a class, or in a lecture of a more popular form, such asssistance has now become indispensable. In the production of negatives from rock sections it is, with few exceptions, only necessary to use low magnifications. Only the other day a section of rock was asked to be photographed, having an elliptical shape, the major axis of which was over an inch in diameter. As no micro low-power objective covers more than $\frac{5}{8}$ in., recourse was had to a Zeiss Unar of $4\frac{1}{2}$-in. focus stopped down to f 11, and this gave a very fine sharp negative. The Microscope portion of the camera was removed, and a supplementary stage on an improvised suitable rigid easel was used to carry the section. Another method used for a different material

* Brit. Journ. Photography, li. (1904) p. 489.

may be mentioned, with which very fine results were obtained. If, for instance, one is required to take a negative of some grains of sand to show the character of any particular variety, the procedure may be as follows: Take an ordinary glass slip 3 in. by 1 in., give it a few strokes with virgin wax (white wax), hold the slip over a Bunsen burner, or spirit lamp, until the wax melts, which may then be spread with the finger, then sprinkle the sand over the melted wax, to which it adheres. The wax will cool at once. The slide is placed on the Microscope stage, with a piece of dead black paper behind it, and after focussing by means of a gas-jet or lamp, the illumination is made by burning a few inches of magnesium ribbon held behind the objective, and gently waved about. The objective used in such a case may be a 70 mm. by Zeiss, and a camera extension of about 18 in. A great number of rock sections, to enable them to be photographed well, require the use of polarised light to differentiate their structure, and many also as well the use of a depolarising selenite. Some of them show best for photographic purposes when examined with the crossed nicols only without the selenite, while others again absolutely require the selenite to reveal the structure properly. Agate and the various forms of felspar may be mentioned as rendering this illumination necessary; while, on the other hand, the selenite may not be used with many of the forms of granite, as the crystals of granite show so much colour that only the crossed nicols are required. No absolute rule can be laid down as to the mode of procedure either as regards the illumination required or the use of polarised light. Every one must just exercise his own discretion and skill in such matters. When a considerable experience with the Microscope is possessed by the operator no difficulty will be found in judging what is the best mode of operating to obtain the best results. One thing is essential above all others for success in this work, and this undoubtedly is that the sections must be thin. There is not much difficulty nowadays in getting thin sections compared to those which could be obtained some years ago. Another point is that the objectives used must be corrected for the chemical focus. It will not do to attempt this work with any ordinary micro-objectives. Even with the low powers which are, except in certain cases, only required, the results obtained must be sharp and clear. They have to be so, as, when projected by the lantern, defects become so very apparent. The illumination used by the writer is invariably magnesium ribbon. The image is first focussed by an ordinary lamp, which is then removed, and a small piece of brass tube, about $\frac{3}{16}$ in. in diameter, having been previously fixed in a shutter, and placed exactly in line with the optical axis of the Microscope, the magnesium ribbon is pushed through the tube and ignited. In this way the exposures are so short that little time is lost. No instructions, however, will render experience useless. It is only by long practice that any one can hope to succeed in any department of photography.

Crosbie, F.—**Directions for Photomicrography.** *Lancet*, 1903, p. 233.

D'Arcy Power, H.—**Laboratory Photography.** *Journ. Applied Micr.*, vi. (1903) p. 2282.

Elliott, L. B.—Ditto. *Ibid.*, p. 2239.

Fischer, H.—**Mikrophotogramme von Inulitsphäriten und Stärkekörnern.** *Ber. d. Deutsch. Bot'an. Gesellsch.*, xxi. (1903) p 107.

Ives, F. E.—**Eine photomikrographische Vorrichtung.**
Zeitschr. Opt. u. Mech., xxiv. (1903) p. 3.

" " **Stereoscopic Photomicrography with high powers.**
[The apparatus used seems to be much the same as that figured in Journal R.M.S., 1903, p. 224. The lenses, etc., were a Zeiss 3 mm. apochromat; 18 compensating eye-piece; amplification, 1700; Welsbach light; Cramer isochromatic plates without colour-screen. The objects were *Pleurosigma angulatum, Coscinodiscus asterocephalus*, and a *Triceratium*.
Trans. Amer. Micr. Soc., xxiv. (1902) pp. 23–7 (1 pl.).

Molesch, H.—**Bacterienlicht und photographische Platte.**
Anz. d. k. k. Acad. d. Wiss., Wien, 1903, p. 50.

(5) Microscopical Optics and Manipulation.

Jamin's Circle for Reflexion, Refraction and Polarisation.*—This instrument (fig. 70) is adapted for repeating the experiments on

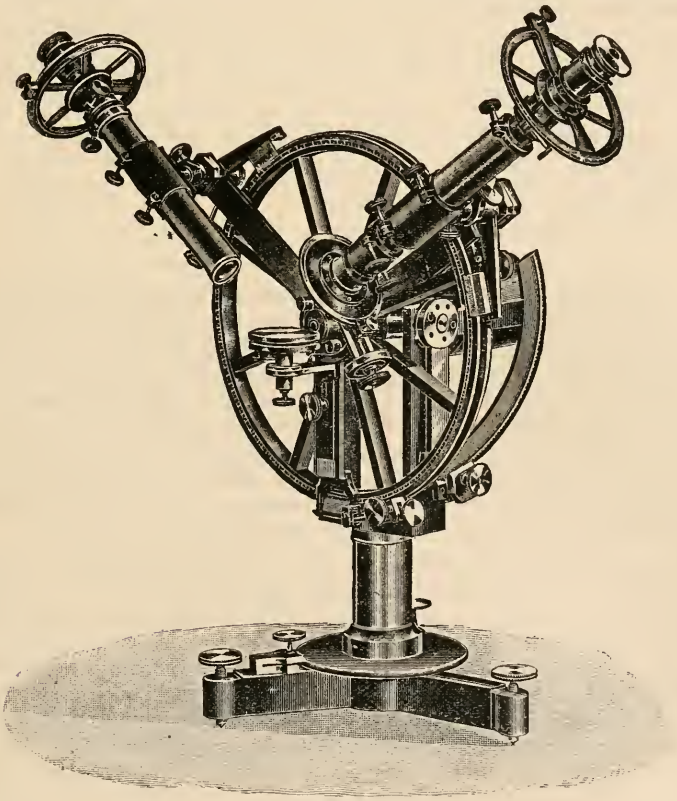

Fig 70.

the above branches of Optics as described in the *Cours de Physique de Jamin*.

* Catalogue of the Société Génévoise, 1900, p. 112, No. 2870.

New Kinds of Glass of Increased Ultra-violet Transparency.*—E. Zschimmer has renewed some earlier attempts to manufacture a glass at Jena, which should be less opaque to ultra-violet radiation than is usually the case. The only media at present known to answer the purpose are quartz, fluorspar, and molten silica; but these, excellent as they are, are never likely to come much into ordinary use. The result has been to discover a method, according to which various kinds of optical glass of large size can be produced; and these glasses are notably more transparent for ultra-violet than the best glasses hitherto known. Whilst with other glasses, 1 cm. thick, rays of wave-length 305 $\mu\mu$ are as good as completely absorbed, the new glass transmits about 50 p.c. of the original intensity.

The following table gives some of the optical constants of the new glass (U.-V. glass).

Title.	N_D	$(F - C)\,10^5$	$\frac{N^D - 1}{F - C} = v$
U.V. Crown, 3199	1·503	781	64·4
U.V. Flint, 3248	1·533	963	55·4
U.V. Flint, 3492	1·533	968	55·2
Heaviest U.V. Flint, S. 249 ..	1·653	1270	51·4

As for many purposes it is desirable that the visible spectrum should be excluded, the inventor has endeavoured to meet this want, and he has been so successful that the light as far as the blue is absorbed, while ultra-violet as far as 280 $\mu\mu$ is transmitted. This particular glass therefore serves as a filter for photography: it is called "Violet, U.-V. Glass" (No. 786'''). A U.-V. aplanat compared with an ordinary apochromatic aplanat in an astrophotographical test showed 359 stars in α Ursæ minoris as against 264. Other tests were equally successful. The glass is also produced as cover-glasses and window glass. A table of photographs shows very clearly the superiority of U.-V. glass.

Direct Micrometric Measurement of Fog Particles.†—C. Barus succeeded in this object by means of a compound Microscope, magnifying about 100 diameters, provided with a filar ocular micrometer. The objective and the whole lower part of the Microscope was submerged in the condensation chamber and suspended from a wide rubber cork through which it passed. All lenses below the cork were hermetically sealed with wax. The lower face of the objective was protected by a glass shield, whose underside was covered by perforated wet blotting-paper. Below this was a horizontal plate of thin microscopic glass covered with a film of oil, and attached to a vertical brass rod by a suitable clip. This rod passed through the cork and terminated in a small lever by which the glass plate could be rotated and focussed.

* Zeitschr. Instrumentk., xxiii. (Dec. 1903) pp. 360–2 (1 pl. of photos. of spectra).
† Amer. Journ. of Science, xvii. (1904) pp. 160–70 (5 figs.)

The part of the rod within the cork was enclosed in a small brass tube, soldered above and below the cork to the body of the Microscope tube. The lowest part of the small brass tube was arranged as a stuffing-box, so that no ingress of external air could take place, but the whole arrangement formed an eccentric focussing device whereby the oiled plate could be made to explore the atmosphere of the condensation chamber, and then rotated for examination into the proper position. The particles observed seem to have varied in diameter between ·0003 and ·0008 cm.

HARTMANN, J.—**Objectivuntersuchungen.**
[An article full of practical details regarding all varieties of optical errors.]
Zeitschr. Instrumentenk., xxiv. (Jan. 1904) pp. 1-12 (9 figs., 7 numerical tables).

PLANK, M.—**Uber die Extinction des Lichtes in einen optischhomogenen Medium von normaler Dispersion.**
[The author compares his results with those of Lord Rayleigh's paper, and finds that they agree.] *S.B. König. preussichen Akad. der Wiss.* xxii. (April 1904) pp. 740-50.

SATO TSUNEJI—**Zur Mikroskopischen Technik.**
[Recommendation to insert coloured glass or gelatin-paper between the mirror and condenser when examining by artificial light. Complementary colours should be employed, e.g. for saffranin, green; for methylen-blue, orange.]
Münchener Med. Wochenschr., l. (1903) p. 327.

(6) Miscellaneous.

Electro-thermic Regulator and Electric Incubators.*—Cl. Regaud and R. Fouilliand have applied the principles, considered by them in an earlier memoir,† to the construction of thermostats for biological laboratories. The subject is considered under five heads: (1) Mode of heating; (2) mode of regulation; (3) various details of construction; (4) practical results; (5) review of previous works upon electric heating and regulation of stoves.

Mode of Heating. The heat is entirely furnished from within, and is radiated from a series of bare wires coiled along the walls and floor of the cupboard. This method is considered much superior to one of radiation from a focus, such as an electric incandescent lamp. To produce uniformity of temperature the number of coils is diminished in the upper tiers and no coils are placed in the ceiling (fig. 71).

Mode of Regulation. The regulation, which is obviously of capital importance, is shown in fig. 72. It consists of a tube A B C D bent into a U. The part A B, or ampulla, is relatively wide and thin-walled; B C D is narrow and thick-walled. To the lower part of the ampulla a pouch G is soldered on. The wall of the thick tube is pierced by two platinum threads placed opposite one another. One of these tubes, E, is bent in the axis of the tube, and its pointed interior extremity is directed towards the elbow C; the other, F, is straight. The regulator is completely closed, and the extremities of the pouch G

* Zeitschr. wiss. Mikr., xx. (1903) pp. 138-68 (8 figs.).
† Chauffage et régulation des étuves par l'électricité. Journ. de Physiol. et de Pathol. Générale, 1900, p. 457.

and of the ampulla are sealed after filling. A B contains pure and dry hydrogen, whose pressure is in equilibrium with the column of pure

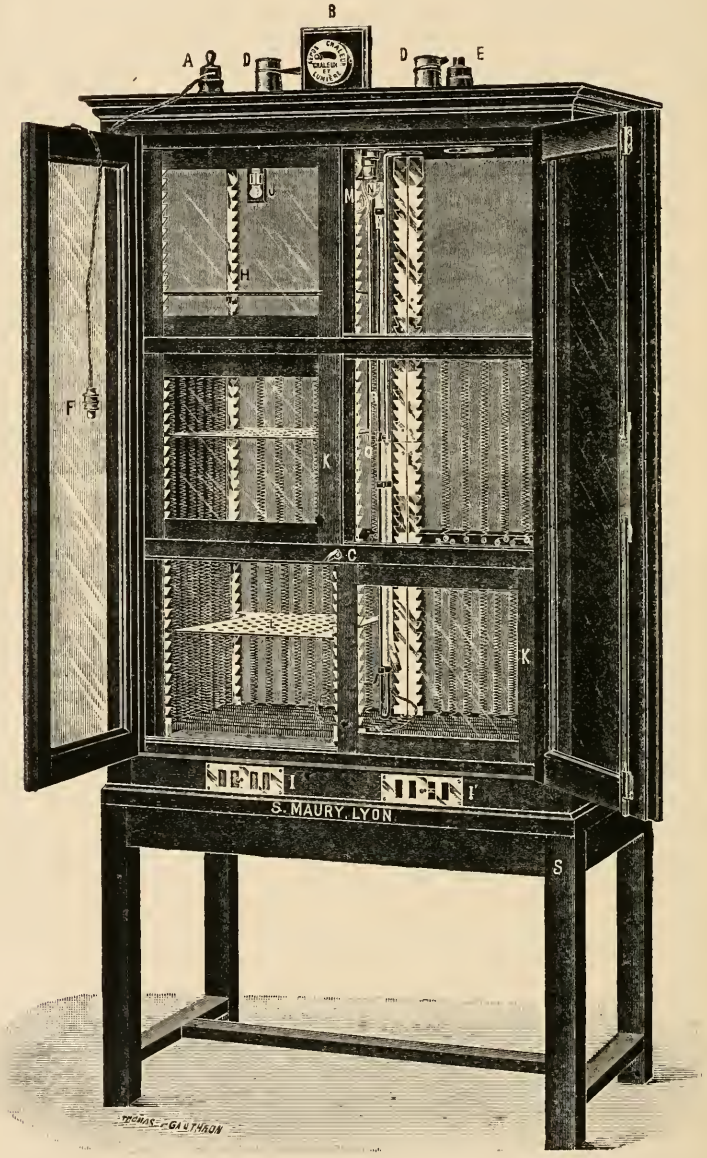

Fig. 71.

and dry mercury in B C D. Above the mercury in C D there is a barometric vacuum. When the regulator is vertical and at ordinary temperature (e.g. 15°) the inferior level of the mercury in B C is above the thread E. The total length varies between 45 and 75 cm., and the hydrogen pressure between 0·45 and 0·75 mm. of mercury, according to the size of cupboard. The regulator is intended to be suspended and in circuit with the heating wire. The current can only circulate when there is contact between the platinum thread E and the mercury; the level of the mercury in B C is dependent upon temperature variations of the hydrogen, the inclination of the regulator to the vertical and the allotment of the mercury between the pocket G and the tube B C D. The effect of each of these is separately considered by the designers. It will be understood that by inversion of the instrument the proportion of mercury and hydrogen in the limbs can be easily adjusted and that the increase of pressure, as the temperature is raised, of the hydrogen in A B will depress the mercury so that electric contact is at length automatically severed. The authors give tables for determining the adjustment.

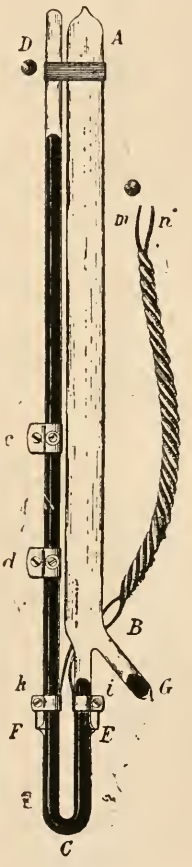

Fig. 72.

Various Details of Construction. The walls are made of wood, varnished externally; the wood is of two thicknesses, enclosing a layer of wadding and lined with glass. In the larger stoves there are two systems of doors, the inner ones being made to slide, the outer ones hinged. Certain modifications of these arrangements obtain in the smaller stoves. A rheoscopic lamp (fig. 73) is in the electric circuit, not for illumination but for signalling the interruption of current. This lamp is formed of a test-tube constricted so that the lower part is bulbous. Above this constriction is a block of paraffin fusible at the temperature at which the circuit is to work; above the paraffin is a small quantity of mercury into which pass the ends of the wires. This mercury ensures contact, and if, from any cause whatever, the temperature rises too high, the underlying paraffin is melted by the heat of the mercury, which thereupon falls into the bulb. In this way the contact is broken and accident from over-heating prevented.

Practical Results. The conditions of maintenance of uniform temperature are fully discussed, and, as an example of the working of the stove, the temperature statistics for a certain day are given. On that day the mean temperature of the stove was 37·9° C., the variations being within 37·7° and 38·2° C. The coefficient of loss of heat from small stoves was found to be greater than from large ones; or, in other

words, the working of large stoves is more economical. The authors are quite clear as to the overwhelming advantages of electric stoves, but admit that the cost of electricity must in many cases be a difficulty.

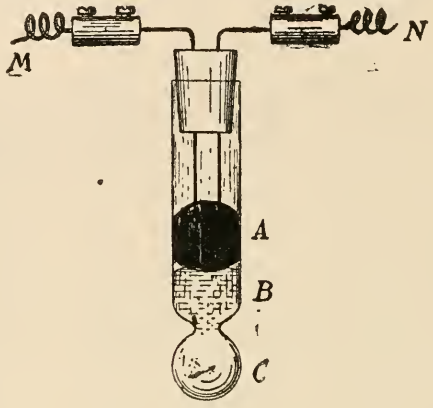

Fig. 73.

Review of Previous Works. This includes a bibliography in chronological order.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Apparatus for the Continuous Agitation of Cultures.†—E. Bodin and E. Cartex describe such an apparatus which they have found especially useful in obtaining homogeneous cultures of the tubercle bacillus.

It consists of a platform *a*, on which rest the tubes to be shaken. This platform is able to turn on a horizontal axis *b b*, and receives an alternating movement by means of a small roller *c*, rolling on an elliptical and eccentric cam *d*, connected by a shaft *e*, with a pulley *f*. The axis of rotation of the platform is constituted by two pegs of wood fixed to it opposite one another. These turn in two supports *g g*, fixed to the table *h*. Between the platform and the supports are two washers *i i*. The roller made of wood or of metal, and surrounded with india-rubber, turns between two pieces of copper, *j j*, 1 mm. thick. The shaft of the cam is a tube of copper or brass, 8 mm. in diameter and 1 mm. thick. The cam is fixed to the shaft by means of a pin. The shaft turns in two wooden supports, *k k*, the holes of which are lined with pieces of copper tubing, *l* D, of sufficient diameter to admit the shaft. Just outside the supports two pieces of the same copper tubing, *m m* A D, are fixed to the shaft to limit lateral movement. 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.

† Ann. Inst. Pasteur, xviii. (1904) pp. 264-6.

pulley of wood is fixed to a washer *n* C, soldered to a piece of the same copper tubing *o*, which is fixed to the shaft by a pin.

The apparatus can be placed in an incubator, e.g. that of Roux No. 2

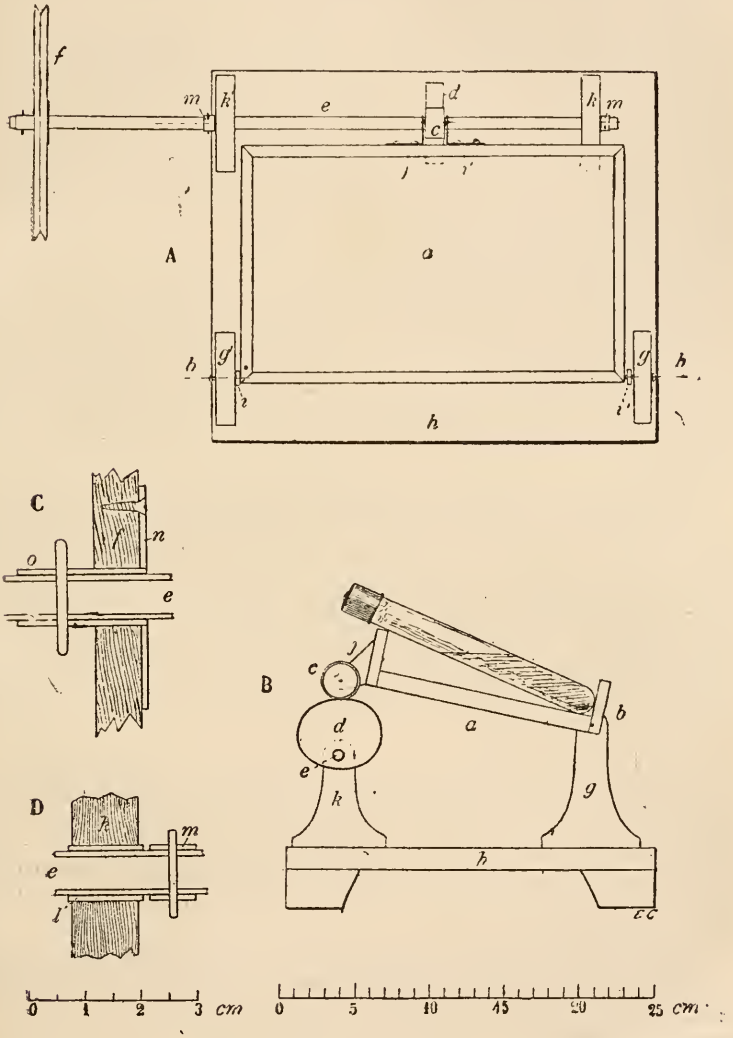

FIG. 74.

model of Weisnegg, the shaft projecting from one of the aerating apertures, and the pulley being thus outside. Movement is supplied by means of a turbine or small electromotor.

The inclination of the platform is such that the liquid contained in the tubes is not able to come in contact with the cotton-wool plugging them. When the apparatus is working the liquid is given a to-and-fro movement, which is sufficient to shake up the whole mass.

Pure Cultures of Diatoms.*—O. Richter has found that by the aid of the Koch-Beijerinck isolation method on agar cultivations of diatoms† can be obtained in a pure condition so that sub-cultures can be made on gelatin. The agar medium is made by washing 10 grm. agar in running water for 2 or 3 days, and then in distilled water, frequently changed, for one day. The mass is then dissolved in boiling distilled water, and after filtering, made up to 1000 c.cm. with distilled water. Then are added 0·2 grm. KNO_3, 0·2 grm. K_2HPO_4, 0·2 grm. $MgSO_4$, 0·2 grm. $CaSO_4$, and a trace of $FeSO_4$. The reaction of the agar should be slightly alkaline.

It was found that the $CaSO_4$ might be omitted with the advantage that 2 p.c., 1·5 p.c., 0·7 p.c., and 0·5 p.c. agar could be used.

