Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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

FOR THE YEAR

1906

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, LONDON, W.

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MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Beck's New Portable Dissecting Microscope.† — This dissecting Microscope is made in a portable form, with all the necessary apparatus packed into the thickness of the wood, so that when folded there are no

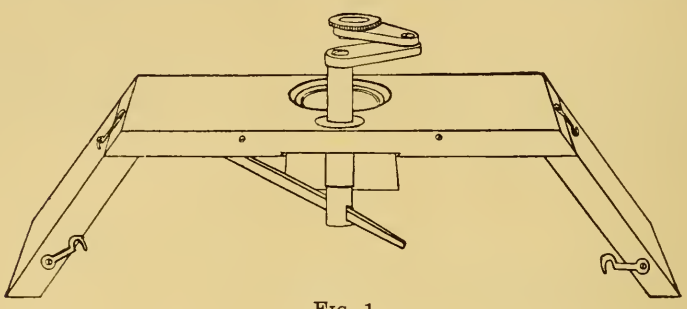


Fig. 1.

projections or loose pieces. The size when folded is 9 by $3\frac{3}{4}$ by $1\frac{1}{8}$ in. Fig. 1 shows the instrument ready for use, and fig. 2 how it is hinged and folded back when not in use. The table has a circular aperture for the reception of a white porcelain saucer or a piece of transparent glass.

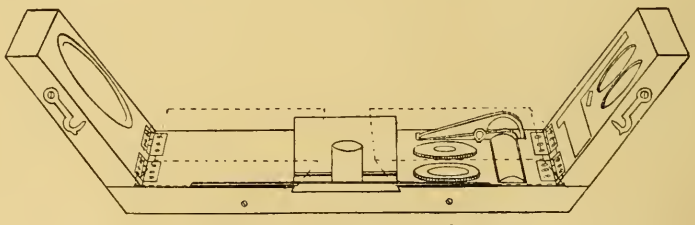


Fig. 2.

The lens carrier consists of a tube which fits into a socket in the table. It has a double arm at the end of which the lens is fitted. At the lower end of this is a lever, which forms a focusing adjustment.

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

† R. and J. Beck's Special Catalogue, 1905.

Reichert's New Stand VII.*—This model (fig. 3) has a circular stage, and a bent arm which serves at the same time as a handle for carrying. There are the usual fittings and adjustments.

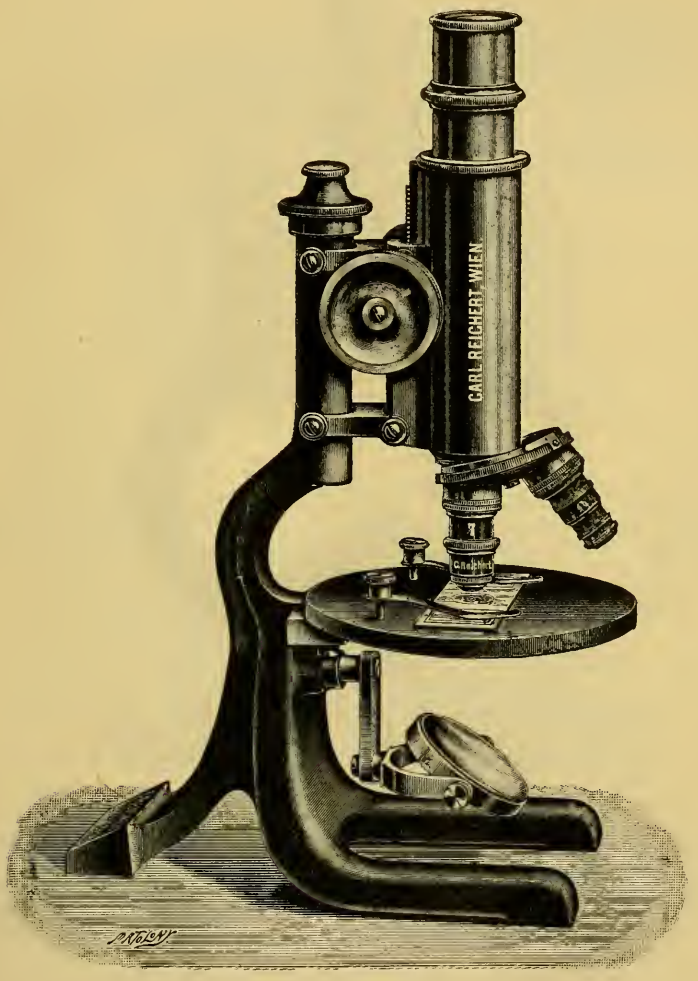


FIG. 3.

Reichert's New Handle Microscope.†—This stand (fig. 4) has an inclination of 45°, a large circular stage, and an extra large curved bar

* Reichert's Special Catalogue, 1905, p. 7.

† Tom. cit., p. 8.

which serves as a handle for carrying. There are the usual coarse and fine adjustments, and the accustomed substage fittings.