The gelatin medium is made by soaking 100 grm. white gelatin in 700 to 800 c.cm. distilled water for two or three hours and then dissolving it. The solution is made up to 1000 c.cm., and then 0·2 grm. K_2HPO_4 and 0·2 grm. $MgSO_4$, and a trace of $FeSO_4$ added. The solution is made slightly alkaline with soda and cleared with egg-albumen.

New Method of Demonstrating Typhoid Bacilli.‡—W. Hofmann and M. Ficker recommend the addition of coffein to media as it inhibits the growth of *B. coli communis*, though it has little influence on other water bacteria. The medium used consisisted of beef 1 kilo., pepton 60 grm., salt 5 grm., water 1·5 litre, reduced to 1 litre by boiling. One part of this stock fluid is mixed with an equal bulk of 1·2 p.c. coffein solution. To 200 c.cm. of the mixture 1·4 c.cm. of 0·1 p.c. crystal-violet solution is added.

In this culture fluid some of the suspected stool is placed, and after 24 hours plates are made.

Demonstrating Typhoid Bacilli in Water.§—M. Ficker finds that when there are but few typhoid germs in water, the sediment may be enriched by precipitating with iron sulphate. To 2000 c.cm. of the water add 0·8 grm. sodium carbonate and 0·7 grm. sulphate of iron. In about two hours a sediment will have formed. The supernatant fluid is decanted off, and some of the deposit pipetted on to litmus-lactose-agar plates.

Preparation of Nutrose Agar.‖—J. W. H. Eyre gives the following improved method of preparing nutrose agar. This medium was originally devised by Drigalski and Conradi,¶ but the author has introduced important modifications.

A. (1) Emulsify 20 grm. pepton sicc. Witte in 100 c.cm. of dis-

* Ber. Deutsch. Bot. Gesell., xxi. (1903) pp. 493-8 (1 pl.).
† See this Journal, *ante*, p. 335.
‡ Hygien. Rundschau, xiv. (1904) p. 1.
§ Loc. cit.
‖ Trans. Path. Soc., lv. (1904) pp. 102-3.
¶ See this Journal, 1902, p. 371.

tilled water previously heated to 60° C.; (2) add 10 grm. sodium chloride; (3) emulsify 40 grm. powdered agar in 400 c.cm. cold distilled water, and mix with the pepton salt solution in a litre flask; (4) Dissolve the ingredients thoroughly by bubbling live steam through the mixture for half an hour, the flask being suspended in a bath of boiling water during the process.

B. (1) Measure out 500 c.cm. ox serum into a "tared" 3-litre flask, and add to it 900 c.cm. distilled water; (2) heat in the steam chamber at 100° C. for half an hour.

C. (1) Add the agar mass to the diluted ox serum, shake thoroughly to mix, and weigh the mixture; (2) titrate the mixture and add sufficient $\frac{n}{1}$ NaOH to adjust the reaction of the mixture to $-3{\cdot}5$; (3) emulsify 20 grm. nutrose in 100 c.cm. distilled water, add the emulsion to the mixture in the flask and heat in the steamer for 30 minutes; (4) weigh the mixture and make up to 2090 grm. by the addition of boiling distilled water; (5) titrate again, and add sufficient standardised $\frac{n}{1}$ lactic acid to render the reaction $+2{\cdot}5$; (6) cool to below 60° C., add the well-beaten whites of four eggs, and heat again in the steam chamber for 30 to 45 minutes; (7) filter through papier chardin with a tared 2-litre flask, and weigh the filtrate; about 1900 grm. or c.cm. clear agar will be obtained: (8) fill the nutrose agar into small flasks in quantities of 150 c.cm.; (9) if not needed for immediate use, sterilise in the steamer at 100° C. for 20 minutes on each of three successive days.

D. (1) Take as many sterilised test-tubes as there are 150 c.cm. flasks of medium, and fill 20 c.cm. Kuhlbaum's litmus solution into each; (2) heat in the steamer at 100° C. for 20 minutes; (3) weigh out and dissolve 1·5 grm. lactose in each tube of litmus solution; (4) add 1·5 c.cm. of a 0·01 p.c. solution of crystal violet (B. Höchst) to each tube; (5) sterilise in the steamer at 100° C. on each of three successive days.

Preparing Plates of Nutrose Agar.* — J. W. H. Eyre gives the following method of making plates of nutrose agar: (1) Liquefy a flask of nutrose agar (for composition and mode of preparation see *ante*) by immersion in a water-bath at 100° C. As soon as the medium is fluid add the contents from one of the prepared test-tubes and mix thoroughly. (2) Pour the coloured fluid medium into sterile Petri dishes to the depth of 3 or 4 mm. One flask (of 150 c.cm.) will supply sufficient medium for about six Petri dishes of 11 cm. diameter. (3) Open each plate and rest the edge of its cover on the side of the lower half, and so allow the steam to escape freely whilst the agar is solidifying. (4) When the medium has set, open and invert the Petri dishes and place in an incubator at 60° C. for 45 minutes, or at 42° C. for 2 hours. At the end of this time the surface of the medium will be firm and dry and ready to inoculate. (5) The material to be plated must first be suspended in either sterile salt solution or sterile broth,

* Trans. Path. Soc., lv. (1904) p. 104.

and a few drops of the emulsion deposited on the surface of the medium in one of the plates by means of a platinum loop, resting the lid of the plate on the bench during the process of inoculation. (6) Smear the suspension over the surface of the medium by means of the short-arm of an L-shaped sterilised glass rod. (7) Without sterilising or re-charging the rod smear the surface of a second plate, then a third, and if necessary a fourth. (8) Cover the plates, invert them, label the under surface which now is uppermost, and incubate (still in the inverted position) at 37° C.

Nets for Gathering Plankton.*—J. Richard describes two nets for obtaining plankton. The first is made of coarse packing cloth at about 5*d.* a yard. The cloth is attached to a strong square iron frame, the sides of which are 3 metres long. The length of the net is about 6 metres, and its bottom is formed by a pail supported by means of cords to the iron frame. It is heavily weighted, and is employed for gathering at considerable depths. The other is a simple net 50 cm. long, with an opening of 6 cm. This is allowed to trail on or near the surface. Both nets have given great satisfaction and are very easily and cheaply made.

(2) Preparing Objects.

Fixative Solutions Isotonic with Sea Water.†—M. C. Dekhuyzen makes a fixative solution isotonic with sea water by mixing 250 c.cm. of 2·5 p.c. potassium bichromate dissolved in filtered sea water; to this, 25 c.cm. of 6·3 p.c. nitric acid and 54 c.cm. of 2 p.c. osmic acid are added. The specific weight of this fluid is 1·038 at 20° C. Its great advantage is that it can be mixed with sea water without altering the osmotic pressure. It fixes the blood-cells of *Sipunculus nudus* admirably, and is equally successful with other organisms such as Cydippa, Terebellina, etc. For fixing organisms which contain calcareous matter, such as larvæ of sea-urchins, the author has devised an isotonic fluid which does not contain free acid. This is prepared by mixing 26·9 c.cm. of 2 p.c. osmic acid and 173·1 c.cm. of 2·5 p.c. bichromate of potash in filtered sea water.

Picroformol for Fixation.‡—A. Guilliermond, for studying the formation of asci and the epiplasm of Ascomycetes, used Maire's modification of Bouin's picroformol. Formalin 40 p.c., 30 grm.; acetic acid, 5 grm.; distilled water, 20 grm. Picroformol to saturation.

Preparing, Staining and Mounting Fresh-water Fauna.§—K. [illegible] recommends a funnel-shaped silk gauze net for catching [illegible] fauna, which should be transported to the laboratory in glass vessels. The great secret of obtaining a successful preparation depends on the skilful use of narcotics. These should be used in very dilute solution, and the palsy of animals awaited with patience. The animal to be mounted should be removed with a pipette to a slide, and on this the rest of the manipulation carried out. The narcotising fluid

* Comptes Rendus, cxxxviii. (1904) pp. 1436–7.
† Tom. cit., pp. 415–7; 445–7. ‡ Rev. gén. Bot., xvi. (1904) p. 49.
§ Zeitschr. wissensch. Mikr., x. (1904) pp. 5–8.

is then to be mixed with the water in which the animal is swimming. The narcotic may be cocain, of which a drop of 1 p.c. solution is usually sufficient to numb and kill the animal in about 10 minutes. Chloral hydrate $\frac{1}{5}$ to $\frac{1}{10}$ p.c. is also good, especially for Bryozoa. The best narcotic is hydroxylamin in $\frac{1}{10}$ to $\frac{1}{4}$ p.c. aqueous solution. But as the commercial article often contains hydrochloric acid, it is necessary to neutralise carefully with soda before using.

The animals are next to be fixed by means of the usual methods, but if cocain has been used for narcotising, corrosive sublimate must not be employed, as a copious precipitate forms; and as hydroxylamin has a strongly reducing action, easily reducing fixatives should be avoided. Instead of ordinary fixatives graduated alcohols answer well. If it be necessary to bleach the animal, peroxide of hydrogen in 1 p.c. solution, much diluted eau de Javelle, or magnesium peroxide may be used.

The preparation should now be thoroughly washed, and is then ready for staining. Mayer's paracarmin is very good for this purpose, and it is prepared as follows: 1 grm. carminic acid, $\frac{1}{2}$ grm. chloride of aluminium, 4 grm. calcium chloride are dissolved in 100 c.cm. of warm 70 p.c. alcohol. The object to be stained should not have an alkaline reaction, and should be washed with a weak solution of aluminium chloride in alcohol.

Nikiforow's neutral borax carmin is also serviceable. This consists of 3 grm. carmin, 5 grm. borax, which are boiled in 100 c.cm. of water. As much ammonia as will dissolve the carmin is then added, and the mixture evaporated down to half its bulk. Dilute acetic acid is then added until the cherry-red colour disappears. This solution should be diluted when used. The preparation should then be dehydrated if it is to be mounted in balsam. But a better medium is prepared as follows: (1) Pyroxylic acid with a little salicylic acid diluted freely with water and glycerin. (2) Ten parts of selected gum arabic are dissolved in 10 parts of water and 5 parts of glycerin, and a little camphor is added. Equal parts of the two solutions are mixed together when required.

As a substitute for Canada balsam, Vosseler's turpentine mixture is recommended. This is prepared by mixing equal bulks of Venetian turpentine and 96 p.c. alcohol in a tall vessel, which is placed in some warm situation. After 3 or 4 weeks the clear supernatant fluid is decanted off. Mounted in this medium, the fine details of an object stand out excellently well.

Fixing and Examining Cyrripida Larvæ.* — H. Rössig, for his researches on gall-formation, mostly used sublimate for fixing the larvæ. The solution employed was Petrunkewitsch's modification of Gilson's formula. This was used hot for a few seconds, the larvæ being afterwards transferred to a cold solution. Flemming's and vom Rath's fluid were also used, but the internal parts were often cloudy.

After the larvæ had remained in the sublimate for 2 to 12 hours, they were washed in 70 p.c. alcohol to which iodine was added. The

* Zool. Jahrb., xx. (1904) pp. 28-9 (4 pls.).

objects were then hardened in 96 p.c. and in absolute alcohol, and afterwards passed through xylol to paraffin. For young larvæ ½ to 1 hour in melted paraffin was sufficient; the larger ones on account of the fat bodies required several hours.

Longitudinal and transverse sections were made, the former being both sagittal and frontal. In thickness the sections varied from 2½ to 15 μ, according to the size and the cuticular density of the animal. The sections were stuck on with glycerin albumen, but occasionally with water; they were then stained and imbedded in balsam. The stain mostly used was Böhmer's hæmatoxylin followed by picrocarmin, but other pigments were also tried.

Preparing and Demonstrating the Structure of Arenicola.*—J. H. Ashworth adopts the following procedure for making sections of Arenicola (lugworm). It is advisable to use specimens not longer than 6 in., as longer ones are difficult to deal with on account of the hardness of the musculature. The sand is first removed from the alimentary canal by keeping the animals for 4 or 5 days in sea water. When free from sand, absolute alcohol is dropped in until the water contains about 5 p.c. After a few hours the animals will be sufficiently narcotised and may then be killed in the extended condition by treating them with sublimate acetic (95 parts sublimate and 5 parts glacial acetic acid) for a few hours. On removal, the worms are washed in fresh water and then transferred to alcohols of increasing strength (50, 70, 90). To the last, iodine is added to remove the sublimate. Pieces intended for sectioning are then dehydrated in absolute alcohol (three changes) and then cleared up with xylol or, preferably, cedarwood oil. The pieces are next impregnated with paraffin in the usual way. Wax with a melting-point of 56° to 58° C. is best for Arenicola.

The best staining results were obtained with iron-alum-hæmatoxylin, but borax carmin, acid hæmalum, Grenacher's and Delafield's hæmatoxylin were also used.

Modification of Zenker's Fluid.†—K. Helly recommends the following modification of Zenker's fixative: it consists of potassium bichromate 2·5, sulphate of soda 1, sublimate 5, distilled water 100. To 100 parts of this fluid are added, immediately before use, 5 parts of formalin. This solution works better at incubation temperature, and should not be allowed to act for more than 6 hours. The after treatment is the same as for Zenker's fluid, viz. thorough washing, graded alcohols, and iodine alcohol to remove sublimate.

Dowdy, S. E.—**Preparing Diatoms.** *English Mechanic*, lxxix. (1904) p. 194.
Smith, H. E.—Ditto. *Loc. cit.*

(3) Cutting, including Imbedding and Microtomes.

Preparation of Frozen Sections by Means of Anæsthol.‡—Katz advocates for the above purpose the use of anæsthol, a solution of

* Liverpool M.B.C. Memoirs, xi. (1904) 118 pp., 8 pls.
† Zeitschr. wiss. Mikr., xx. (1904) pp. 413–5.
‡ Deutsche Med. Wochenschr. (1903) No. 24, p. 331. See also Centralbl. Bakt. xxxiv. (1904) Ref. pp. 652–3.

methyl-chloride in ethyl-chloride, having its boiling-point at 4° C. When an object is exposed to a spray of anæsthol it very quickly becomes frozen. Alcohol-hardened preparations should be placed for a few hours, and fresh preparations for a few minutes, in formalin before being frozen.

Neuhaus, E.—**Beitrag zur mikroskopischen Technik.**
[On the value of the freezing method, and on the superiority of ethyl chloride as a freezing agent over ether.]
Deutsche Med. Wochenschr., xxix. (1903) pp. 569–70.

Ramón y Cajal, S.—**Un consejo util para evitar los inconvenientes de la frabilidad y arrollamiento de los cortes en los preparados de Golgi y Marchi.** (Device for obviating the brittleness and curling up of sections prepared by the Golgi and Marchi methods.) *Trabajos lab. investigacion biol. Madrid.* ii. (1903) pp. 99–100.

(4) Staining and Injecting.

Concretions in Acetic-methyl-green.*—E. André calls attention to the concretions which form in acetic-methyl-green, and points out that their presence may give rise to some confusion, as they present the appearance of organised bodies. They look something like starch-grains, are concentrically laminated, are liable to linear fracture, are round, ovoid, or occasionally of irregular shape. They begin to deposit themselves in from 2 to 3 months; at first are very small, but eventually may attain a considerable size. They are easily dissolved by alkalis, are not attacked by weak acids, and are coloured yellow by iodopotassic iodide.

Hæmatein and Hæmalum.†—P. Mayer writes that for some time past he has made hæmalum directly from hæmatoxylin by oxidation with sodium iodate, $NaIO_3$, and that he has recently prepared hæmateïn in a similar way. For the complete conversion of hæmatoxylin into hæmateïn, nine parts of the former to two of the latter would suffice; but in order to avoid too strong oxidation it is advisable to mix them in the proportion of 10 to 2.

One gramme of hæmatoxylin is dissolved in 10 c.cm. of distilled water by boiling; to the hot solution is added 0·2 grm. of sodium iodate dissolved in about 2 c.cm. of water. The mixture is well shaken and then cooled by placing the vessel in cold water.

The hæmateïn comes down as minute spherules or as microscopic crystals. The deposit is placed on a filter and washed with cold water to get rid of any sodium iodide. The hæmateïn is then dried at room temperature or with moderate heat.

To make hæmalum, 1 grm. of hæmatoxylin is dissolved in water by boiling. The solution is made up to 1 litre with water; 0·2 grm. sodium iodate and 50 grm. alum are added and allowed to dissolve at ordinary temperature. When quite dissolved the mixture is filtered, and is then ready for use.

After a lapse of time hæmalum becomes liable to the formation of scum on the surface, and a sediment. These may be avoided by the addition of both chloral-hydrate and citric acid; of the former, a

* Zeitschr. wiss. Mikr., xx. (1904) p. 412. † Tom. cit., pp. 409–11.

quantity equal to that of the alum used; of the latter, as much as the hæmatoxylin. These additions impart to the hæmalum a red-violet hue. The stained sections should be treated with tap-water to bring out the blue.

Both preparations can be obtained ready-made from Grübler, of Leipzig.

Modified Nocht's Stain for Blood Films.*—T. W. Hastings gives the following modification of Nocht's stain. Three solutions are required: (A) 1 p.c. eosin; (B) 1 p.c. alkalin-methylen-blue; (C) 1 p.c. methylen-blue. B is prepared by adding to a warm 1 p.c. solution of dry sodium carbonate 1 p.c. of methylen-blue powder. The mixture is heated over a water-bath for 15 minutes, and 30 c.cm. of water added for each 100 c.cm. of original fluid to replace loss by evaporation. After heating a second time over a water-bath for 15 minutes, the warm alkalin-methylen-blue solution is poured off from the gummy residue, partially neutralised with 5 to 6 c.cm. of 12·5 p.c. acetic acid, and mixed with solutions A and C as follows: Distilled water, 1000 c.cm.; eosin solution A, 100 c.cm.; alkalin-methylen-blue solution B, 200 c.cm.; methylen-blue solution C, until a fine precipitate forms (from about 70 to 80 c.cm.). This mixture of three solutions is allowed to stand for ½ to 1 hour, filtered through one filter, the residue allowed to dry in the air for 24 to 36 hours, and then dissolved in methylic alcohol. About 0·3 grm. will dissolve 100 c.cm. of methylic alcohol, but must be rubbed well in a mortar with pestle to obtain solution.

To use the stain no fixation is required. The dried blood smears are flooded with the staining solution for 1 minute; the solution is then diluted with distilled water (a few drops), and the diluted stain allowed to act for 5 minutes. The specimen is then washed thoroughly with distilled water and mounted in the usual way.

Staining the Myelin in Sections of Nervous Tissue previously treated by Marchi's Method.†—S. Ramón y Cajal recommends the following procedure. Thin sections are first washed in distilled water, and then placed for 24 hours in the following solution: Hydrochinon 4 grm., water 100 grm., glacial acetic acid 5 grm. After washing in distilled water for a few seconds they are transferred to silver nitrate solution: silver nitrate 1 grm., water 100 grm., ammonia 1 drop. After 10 minutes the sections are re-transferred to the hydrochinon solution for 2 to 5 minutes. After a rapid washing in distilled water they are placed again in the silver bath for 5 to 10 minutes. On removal they are again washed and then placed in a decolorising fluid, composed of potassium ferricyanide 1 grm., water 100 grm., potassium carbonate 0·5 grm. Herein they remain until the white substance has assumed a pale brown hue (from 2 to 5 minutes). The sections are then immersed for 2 to 5 minutes in a 12 p.c. solution of sodium hyposulphite. After this the sections must be washed in several changes of water, and then treated with 40 p.c. and absolute alcohol; this last step must be done rapidly in order not to damage the celloidin. They are then cleared up in bergamot oil and mounted in dammar.

* John Hopkins Hosp. Bull., xv. (1904) pp. 122–3.

† Trabajos Lab. Investigacion biol. Madrid, ii. (1903) pp. 93–7.

Methods for Silver Impregnation of Nervous Tissue.*—S. Ramón y Cajal describes the following methods for impregnating nervous tissue with silver.

1. Method specially adapted for the fibrils of small and medium-sized cells. Pieces of tissue about 3 mm. thick, and as fresh as possible, are immersed in a 0·75 to 3 p.c. solution of silver nitrate in distilled water, and incubated for 3 days at from 30° to 35° C. On removal, the pieces are washed for a minute or two in distilled water, and placed in the following reducing medium for 24 hours: Pyrogallic acid or hydrochinon 1 to 2 grm., water 100 grm., formalin 5 grm. The pieces are washed for some minutes in distilled water, hardened in alcohol and imbedded in celloidin.

2. Method adapted for medullated nerves and the fibrils of the large cells. The pieces of tissue are fixed for 24 hours in 97 p.c. alcohol. After washing in distilled water for a few seconds, the pieces are immersed in 1 p.c. silver nitrate solution and incubated at from 30° to 35° C. After washing for a few seconds the pieces are placed in a reducing solution composed of hydrochinon 2 grm., water 100 grm., formalin 5 grm. The reduction may be hastened by the addition of 0·5 grm. sodium sulphite. The pieces are then washed, dehydrated and imbedded in celloidin. Should the sections from the deeper parts be insufficiently impregnated they are to be treated with the following gold solution: Ammonium sulphocyanate 3 grm., sodium hyposulphite 3 grm., gold chloride 1 p.c. solution (a few drops). The sections are washed, dehydrated, cleared up and mounted in dammar.

3. Method for staining non-medullated fibres and terminal twigs. The pieces are fixed for 3 days in alcohol, but all the other steps are the same as in the two previous methods.

4. Staining the fibrils of large cells and of fine nerve-fibres. The pieces of tissue are placed in the following solution: Alcohol 97 p.c. 100 c.cm., ammonia 0·5 to 1 c.cm. If the pieces are large or numerous a 1·5 ammoniated alcohol solution may be used, or the immersion may be prolonged up to 2 days.

The preparations are next washed in water, and then transferred to 1·5 p.c. silver nitrate solution; after which they are treated with the reduction fluid previously described.

The best results were obtained by an immersion of the pieces for 24 to 36 hours in the ammoniated alcohol. Should the sections be insufficiently impregnated they may be afterwards treated with the gold chloride solution. Instead of alcohol, ammoniated formalin may be used, e.g. formalin 20 c.cm., water 100 c.cm., ammonia 0·5 c.cm. The pieces must be washed in running water for 24 hours in order to get rid of the formalin before they are placed in the silver nitrate solution.

Demonstrating a Parasite Found in Cases of Enlarged Spleen.† S. R. Christophers, in a preliminary report on a parasite found in persons suffering from enlargement of the spleen in India, employed the following method for demonstrating their presence in the tissues.

* Zeitschr. wiss. Mikr., xx. (1904) pp. 401–8.

† Scientific Mem. Med. and San. Departs., Govt. of India, No. 8 (1904) 17 pp., pl 1.

Fix in absolute alcohol or in saturated aqueous solution of sublimate. Embed in paraffin. Stain the sections for 10 to 15 minutes in 1 to 1000 eosin. Pour off excess of eosin and mop up with filter-paper. Stain for 15 to 20 minutes with methylen-blue solution prepared as follows: 100 c.cm. medicinal methylen-blue solution in distilled water, 5 c.cm. of 10 p.c. solution of sodium carbonate. Leave in sunlight till deep red colour is seen on shaking. Dilute 25 times for use. Pour off excess of stain and wash rapidly in 70 p.c. alcohol. Transfer to water. If too blue, wash in 0·25 p.c. acetic acid and then in water. Allow the section to dry on the slide. Mount in balsam or keep as a film moistened with cedar oil.

BIELSCHOWSKY, M.—**Die Silberimprägnation der Neurofibrillen.** *Neurol. Centralbl.*, xxii. (1903) pp. 997–1006 (5 figs.).

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

New Mounting Device.—This apparatus (fig. 75) by Watson and Sons was exhibited at the May meeting, and was described by Mr. Watson Baker (see *ante*, pp. 382–3).

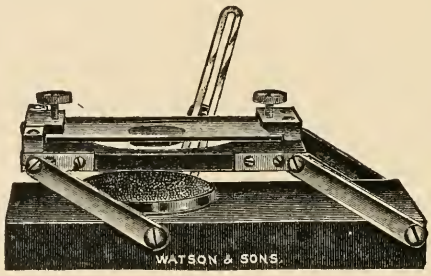

FIG. 75.

(6) Miscellaneous.

New Method for Sterilising Vessels.* — Rothenbach states that flasks and other vessels can be effectually sterilised by merely inverting a glass cap over the neck or other opening of the apparatus.

Differentiation of B. typhosus and B. coli communis by Means of the Photographic Plate.†—W. C. Stevenson claims to be able to differentiate *B. typhosus* from *B. coli communis* by means of their action on the gelatino-bromide photographic plate. His method is as follows: Cultures of the bacilli are made in broth, samples of the same broth being used for each culture. After, say, 24 hours, a few drops of each culture are placed upon the sensitive surface of the plate, and spread out so as to wet an area of any desired extent. This is done in a faint red light. The plates are then covered up, and allowed to stand for 40 minutes. They are then developed in the usual way. It will be found that the moistened areas develop with very different densities

* Deutsche Essigindustrie, vii. No. 37. See Centralbl. Bakt., 2te Abt. xii. (1904) pp. 152–3.

† Brit. Med. Journ., i. (1904) p. 1004.

of silver deposit. The coli culture produces a full and marked reduction of the salt, but with the typhoid culture only a very faint deposit is, in general, obtained.

Kingsford's Glass Troughs.—For the description and purposes of these troughs (figs. 76, 77) see *ante*, p. 383.

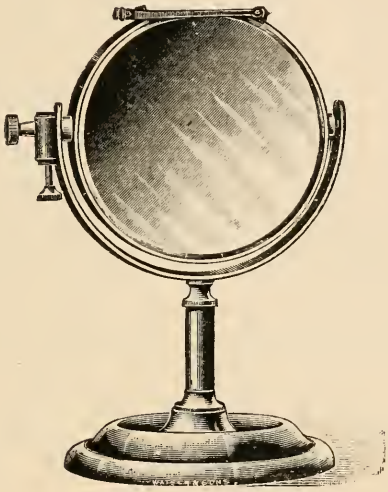

Fig. 76.

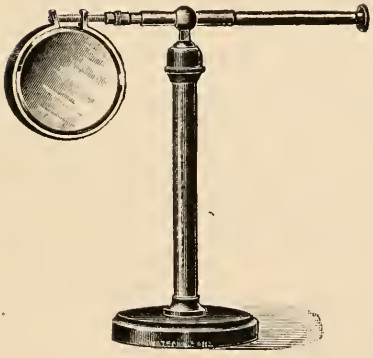

Fig. 77.

Ebonising Laboratory Tables.*—W. J. Wood states that any kind of wood may be stained by the following method: (*a*) 250 grm. of anilin chloride dissolved in 1 litre of water. This solution is applied daily for 2 or 3 days. (*b*) 125 grm. of sulphate of copper dissolved in 80 grm.

* Journ. Quekett. Micr. Club, ix. (1904) pp. 67-8.

of boiling water, and 125 grm. of potassium chlorate dissolved by boiling in about 250 grm. of water. These solutions are mixed together while quite hot, then allowed to cool. Then filter, and dilute the filtrate to 1 litre. This solution is applied to the wood the same as *a*, the wood being allowed to dry thoroughly after each application. (*c*) At the end of this operation all crystals covering the surface of the wood are to be washed off with clean water. (*d*) Once more dry the wood thoroughly and then paint over with cottonseed or raw linseed oil. Leave the oil for one day and then rub dry. This preparation takes about six days, allowing two days for *a*, two for *b*, one for *c*, and one for *d*. The result is a beautiful black surface, which will withstand the usual reagents used in biological work.

Preparing Lantern Slides of Histological Objects.*—J. Cameron employs the following method of making lantern slides, the chief advantage being that it saves the trouble and expense of preparing photographs. The first requirement is a set of glass plates, lantern size, finely ground on one surface. Camera lucida tracings are made of the desired specimen on the ground surface. A sheet of white paper placed behind the plate makes the object more distinct. Flaws or inaccuracies in the drawing are easily removed by means of a wet cloth. When the drawing is complete the surface of the plate is covered with a layer of transparency varnish. The film should be thin, and care should be taken that the plate is quite dry before the varnish is applied.

Instead of making a drawing directly on the plate, a tracing on paper may be placed under the plate and the outlines of the object copied indirectly.

After the varnish has become quite dry it is best to place a lantern slide cover-glass over the plate ; a suitable form of lantern slide mask being previously inserted between the two in the usual way.

Prints from these slides may be made, and, though negatives, are useful for handing round during a communication.

ABEL, R.—**Taschenbuch für den bacteriologischen Praktikanten, enthaltend die wichstigsten Detailvorschriften zur bacteriolgischen Laboratoriumsarbeit.**
7 Aufl. Würzburg (Stuber, 1903) 108 pp., 8vo.

KAMEN, L.—**Anleitung zur Durchführung bacteriologischen Untersuchungen für Klinisch-diagnostiche und hygienische Zwecke.**
Wien (Safár, 1903) 311 pp., 8vo, 118 figs., 12 plates.

REZNIK, B.—**Technika mikroskopická.** *Brünn*, 1903, 168 pp. 8vo.

MERLIN, A. A. C. E.—**Amphipleura pellucida (Resolution of).**
English Mechanic, lxxix. (1904) p. 284.

TREADLE—**Amphipleura pellucida (Resolution of).** *Tom. cit.*, p. 63.
„ „ **Diatom resolving.** *Tom. cit.*, pp. 84–105.
„ „ **Pinnularia nobilis (Resolution of).** *Op. cit.*, lxxviii. (1904) p. 554.
„ „ Ditto. *Op. cit.*, lxxix. (1904) p. 35.
„ „ **Pinnularia nobilis (Resolution and Structure of).**
Tom. cit., p. 14 (1 fig.).

VILLAGIO—**Resolution of Diatoms, etc.** *Tom. cit.*, p. 193.

* Proc. Scot. Micr. Soc., iii. (1904) pp. 350–2.

Metallography, etc.

Sorbitic Steel.*—H. C. Boynton finds that: (1) Furnace-cooling of an under-saturated steel produces ferrite and *pearlite*; (2) air-cooling of the same steel produces in samples of relatively small section, ferrite and *sorbite*; (3) the composition of sorbite depends upon the rate of cooling; (4) the carbon in sorbite is partially in the hardening condition, therefore all specimens subjected to "colour analysis" should be previously annealed; (5) air-cooling of a supersaturated steel greatly increases the tensile strength and elastic limit, producing a structure made up of pearlite containing an excess of cementite, and less free cementite than under-furnace cooling.

DUDLEY, P. H.—**Unit Fibre Stresses in the Base of Steel Rails.**

[Microscopical measurements and investigations of autographically-recorded strains in the base of steel rails under moving locomotives, cars and trains, to ascertain the apparent mean unit fibre-strains of the extreme fibres of the metal, and some of the experimental laws of their distribution.]

Journ. New York Micr. Soc., Annual of 1902, pp. 23–42.

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* Iron and Steel Mag., pp. 470–80 (80 photomicros.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Ortner's Entomological Microscope.† — E. Küster describes this instrument (fig. 78) made by the firm of Ortner Bros. and Co., of

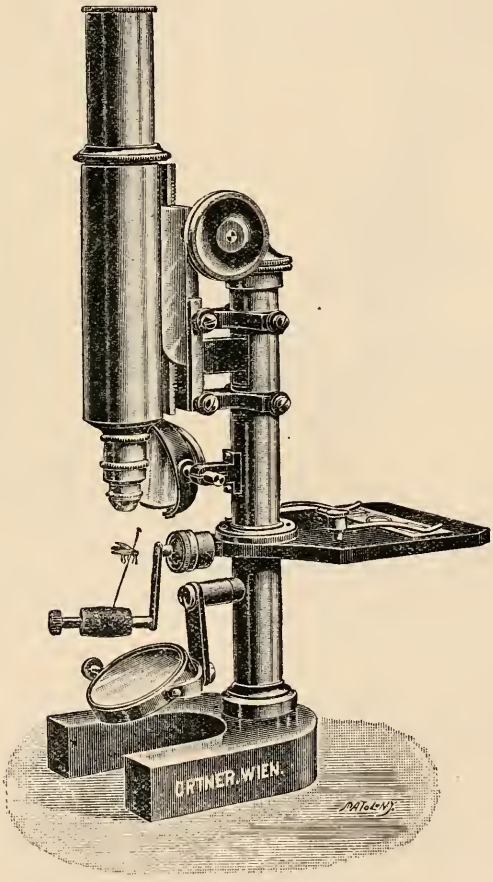

FIG. 78.

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

† Zeitschr. wiss. Mikr., xx. (1904), pp. 429, 430 (1 fig.).

Vienna. It is differentiated from ordinary Microscopes by making the object-stage swing round the tube-holder. When the stage has been rotated through 180°, a movable bent object-holder can be brought into position between the mirror and objective, and on its free end is applied an extensible collar bearing a cork. The object, on a pin, is set in this cork, and, by the variety of movements possessed by the arrangements, can be brought into any desired position in front of the objective. For the examination of opaque objects, a second mirror fastened on the tube-holder furnishes the required incident light. The instrument might also be used for botanical objects, or for any others which should be viewed from all sides.

Hollick's Naturalists' Microscope.—This instrument (fig. 79) is a modification of R. and J. Beck's well-known Star Microscope, and

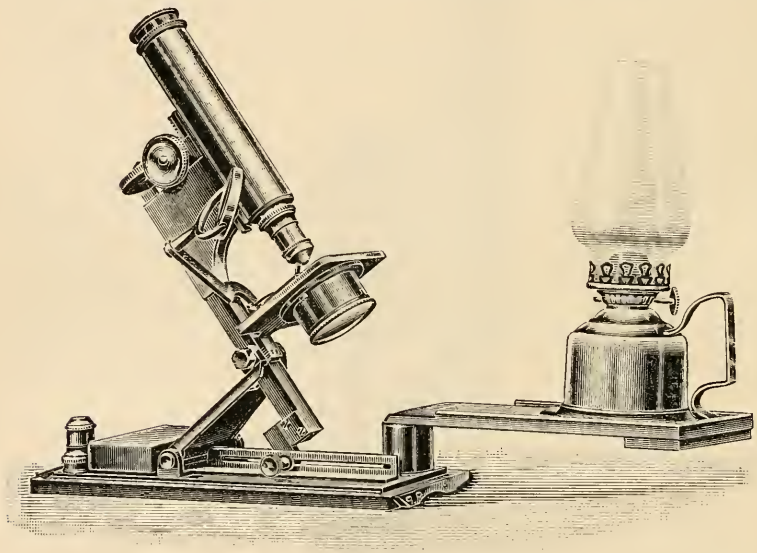

Fig. 79.

was made to the drawings of A. Hollick, who wished to have: first, the utmost compactness; and secondly, good illumination for opaque objects.

The former of these objects is obtained by making the bottom of the Microscope case the base of the instrument, and by folding the Microscope down on to it on the principle of R. and J. Beck's Popular Microscope; but the lower end of the pillar, instead of dropping into a series of holes, slides in a slot, and can be clamped in any position, so that any desired inclination can be imparted to the Microscope. Owing to its large base, the instrument, though light, is very stable.

The second object is attained by swinging the mirror on a centre above the stage approximately level with the object; that is to say, on an arm of such length that the lamp flame is focussed on to the object

with the concave mirror, and therefore, when used for opaque illumination, is practically always in focus whatever the inclination. The mirror can be swung below the stage for use with transparent objects. This arrangement is very convenient, as the mirror arm is not in the way of the fingers when manipulating the object.

Another point to be noticed is that the front lens and cell of the $\frac{1}{6}$ object-glass are coned to the utmost that is possible without limiting the aperture. The apex of the cone is so small that very effective illumination of opaque objects by the concave mirror can be obtained even with this high power.

When the Microscope is in use the fitting on the base-board in which the spare eye-piece is packed is utilised to support a wooden bracket which carries a light lamp. This arrangement allows of the Microscope being slid along a table for exhibition without disturbing the illumination. The outside dimensions are 5 in. by $3\frac{3}{4}$ in. by $9\frac{1}{4}$ in., and the weight 4 lb. 2 oz.

Notched Fine Adjustment for Optical Instruments.§—The firm of A. Pfeiffer, Wetzlar, have designed a new form of adjustment in-

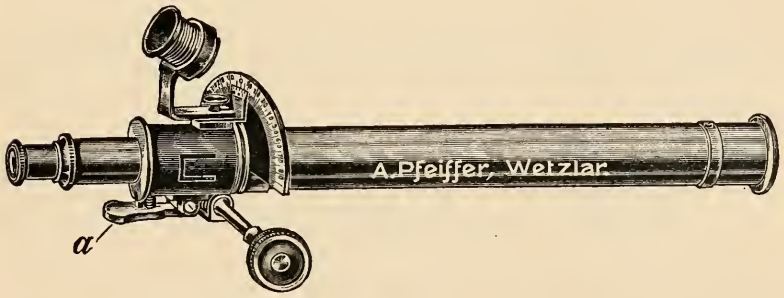

Fig. 80.

tended to simplify the movements of the usual types of coarse and fine adjustments. Fig. 80 shows it as applied to a polarimeter. The part of the apparatus acting as the fine adjustment consists of an endless screw on one end of a two-armed lever; the other end of the lever terminates in a handle *a*, a projection on which is pressed by a clip into a notch. The axis of the lever can be seen on the left of the endless screw; this axis also provides the means for securing the fine adjustment to the front part of the polarimeter. This part of the polarimeter contains the analyser, and is rotatory about the long axis of the whole instrument, and surrounds the part bearing the divided circle. This inner part also bears the thread in which the endless screw works through an opening in the analyser tube. It will now be understood that if, by pressure, the handle *a* be released the fine adjustment is put out of gear, and the movement of the front part serves as the coarse adjustment; the fine adjustment is then reinstated by relaxing the spring, and the movement completed.

* Central-Zeit. f. Opt. u. Mech., xxv. (1904) pp. 13–44 (1 fig.).

Application of the Stereo-Komparator to Monocular Use, and a Specially Designed Monocular Comparison Microscope.*—C. Pulfrich's article is mainly occupied with the testing of star-photographs; but he shows how a microscopic method may be adapted to the comparison of

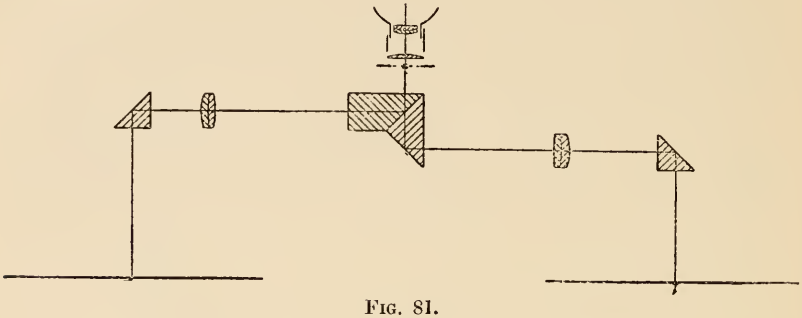

Fig. 81.

two plates for monocular observers, that is, by observers who prefer to work single-eyed. The paths of the rays are shown in fig. 81, which will be easily understood. The author seems pleased with the results obtained.

Gelblum, S.—**Le mouvement lent du tube de microscope.**
[The author attacks the problem by methods of mathematical analysis. He suggests that a part of the tube should be threaded, and should work in a nut—the whole forming a male and female screw—so that the fine adjustment would be obtained by rotating the tube.]
Zeitschr. wiss. Mikr., xx. (June 1904) pp. 421–8 (7 figs.)

M.—**Die neue Binocular-Lupe von E. Leitz Wetzlar.**
Zeitschr. angew. Mikr., ix. (1903) p. 291.

(2) Eye-pieces and Objectives.

Blakesley, Th. H.—**Single-piece lenses.**
Proc. Phys. Soc. Lond., xviii. (1903) p. 591.

Conrady, A. E.—**On the chromatic correction of object-glasses.**
Monthly Not. Roy. Astron. Soc., lxiv. (1904) p. 274.

Fèry, Ch.—**Méthode nouvelle pour la détermination des constantes des lentilles.**
Bull. Soc. franç. de Physique, 1903, p. 226.

Hartmann, J.—**Objectivuntersuchungen.**
Zeitschr. Instrumentenk., xxiv. (1904) p. 1.

Kerber, A.—**Ueber den Astigmatismus von Fernrohr- und Mikroskopobjectiven.**
Mechaniker, xi. (1903) p. 157.

Trotzewitsch, S. E.—**Anfertigung von Objectiven für Telescope, Mikroskope und photographische Apparate. Die optische Technik du Mikroskope und Teleskope.**
[Russian.] Warsaw (1903) 322 pp.

Anonymous—**Sammellinse mit Irisblende von Carl Zeiss.**
Deutsche Mechaniker-Zeitung, iii. (1904) p. 28.

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* Zeitschr. Instrumentenk., xxiv. (1904) pp. 161–6 (1 fig.).

(3) Illuminating and other Apparatus.

An Easily Set-up Heliostat.*—A. W. Gray has contrived a heliostat (Fig. 82) out of simple materials. He uses a framework in the shape of a right-angled triangle, the vertical side being applied to the window of the room, and the base resting on the window-sill: means are provided for fixing. The hypotenuse of the frame must be inclined to the base at an angle equal to the geographical latitude of the place. By help of

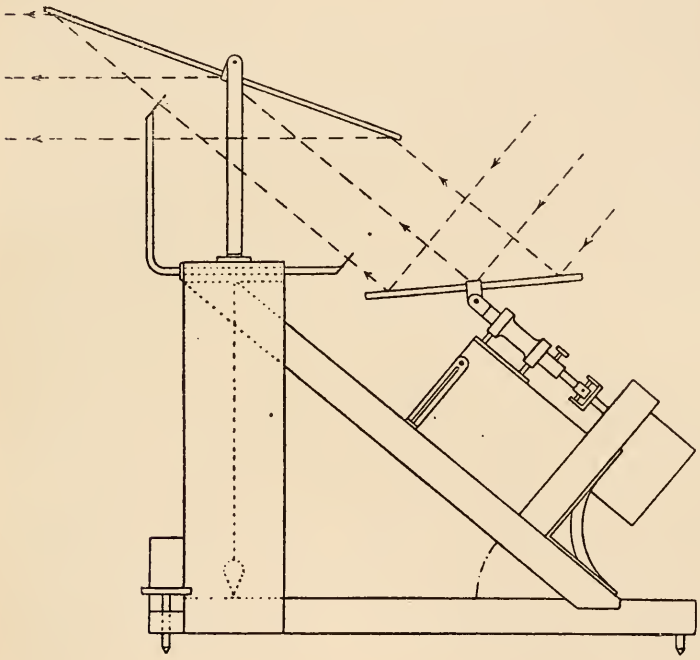

Fig. 82.

a bracket at right angles to the hypotenuse the mirror axis (made out of a bicycle pedal) is arranged parallel to the hypotenuse. One extremity of this axis bears a plane mirror, which reflects the sunlight upwards on to another plane fixed mirror, which, again, reflects it horizontally into the room. In order to secure the rotation of the lower mirror, the axis above mentioned is connected at its lower end

*[Deutsche Mechaniker-Zeit., ii. (June 1, 1904) p. 104 (fig.); Zeitschr. f. d. phys. u. Chem. Unterr. xvii. (1904) p. 25.

with the hour-hand axle of an ordinary alarum clock. This hour-hand, of course, rotates twice per diem, so connexion is made between it and a wheel of twice as many teeth; but, inasmuch as the rotation is thereby reversed, a third wheel equal to one of the other two is required. It is necessary that the hypotenuse should lie due north and south.

Polariscope and Microscope Lantern.* — The following details will enable any one to make a polariscope for the lantern. Make first a tube of tin or brass, about 4 in. diameter, to fit the tube of the lantern, and at an angle of 56° 45′ fix a similar tube 4 in. long. Part of the elbow is cut away to introduce a bundle of 10 or 12 plates, $4\frac{1}{4}$ in. by $3\frac{1}{4}$ in. of thin patent plate-glass. The lowermost of these is blackened. A hole for stage, 2 in. by $1\frac{1}{2}$ in., is cut on each side of this tube, and a plate is fixed in tube here with a 2-in. hole in centre. This forms the stage. A sliding tube with a similar plate at end, and a spiral spring serves to keep objects in position. At the end of tube fix a flange and another short tube about 3 in. diameter, which carries the objective,—of about 4-in. focus. The objective moves in this tube with a sliding or rack-and-pinion movement. Beyond this again is still another tube 2 in. diameter and 2 in. long. In this slides a smaller tube, in which is fitted a Nicol prism. This fits in a cork, which cork fits in small tube, and the smaller tube rotates in the other.

Lantern Microscope. Get a brass tube 3 in. long and 2 in. diameter, and at one end fix a screw, fitting flange of the lantern. Two inches from this end cut holes on either side, 2 in. by $1\frac{1}{2}$ in., and fit for stage as in the polariscope. At about $1\frac{1}{2}$ in. from end is fitted a lens about $2\frac{1}{2}$-in. focus, which acts as an additional condenser. To the other end of the tube fix a plate, in centre of which fix a tube 1 in. diameter and $1\frac{1}{2}$ in. long. In this slides a smaller tube carrying the magnifying lenses, which may be two lenses each about 2-in. to 3-in. focus. If these are not achromatic a diaphragm with $\frac{1}{4}$-in. hole must be placed about $\frac{3}{4}$ in. in front. The best position is determined by experiment. Achromatic lenses will be best. Micro-objectives of 1-in., $1\frac{1}{2}$-in., or 2-in. focus may be utilised with advantage by fitting them by means of a cork in the sliding tube in place of those mentioned. Instead of a sliding tube a rack-and-pinion will be a great advantage.

(4) Photomicrography.