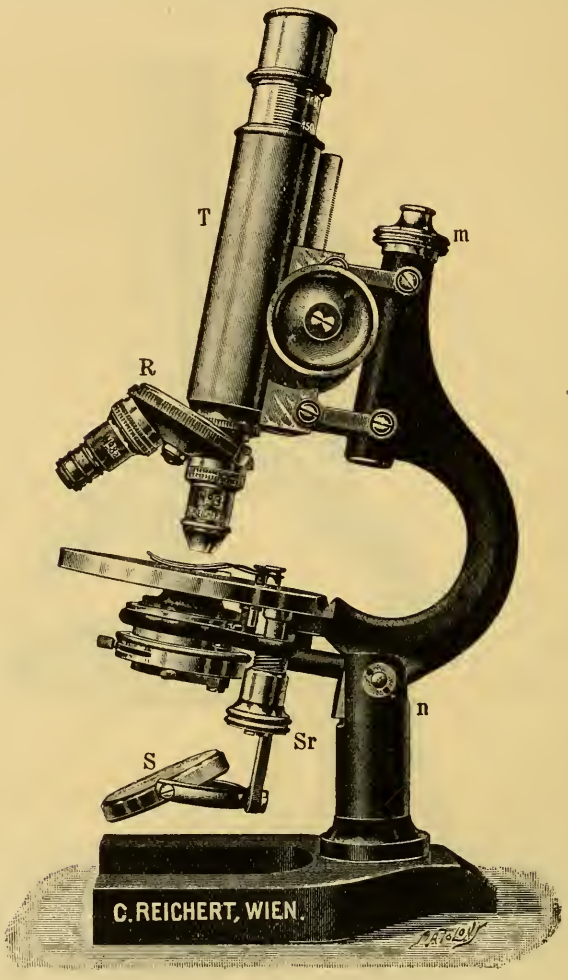


Fig. 4.

(3) Illuminating and other Apparatus.

Nernst-Paul Optical Electric Lantern.*—This compact and portable lantern (fig. 5) is constructed entirely of metal, and may be connected to any electricity supply system. It does not require any special preparation or external appliances. It is specially adapted for travelling, as

* R. W. Paul's Special Catalogue, 1905.

the whole apparatus, ready for use, can be carried in one hand. The measurements of the case are 18 by 7 by 7 in., and the weight 15 lb.

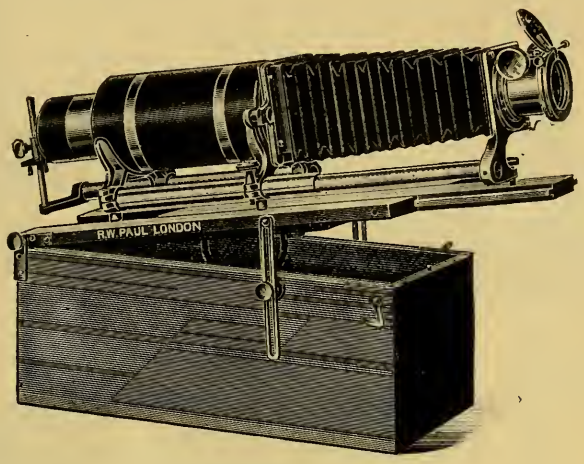


Fig. 5.

Nernst-Paul High-power Electric Projector Lamp.*—This projector lamp (fig. 6), which is a high-power illuminant for the lantern, takes a current of about three amperes, and in the same lamp a burner

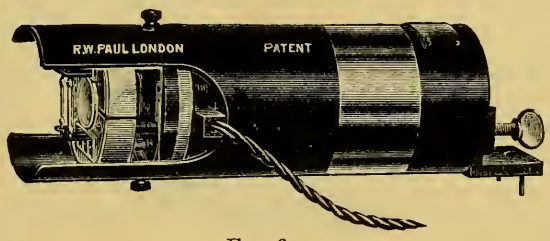


Fig. 6.

may be used suited either for direct or alternating current, or for pressures of 100, 200, or 250 volts, a different burner being required for each of the systems of supply.

Nernst-Paul Electric Science Lantern.†—This lantern (fig. 7) is adapted for horizontal or vertical projection, the whole apparatus being mounted on trunnions. When used for vertical projection the lantern is turned into the upright position, so that one reflector only is needed and brilliant illumination insured. The change from one position to the other is effected instantaneously. The metal stand has levelling

* R. W. Paul's Special Catalogue, 1905. † Op. cit.

feet and substantial clamps for fixing the lantern, the body of which, as well as all the working parts, is of metal.

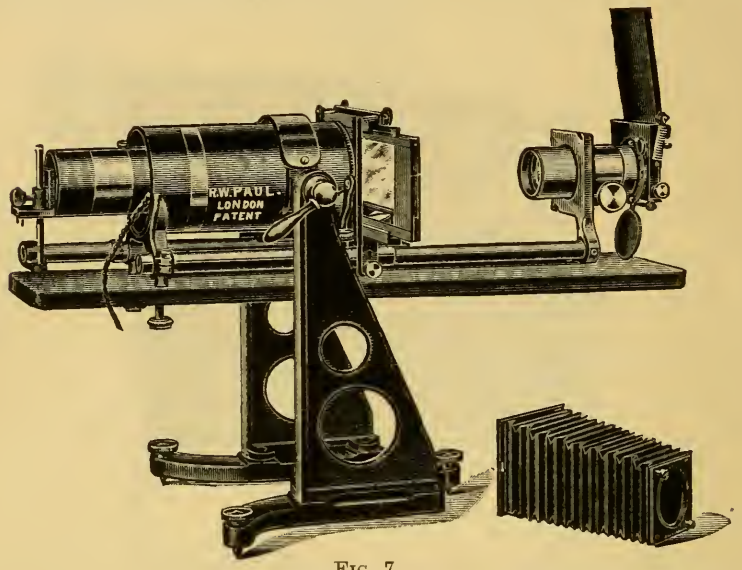


Fig. 7.