Microphotographs.† — The production of these small views, or microphotographs, is a branch of work which requires very considerable patience and skill, inasmuch as it is necessary to perform the operations of development, etc., in the field of a magnifier or small Microscope, since the size of the image is so minute. The majority of the microphotographs sold are made on the Continent, and details of their manu-

* Photographic Reference Book, 2nd ed., 1904, p. 238.
† Tom. cit., pp. 191–2.

facture are not given in English treatises. The collodion process (wet plate) is used, or collodio-albumen may also be employed. In either case, the collodion used for making the plates must be absolutely structureless, for if it is not the magnified images will have a disagreeable reticulated appearance. Pyrogallic acid is preferable to iron sulphate for development, since it gives a much finer deposit. The process consists in making a positive by copying an illuminated negative, a 1-in. microscopical objective being used for this purpose. An apparatus devised by Mr. Hislop, and described in Mr. Sutton's "Dictionary of Photography," may be employed. It consists of a rigid mahogany board about 6 in. wide and 3 ft. 6 in. in length. At one end two uprights are fixed, between which a miniature camera, fitted with the microscopical objective, can be moved up and down, so as to allow it to be placed opposite the centre of the negative to be copied. The objective is screwed to a brass tube, projecting from the camera towards the negative, the tube being fitted with stops of various sizes. A micrometer head for the fine adjustment of the lens is also necessary, because the majority of microscopic objectives are corrected only for the visual rays. The sharpest visual focus must be found by means of a powerful magnifying-glass, and the chemical focus ascertained by racking the lens in or out to various distances until the proper chemical focus is found. When this has been done, the same correction may always be applied unless the negative's distance from the lens is altered. The negative is placed in a frame at the required distance on the long mahogany board. The illumination may be natural or artificial, but must, of course, pass through the negative. The variations of light, negative, and collodion plate render it impossible to give any idea of exposure. After exposure the little plate is placed under a low-power Microscope, in yellow light, and a few drops of developer poured over it. Development must be watched through the instrument, remembering that a transparency is required, and that, therefore, rather greater density than otherwise should be obtained. After fixing and drying, the tiny plates are examined through a magnifier of about the power which it is intended to subsequently attach to them, in order to see if they are perfect and worth the subsequent trouble of mounting. The photographs chosen are then cut into small squares with an ordinary diamond. Care must be exercised that no dust adheres to the film side of these small squares. The little lenses (or Stanhopes) to which the view is to be cemented are now placed on the top of a small stove, and very cautiously heated. A drop of Canada balsam is placed on the end and allowed to soften, and the little square transparency taken up in a pair of forceps and pressed—gently at first, afterwards more strongly—into contact with the melted cement. The two are then allowed to harden together for some hours. In order to be certain that the operation has succeeded, and that the contact is perfect, the transparency is examined through the rounded end of the little glass cylinder, to which it is cemented, which acts as a Microscope, and gives a magnified and distinct image of the object. If air-bubbles show they are most likely due to unequal pressure in cementing the glass. The

balsam must be resoftened by placing it for a few minutes on the stove, and the operation repeated with greater care.

ANONYMOUS—**Praktische Arbeitserfahrungen in der Photographie (Mikrophotographie).** *Zeitschr. angew. Mikr.*, x. (1904) p. 24.

LEISS, C.—**Ueber eine neue Camera zur stereoskopischen Abbildung mikroskopischer und makroskopischer Objecte.** *Zeitschr. Instrumentenk.*, xxiv. (1904), p. 61; *Zeitschr. Krystallog. u. Mineral*, xxxviii. (1903) p. 99.

(5) Microscopical Optics and Manipulation.

CHABRIÉ, C.—**Sur la fonction qui représente le grossissement des objets vus à travers un cône de cristal.** *Comptes Rendus*, cxxxviii. (1904) p. 349.

DOKULID, TH.—**Die Bestimmung der optischen Constanten eines centrirten sphärischen Systems mit dem präcisionsfocometer.** *Der Mechaniker*, xii. (1904) p. 37.

EVERETT, J. D.—**On skew refraction through a lens; and on the hollow pencil given by an annulus of a very obliquely-placed lens.** *Proc. Roy. Soc.*, lxxi. (1903) p. 59.

„ „ **On the resolving power in the Microscope and Telescope.** *Rep. British Assoc., Glasgow*, 1901, p. 569.

KLEIBER, J.—**Astigmatismus bei Hohlspiegeln.** *Zeitschr. Unterr.*, xvi. (1903) p. 208.

MACÉ DE LEPINAY, J., & H. BUISSON—**Ueber eine neue Methode der optischen Dickenmessung.** *Zeitschr. Instrumentenk.*, xxiv. (1904) p. 30; *Comptes Rendus*, cxxxv. (1902) p. 283.

ANONYMOUS—**Ueber die Grenzen der mikroskopischen Abbildung und die Sichtbarmachung "ultra mikroskopischer." Theilchen.**

[After referring to Abbe's theorems on the limits of visibility, the writer describes the experiments of Siedentopf and Zsigmondy, which have been more than once described in our Journal.]

Central-Zeit. f. Opt. u. Mech., xxv. (March 1, 1904) pp. 51–3 (3 figs.)

(6) Miscellaneous.

Optical Bench.* — The firm of R. and J. Beck manufacture an optical bench and appliances for Microscope illumination, photomicrography, micro-projection, and optical lantern projection. It consists of a table (fig. 83), having a rigid iron framework and a wooden top, 54 in. by 20 in., which supports the optical bench, the Microscope and the illuminant. It runs on four castors, by the side of which are screw pillars with lock-nuts, by which the castors may be raised off the ground. The bench proper is a steel rail 30 in. long, with a prismatic section; this is carried on two cross bars, at the ends of which are four screwed pillars with milled heads and clamp nuts, the ends of which fit into sockets fixed upon the wooden table. By means of the pillars the rails may be raised or lowered. Along the dove-tailed rail the various pieces of apparatus slide with a spring fitting, and may be clamped in

* R. & J. Beck's Special Catalogue, 1904 (12 figs.).

any position by means of a milled head and screw. The condensers, light filters, iris diaphragms, cooling chambers, lenses, mirrors and prisms (figs. 84, 85, 86, 87, 88, 89) are so made that when in position on

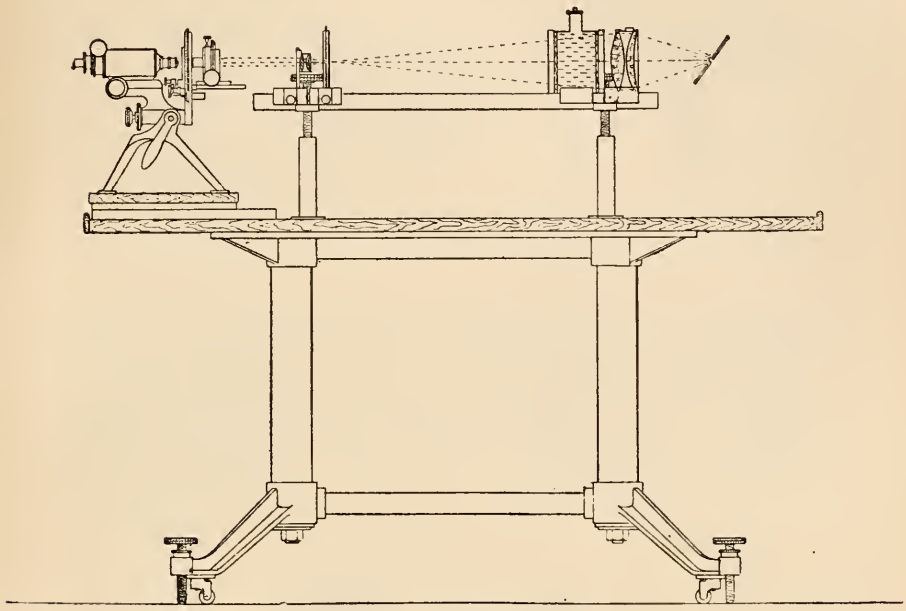

Fig. 83.

the rail their centres are in alignment on the optic axis. The illuminating apparatus, arc, incandescent gas or paraffin lamp, fits on the bench, and is provided with an adjustment for altering its position.

Fig. 84.

Fig. 85.

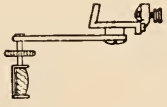

Fig. 86.

The platform upon which the Microscope is placed is provided with a tilting movement by which the optic axis of the instrument may be inclined up or down. The platform runs on three sets of steel rails;

one set places the optic axis of the Microscope in line with that of the bench; the second set allows the instrument to be placed with its optic axis parallel to but to one side of the axis of the bench, a position suitable for the illumination of opaque objects; while the third set permits the

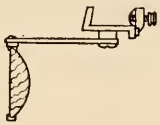

FIG. 87.

FIG. 88.

FIG. 89.

Microscope to be used at right angles to the optic axis of the bench. When used as an optical lantern the height of the bench (fig. 90) is increased by a supplementary table. A set of rods and curtains is provided to cover the apparatus. A photomicrographic and enlarging camera (fig. 91) on a similar turntable is made of the same height as the Microscope table, so that it can be placed in alignment for photomicrography. This camera carries a $\frac{1}{1}$ plate ($8\frac{1}{2}$ in. by $6\frac{1}{2}$ in.) with adapters for smaller sizes, and has a variable extension of from about

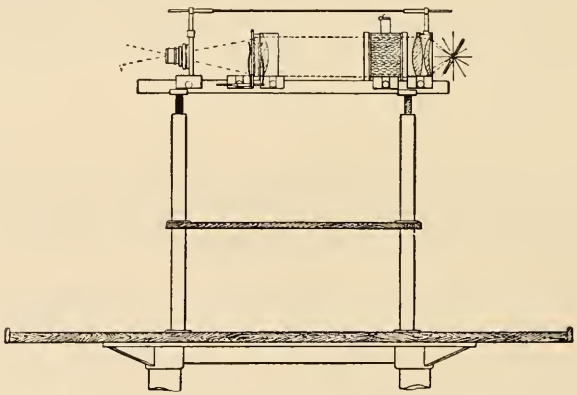

FIG. 90.

12 in. to 7 ft., the front portion being extended by means of a steel rod which slides in bushed fittings, while the back slides and clamps upon the main bar of the table. The front of the camera is arranged to take a small photographic plate-holder, and a sliding panel in the

fixed frame of the camera takes a photographic lens, so that the camera may be turned into an enlarging apparatus.

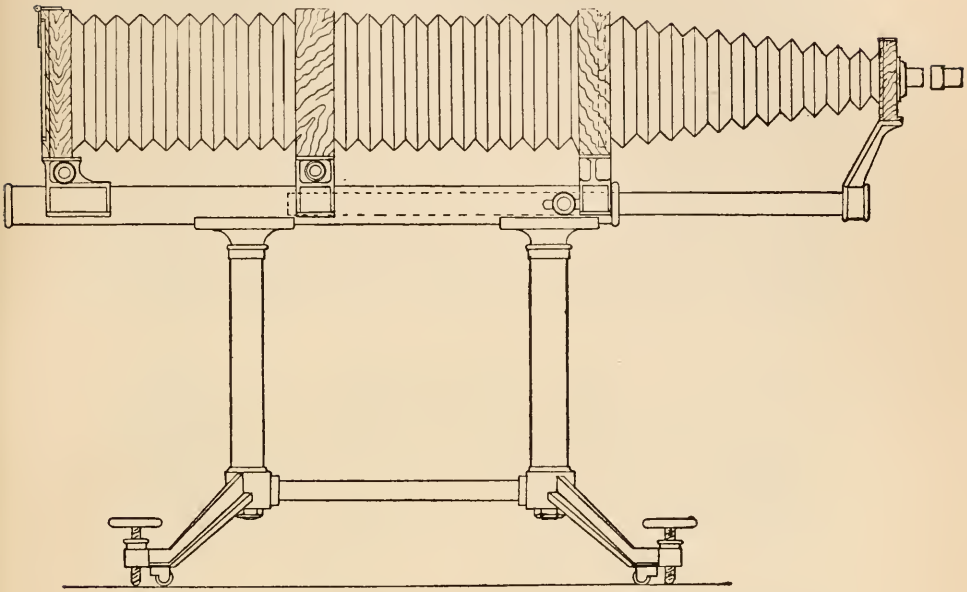

Fig. 91.

Manissadjam, J. J.—**Microscopical Work in Turkey.** *Journ. Applied Micr.*, vi. (1903) p. 2547.

Oertel, T. E.—**Medical Microscopy.** London (Rebman), 9 pp.

Percival, A. S.—**The Microscope.** *English Mechanic*, lxxvi. (1903) p. 430.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Culture of Anaerobic Bacteria.†—J. Bordet recommends the following method for the cultivation of anaerobic bacteria. He employs an apparatus used ordinarily for desiccation in vacuo (fig. 92). This is composed of two receivers, the inferior of which, A, is cylindrical, and has its edges ground. It is 0·14 m. high, and has an internal diameter of 0·14 m. The superior receiver B is a hemispherical bell-glass with a stop-cock, and furnished with a flat bottom, the inferior surface of which is carefully ground for adaptation to the edges of the cylinder A. The flat bottom of the bell-glass is raised towards 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.

† Annales de l'Institut Pasteur (1904) No. 5, pp. 332–6.

centre in a ridge 0·05 m. high, and this ridge surrounds a circular opening *b*, which furnishes a communication between the two parts of the apparatus. It is in the cylinder A that the vessels are placed in which the cultures are made. This being done, a small packet of about 5 grm. of pyrogallic acid in filter-paper is introduced through the opening *b* into the bottom of the bell-glass. The latter is then applied to the cylinder. The whole apparatus is then inclined, so that the highest part of the floor of the bell-glass is that on which rests the packet of pyrogallic acid. This position is maintained by means of a block of wood (fig. 93). The stop-cock is then removed, and by means of a funnel, the stem of which is suitably bent, about 100 c.cm. of a 10 p.c. solution of caustic potash are introduced into the bell-glass in such a way that, thanks to the inclination, none of it touches the pyrogallic acid. The stop-cock is then replaced and the air exhausted. When the rarefaction has reached a maximum, the stop-cock is closed, and the

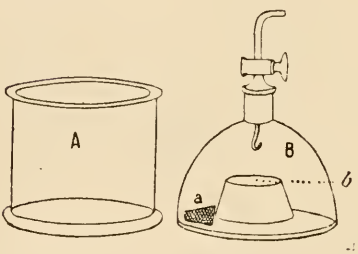

Fig. 92.

Fig. 93.

apparatus placed in a horizontal position, the latter causing the mixture of the acid with the potash solution. Thus the traces of oxygen left after exhaustion of the apparatus are absorbed by the pyrogallate of potash. Before placing in the incubator the author recommends that all the apposed glass surfaces of the apparatus should be covered with a mixture in equal parts of wax and vaselin. This renders it more surely air-tight.

Pure Cultures of Chlorella vulgaris.*—E. Herouard obtains pure cultures of this alga on potato. Obliquely cut cylinders of the medium are placed in test-tubes having a constriction near the lower end. At the bottom of the tube is placed a little water, or a mixture of water and 10 p.c. glycerin. The tube is plugged with cotton-wool and sterilised in the autoclave. The sterilisation should be lengthy or repeated on several occasions. The medium should be inoculated with the usual precautions, and care should be taken to spread the seed over

* Bull. Soc. Zool. de France, xxix. (1904) pp. 110–4.

a considerable surface, as the alga grows but little beyond the inoculation site. The tubes should be covered with rubber caps to prevent evaporation. Cultures of Chlorella obtained by the foregoing method enabled the author to rear Infusoria and Cladocera.

Scotia Closing Plankton Net.*—W. S. Bruce describes a form of closing net (fig. 94) constructed after a design the idea of which was

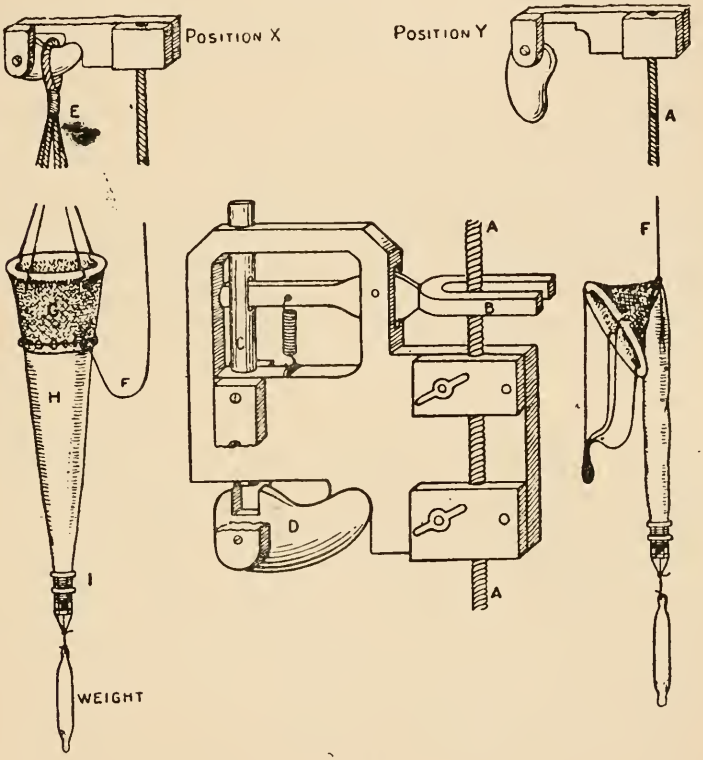

FIG. 94.

derived from the Scottish reversing thermometer frame. A weight runs down the cord A, strikes the lever B, raises brass rod C, which liberates hook D from position X to Y. This lets go net-cords E, and the net becomes suspended as in position Y by cord F, which has a continuation of A and draws up neck of net and closes it. F is passed through a series of rings round the neck. G is coarse material. H, Swiss silk or such-like material. The end takes off at I, as in Hensen's net. Thus by letting the whole apparatus down nothing enters the net, but on hauling up the tow-netting proceeds and goes on vertically until the

* Proc. Roy. Physical Soc., xv. (1904) p. 141 (5 figs.).

weight is sent down cord A at desired depth, when position Y is obtained and nothing enters or gets out of the net. It is easy to trawl in fast in this position. The net can be made of any size.

Preparing Agar.*—K. Rosam states that the following procedure prevents the too rapid setting of agar, and facilitates filtration. Powdered agar is treated for about five minutes with 10 p.c. acetic acid; it is then placed on a sieve and the acetic acid washed out with running water. Thus prepared, agar is rapidly filtered, has a low melting-point, and solidifies at 35° C. It may be stocked dry, and will keep for quite a long time. The filter-paper recommended is Schleicher and Schüll's No. 604.

Cultivation of Algæ.†—Th. Frank obtained pure cultures of *Chlamydomonas tingens* by inoculating agar with single cells. He also used Knop's medium, which consists of 4 parts calcium nitrate and 1 part potassium nitrate, magnesium sulphate, potassium monophosphate, and a trace of iron sulphate. Made up with distilled water, this medium has a slightly acid reaction, and the free acid it contains corresponds to about 0·033 p.c. phosphoric acid. When used in concentrations varying from 0·05 to 3 p.c., the results obtained were good. Besides agar and Knop's medium, cultivations were made successfully on gelatin and on clay plates saturated with nutrient fluid.

Cultivation of Anaerobes.‡—D. J. Hamilton describes a method which aims at the exclusion of any atmosphere whatever. The first step is to encourage sporulation, and this is done by incubating (at 37° to 38° C.) the organism in the liquid upon which it is found growing naturally within the animal body. The fluid is removed in a Pasteur's pipette; this is then sealed off, and the tube incubated for 24 to 48 hours. By this means the organism is obtained in the sporing state.

The medium used is glucose-pepton-beef-tea. This must be boiled and filtered until precipitation of phosphates ceases. The reaction must be distinctly alkaline to phenolphthalein. The medium is decanted into test-tubes or flasks, and sterile olive-oil to the depth of 1·5 cm. is then poured over the surface. The tubes or flasks are sterilised again on three successive days; on the first day for ¾ hour, on the second and third day for ¼ hour.

The spores are inoculated by drawing up some of the spore-containing fluid in a Pasteur's pipette, which is plunged into the beef-tea and some of the contents blown out, care being taken not to empty the tube lest any air might enter. The plug is then readjusted, and the vessels heated in a water-bath at 80° C. for 20 minutes, to kill off any non-sporing contaminations. If the organism be contained in a tissue a minute piece is snipped off and dropped into the tube or flask. After the last-mentioned heating the vessel is cooled down quickly in running water. The inoculated vessels are then incubated. Within 24 hours, as a rule, germination is in full activity, and the growth may be examined by withdrawing some fluid by means of a sterilised pipette.

* Centralbl. Bakt., 2te Abt., xii. (1904) p. 464.
† Bot. Zeit., lxii. (1904) pp. 153–88 (1 pl.).
‡ Brit. Med. Journ., 1904, II. pp. 11–2.

For making surface growths the most suitable medium is glucose-pepton-agar, but any other solid medium not coagulable by heat may be substituted. The vessels used are circular capsules, with an inside diameter of 7 cm. and a depth of 2½ cm. They are provided with a flat ground flange 1½ cm. broad. The cover is made of plate-glass and extends outwards to half the breadth of the flange, so as to leave a margin uncovered. It is ground to fit closely on to the flange. In the capsule is placed a layer of medium about 1 cm. thick, and then olive-oil is poured in nearly up to the rim. It is then covered and sterilised. When cool, the medium is inoculated by means of a pipette containing pure culture. Growth is usually abundant after incubating from 24 to 48 hours. Such cultures may be preserved permanently by killing the organisms with formalin, and then mounting the capsules with refined castor-oil.

(2) Preparing Objects.

Preserving Insects.*—In order to preserve insects collected in the summer for dissection and mounting in the winter, Villagio recommends the following procedure: Kill the insect in chloroform vapour, then drop it into a test-tube half full of water. Raise to the boiling-point and then transfer at once to 30 p.c. alcohol. After 24 hours remove to a mixture of equal parts of 90 p.c. alcohol, glycerin and distilled water, with ½ p.c. of acetic acid added. From this fluid the insect is removed to diluted alcohol for dissection, or passed through graded alcohols for imbedding in paraffin.

Preparation of Spicules of Silicious Sponges.†—R. von Lendenfeld takes a piece of the sponge of the size of a hazel-nut, and boils it in water. The piece of sponge is then placed in a test-tube and covered with strong nitric acid. After standing for some hours it is boiled until the acid is quite clear. The tube is then almost filled with distilled water and shaken, and after about 20 seconds the supernatant fluid is decanted off into another test-tube. After some 40 seconds the supernatant fluid in the second tube is removed to a third test-tube, and this procedure is repeated until no spicules are obvious to the naked eye. The last fluid is then centrifuged for 1½ minutes. The deposit is washed with distilled water several times, and afterwards placed on a slide. After removing the excess of water, the preparation is dried over the flame and mounted in balsam or dammar.

Collodionage of Cells.‡—Cl. Regaud describes an ingenious method of preparation applicable to anatomical elements naturally or artificially dissociated.

The first step consists in dissociating and fixing the cells. When dealing with a fluid rich in cells, e.g. blood, semen, etc., one or two drops of the liquid are allowed to fall into several cubic centimetres of a fixative, such as 1 to 2 p.c. osmic acid or 10 p.c. formalin. The fixative must be kept shaken for a while to prevent agglutination of the cells. If more rapidly coagulating fixatives such as chromic, picric, or

* English Mechanic, lxxix. (1904) p. 556.
† Zeitschr. wiss. Mikr., xxi. (1904) pp. 23–4. ‡ Tom. cit., pp. 10–4.

acetic acid, bichloride of mercury, alcohol, etc., be used, the cells must be previously washed with physiological salt solution, and, after sedimentation, the supernatant fluid decanted off. The deposit is then fixed. When the elements are scanty, as in urine, pleural fluid, etc., they must be concentrated by centrifuging before being fixed. In the case of cells not naturally dissociated, e.g. of the liver, spleen, bone-marrow, etc., they may be dissociated first and fixed afterwards, or *vice versâ*.

The next step consists in washing the fixed cells in a centrifuge, and this operation may be repeated once or twice.

The third step is to dehydrate the sediment by dropping in absolute alcohol, and after this an equal quantity of anhydrous ether, shaking or inverting the tube from time to time.

The fourth step is to add some few drops of collodion solution, and then shake the mixture again.

Fifth step: with a thin dry pipette draw up some of the collodionised fluid and place droplets on cover-slips. While the films are still moist, transfer the cover-slips to 80 p.c. alcohol. The preparations are next passed through 60 p.c. alcohol and then to water. After this, the treatment is the same as for ordinary histological sections stuck on a slide.

(3) Cutting, including Imbedding and Microtomes.

Rapid Method of Hardening and Paraffin Imbedding.* — The following are the steps in a method employed by O. Lubarsch by means of which hardening and imbedding are accomplished in from 1 to 3 hours, enabling perfect sections to be cut and all stains to be used with success: (1) Blocks of tissue 0·5 cm. thick are placed in 10 p.c. formalin for 10 to 15 minutes, with one to two changes; (2) 90 to 95 p.c. alcohol for 5 to 10 minutes, with one change; (3) absolute alcohol for 10 minutes, with two changes; (4) anilin oil, to clear, for 10 to 30 minutes, according to size of block of tissue; (5) xylol, to remove oil, for 10 to 20 minutes, with two to three changes; (6) paraffin for 10 to 60 minutes. All the steps of the process are carried out in a paraffin oven at 50° C. to 53° C.

Rapid Hardening and Imbedding.†—A. Stein gives the following modification of Lubarsch's method of rapidly hardening and imbedding fresh tissue: 1. Immersion in 10 p.c. formalin (5 minutes). 2. 95 p.c. alcohol (5 minutes). 3. Absolute alcohol, two changes (10 minutes). 4. Anilin oil, till quite cleared up (15 to 20 minutes). 5. Xylol, two to three changes (15 minutes). 6. Paraffin (10 to 30 minutes, according to the size of the piece). The first four stages are made in incubator at 50° to 52° C.; the last two at 58° to 60° C.

Use of Radium in Section Cutting.‡—H. H. Dixon remarks that every one who cuts paraffin sections is frequently troubled by their electrification, which makes them stick to the knife or curl up and, even when successfully removed from the knife, fly about in an erratic manner. These undesirable phenomena may be completely obviated

* Deutsche Med. Wochenschr., No. 48 (1903) p. 896.
† Op. cit., xxix. (1903) p. 806. ‡ Nature, lxx. (1904) p. 198.

by fixing a 5 mgrm. tube of radium bromide on the microtome knife close to where the paraffin ribbon is forming. Apparently the radiations from the radium discharge the electrification of the paraffin sections by ionising the air in their neighbourhood.

Fixation and Staining of Eumesostomina.*—A. Luther fixed the objects chiefly with sublimate either in the form of Lang's fluid of medium strength, or as a saturated solution in physiological salt solution. The fixative was used hot, and the objects afterwards washed in distilled water. They were then transferred to graded alcohols (50, 70, 96 p.c.). The sublimate was removed by means of iodine immediately before saturation with paraffin. Sometimes Flemming's mixture was used as fixative, the results being good, especially for the eggs of *Mesostoma lingua*. The stains mostly used were Ehrlich's hæmatoxylin and eosin, or Benda's iron hæmatoxylin and eosin. Toluidin blue (1 p.c. aqueous solution for 8 hours) combined with a weak solution of erythrosin (a few seconds) was often successful. Golgi's impregnation method and intra-vitam staining with methylen-blue were failures. As maceration fluid, especially for the isolation of muscle, nitric acid was found serviceable; 10 p.c. for fresh material, 20 p.c. for that hardened in alcohol.

Behr, M.—**Über Schnellhärtung und Schnelleinbettung.**
[On rapid hardening and imbedding.]
Münchener Med. Wochenschr., l. (1903) pp. 2256–7.

Guttmann, C.—**Über Schnellhärtung und Schnelleinbettung.**
Deutsche Med. Wochenschr., xxix. (1903) pp. 740–1.

(4) Staining and Injecting.

Hæmatoxylin Staining of Nerve-fibres of the Central Nervous System.†—W. Pavlow recommends that the brain should be cut up into pieces of about 4 cm. diameter, and fixed in Müller's fluid or 3 p.c. potassium bichromate at 35° C. The fixative should be changed daily for the first week and twice a week afterwards. The pieces are fixed at 35° C. for 3 weeks, and for the next week at ordinary temperature. On removal they are washed in running water for 2 hours, and then transferred to 75 p.c. methyl-alcohol for 3 days; after this to absolute alcohol for 3 days, and subsequently to a mixture of absolute alcohol and ether for 5 days. They are next placed for a week in celloidin, kolloxylin or photoxylin solutions. The celloidin solution is made by dissolving 40 grm. of celloidin in a mixture of 500 grm. methyl-alcohol and 500 grm. of sulphuric ether. For the kolloxylin or photoxylin 30 grm. are dissolved in 800 c.cm. of the ether mixture.

The pieces of brain are then fixed on wood or paraffin blocks by means of the same mixture, and after the lapse of 15 minutes are placed in 60 p.c. methyl-alcohol.

The celloidin sections are stained with hæmatoxylin solution made by dissolving 10 parts of hæmatoxylin in 100 parts of absolute ethylic-

* Zeitschr. wiss. Zool., lxxvi. (1904) p. 3.
† Zeitschr. wiss. Mikr., xxi. (1904) pp. 14–8.

alcohol, and then adding 870 of distilled water and 20 of glacial acetic acid. This solution must stand uncovered in the light for 3 weeks before use. The sections are stained for 20 hours at a temperature of 30° C. On removal the sections are treated for 10 minutes with a saturated solution of lithium carbonate, and are then washed with distilled water until the water runs off quite clear. The sections are now decolorised after Pal's method, though the permanganate solution is stronger. In solution A (pot. permang. 5, H_2O 1000) the sections remain 1 minute; in B (acid. oxalic. 5, pot. sulphurosum 5, H_2O 1000) 5 minutes. If not sufficiently decolorised, the whole business must be gone through again.

The decolorised sections are next washed and treated successively with methyl-alcohol, creosote and carbolxylol. In each of these fluids they remain 5 minutes, after which they are mounted in balsam.

If it be desired to double-stain the sections, this may be done with magdala red, congo red, or fuchsin; but the preference is given to the following: Rubin 1, H_2O 200, glacial acetic acid 4. The counter-staining must be done after differentiation in B solution and washing in water. It takes about 3 hours, after which the sections are immersed for 24 hours in 2 p.c. acetic acid.

Modification of the Van Gieson Method.* — K. Weigert recommends the following improvement of the Van Gieson method. For alum-hæmatoxylin is substituted iron-hæmatoxylin. This is prepared by mixing, when required for use, equal parts of two solutions: A, consisting of 1 grm. hæmatoxylin to 100 c.cm. of 96 p.c. alcohol; B, of 4 c.cm. liq. ferri sesquichlorati, 1 c.cm. of hydrochloric acid, and 95 water. The iron chloride solution contains 10 p.c. iron; the specific gravity of HCl is 1·124, 'German Pharmacopœia.'

The acid fuchsin-picric acid mixture is made by adding 10 parts of 1 p.c. aqueous solution of acid fuchsin to 100 parts of saturated aqueous solution of picric acid.

The sections previously stained with iron-hæmatoxylin are placed in the picric-fuchsin solution for only a short time; they are then quickly washed in water, dehydrated in 90 p.c. alcohol, and cleared up in carbolxylol.

Method of Staining Sections Quickly with Picrocarmin.†—W. Freeman gives the following method by which staining with picrocarmin is complete in a few minutes. The staining is almost entirely that of carmin, but the picric acid can be easily added by passing the sections through alcohol tinged with picric acid in the usual way for successive double stains. The fixatives used were Müller's fluid, potassium bichromate, Weigert's chrome-alum mixture and formalin, with after-hardening in alcohol. The picrocarmins used were Bourne's and Hoyer's. (1) To 1 volume of Bourne's picrocarmin 9 volumes of 0·2 p.c. acetic acid are added; the mixture is filtered preferably after boiling. The sections cut with a freezing microtome are placed in the dilute picrocarmin, which is then heated quickly just to the boiling-

* Zeitschr. wiss. Mikr., xxi. (1904) pp. 1–5.

† Proc. Physiol. Soc., May 1903; Journ. Physiol., xxix. (1903) pp. xxx–i.

point and allowed to cool. As the fluid cools the sections stain, and are at their best in 3 to 4 minutes. (2) To 1 volume of Hoyer's picro-carmin 19 volumes of distilled water are added. The sections are treated as above, but the staining takes 10 to 15 minutes.

Fixing, Staining and Mounting Sections of Skin.*—E. Retterer, in his researches on the structure of the skin, fixed the material in Flemming's, Zenker's or Branca's fluid, giving the preference to the two last. The sections were stained by various methods: some with hæmatoxylin, and fuchsin and Israel's eosin-orange-aurantia; others with fuchsin-resorcin, followed by hæmatoxylin and safranin (24 hours); others with fuchsin-resorcin and alum-carmin; others with lithium-carmin, vesuvin and fuchsin-resorcin. The specimens were mounted in glycerin, Farrant's medium, and balsam.

The author pertinently remarks that if all the structure and details of a histological specimen are to be made out satisfactorily no single method will suffice, and that no rule can be given for determining *a priori* the precise routine for obtaining the best results.

New Method of Staining the Epithelial Fibres and the Membrane of Prickle Cells.†—P. G. Unna fixes the material partly in absolute alcohol, partly in formalin, hardens in alcohol and imbeds in celloidin. The sections are stained in the following mixture: Water blue 1; orcein 1; acetic acid 5; glycerin 20; spirit 50; water to 100. One gramme of this solution is placed in a test-tube and mixed with 0·3 grm. of 1 p.c. alcoholic solution of eosin, and then with 0·3 grm. of 1 p.c. aqueous solution of hydrochinon. The sections are stained in the cold for 10 minutes. After washing with distilled water they are immersed in 1 p.c. aqueous solution of safranin for 10 minutes. They are again washed with distilled water, and transferred to ½ p.c. bichromate of potassium solution for 10 to 20 minutes. On removal the sections are washed in distilled water, after which they are dehydrated in absolute alcohol and then mounted in balsam.

Should the sections (which should have a violet hue after dehydration) be too red from excess of safranin, they must be re-treated with alcohol.

Staining with Chrom-hæmatoxylin.‡—O. Schultze recommends the following procedure for staining tissues previous to sectioning: (1) Fix the material in solutions of bichromate of potash or of chromic acid, or better still, with osmic acid added to both, for 12 hours or longer; (2) 50 p.c. alcohol, in the dark for 24 hours or longer; (3) 70 p.c. alcohol with 0·5 p.c. hæmatoxylin, for 24 hours or longer; (4) 80 p.c. alcohol; (5) absolute alcohol; (6) imbedding: the sections should be thin, not thicker than 5 μ.

Modification of van Ermengem's Method of Staining Flagella.§ J. W. W. Stephens describes the following modification of van Ermengem's method: (1) The mordant consists of 2 p.c. osmic acid, 1 part; tannin 20 p.c., 2 parts; this is allowed to act for ½ to 1 hour or longer.

* Journ. Anat. et Physiol., xl. (1904) pp. 337–86 (2 pls.).

† Monatsch. prakt. Dermatol., xxxvii. (1903) pp. 1–18 (1 pl.). See Zeitschr. wiss. Mikr., xxi. (1904) pp. 68–9.

‡ Zeitschr. wiss. Mikr., xxi. (1904) pp. 5–9.

§ Lancet, 1904, II. p. 22.

(2) Silver nitrate solution, 0·2 p.c. (3) Ammonium tannate solution; of this, a quantity sufficient for staining one slide is freshly made thus: tannin 20 p.c., 0·2 c.cm.; equal parts of strong ammonia and water, 1 c.cm. A clean slide is flooded with an emulsion of culture, the surplus fluid is drained off, and when dry the slides are mordanted. After washing with water a few drops of the silver solution are put on the slide, and then a few drops of ammonium tannate. The slide is rocked to and fro for a few minutes. The washing and staining are then repeated three or four times.

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

Iodine-Paraffin Oil: a New Micro-reagent and Mounting Medium.*—C. O. Harz makes this medium by dissolving one part of iodine in 100 parts of neutral, colourless paraffin oil by the aid of gentle heat. Thus prepared, the mixture has a beautiful red colour. It is well suited for mounting bacteria, fungi, starch, ligneous tissue and other vegetable preparations. The method of mounting starch-grains is simple. The grains are spread out on a slide or cover-glass, with water or with iodine solution (1 p.c. iodide of potassium solution saturated with iodine). The preparation is dried in the air or by means of gentle heat, and then mounted in the usual way in paraffin oil or in iodine-paraffin oil. The cover-glass is then ringed round with 10 p.c. gelatin previously warmed.

Method for the Removal of Air-Bubbles from Frozen Sections.† E. Neuhaus recommends the following method for use chiefly when ethyl-chloride is employed as the freezing agent in the rapid preparation of sections. The sections having been cut, placed in salt solution, stained and washed, are transferred to alcohol, which is then slightly warmed. By this the air-bubbles are seen to disappear, especially if the alcohol is agitated or the sections moved about with a needle. The warming does not interfere with the staining reaction of alum-carmin, hæmatoxylin, or any of the usual stains.

Dowdy, S. E.—**Micro-mounting methods for amateurs.**
[A useful compendium for beginners.]
English Mechanic, lxxix. (1904) pp. 580–2.

(6) Miscellaneous.

Demonstrating Fœtal Cartilage.‡—Halvar Lundvall, after alluding to Wijhe's method,§ describes his own procedure: (1) Fixation in 10 p.c. formalin for at least 48 hours; (2) 95 p.c. alcohol for at least 48 hours; (3) $\frac{1}{4}$ p.c. toluidin blue in hydrochloric acid alcohol for some days at 40° C.; (4) decolorising in hydrochloric acid alcohol at 40° C.; (5) 95 p.c. alcohol (frequently changed) for some days; (6) dehydrating in absolute alcohol for 24 to 48 hours or longer; (7) 2 parts absolute alcohol plus 1 part benzol for 12 to 24 hours; (8) 2 parts benzol plus 1 part absolute alcohol for 24 to 48 hours;

* Zeitschr. wiss. Mikr., xxi. (1904) pp. 25–7.
† Deutsch. Med. Wochenschr., No. 32 (1903). See also Zeitschr. angew. Mikr., ix. (1903) pp. 210–1.
‡ Anat. Anzeig., xxv. (1904) pp. 219–22.
§ See this Journal, 1902, p. 372.

(9) pure benzol; (10) carbon bisulphide; (11) carbon bisulphide 1 part plus benzol 4 parts. The preparations are preserved in small glass jars, the lids being luted on with sodium silicate.

Preparation of Slides for Blood Films.* — A. E. Wright states that ideally perfect films can be obtained by simply rubbing the slide with the finest emery-paper. The paper is mounted on a stout cylindrical roller by means of a rubber ring. In making a film a drop of blood is placed on a slide thus prepared; another slide is brought down on it, and as soon as the blood has spread out in the included angle the upper slide is drawn along the surface of the lower. The foregoing method is ill-adapted for a differential count of white corpuscles unless a line be ruled with a needle longitudinally from end to end through the equatorial region of the film. The count should then proceed from one end of the equator to the other.

SHENTON, J. P.—**Application of the Microscope to the study of potable water.** *Trans. Manchester Micr. Soc.*, 1903, pp. 41–53.

SIMON, R.—**Dendritic forms in paper.** *Tom. cit.*, pp. 92–5 (1 pl.).

Metallography, etc.

Hard and Soft States in Metals.†—G. T. Beilby, in a paper read before the Faraday Society, advances the following argument on the above subject. Metals ordinarily occur in two distinct solid phases—the hardened or amorphous (A phase), and the annealed or crystalline (C phase). The A phase is transformed into the C phase by the agency of heat; the C phase is transformed into the A phase by mechanically produced flow. In the transformations $A \rightleftarrows C$ there are two intermediate mobile phases, M and M′, so that the transformations may be written $A \rightarrow M' \rightarrow C$ and $C \rightarrow M \rightarrow A$. The author's experiments and observations lead to the conclusion that mere modifications of the crystalline state in respect of the arrangement and size of the crystals, forming the solid mass of a particular metal, are insufficient to explain the difference between its hard and solid state. He considers that the kind of hardening which is due to purely mechanical force involves a process the effect of which is to cause the breaking down of the crystalline condition more or less completely, and the production of a superficial, and sometimes inter-crystalline, flow of the metal, which transforms it from the crystalline to the amorphous state.

Influence of Varying Casting Temperature on the Properties of Steel and Iron Castings.‡—P. Longmuir concludes, as the result of prolonged microscopical research, that a suitable casting temperature for any given alloy is not constant, but varies with the form and weight of the casting. Other determining conditions are the rate of pouring, the form of runner and gate, and the distance travelled by the metal before entering the mould. By taking advantage of these determining conditions, and commencing with a sufficiently high casting temperature,

* Lancet, 1904, II. p. 73.

† Electro-chemist and Metallurgist (June 1904) pp. 806–26 (5 figs. and 20 photo-micrographs.

‡ Iron and Steel Mag., viii. (July 1904) pp. 32–47 (20 figs.); Iron and Steel Institute May (1904) Meeting.

matters can be readily arranged so that each mould is poured at the correct heat. In determining this correct heat, experience must, until a very considerable advance has been in pyrometer methods, be the only guide. Empirical though this may be, when carefully applied regularly successful results follow.

Structure of Metals.*—J. A. Ewing, in the Rede lecture, deals with the insight into the structure of metals as yielded by metallographic methods of research. He showed by lantern projection how the crystalline nature of metals could be observed, and pointed out how stress produced slip-lines among the crystals. This was of great practical interest in connection with "fatigue" in metals, which was shown to be due first to slips appearing on isolated grains, and then to the development of these slips into cracks. He dealt at length with binary alloys and eutectics, giving it as his opinion that the formation of a eutectic occurred by alternate surfusion or supersaturation of each constituent in the other. Eutectics in which the constituents were not of the same crystalline system appeared to be mechanically weak. The properties connected with recalescence were illustrated by experiments on a steel wire coiled into the form of a spring, and carrying a light weight. The spring extended in a conspicuous way while the process of re-crystallisation associated with recalescence was going on. The gradual changes of structure which go on even at atmospheric temperature in lead and other metals after the structure has been broken up by severe straining were next described, and, in conclusion, the lecturer referred to the analogous case of glacier-ice, which had for long been known to possess a granular structure, each grain being a crystal, just as in the case of metals. Photographs by Principal Skinner, illustrating this granular structure, were shown. In the upper névé the grains were vague and comparatively small; as the glacier slowly travelled down, the grains became consolidated and large, and their outlines became well defined. Clearly a slow process of crystal growth was going on, and it was to this very process of growth that the plasticity of the glacier as a whole was to be ascribed. Nothing was more striking to a worker in this field than the evidence to be found that those substances on which we were most accustomed to rely as constant were undergoing, sometimes comparatively fast and sometimes very slowly, a process of internal flux. A monument more enduring than brass might be a lofty ideal, but it was seen at least to be an ideal easy of conception when one realised how far from constant the inner structure of brass and other metals was apt to be.

BOYNTON, H. C.—**Troostile.** *Iron and Steel Mag.*, vii. (June 1904) pp. 606–28 (22 figs.).

HOFMAN, H. O., GREEN, C. F., & YERXA, R. B.—**Laboratory study of the stages in the Refining of copper.**

[Micrographic studies of a number of copper samples in different stages were made; full statistics are given.]

Technology Quarterly and Proc. of Soc. Arts, xvii. (March 1904) pp. 76–100 (6 tables of statistics, 31 figs.).

JOHNS, C.—**Notes on the production and thermal treatment of steel in large masses.** *Iron and Steel Mag.*, vii. (June 1904) pp. 596–606 (7 figs.).

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* Abstract of Rede lecture before the University of Cambridge, June 11, 1904; and Nature, 1808 (June 23, 1904), pp. 187–8.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Exhibition Microscope.†—B. J. Howard, of the Bureau of Chemistry, U.S.A. Department of Agriculture, gives a description of the Microscope used in connection with the exhibit at the St. Louis Exposition.

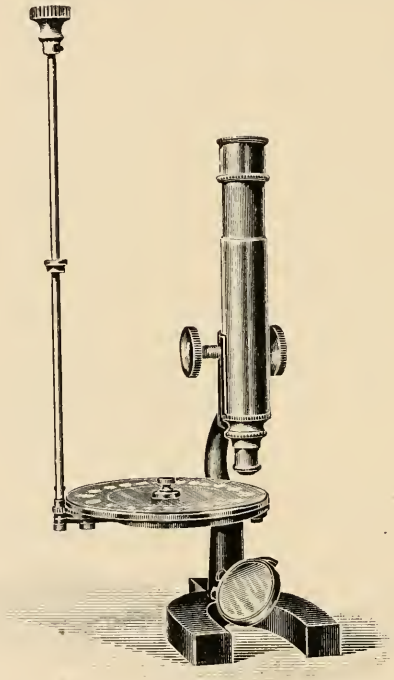


Fig. 102.

The chief feature is a specially devised stage which carries three cog-wheels so arranged that for each half revolution of the small pinion the large one is driven forward $\frac{1}{20}$ revolution. The large wheel carries a circular plate-glass disk of 5 in. diameter, attached to it by means

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

† Journ. App. Micr., vi. (1903) p. 2727 (1 fig.).

of a thumb-screw passing through a hole in the centre of the disk. The specimens are carefully mounted, so that their centres are at an equal distance from the centre of the disk, and are covered with ½-in. slips. In this way each disk will carry twenty specimens. On the shaft carrying the hard rubber button by which the small pinion is turned is an intermittent gear arrangement which drives a dial with figures or names on it, indicating the specimens as they come under the objective. The whole instrument (fig. 102), with the exception of the ocular and the hard rubber button, is inclosed in a glass case, the focussing being accomplished by raising or lowering the ocular ; a set-screw preventing its being removed from the draw-tube.