Adjustable Microscope Lamp.*—R. W. Paul exhibited at the November Meeting an adjustable Miscroscope lamp adapted for the

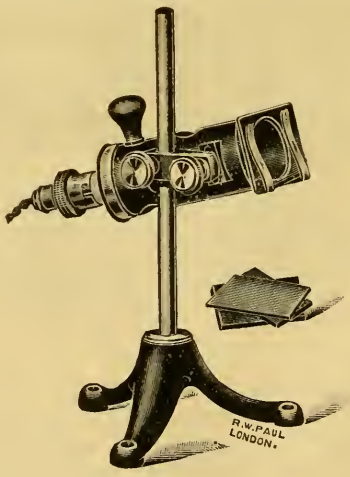


Fig. 8.

B-type Nernst lamp of any required voltage (fig. 8). It is readily fixed in place by means of the screw collar at the back of the lantern ; the

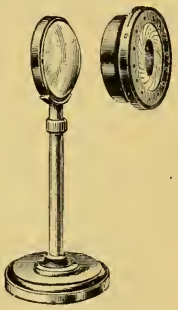
* R. W. Paul's Special Catalogue, 1905.

latter has a double tubular body and a knob by which it may be handled. The feet of the tripod are drilled for screwing to the table, and are provided with leather pads. Glass tinters and a ground-glass screen are supplied, and these are fixed to the front of the lantern by means of clips.

Aitchison Photometer.*—This photometer is for measuring the loss of light by absorption and reflection in binoculars and telescopes. The instrument comprises, a lamp placed between two screens, the lamp being movable along a finely divided scale, and the screens are set at the extremes of a triangle, of which the scale forms the base. The other sides of the triangle converge upon the observation telescope, which consists of a triangular box with tubes projecting from each side. The tubes facing the screens carry object-glasses, while the third is arranged as an eye-piece. Two prisms are so arranged in the telescope that the light from each screen is made to illuminate half the field as seen in the eye-piece; the illumination of the field therefore varies according to the distance of the lamp from the screens. If a binocular or telescope be placed between one of the screens and the observation telescope, the light can be so moved that the two halves of the field are equally illuminated, and the loss of light is calculated by a reading from the scale.

Beck's Large Bull's-Eye Condensing Lens.—This is shown in fig. 9, on stand, with raising motion and clamp; the lens being over the centre of stand.

Beck's Iris Diaphragm.—This (fig. 10) is attachable to the above apparatus.



FIGS. 9, 10.

Sauver's Bridge Object Holder.—This consists of a bridge-shaped plate of metal which is placed on the stage of the Microscope (fig. 11). The

FIG. 11.

specimen is held by rubber bands so that its flat surface is held against the under-surface of the bridge, the hole therein allowing of its examination. It is made by R. & J. Beck.

(4) Photomicrography.

Portable Photomicrographic Camera.—This instrument (fig. 12), which was exhibited at the October Meeting, 1905, by E. Moffat, is suitable for travellers, and is only a few ounces in weight; it will pack up with travelling Microscope in case, and when placed horizontally is quite reliable with oil immersion lenses up to 1000 diameters. A is a telescopic tube, made in three lengths of 6 in. and of aluminium for lightness.

* Catalogue, Optical Convention, p. 230, fig. 1.

B, a plate with screw to fit into socket on lid of Microscope case; C, a square of ¼ in. mahogany with hole 3 by 3 in. in centre; D, two small guides on each side of hole with stop to hold focusing screen and afterwards the dry plate when making the exposure; E, a cloth bag of thin light-tight material, or black kid leather bellows with light stiffening; F, elastic band to grip around ocular. No dark slide is necessary;

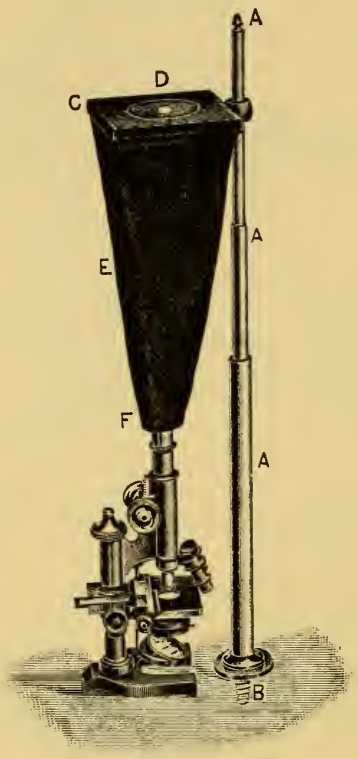


Fig. 12.

simply cover the plate when making exposure with an ordinary focusing cloth of dead black material, which will be found quite sufficient even for the finest work.

White, T. Charters—**Photomicrography as an Aid to Dental Research.** *Brit. Dental Journ.*, xxvi. (1905) pp. 1045–8.

(6) Miscellaneous.