Société Genevoise Second Large Model Microscope.* — This instrument (fig. 103) is of similar but lighter construction to the Microscope previously described and figured in this Journal.†

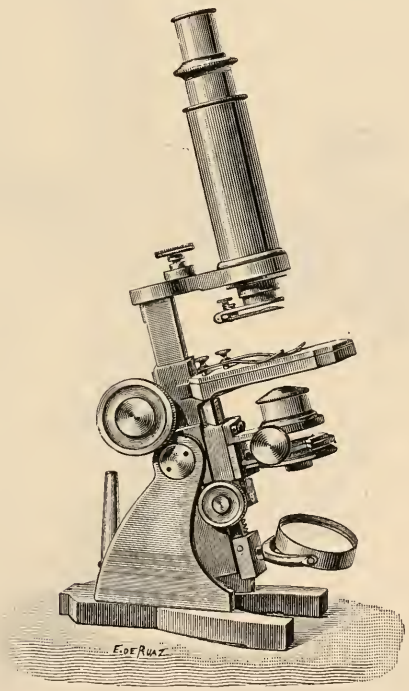


FIG. 103.

Culmann's Monocular Image-Erecting Prism-Microscope.‡—This instrument (fig. 104), constructed by the Zeiss firm, has been designed

* Cat. Soc. Genevoise pour la Construction d'Instr. de physique et de mécanique, 1900, p. 99. † See this Journal, 1884, pp. 281–2, figs. 30 and 31.
‡ Zeitschr. wiss. Mikr., xx. (June 1904) pp. 416–20 (1 fig.).

by P. Culmann to serve the combined purposes of a preparation, an observation, and a drawing Microscope. The stand is fitted with Zeiss'

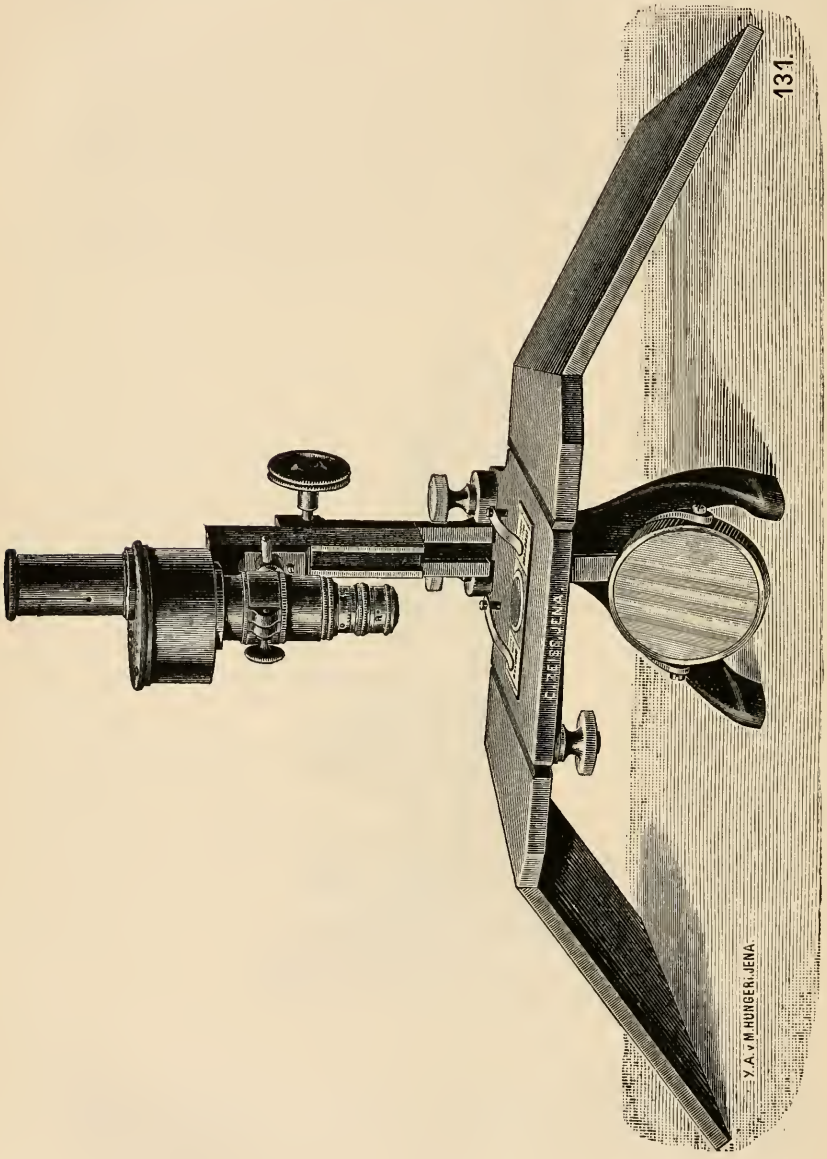


Fig. 104.

objective *a** with changeable magnifying power, and the object is placed at about 10 cm. distance. The stage opening and mirror are

of correspondingly large dimensions. The underside of the stand resembles Zeiss' binocular preparation Microscope. The mirror is plane one side, concave the other, 7 cm. diameter, and has universal movement. Over it there extends a frame: this can be placed upon a sheet of white paper for affording diffused illumination. By means of the frame black paper diaphragms can be fastened over the mirror, if required, for stopping down the light-cone. The 10 by 10 cm. stage has an aperture of 4 cm., which can be reduced to 2 cm. by a diaphragm. Under the stage is a rotatory disk half-black, half-white, so that, if one is working with reflected light, a black or a white background can be had, as desired. The rotation axis of the disk which, in the binocular stand is placed on the right, is here placed on the left, so as to leave the right side quite clear for the drawing-paper. The entire upper part of the stand is fastened by two screws to the lower part. The bent arm bearing the optical system can be moved vertically up and down in two different ways: first, in the ordinary way by rack-and-pinion; secondly, by push-movement in a swallow-tailed groove. A screw provided with a short lever clamps the arm in the groove. The second movement is intended to lengthen the rack-range and to increase the object distance beyond 10 cm. The reversal system is in a drum with two tube-unions; the upper one bears an ordinary Microscope ocular; the lower has the English objective thread and can take either a revolver or a single objective. The construction is so arranged that the tube-length without the revolver is 145 mm.; with it, 160 mm., so that even medium-power objectives can be used with the stand. An extension ring of 15 mm. length allows of stronger systems to be used even without the revolver. The author gives full details of objectives and oculars.

Ortner's Pocket-Loup.*—This instrument (fig. 105) is fitted with two lenses; one, an aplanatic, has a magnification of twenty; the

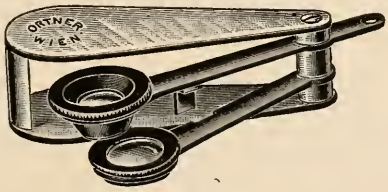


Fig. 105.

other, an achromatic, has a magnification of ten, the combination giving a magnification of 30 diameters. By pressing the projection or handle to the right the aplanat only comes out, while by pressing it to the left both loups are simultaneously extruded from the mount, and by a special contrivance are accurately centred.

Ortner's Loup-Stand.†—This loup-stand or lens-holder (fig. 106) which is chiefly intended for the use of entomologists, consists of a firm

* Ortner's Katalog No. 7 (Entomologie), 1904, p. 42.
† Tom. cit., p. 44.

pillar, supported on a circular base, and of two arms. One arm carries the lens, the other the object-holder. Both arms are fitted with a ball-and-socket joint. The lens arm has also vertical and horizontal move-

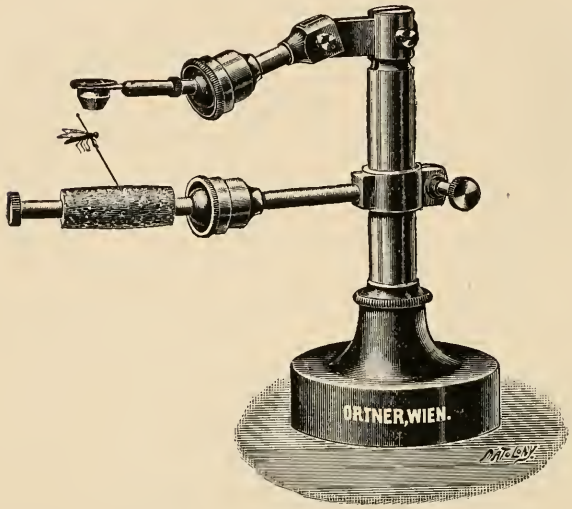


Fig. 106.

ments. This object-holder can be raised or lowered along the pillar, and its outer end is covered with cork ; this part of the apparatus can be rotated and also pushed to and fro. The apparatus can be supplied with lenses having magnifications of from 10 to 35 diameters.

(3) Illuminating and other Apparatus.

Artificial Light for the Microscope.* — C. J. Chamberlain states that excellent illumination is obtainable by means of a hollow sphere filled with liquid. The globe should be made of the finest flint glass, have a diameter of 6 in., and be mounted in a black frame. The liquid content mostly used is a weak solution of ammonia copper sulphate, made by adding 50 c.cm. of ammonia to 25 c.cm. of 10 p.c. solution of copper sulphate, and then adding enough distilled water to fill the globe. If the solution be milky more ammonia must be added.

The best source of light is an incandescent gas burner, so placed that the rays will be focussed on the mirror of the Microscope. With less powerful lamps a reflector is required.

Apparatus for Examination of Ultra-Microscopical Particles.†— (1) *In Solutions.*—The firm of Carl Zeiss have prepared the apparatus

* Journ. App. Micr., vi. (1903) pp. 2663–5 (2 figs.).

† Catalogue, Beschreibung der Einrichtungen zur Sichtbarmachung ultramikroskopischer Teilung, 1904

required for the investigations of Siedentopf and Zsigmondy on ultra-microscopical particles. Some of the results of these inquiries, more especially in regard to gold ruby glass and bacteria, were described by H. Siedentopf in a paper read before the Society.* It will be found, on reference to the paper, that the principle of the experiment consists (pp. 575, 576) "in illuminating only those particles which are to be made visible, by focussing an arc light upon a small spectroscopic slit; the light from this slit being focussed by a condenser upon those particles which are to be made visible. The size of the slit can be precisely controlled, and, with a knowledge of its width and of the condensing system employed, the exact thickness of the layer of illuminated particles can be regulated to a nicety."

The axis of the Microscope must be at right angles to the plane of

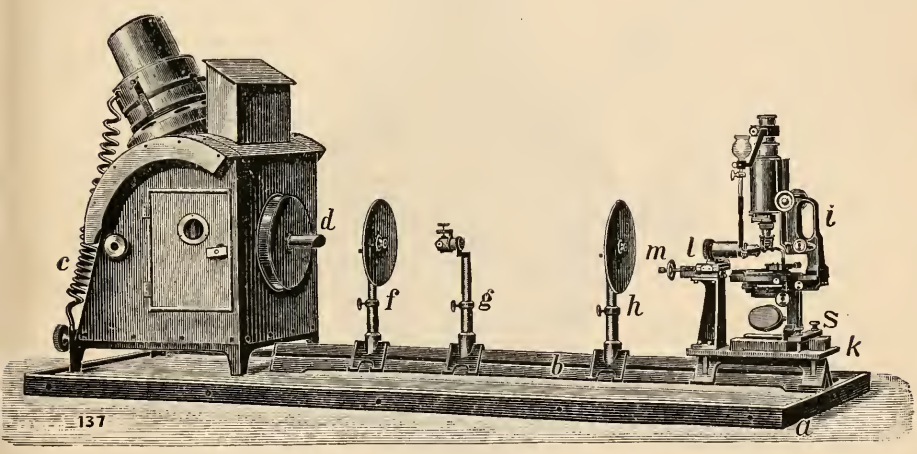


Fig. 107.

the beam, and the general arrangement of the apparatus is shown in fig. 107. On the stand *a*, an optical bench *b*, one metre long, is mounted. The stand is 34 cm. longer than the bench; the free part is unused, in case of sunlight, but serves for an arc lamp in case of artificial light. With sunlight a heliostat is indispensable. The figure shows at *c* a self-regulating arc lamp mounted on the stand. The lamp is so arranged that the axis of the narrow light beam emerging through the previously erected diaphragm *d* is parallel to the optical bench. A small projection objective *f* of 80 mm. focus, mounted on a rider, is arranged about 41 cm. from the beginning of the bench. The objective is surrounded by a circular diaphragm disk of 15 cm. diameter to keep off side light, and is chromatically and spherically corrected.

The next piece of apparatus *g* is a precision slit-head, and is also on a rider. It is moved along the optical bench until the projection objec-

* Journal R.M.S., 1903, pp. 573–8.

tive f throws on the slit a real image of the light source. With sunlight the distance of the slit from the objective is about 80 mm., and the sun's image is then 1 mm. in diameter. The slit-head is shown separately in fig. 108. The drum c, graduated on rim into 50 divisions, must always be on top: the entrance-slit is then horizontal. One complete rotation of the drum opens the slit about $\frac{1}{2}$ mm., so that the rotation of one division of the drum produces an aperture of $\frac{1}{100}$ mm. For the examination of fluids the most favourable slit-breadth is from 0·1 to 0·4 mm. The figure also shows the two slit-cheeks, one of which is secured by springs and is operated by the screw a. These cheeks limit the slit-length, which, with sunlight, should be about

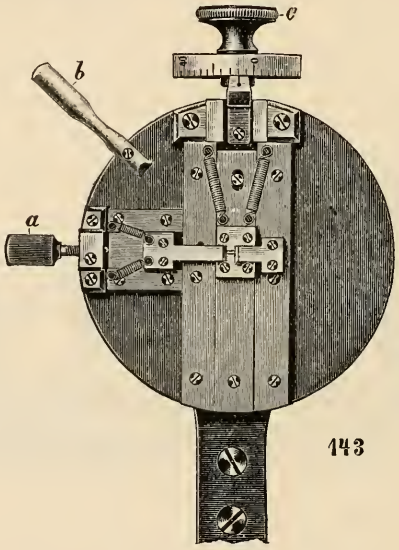


Fig. 108.

1 mm. The whole head can be rotated through 90° by the lever b. The effect is to make the slit vertical, which is of importance for gauging purposes. The slit answers a two-fold purpose: firstly, a measurable, illuminated volume is delimited in the preparation; secondly, the depth of this volume must be made as suitable as possible to the penetrating power of the Microscope objective used (in this case, the water-immersion D✱).

Details of the gauging process are given below. At h (fig. 107) there is a second projection objective of 55 mm. focus at a distance of about 14 cm. from the slit. Like the first objective, it is mounted on a rider with its front side directed towards the Microscope. It casts a real, about $1\frac{1}{2}$ fold reduced, image of the slit at a distance of 90 mm. from the lens. The function of this second lens is to bring the image

of the slit into the image plane of the Microscope objective A A. Quite at the end of the bench there is a Microscope stand *i*, with the base-plate *k* and cross-carrier *l*. The base-plate is clamped by the screw *s*, and the cross-carrier by two screws *m* (only one of which is visible in

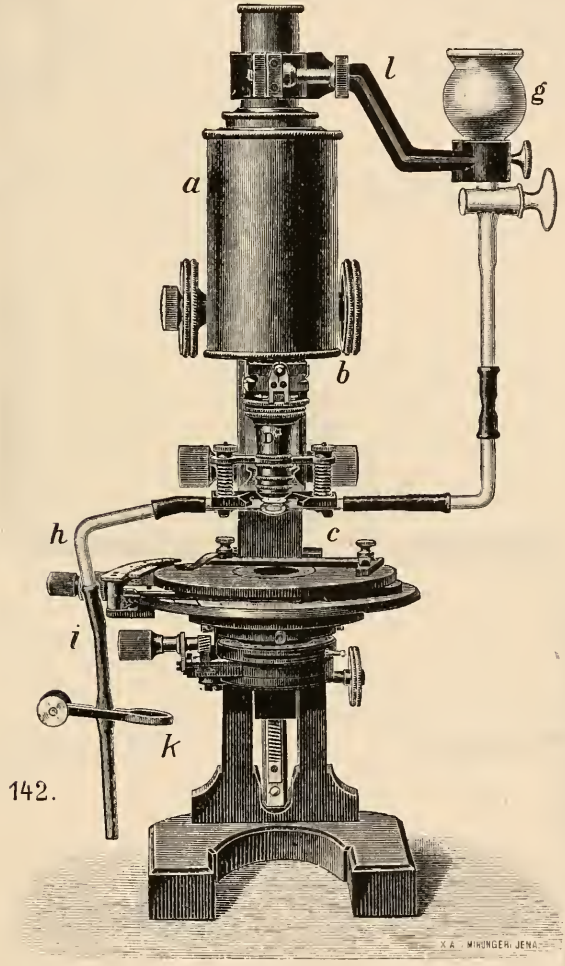


Fig. 109.

the figure), which move it micrometrically in two directions at right angles. The Microscope objective A A for the illumination is fastened to the carrier by a sleeve and moves with it, and thus the beam of light can be centred for the observation Microscope objective D*. When in

adjustment, the front lens of A A must be about 1 mm. from the mount of D*. On the tube *a* (fig. 109) of the Microscope stand the

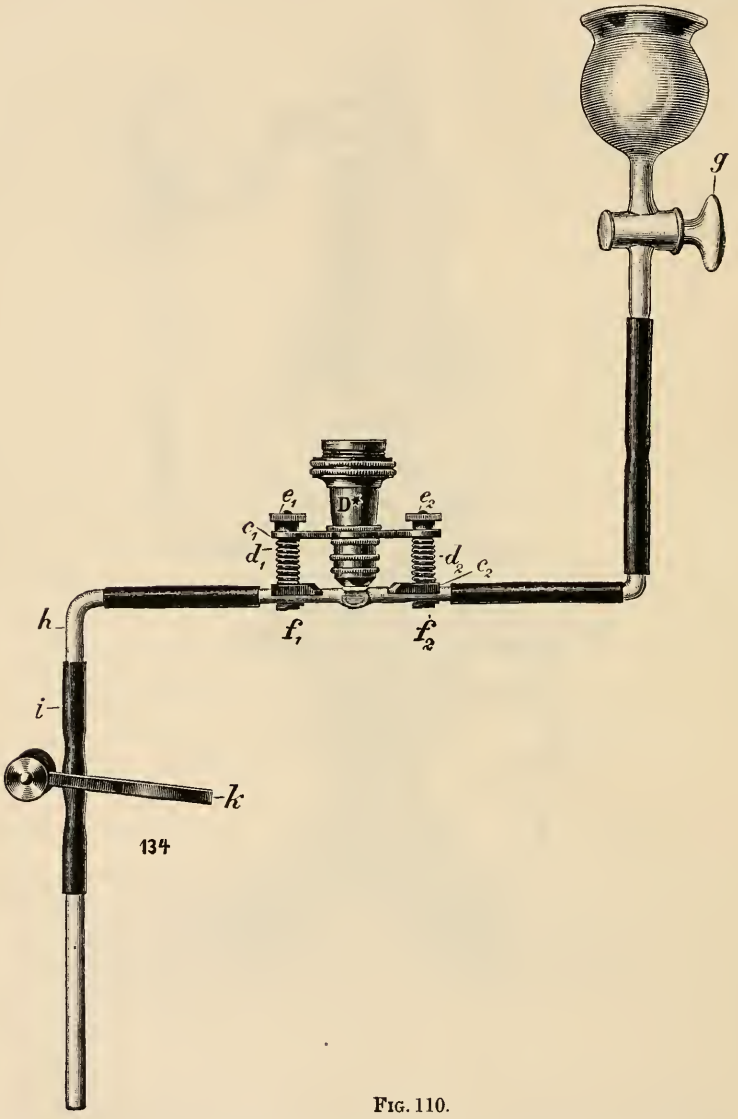


FIG. 110.

objective D* is fastened with a sliding objective change-piece. On this objective a special holder secures the cuvette used for observation.

The holder consists of an upper band c_1 (fig. 110), set round the objective mount, and a lower band c_2 encircling the back half only of the front lens mount; both these bands are held together by the springs d_1, d_2. The lower band can be moved upwards by means of the screws e_1, e_2. The cuvette is placed in two sections on the underside of the band c_2, and is then held fast by two springs secured by screws. The cuvette is again shown in fig. 111, and its two quartz windows must be so arranged, that one faces the light source and the other is parallel to the front lens of the objective. The screws e are

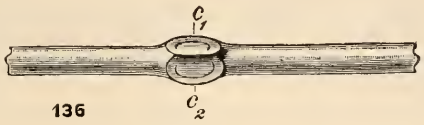


Fig. 111.

turned so as to bring cuvette and band to a position such that the quartz window is about 0·2 mm. from the front lens. The water-immersion is filled by injection, and the superfluous water carefully removed from the quartz window facing the light source. Quartz is recommended on account of its resistance to fluids, and as being in its molten state free from double refraction, and giving a sharp image of the slit. The ends of the cuvette are connected by indiarubber couplings with the thistle funnel g and the delivery tube h (fig. 109), the

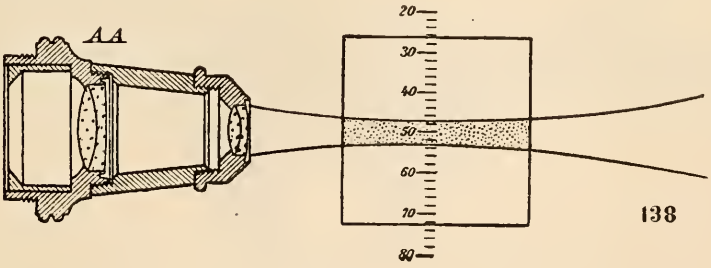


Fig. 112.

delivery tube being closed by a pinchcock k, and led away by a second coupling i to a final delivery tube. The pinchcock is only opened when it is desired to empty out the liquid in the funnel and cuvette. The attachment of the funnel by its holder l is made after the insertion of the objective.

The illuminated fluid is now gauged, so that its breadth is read off with an ocular micrometer as shown in fig. 112. The precision slit-head is next rotated 90° into its position, and the proper slit-breadth, corresponding to the depth of the observation, is then projected in the

microscopic image from left to right. The reading on the ocular micrometer now gives the depth. The slit-cheeks are brought as closely together as is suitable for the purpose.

It remains now to delimit forwards and backwards a portion of the light cone ; and this is done by rotation of the ocular micrometer into the position shown in fig. 113. The gauging can also be done by

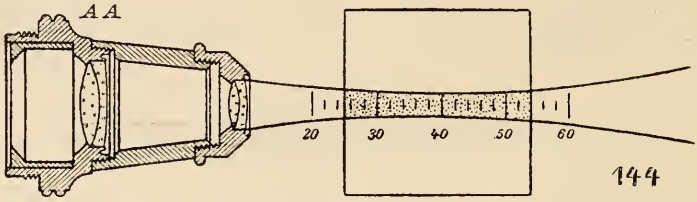


Fig. 113.

placing in the ocular quadratic fields, whose dimensions are known. Fig. 114 shows the network in Huyghens' ocular 4, which contains eighteen squares. The side-length of such a square has, in the combination of water immersion D✳ with a tube-length of 160 mm., a value of about 9 μ shown on the object. This arrangement suffices for approximate measurements ; but for accurate determinations the ob-

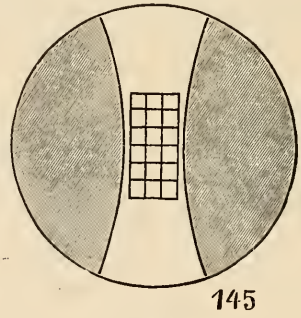


Fig. 114.

server must ascertain its value for his objective and ocular by comparison with an object micrometer.

Finally, for the observation of polarisation effects, an analyser is set up on the ocular. The particles show themselves the more polarised in proportion as they are more minute, according to the plane which passes through the axis of the illuminating and refracted beams. The analyser also serves for distinguishing the non-polarised fluorescent light from the refracted light.

(2) *For Ultra-microscopical Bacteria between Object-carrier and Cover-glass.*—The principle involved was described by Siedentopf in the above-mentioned paper,* as follows: "In the arrangement for this purpose the axis of the illuminating cone of light, and that of the rays diffracted by the object, are in a straight line, and not at right angles to each other, as in the other methods. Preparations of bacteria can therefore be mounted in the usual way." The general arrangement of apparatus is shown in fig. 115; and, on comparing it with fig. 107, it will be noticed that the base-plate, the optical bench, the heliostat (or arc lamp), and the projection objective have been retained. The objective of the Microscope is illuminated by the rear focus of its Abbe condenser, which itself receives the direct beam from the arc lamp through the diaphragm *d*. The observation Microscope is arranged at the end of the optical bench, and is secured on the stand *k* by means

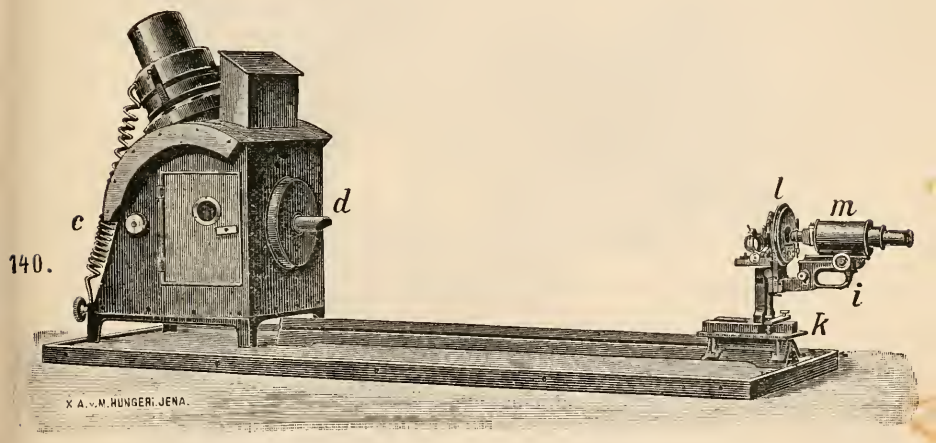


Fig. 115.

of clamps. It is set horizontally, so that its axis is parallel to that of the light cone: the object-stage is therefore vertical.

The illuminating apparatus consists of an exchange condenser (fig. 116) which permits of an easy alteration from ordinary illumination to dark-ground illumination. It includes the push-tube *a*, the three-lens condenser *b*, the special objective for dark-field illumination *c*, and the centring apparatus *d*. The tube *a* slides directly into the sliding collar of the illuminating apparatus, and, when fully pushed in, it engages with the clamp *h* of the condenser *b*. The iris diaphragm with ground-glass disk is then inserted from the side, and the illumination now takes place in the ordinary manner (fig. 117). The handle *m* serves for lateral movement of the iris. The objective used is the

* Journal R.M.S., 1903, pp. 577–8.

apochromat 2 mm. N.A. 1·30, with intense dark-field stop. This dark-field stop is after Prof. Abbe's suggestion, and has the front lens of the objective in its central part as far as aperture 0·33 mm. accurately cut away, and the corresponding plane face blackened. The only rays which enter the objective are those between apertures 0·3 and 1·3.

Among the advantages of the arrangement are: Firstly, absence of reflexions between the lenses; secondly, the tedious centring for dark-ground illumination is obviated; thirdly, a stop made like this cannot be decentred; and lastly, the objective remains available also for observation in the ordinary way without dark-ground illumination. If the illumination should now appear unequal, the inequality is due to

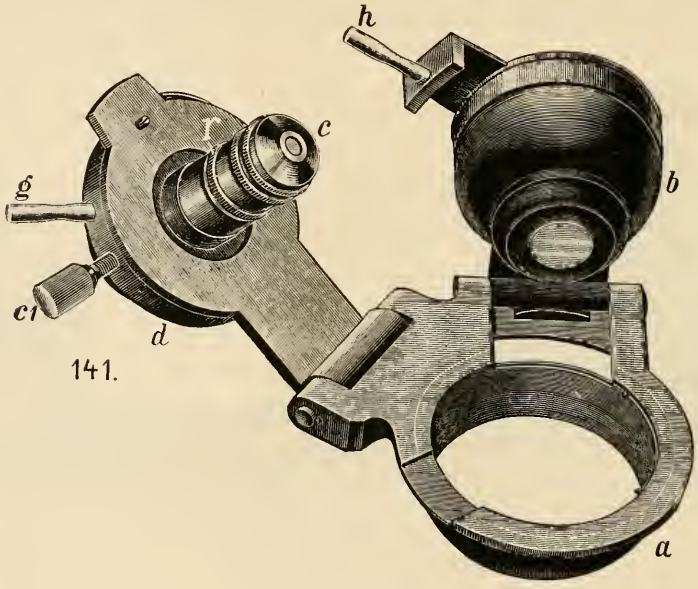


Fig. 116.

the fact that the reduced image of the light source of perhaps 0·1 mm. does not generally lie in the field of view of the observation objective. To correct this, two centring screws, c_1, c_2 (of which only one is visible in figs. 116 and 117), are provided, and must be so adjusted that the image of the light source appears in the preparation. This image is only indirectly visible, as only the particles which are encountered by the beams appear self-luminous through diffraction. The centring succeeds best with a not too high ocular (perhaps compensation ocular No. 4). The illumination can be increased or reduced by rotation of the ring *r*.

In the use of liquid films between object-carrier and cover-glass, care must be taken that the film thickness is neither too great nor too

small. The best is 1 to 3 μ. If the distance is much greater there is much disturbance from the indistinctness of the extra-focal parts of the

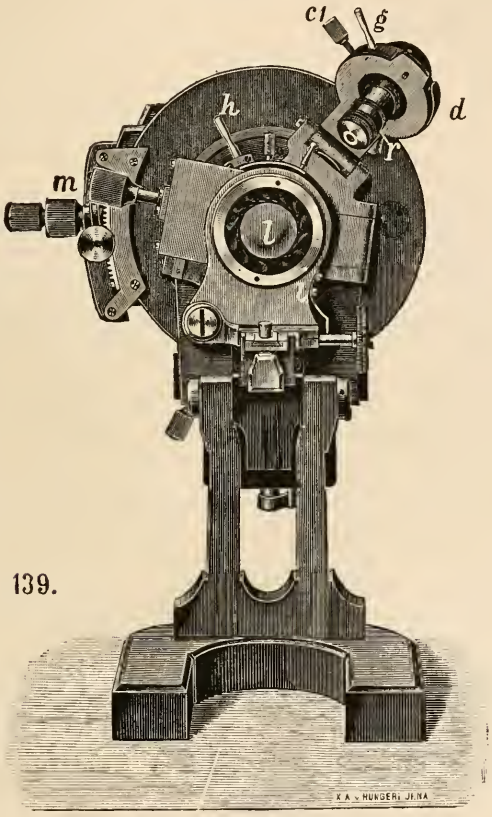


FIG. 117.

image; if the distance is less there is a very disturbing adsorption effect of the glass planes on the ultra-microscopical particles.

SIEDENTOPF, H.—**Ueber die physikalischen Principien der Sichtbarmachung ultramikroskopischer Teilchen.**

[This is substantially the same as Dr. Siedentopf's lecture before the Society, June 17, 1903, and printed in the Journal, October 1903.]

Berliner Klinischer Wochensch., 1904, No. 32; also reprinted as an extract, 7 pp.

(4) Photomicrography.

Grain in Photographic Plates.*—R. J. Wallace gives an account of the circumstances which control the size of the silver particles in a developed gelatino-bromide plate. Generally speaking, these particles

* Astrophysical Journal, Sep. 1904. See Nature, lxx. (1904) p. 571 (1 fig.).

were found to be spherical in ordinary plates, while isochromatic plates of several makes showed the peculiarity of having elongated or spicular grains at the surface of the film. These in passing downwards through the film gradually gave place to rounded particles, until close to the supporting glass these latter were the only ones found. Intensification increased the size of the particles, and these also varied with rapid and slow development. With rapid development the silver particles most nearly approached the size of the original particles of the silver salt from which they were produced. Prolonged development favoured enlargement of the particles by reason of the formation of "group particles" as well as by accretion.

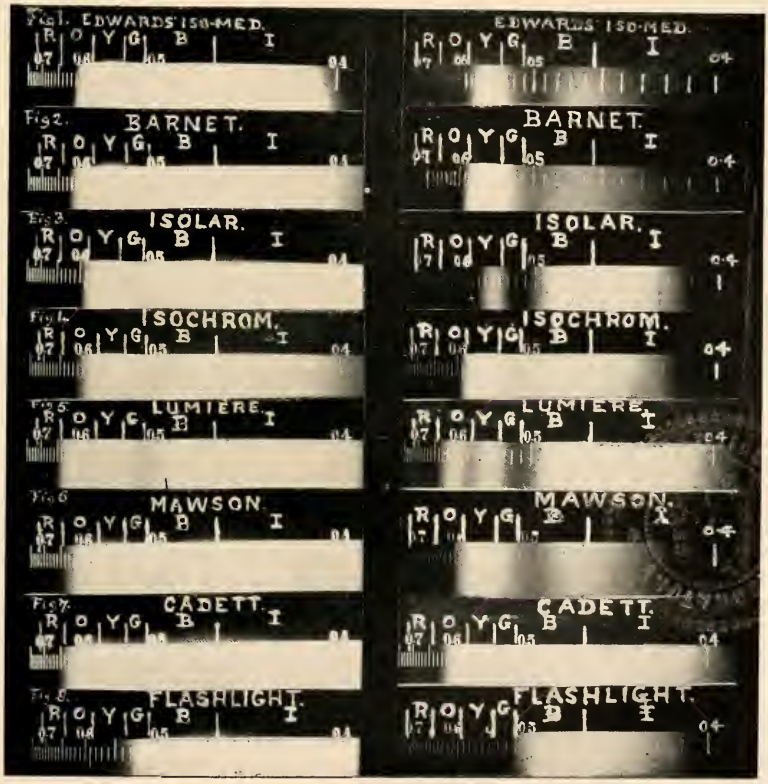
On Suiting Contrast Screens for the Photography of Bacteria.* E. J. Spitta commences his article by reminding his readers, that while the eye is sensible to differences of *colour*, the photographic plate can only perceive *contrast*. If, therefore, the images of two selected coloured objects of equal brightness are thrown upon a plate—provided it is specially prepared to be equally *sensitive* to both colours—their effect upon the emulsion is precisely the same, and their images appear similar within certain limits. But if it is desired to increase the contrast between two colours in photomicrography, one colour must be made less bright than the other. The object of the author's paper is to discover suitable screens for producing this effect. If the spectral colours of red, orange, yellow, green, blue, and violet are thrown upon an ordinary photographic plate (Plate XII.), it is at once seen that the emulsion is not sensitive to the entire range of the spectrum, and that the different colours which affect it do not do so equally with one another. This selective capacity may be called the "eye" of the plate. It is known that isochromatic or orthochromatic plates are those in which the sensitiveness of an ordinary plate has been extended by staining the film with some dye. Plate XII. gives a selection of "eyes" of several isochromatic plates. The wave-lengths in $\mu\mu$ are given the entire length of the spectrum, whilst little linear demarcation-limits are also placed (somewhat empirically chosen) where one colour may be said to merge into its neighbour. Inasmuch as all plates have a cumulative power, so with a long exposure (say 15 to 20 seconds) one part of the spectrum seems as it were to catch up the other parts; hence the final effect appears very similar in many cases, so far as relates to *density*, although differing in distribution *along* the spectrum, one part appearing to be affected more than another. This apparently equal density, as a matter of fact, is more apparent than real, for each emulsion, in reality, is more sensitive to one or two particular wave-lengths of light than to any others. This is the reason for supplying the extra column of exceedingly short exposures on the right hand of Plate XII., which shows at a glance where the chemical action in each case seems to have commenced. It will be observed (Plate XII.) that:

1. In the *Edwards Iso-medium* plate, action begins between wave-lengths 525 and 570, that is in the yellow; whilst with fairly long exposure its sensitiveness reaches to about 607 in the orange and to nearly the extreme end of the violet.

* Photography, xvii. (June 25, 1904) pp. 577–9 (4 plates).

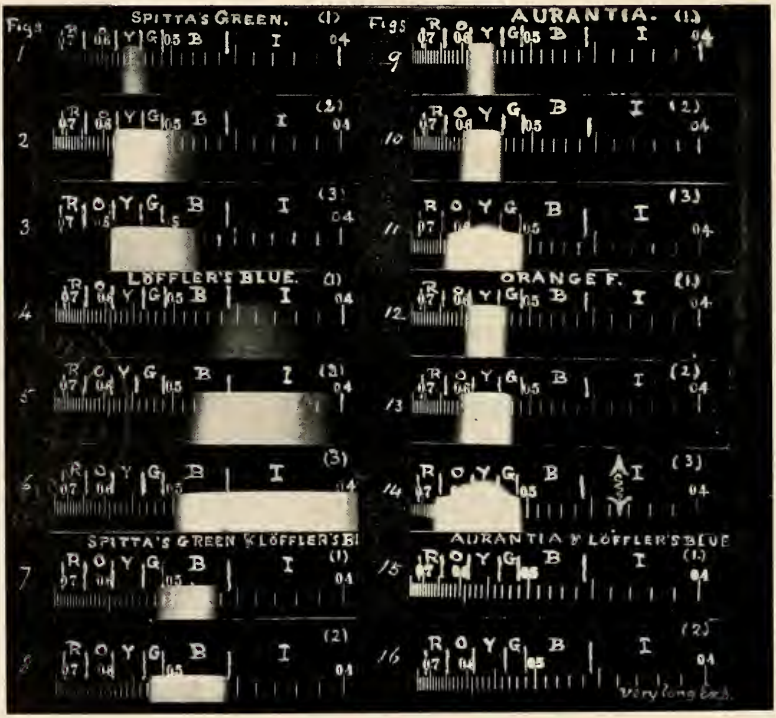
THE "EYE" OF DIFFERENT PLATES.

Long Exposure. *Very short Exposure.*



[*To face p.* 712.

LÖFFLER'S BLUE.



2. In the *Barnet* plate, action begins about the same place and extends somewhat further each way.

3. In the *Isolar*, action begins in the blue and indigo, where it is sharply sensitive, but is feeble in the yellow. With a prolonged exposure its sensitiveness reaches to about 596 in the orange.

4. In the *Isochrom*, a very rapid plate, fairly sensitive in the yellow, blue and indigo with a short exposure, action reaches to nearly 610 in the orange.

5. In the *Lumière Pantachromatic*, action starts away strongly and extensively in the blue and indigo, though faintly in the orange and yellow, and very weakly in the green. With exposure it reaches to nearly 650.

6. The *Mawson* plate is not unlike the Barnet, but it is a trifle quicker and a little more evenly sensitive.

7. In the *Cadett* plate we seem to have the greatest evenness of any isochromatic on the market. Action commences over nearly the entire range of the spectrum at one and the same moment, even with the exposure of half a second. It extends with a long exposure far into the ultra-violet, and to 650 at the red end.

8. The *Flashlight* plate is merely given as an example of the limited sphere of sensitiveness in the ordinary unstained plate. Action commences in the blue and violet nearly evenly, but no amount of reasonable exposure will produce effect much further than about 550.

Suppose that it is desired to photograph a blue-stained bacillus on a white ground. Then in order to increase contrast between the two colours in the photographic image, the brilliancy of one or the other must be weakened so as to affect the emulsion less. This can be done by staining the screen with such a colour that the blue is obliterated, i.e. that it becomes black to the "eye" of the plate—but the plate must be sensitive to the colour itself.

The three leading dyes for which we have to find contrasting screens are: Löffler's blue, gentian violet, and carbolfuchsin. Plate XIII. gives a spectrograph of Löffler's blue; and figs. 4, 5, 6 show the absorption bands peculiar to it, with short, medium, and long exposures. It will be seen that this dye transmits light as far as 500. If we now try and use a green pot-glass screen (much recommended for *general* use by the author, three exposures of which are shown in figs. 1, 2, 3, Plate XIII.), it will be seen that the glass transmits light from 474 to 580 or 590. There is, therefore, an overlap, through which a considerable amount of light passes (figs. 7 and 8). Such a combination of dye and screen is therefore useless.

Amongst the many dyes tried, Aurantia was found to be the best. Its absorption bands are shown in figs. 9, 10, and 11. In the longest exposure (No. 11) only light between 510 and 632 is transmitted, so that if this screen be used with the blue (fig. 15) there is just a margin of safety. Orange F is almost as good, but with a fairly long exposure there is a suspicious leakage at the position of the arrow.

Plate XIV. deals with gentian violet, figs. 1 and 2 showing its two spectrographs. A single thickness of green pot-glass (fig. 4) is not dense enough to cut off all the light; but two thicknesses make it a

safe screen to use (fig. 5). Plate XIV. also shows the spectrograph of carbolfuchsin (fig. 1). This dye passes much more indigo than red (as shown by the Edwards' plate—which was used for all these experiments). Although a fair photograph may be obtained without any screen, it is better to use the green pot-glass, which perfectly cuts off the light (fig. 2).

DOWDY, S. E.—**How to photograph crystals.**
Amateur Photographer, xl. (1904) pp. 93–5 (6 figs.).

HERTZSPRUNG, E.—**Ueber Tiefenschärfe.**
[The article is mainly concerned with the "penetration" attainable in ordinary photography; but the author also deals with the subject as affecting microstereoscopy.]
Zeitschr. f. wiss. Photographie (*Leipzig*), ii. (1904) pp. 232–44; also as an extract in pamphlet form.

JONES, C.—**Developments of three-colour photographic processes.**
Nature, lxx. (1904) pp. 553–5, 578–80.

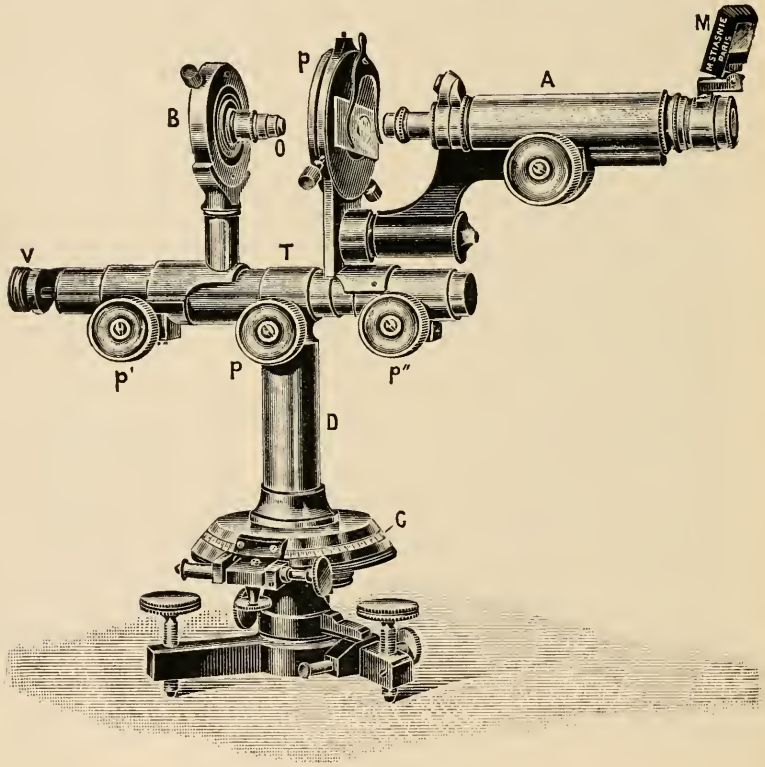


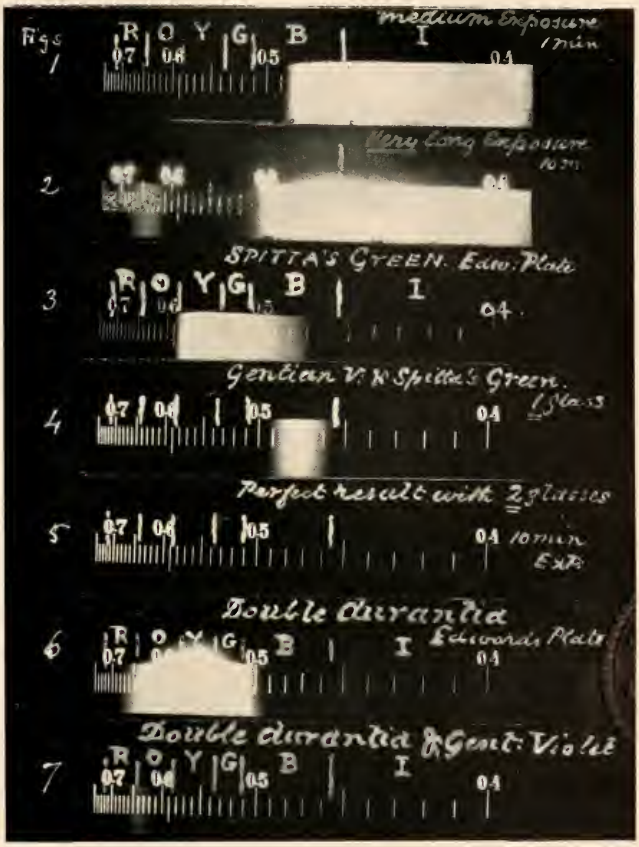
FIG. 118.

(5) Microscopical Optics and Manipulation.

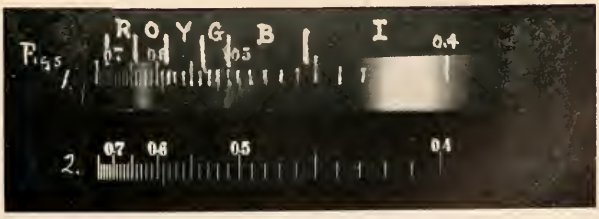
Photogrammetric Focimeter for Microscopical Optics: an Instrument for Verifying Microscopes.*—This instrument (fig. 118), due

* Comptes Rendus, cxxxvii. (Aug. 3, 1903) pp. 314–6 (1 fig.).

GENTIAN VIOLET.