Cinematograph and Microscopy.*—At a meeting of the Society of Arts, F. Martin Duncan showed examples of the successful application of the cinematograph to microscopical investigation, illustrating the

* Journ. Soc. Arts, liv. (1905) pp. 26–8.

circulation and rotation of protoplasm and the movement of the chlorophyll bodies within the cells of the leaf of *Elodea*; the circulation of the blood in the web of the frog's foot and in the tail of the goldfish. The lecturer also exhibited microbioscope pictures of *Hydra viridis*, various birds, beasts, and reptiles in motion, and of the life and work of the wood ant.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Endo's Fuchsin Agar.†—K. Fürntrat finds that when fuchsin solution has been decolorised by sodium sulphite, the colour can be restored by the addition of the smallest quantity of either a mineral or organic acid, but the colour can again be removed by a further addition of sodium sulphite or by excess of acid; the colour can also be restored by the addition of formalin, but can only be removed again by excess of sodium sulphite; the solution decolorised by sodium sulphite regains its colour on warming, but on cooling the colour is again lost; fuchsin solution is decolorised by a relatively large addition of acid, but if mineral acid is used the colour is not restored on heating.

Endo's medium consists of lactose nutrient agar coloured red with fuchsin, and to which sufficient sodium sulphite has been added to render it colourless when cool. On this medium the colonies formed by *B. typhosus* are small and colourless, whereas in the same period of time those formed by *B. coli* are large and of a deep red colour, which is diffused in the medium; after 15 hours growth these organisms may be differentiated. The author finds that single surface colonies of *B. typhosus* after 36 hours exhibit a faint pink colour, especially if the medium is more than two weeks old; that the colonies of *B. coli* and the surrounding medium begin to decolorise after 24 hours, and in the course of the next day all colour is lost, especially with grouped colonies, the isolated colonies retaining the red colour for a much longer time; the colonies of *B. coli* lose their colour more quickly if colonies of *B. typhosus* are grown simultaneously on the same plate.

The author applies the results of his observation on the chemistry of fuchsin to explain these bacteriological phenomena.

Modification of Endo's Medium.‡—W. Gaehtens has modified the fuchsin agar medium devised by Endo for the differentiation of *B. typhosus* and *B. coli* by the addition of caffein, which hinders the growth of *B. coli*. He gives full details of the method for preparing his medium. After many trials of various doses of caffein and of degrees of alkalinity, he finds that the addition of 0·33 p.c. of chemically pure crystalline kaffein to Endo's medium of an alkalinity of 1·5 p.c. normal sodium hydrate, (? + 1·5 N) serves best to considerably hinder

* 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. Orig., xxxix. (1905) p. 487. ‡ Tom. cit., p. 634.

the growth of *B. coli* without affecting the development of *B. typhosus* and *B. paratyphosus*.

Electrically-controlled Low Temperature Incubator.* — L. A. Rogers has described the following arrangement for a low temperature incubator. It is adapted from a small refrigerator (fig. 13) by putting in an insulating partition between the ice box and the lower chamber; a $\frac{5}{8}$ inch lead pipe C is coiled in the bottom of an ice box, and in the

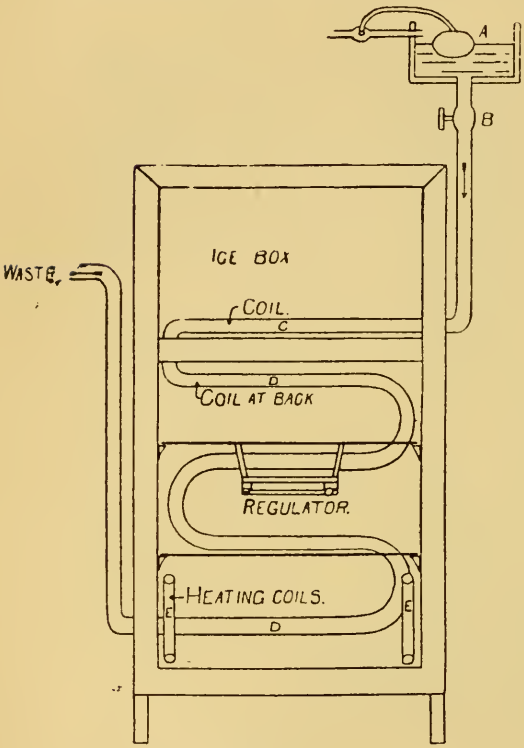


FIG. 13.

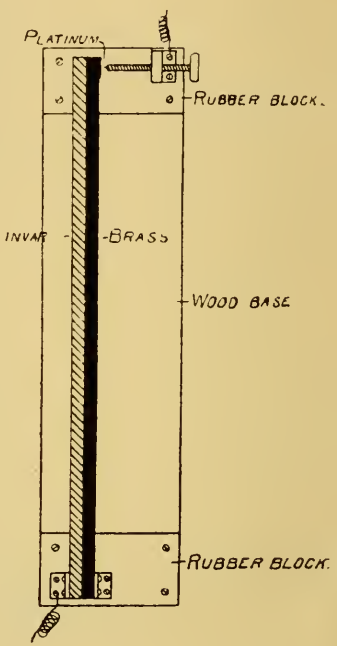


FIG. 14.

lower chamber D D; the ice rests on the coil C which is connected with a reservoir A containing a float valve, to insure a constant pressure; the other end of the pipe is connected with the waste. A slow current of water through the coil will reduce the temperature of the lower chamber below 20° C.; the temperature may then be raised and maintained at any desired point by an electrical device. This consists of a resistance coil for heating, a bimetallic regulator connected with a low voltage circuit obtained from resistance coils, and a circuit-breaker operating the heating circuit. The regulator is composed of two strips of brass and ivar (a nickel-steel alloy) each $\frac{1}{8}$ by $\frac{1}{2}$ by 15 inches, riveted together and