CARBOLFUCHSIN



[To face p. 714.

to the combined efforts of V. Legros and M. Stiassnie, is intended to bring into the regular practice of the workshop and of centres of microscopical instruction, the results which formed the subject of a previous communication * by M. V. Legros. The base C (fig. 118) is a divided circle from whose centre arises a vertical column D, terminated by a horizontal sleeve T. In this sleeve there glides, governed by a rack-and-pinion p, a rod on which move also under the action of pinions p', p'', two other sleeves bearing the optical parts. These sleeves can ride one over the other, their displacements being measured by verniers. The sleeve manipulated by p' has also a slow movement governed by a screw with divided head V. The part A represents the body of an ordinary Microscope with its stage P : a slight displacement can be given by the revolver for purposes of parallax. The stage and substage are fitted with centring and rotating movements. Micrometers are fitted to both faces of P, and the orifice in the substage is provided with interlocking screw-jaws for receiving optical systems. Details are given of the methods for measuring (1) the focal length of an objective or ocular ; (2) the angle of aperture ; (3) distortion.

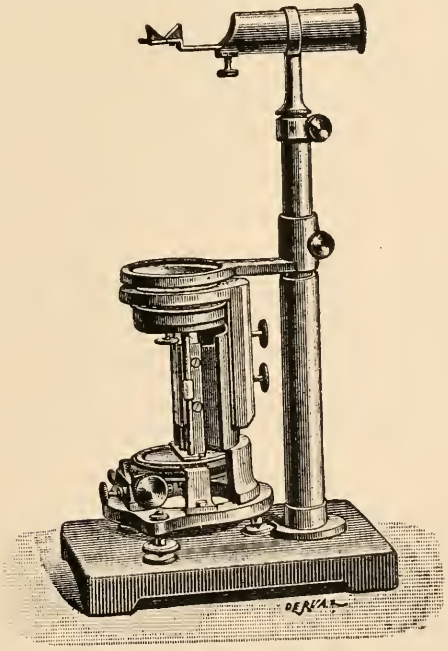


Fig. 119.

Desains' Apparatus.†—This instrument (fig. 119) is intended for measuring wave-lengths by Newton's rings.

* Comptes Rendus, cxxxvii., Jan. 29, 1900.

† Cat. Soc. Genevoise pour la Construction d'Instruments de Physique et de Mécanique, 1900, p. 111.

Chromatic Correction of Object-Glasses.* — A. E. Conrady, after drawing attention to the utter uselessness of Cauchy's dispersion formula, gives as an alternative

$$n_\lambda = n_0 + v_1 \lambda^{-1} + v_2 \lambda^{-\frac{7}{2}}$$

Next, he explains the method of trigonometrically tracing a ray through a spherical surface, and then shows that if d be the thickness of a lens at the axis, and D its thickness where traversed by an extra axial ray, and if δn be a small increment of the refractive index n, the equation for an achromatic condition will be

$$\Sigma \, \delta n \, (d - \mathrm{D}) = 0.$$

Finally, he points out that when a ray is near the axis the angles become so small that in the computation sufficient accuracy is obtained by writing $\frac{1}{2}$ (circular measure)^2 instead of the versed sine of the angles.

(6) Miscellaneous.

Ultra-microscopic Observations in Solutions of Pure Glycogen.† W. Biltz and Z. Gatin-Gruzewska used the apparatus of Siedentopf and Zsigmondy for their observations on glycogen. Similar observations had been made previously by Raehlmann and others, but the samples of glycogen used by these observers were not pure. The authors used A solutions of glycogen in water and B solutions, to which different reagents were added. The A set showed that in an aqueous solution of glycogen when examined ultra-microscopically there are corpuscles of different sizes; the size varying with the conditions of the solutions. The B set showed the progressive and regular course of the precipitation of glycogen under the influence of increasing quantities of certain precipitants.

Microscope and Expert Testimony.‡ — A. S. Osborn shows how useful the Microscope is for examining documents, especially in case of fraudulent additions, interlineations and erasures. The paper is furnished with excellent illustrations giving examples of retouched writing, forgeries, and lines showing the sequence of writing.

Reed, L.—**The Microscope and food adulteration.**
Proc. and Trans. Croydon Nat. Hist. and Sci. Soc., 1904, pp. 41–4.

B. Technique.§

(1) Collecting Objects, including Culture Processes.

Detection of Nitrifying Organisms in Sewage Filters.‖ — The following is the technique employed by Schultz-Schultzenstein (see p. 695): 100 c.cm. of Winogradsky's nutrient solutions for the nitrite-

* Monthly Notices Roy. Astron. Soc., lxiv. (1904) pp. 182–8 (2 figs.); pp. 458–60.
† Comptes Rendus, cxxxix. (1904) pp. 507–9.
‡ Journ. App. Micr., vi. (1903) pp. 2637–43 (8 figs.).
§ 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.
‖ Technology Quarterly, xvii. (1904) pp. 186–203.

and nitrate-forming bacteria were put in Erlenmeyer flasks. To these flasks were added coke from experimental contact beds, soil from irrigation field, etc., in quantities of a few grains. The solutions were kept at 25° C. to 26° C., and examined daily for ammonia, with Nessler's reagent; for nitrites, with sulphanilic acid and α naphthol; and for nitrates, with diphenylamine. After six days sub-cultures were made, and from these inoculations were made on silica jelly. By such means organisms were isolated agreeing completely with Winogradsky's *Nitrosomonas* and *Nitrobacter*.

Identification of the Bacillus typhosus in Stools.*—E. Klein and A. C. Houston, from a research on this subject, conclude that the Drigalski-Conradi medium in plates incubated at 37° C. is of value in assisting detection in a short time (24 hours) of the presence of *B. coli communis* and allied forms; the colonies of this microbe being noticeable by their red colour. Accordingly, in the search for the *Bacillus typhosus* in stools the above colour reaction permits of many colonies being excluded. The recognition of the typhoid colonies was found possible only in the plates made with high dilutions; and in these alone were the (red) colonies of *B. coli* sufficiently reduced in number to allow recognition of the typhoid (blue) colonies. Tests with sub-cultures are necessary. It follows, therefore, that where the typhoid bacilli are present in a stool only in small numbers the Drigalski plate is not able to demonstrate them with certainty, for the reasons that: the method does not alter the initial proportion of *B. coli* to *B. typhosus*; high dilution of the stools is necessary; all blue colonies are not those of *B. typhosus*.

Bacteriological Test for Estimating Pollution of Air.†—M. H. Gordon has undertaken an inquiry to determine whether it is possible to find a bacteriological test of the pollution of air by material given off from the human body, comparable to the *B. coli* (etc.) test for the pollution of water by material derived from a like host: a test capable of application as an index of the possible access of morbific virus to air in a manner similar to that in which the *B. coli* (etc.) test is an index of its possible access to water. Air is liable to be polluted by material given off from the human body in the acts of expectoration, coughing, sneezing and speaking, and such material consists of mucus derived from the respiratory passages. The procedure adopted was: (1) A bacterial analysis of a number of samples of saliva obtained from normal individuals was made, special attention being paid to the micro-organisms most abundant therein, with the object of determining whether any particular micro-organism is by the abundance and constancy of its presence characteristic in the way that *B. coli* is characteristic of fæces. The most abundant and constant organism in normal saliva was found to be *Streptococcus brevis* of Lingelsheim. The sparse occurrence of bacilli was noticeable. Neutral-red broth, for the reason that its colour is markedly changed by *S. brevis*, is, when incubated anaerobically for 48 hours at 37° C., a culture test whereby very minute

* Rep. Med. Off. Local Govt. Board, 1902–3, pp. 622–46.
† Tom. cit., pp. 421–71.

droplets of saliva may be readily detected. (2) A series of speaking experiments was made in a small and also in a large room, first with the artificial infection of the mouth with a living emulsion of *B. prodigiosus*, and afterwards with no artificial infection, culture plates being placed at different distances on the floor. By this means the presence in the air of a room of invisible droplets of ordinary saliva emitted from the mouth during the act of loud speaking was demonstrated at a distance of 40 feet in front of the speaker, and at a distance of 10 feet behind him. (3) The open air in several localities was examined both by exposing broth plates for definite periods, and by aspirating the air through a special apparatus. By these means twenty-two streptococci were isolated from the open air, three of which resembled *S. brevis* of the saliva. Virulent anaerobic bacilli resembling *B. enteritidis sporogenes* were isolated five times, and micro-organisms of the *B. coli* type thrice.

Simple Method for Cultivating Anaerobic Bacteria.* — B. R. Rickards recommends the following method (fig. 120) for solid media.

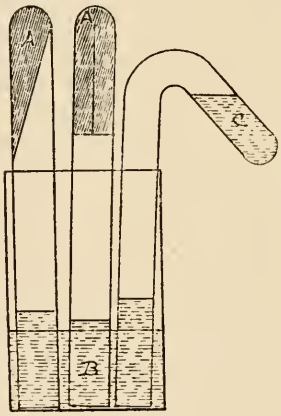
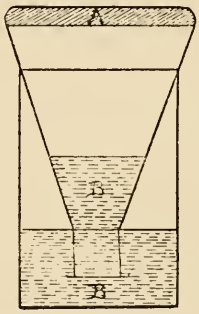


Fig. 120.



A Agar.
B Pyrogallol.
C Broth.

Fig. 121.

The tube of inoculated media is inverted into a tall vessel containing a layer of dry pyrogallol, to which is then added a strong solution of sodium hydroxide. As the oxygen is absorbed the solution rises in the tubes. For liquid media the same procedure is followed, but a tube is employed, the lower two inches of which is bent at an angle of 60°, and in this part is contained the liquid medium. For plate cultures an inverted Erlenmeyer flask answers well (fig. 121).

Symmers, W., St. C.—**Method of maintaining the virulence of a pathogenic micro-organism, Bacillus choleræ asiaticæ.**
Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) pp. 23–4.

* Centralbl. Bakt. Orig., xxxvi. (1904) pp. 557–9 (2 figs.).

(2) Preparing Objects.

MARPMANN—Ueber die Präparation der Diatomaceen, Foraminiferen, Polycystineen and Spongillen. *Zeitschr. angew. Mikr.*, x. (1904) pp. 141–5.

(3) Cutting, including Imbedding and Microtomes.

Agar Method for Imbedding Plant Tissues.* — H. H. York recommends the following quick and simple method for fixing and imbedding plant tissues. 10 grm. of agar are boiled in 500 c.cm. of distilled water for 2 hours. The hot solution is poured into a tall cylindrical vessel. When cold, the clear upper portion is cut off and put into a glass jar. The jar is placed in a basin of hot water until the agar is melted, and then 1 part of formalin is added to 9 parts by volume of the melted agar. A 5 p.c. solution is prepared in a similar way. The fresh tissue is placed in hot 2 p.c. solution for about 2 hours, and is then transferred to the 5 p.c. solution for an hour or so, after which it is imbedded on wooden blocks. A layer of agar is smeared on the block, and allowed to cool; then the piece of material is placed thereon and covered with a sufficient amount of agar. When properly fixed to the block the whole mass is placed in 95 p.c. alcohol for 12 hours, after which it is sectioned on a sliding microtome.

Sectioning Wheat Kernels.† — B. J. Howard soaks the grains in 90 to 95 p.c. alcohol for 10 to 14 days, after which 90 p.c. glycerin is added to the alcohol in small proportions at intervals of a few days, until the proportions of alcohol and glycerin are about equal. The material is then allowed to stand until the grains have attained a firm cheesy consistence. When the softening has attained a satisfactory stage, the grains are placed in a shallow dish just covered with the fluid. When the alcohol has evaporated (2 to 3 days) the grains are treated (1) with 98 p.c. alcohol for 30 to 60 minutes; (2) with chloroform, 30 to 60 minutes; (3) chloroform and paraffin shavings, 60 to 90 minutes; (4) melted paraffin, changing 2 or 3 times, for 2 hours; (5) block; (6) sections.

Imbedding Medium for Brittle Objects.‡ — J. B. Johnston has found that rubber mixed with paraffin wax makes a satisfactory medium for imbedding brittle objects, such as amphibian embryos. Mix with hard paraffin about 1 p.c. of indiarubber cut up into very small pieces. Dissolve by heating to 100° C. (not more) for 24 to 48 hours, though several days at from 55° to 60° will serve the purpose. Filter or use the supernatant fluid. Keep a stock of the prepared mixture cold, as the rubber separates out after a few weeks if the mixture is kept melted. Use as ordinary paraffin, except that xylol and not cedar-wood oil must be used for clearing. The hardened block is light brown, and the melted solution is murky. This murkiness may be prevented by dissolving in the paraffin before the rubber is added enough "mineral rubber" (asphalt) to give the paraffin a light amber colour. This paraffin-asphalt solution is more transparent than simple paraffin, and so facilitates orientation of the object.

* Journ. App. Micr., vi. (1903) pp. 2591–2.
† Tom. cit., pp. 2498–9 (1 fig.). ‡ Tom. cit., pp. 2662–3.

Radais' Microtome with Vertical Slideless Carrier.* — This instrument, designed by Radais, belongs to the class of microtomes in which the histological object borne by a carrier receives a vertical movement. It is the knife which governs the adjustment and regulates the thickness of the section. The mechanical arrangements of the various parts are essentially different from the instruments hitherto in use; the results attained are marked by easy manipulation and an evenness of section, which remains uniform even in the weakest section-strengths.

Fig. 122 shows the apparatus arranged for celloidin sections. The

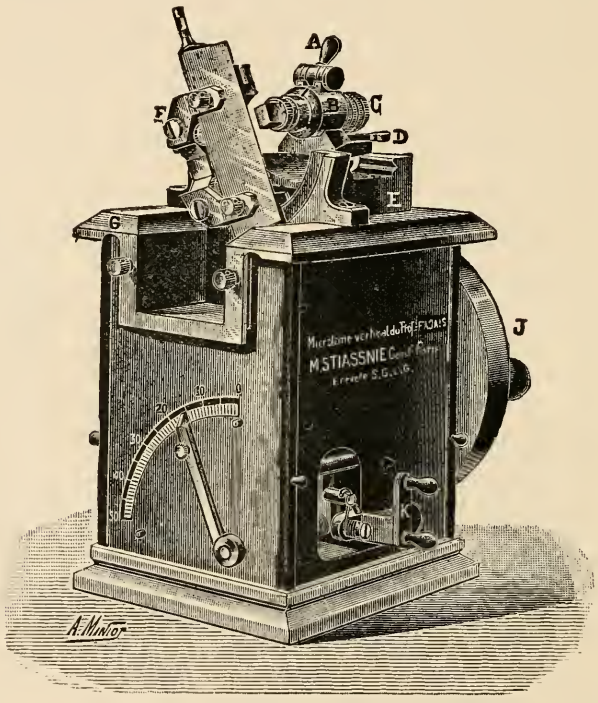


Fig. 122.

carrier is guided in a straight-lined course by means of two Watts' balance-wheels, movable between conical steel points. Such a kind of adjustment lends itself to a very exact control, and obviates the working-space required for the slides generally recommended. Indeed it is evident that in many machines the unequal pressure of the oil layer is the main cause of the irregularity of the section thickness, and, moreover, the fouling is very considerable. In the axle movements between the points the upper planes are in no wise exposed to the dust, the

*. Zeitschr. angew. Mikr., ix. (1903) pp. 206–9 (2 figs.).

wear and tear is almost nil, and the accuracy is unlimited. The regularity of the carrier-track is also secured by means of the arrangement of the device which keeps the bearer of the histological object vertically over the engage-point of the driving-wheel. This orderly arrangement, to which constructors have hitherto paid too little attention, avoids all quivering which could influence the carrier. The orientation of the object to be cut is easily and quickly accomplished by the application of a special handle A B C, which is fastened in a circular-shaped groove of the carrier E. With the help of this groove and the rotation of the cylindrical object-holder C about its axis, the celloidin plug moves,

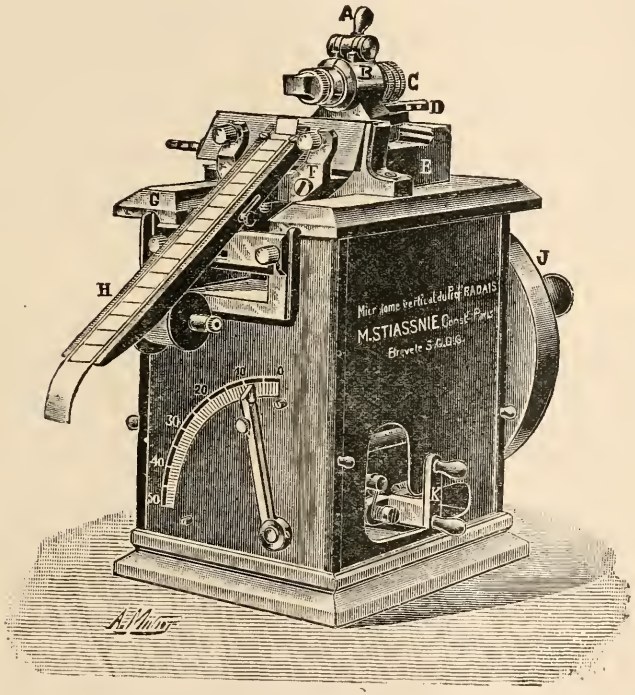


Fig. 123.

so that the object can be oriented without removal from the vertical line over the engage-point with the driving-wheel. The motive system of the micrometer screw removes all back-friction of the catch on the toothed wheel, and thus excludes any possibility of back-action. The female screw of the micrometer is movable, and of the ordinary type. A special form of screw-division permits, by a simple manipulation of the swing-piece of the handle K, the knife to approximate directly to the upper plane of the object to be cut. The automatic micrometric forward movement can then be immediately begun.

The apparatus will produce sections of thicknesses varying from 1 μ to 50 μ. A change may be made during operation by the application of a needle on the quadrant of a divided circle, and in this way the thickness may be quickly determined in the case of series sections at the beginning of the cutting. Fig. 123 shows the machine arranged for paraffin and series-cutting. The knife cuts horizontally or obliquely without any exchange, and the operator can therefore immediately change the section-angle with the carrier of the histological object. This carrier is united to the vertical diameter of a metallic semicircle F, which serves as a carrier to the knife. The edge of the section passes through the centre of this circle, which can rotate around itself in a circular track, or can be clamped fast. It therefore follows that the knife, in consequence of a rotation of 90°, can take every required position from the horizontal to the vertical. In each individual case the oblique setting of the section is arranged, as seems best, and serial sections are cut without changing any part of the apparatus. A paper-strip H can be applied, as shown in figure, for the more convenient reception of the serial sections. The gearing is inside the frame.

HANDLEY, W. S.—**Method of obtaining uniplanar sections with the ordinary rocking microtome.** *Journ. Anat. and Physiol.*, xxxvi. (1903) pp. 290–2.

(4) Staining and Injecting.

Staining Hyphomycetes in Horny Tissues.* — A. Kraus uses a methylen-azur solution prepared according to Michaeli's formula.† It is made by dissolving 2 grm. of medicinal methylen-blue in 100 c.cm. of water; 10 c.cm. of one-tenth normal caustic soda solution are added, and the mixture boiled for a quarter of an hour. When cold 10 c.cm. of one-tenth normal sulphuric acid are added, after which the solution is filtered.

The material (scales and crusts from the skin and hairs) is stained for 5 minutes or so, and is afterwards differentiated in 96 p.c. alcohol. Good results were obtained with *Pityriasis versicolor*, *Herpes tonsurans*, *Favus*, *Eczema marginatum*, *Erythrasma*. It is advisable to remove fatty matter with a mixture of ether and alcohol before staining.

Simple Method of Spore Staining.‡ — E. Thesing fixes the air-dried film in the flame, then covers it with 1 p.c. platinum chloride solution and heats it till it vaporises. The film is then washed with water and mopped up with blotting-paper, after which it is flooded with the staining solution (carbol-fuchsin or Loeffler's methylen-blue) and then heated again over the flame. The stain is poured off, and after having been treated with 33 p.c. alcohol the preparation is thoroughly washed. When dry it may be contrast-stained (Loeffler after carbol-fuchsin; safranin, vesuvin or fuchsin after Loeffler). The film is then treated in the usual way, and mounted in balsam.

* Centralbl. Bakt., 1te Abt. Orig., xxxvii. (1904) pp. 153–5.
† See this Journal, 1901, p. 602.
‡ Zeitschr. angew. Mikr., x. (1904) pp. 147–8.

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

Sticking of Celloidin Sections.* — K. v. Tellyesniczky suggests that, instead of using Mayer's glycerin-albumen as in Argutinsky's method, albumen simply diluted should be employed, as the white of one egg diluted to 100 c.cm. with distilled water and filtered. This he claims gives a much smoother and more uniform surface of coagulated albumen than Mayer's glycerin-albumen, and does not stain appreciably. He also advocates the use of mica plates for mounting celloidin sections.

(6) Miscellaneous.

Ink for Writing on Glass.†—Dissolve 20 parts resin in 150 parts of alcohol, then add, drop by drop, stirring all the while, a solution of 35 parts borax in 250 parts of water. Finally dissolve 1 part methylen-blue in the mixture.

Metcalf, H., & G. G. Hedgcock—**New apparatus for phytopathological work. 1. A transferring "Oese." 2. Apparatus for growing seedlings and small plants under sterile conditions.** *Journ. App. Micr.*, vi. (1903) pp. 2493–5 (2 figs.).

Dickerson, W. S.—**Useful modification of the life-box.**

[This consists in substituting for the ordinary cover-glass of the life-box, a thin glass perforated by a small opening near one margin.]

Tom. cit., pp. 2499–500 (1 fig.).

Metallography, etc.

Evolution of Structure in Metals.‡—M. G. Cartaud has been able by means of picric acid in acetone to etch the surfaces of soft metals such as lead, zinc and tin. He gives his reasons for thinking that the cellular surface structure so displayed is antecedent to the perfectly developed crystalline structure of the interior. The cellular structure is, as it were, embryonic; the crystalline, adult.

Behrens, H.—**Notes from the Microchemical Laboratory at Delft.**

[1. Movements in metals under annealing. 2. On tinning and soldering. 3. Etching by means of electricity.

Iron and Steel Mag., viii. (Aug. 1904) pp. 150–5.

Campbell, W.—**Change of structure in the solid state.**

[A useful *résumé* of our present knowledge of changes in metallic structure during and after solidification.

Journ. Franklin Inst., clviii. (Sept. 1904) pp. 161–84 (34 figs.).

Shepherd, E. S.—**Some neglected details in the experimental study of alloys.**

Iron and Steel Mag., viii. (Sept. 1904) pp. 222–31 (6 photos).

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* Eine einfache und zuverlässige Methode Celloidinserien mit Wasser und Eiweiss aufzukleben. Arch. Mikr. Anat., Bd. lv. (1900). See also Anat. Anzeig., xxv. (1904) p. 182.

† Pharmaceutical Era, Sept. 1903. See Journ. App. Micr., vi. (1903) p. 2636.

‡ Comptes Rendus, cxxxix. (1904) pp. 428–30.