* Centralbl. Bakt., 2te Abt., xv. (1905) p. 236.

attached firmly at one end to a block of hard rubber (fig. 14), the other end moving freely over a similar hard rubber block, to which is fastened the screw closing the current; the adjustment of the temperature is secured by movement of the screw. The low voltage current is best obtained from a series of resistance units connected in a lighting circuit (fig. 15); a 32 c.p. lamp A connected in series with a number of coils of small iron wire, B B, answer the purpose. The circuit passes to the regulator C, then to the magnet of the circuit breaker D, and back to some point on the wire resistance, which is regulated by changing the connection H until it gives a current just sufficient to operate the magnet; the regulator should be so arranged that the heating circuit is closed when the magnet pulls the armature F up against the binding post E.

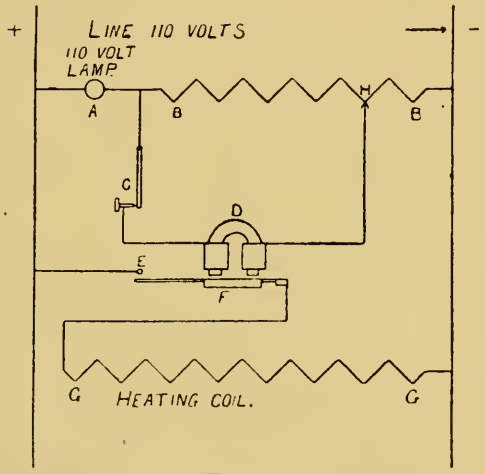


FIG. 15.

Observations on the Drigalski-Conradi Method of Diagnosing Typhoid Bacilli.*—Ed. Monti has shown that by means of the Drigalski-Conradi medium, or other chosen media, or even the agglutination reaction, a positive diagnosis of a typhoid-suspected colony cannot be assured. For on this media there grow different colonies which resemble typhoid bacilli and more or less agglutinate with typhoid serum; and, further, typhoid colonies can be found which agglutinate less actively than other species (Lipschütz, Klinger, etc.).

With our present knowledge of the biology of typhoid bacilli it is useless to hope to make a certain diagnosis in 16–20 hours, or even to separate and identify the specific organism from the fæces or urine. To control the suspected colony thoroughly necessitates 2–3 days.

Further, a negative result with the Drigalski media does not exclude the presence of typhoid.

The author could find the specific germ only in 5 out of 12 cases. His repeated negative results agree with those of Lipschütz, Krause,

* Archiv Sci. Med., xxix. No. 4. See also Centralbl. Bakt., xxxvii. (1905) p. 267.

and Stertz, who examined the fæces and urine, and of Fickers and Hoffmanns, who experimented with the natural fæces and also with fæces mixed with typhoid bacilli.

The method therefore serves only as a useful confirmation in the hands of an experienced laboratory worker.

New Method for Differentiating Eberth's Bacillus from Pseudo-typhoid and Colon Bacilli.*—Trapani says that in neutral glycerin the growth of typhoid and other pathogenic organisms is inhibited, whilst pseudo-typhoid and coli are uninfluenced. His method is as follows:—Typhoid, pseudo-typhoid, and colon bacilli are emulsified in distilled water and placed for one hour in the thermostat at 30° to destroy the clumps. Neutral glycerin tubes are then inoculated and incubated at room temperature, shaded from light, for 48 hours. The two latter flourish prolifically, but the former grows either not at all or very sparsely, owing to the clumps not having been perfectly destroyed.

Technique of the Gruber-Widal Reaction.†—Ernst Schottelius describes a simple and cheap means of obtaining blood for Widal's reaction. The blood is absorbed from the puncture on to a densely rolled gauze or sponge swab, which is fixed on to a glass or metal needle, which in its turn is fastened to a cork or rubber stopper. This fits into a tube, and prevents evaporation. The plasma is separated from the clot by centrifugalising, and removed with a pipette.

Glucose in Pneumococcus Cultures.‡—R. Turró finds that the presence of grape-sugar in liquid media is very conducive to the growth of pneumococcus. It is also inhibitory to other organisms, and may be used in quantities of 8–10 p.c. Pure cultures may be obtained directly from sputum.

Caffein Enrichment Method.§—C. Birt draws the following inferences from his investigations on the action of cultivation media containing caffein:—(1) 0·5 p.c. caffein in 1 p.c. pepton water does not always restrain the development of the *B. coli communis*; (2) 0·5 p.c. caffein in 1 p.c. pepton water inhibited the growth of 26 out of 31 races of *B. typhi abdominalis* examined; (3) 0·5 p.c. caffein in 1 p.c. pepton water completely arrested the development of 18 varieties of dysentery bacillus; (4) caffeinated media are of service in isolating streptococci and staphylococci; (5) Negative results with caffeinated media cannot be relied upon to exclude the presence of *B. typhi abdominalis* in water or dejecta.

SMITH, BERTRAM G.—**Collection and Preparation of Material for Classes in Elementary Zoology.**

[An excellent and practical article; very useful for a course of elementary invertebrate zoology.] *American Naturalist*, xxxix. (1905) pp. 779–89 (1 fig.).

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* Gaz. Osped. Clin., 1905, No. 58. See also Centralbl. Bakt., 1te Abt., xxxvii. (1905) p. 268.

† Münch Med. Wochenschr., 1905, No. 15. See also Centralbl. Bakt., 1te Abt., xxxvii. (1905) p. 268.

‡ Journ. Physiol. et Pathol. gén., vi. (1904) pp. 718–19.

§ Brit. Med. Journ. (1905) ii. pp. 1110-11.

(2 Preparing Objects.

Fixing and Staining the Goblet Cells in the Epidermis of Fishes.*—M. Oxner found that only two fixatives gave good results. These were Apáthy's (equal parts of a saturated solution of sublimate in ½ p.c. sodium chloride and 1 p.c. osmic acid) and Johnson's (in the same proportions as used for the Golgi reaction, but without the platinum chloride). The fixing time was from 15–24 hours. The material was cleared up in chloroform, cedar-wood oil, or xylol. The sections were stained with iron-hæmatoxylin, hæmatein IA, and after-stained with acid rubin, orange G, orcein, light green S.F., or with erythrosin, saturated aqueous solution of kreso-fuchsin, with subsequent differentiation in picric acid. Acid rubin was found to be very effective. Victoria blue stained the goblet-cells dark blue, the rest of the tissue being unaffected.

Apáthy's gold method, alcoholic safranin, Apáthy's rubin S, were also of much service.

Demonstrating the Heart and Arteries of Rhipidoglossa and Docoglossa.†—J. Spillmann fixed most of the animals in aqueous or alcoholic solution of sublimate. For the heart muscle Flemming's fluid and osmic acid were used with good result. Picro-acetic (saturated solution picric acid and glacial acetic acid in equal parts) was employed for fixing the kidney. Owing to the brittleness of the material, difficulties were experienced with the paraffin imbedding, but these were obviated by using cedar-wood oil instead of xylol. At first the sections were stuck on the slide with glycerin-albumen, but this method was afterwards superseded by warm water. The preparations were dried (? incubated) for 2 days, and then coated with a thin layer of collodion.

The best stain was iron-hæmatoxylin, but Böhmer's and Delafield's hæmatoxylin were also used. Safranin was employed for detecting nuclear fission in the pericardiac glands.

Demonstrating Spermatogenesis of Scolopendra heros.‡—M. W. Blackman, when studying the spermatogenesis of *Scolopendra heros*, fixed the material with Flemming's chrom-osmic-acetic mixture or with Gilson's nitric-acetic-sublimate. The latter gave the better results. After a fixation of from 48–60 hours the objects were washed for several hours in running water, and then dehydrated in graded alcohols. The combined celloidin and paraffin method of imbedding was used. The sections made with the Minot microtome were fixed to the slide with albumen. The paraffin was then removed, and in some cases the celloidin also. The sections were stained with Heidenhain's hæmatoxylin, either alone or in conjunction with Congo red. Other stains used were Bismarck brown, cyanin, methyl-green, methyl-green-acid-fuchsin, Flemming's tricolour stain, and others.

(3) Cutting, including Imbedding and Microtomes.

Acetone-celloidin Method of Rapid Imbedding.§—F. Scholz places pieces not thicker than 3 mm. in pure acetone for half an hour. They

* Jena Zeitschr. Natur., xl. (1905) pp. 589–646 (5 pls.).
† Tom. cit., pp. 537–88 (3 pls.).
‡ Bull. Mus. Comp. Zool. Harvard, xlviii. (1905) 138 pp., 9 pls.
§ Deutsch. med. Wochenschr., xxxi. (1905) pp. 419–20.

may then be transferred to celloidin, though it may be necessary to pass certain material through alcohol-ether for 15 minutes. The pieces remain in a thin celloidin solution for 4–5 hours, at 37°–40°. They are then transferred to a thicker solution for 2–3 hours, after which they are placed in thick celloidin. In the last condition they are submitted to the action of chloroform vapour in a closed vessel. In about 14 hours they will be of the consistence of cartilage. The blocks are next further hardened in alcohol for some hours.

Using a Lathe as a Microtome.*—Having a few micro-sections to cut, and being in possession of a small lathe, W. Gribben made the fixture shown in figs. 16 and 17, which enabled him to hold in the slide-rest the razor. By locking the lathe-spindle, to prevent its rotation, the

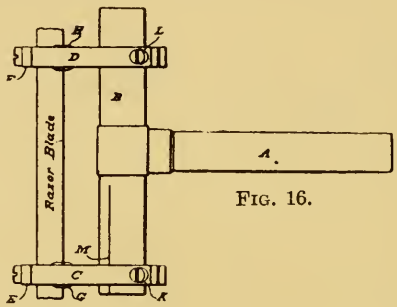

FIG. 16.

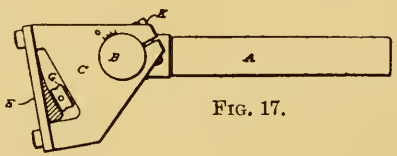

FIG. 17.

object to be cut could be held in a chuck, while the cross-slide of the rest was used to give the cut, and the longitudinal slide to give the feed. Both screws of the slide-rest were provided with micrometers reading to 0·001 in., but the cross-slide screw was removed during the cutting to give a more rapid cut.

The fixture, shown in figs. 16 and 17, is made of two steel bars, A and B, riveted together, and the two pieces of $\frac{1}{4}$-in. sheet-brass, C and D, which have each a cavity cut out to admit the razor-blade, as shown in section in fig. 17. The flat steel bars E and F are screwed fast to C and D, and the flat side of the razor-blade is held firmly against E and F, by the two capstan-head screws G and H bearing on the concave side of the blade. C and D are held on the round part of B by the two pinching screws K and L, and by loosening these screws, C and D may be swivelled around B, as a centre to alter the clearance angle of the razor. C is graduated into spaces of 5° from 0°–30°, the graduations being read by means of the straight line M scratched on B.

* Optical Instrument Monthly, i. (1905) pp. 13–14 (3 figs.).

C and D are so shaped that when the clearance angle is 10°, the cutting edge of the blade is approximately in line with the centre line of A.

The fixture described above was all the author had to make for microtome work. The slide-rest was already provided with a boring-tool holder, which is a cast-iron fixture fitting the slide-rest in place of the usual tool-post, and having a ½-in. round hole in it, parallel with the upper slide, and at the same height as the lathe-spindle. This hole is split on one side, and has pinching screws to close the split and clamp the round boring tools securely on the round shank A of the razor-holder. This arrangement admits of turning A on the boring-tool holder, so as to bring the razor edge vertical to give a straight cut, or with an oblique edge to give a drawing cut. C and D may be moved along to different parts of B in order to bring different parts of the cutting-edge into action. When necessary to loosen C and D, this is

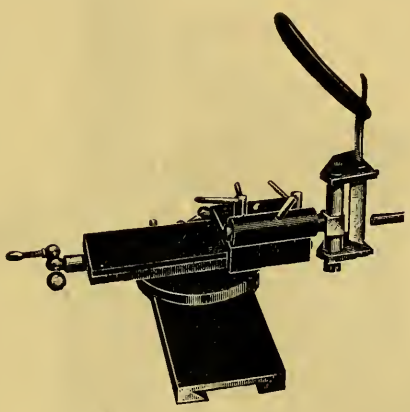

FIG. 18.

done while the razor is clamped in place, so that C and D will be properly located in regard to each other.

This fixture in conjunction with a lathe makes a fairly good microtome, if the requirements are not too exacting, as it cannot be used for the best or for riband work.

Triepel's Cylinder-Rotation Microtome.*—This has been designed by H. Triepel, and is made by the firm of G. Miehe, of Hildesheim. It is shown in fig. 19 one-third of the full size. A strong-walled hollow cylinder, 107 mm. external diameter, is firmly connected with a base-plate. The cylinder is supported on three uprights, and within it is a second hollow steel cylinder, 115 mm. in height and 80 mm. in external diameter. Its upper and lower ends are both closed by brass plates. To the under plate a small disk of hardened steel is screwed on, by means of which the inner cylinder rests on the micrometer screw. The steel cap of the screw is also hardened. The raising arrangement is of the usual kind. Rotation through the space of one tooth raises the cylinder 2 μ. The object-holder is secured on the upper plate of the inner cylinder.

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 118–25 (3 figs.).

In section-cutting the cylinder with object is rotated, whilst the knife remains motionless. The knife is fastened on a massive four-sided prism, which is somewhat reduced at the upper end. This prism is 23 cm. high, and stands on the right-hand side of the cylinder, somewhat behind the horizontal middle line. On its front side the prism carries the bearing in which the axis of the winch rotates. On the left hand of the axis there is a toothed wheel, made of vulcanite, whose cogs engage in vertical flutes which are fitted on a projection of the upper plate of the inner cylinder, and which reach, collar-like, over the outer cylinder. Rotation of the winch causes a translation movement

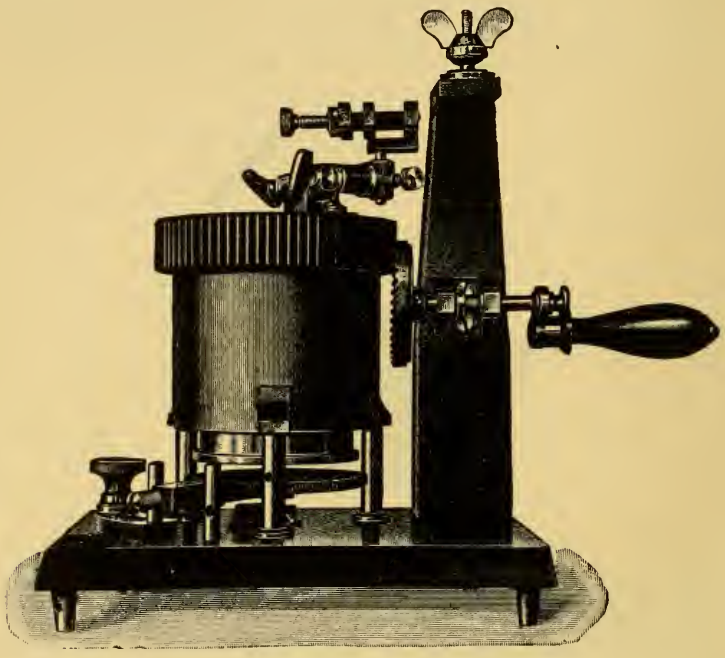

Fig. 19.

of the cylinder in the ratio of 2 : 1. The object-holder is so arranged that it can be set once for all at a certain distance from the cylinder axis. After the cutting of a section, further rotation of the winch in the same direction brings the object-holder into position for the next section. The application of a lubricant is superfluous, or only necessary after very long use of the instrument. It is to be noted that the object is moved with accurate perpendicularity against the knife-edge. The knife can also be arranged for oblique sections. The accuracy of the section-cutting is stated to be remarkable, and approximates very closely to theory. The absence of oil-layers removes a difficulty met with in many microtomes, and this improvement was a great consideration with the inventor.

(4) Staining and Injecting.

Staining Spirochæta pallida.* — K. Reitmann advises fixing the film in absolute alcohol for 10 minutes, and, after washing in distilled water, mordanting for 5 minutes in 2 p.c. phospho-molybdic acid. After washing with 70 p.c. alcohol and distilled water, the film is stained with hot carbol-fuchsin. The preparation is then treated in the usual way.

G. Giemsa recommends that 1–10 drops of a 1 : 1000 solution of potassium carbonate should be added to the water before it is mixed with the staining solution. The stain should be allowed to act for from 15–60 minutes.

K. Herxheimer and H. Hübner stained films with a filtered aqueous solution of Nile blue B. R. (1 : 1000) for from 16–24 hours. The *Spirochætæ* stained dark blue. When treated with Capri blue (1 : 1000) the *Spirochætæ* were grey.

M. Oppenheim and O. Sachs stained films without any preliminary fixation, with hot carbol-gentian-violet solution (5 p.c. carbolic acid to 10 p.c. alcoholic solution of gentian-violet). The films were then washed and dried. The *Spirochætæ* are blue, and seem thicker than when treated by other methods.

Staining Neurofibrils.†—By use of Bielschowsky's method of reducing the ammoniacal silver with acetic acid,‡ which he says is less complicated and more certain than Ramon y Cajal's method, Wolff claims to show that the "contiguity but not continuity" view of the nerve dendrites is not supported. The dendrites are merely peculiarly differentiated sensory terminals in which there is not the slightest discontinuity of neuroplasm or fibrils to be demonstrated. Successful results are conditional on minute care. Method :—

1. Fixation in 6–10 p.c. neutral formalin. Wolff has got good results with weak acid reacting formalin. Previous treatment with Flemming's solution, Müller, etc., does not matter if carefully washed out for several days with distilled water.

2. Wash out thoroughly with distilled water. The pieces should not be more than 2 mm. thick. Sections are best cut on the freezing microtome, but may be silvered *en bloc*, or imbedded in paraffin and the cut sections silvered.

3. Preparatory silvering. The sections, block or paraffin cut sections, placed in 2 p.c. $AgNO_3$ solution in dark for two or more days.

4. Wash for few minutes.

5. Characteristic silvering. To 10 p.c. silver nitrate is added 40 p.c. caustic soda, drop by drop, until no further grey-brown precipitate appears. This precipitate is then dissolved in as little ammonia as possible, and diluted with 4 or 5 times its volume of distilled water (to be made fresh and used with horn needles and instruments only). In ½–2 or more hours the yellow tone changes to a more or less deep red brown.

6. Wash in distilled water for short time to remove excess of silver.

* Deutsche med. Wochenschr., 1905. See also Centralbl. Bakt., 1te Abt. Ref. xxxvii. (1905) pp 507–8. † Biol. Centralbl., xxv. (1905) pp. 679–687.
‡ Journ. Psychol. u. Neurol., 1905.

7. Treatment with acetic acid : 5 drops in 10 cm. distilled water only until red-brown colour changes to yellow.

8. Reduction in 4–5 p.c. formalin of the more firmly combined silver (i.e. with the neurofibrils). Control under low magnification until the nuclei appear unstained on a brown and black background. Failure is denoted by nuclei more or less blackened and Nissl's spindles in the cytoplasm. It is impossible to exactly control reduction in blocks, which take from 1–6 hours according to size. A small piece of the margin should be teased and examined.

8A. Imbed in paraffin with melting point of 45°–50°.

9. Fixation of the silver picture : All sections obtained in any way and treated as above are washed in tap water for 1–2 hours, and placed in a faint yellow watery gold chloride solution (1–0·5 p.c.), neutralised with lithium carbonate. The groundwork varies with the reaction of the gold solution, red if acid, faint blue if alkaline or neutral, whilst the impregnated fibrils are deep reddish violet or dark blue.

10. Wash for a short time in tap water, then in 5 p.c. sodium carbonate for 5–15 minutes, and finally in tap water for 6–12 hours with frequent changing.

11. Dehydrate ; clear in xylol. Mount in balsam without applying any heat.

Note.—If the neurofibrils do not stain by this method, the tissue is not spoilt for other staining methods.

Staining of Spirochæta vel Spironema Pallida.*—El. Metchnikow and Em. Roux remark that too much importance should not be attached to the tint assumed by the *Spirochæta pallida* when stained by Giemsa's method, nor to the number of turns of the spiral. They accept the view that the *Spirochæta* of Schaudinn is the cause of syphilis, and regard the disease as a chronic spirillosis with relapses.

It has been recently suggested to alter the name to *Spironema pallida*, on account of the numerous differences between the microbe of syphilis and true *Spirochætæ*, such as *plicatilis* and *refringens*.

Demonstrating the Parasites of Smallpox.†—Siegel recommends a mixture of 7 parts of eosin (1 : 15000), and 1 part of Giemsa's azur ii. (1 : 1000) for staining Guarnieri's bodies. The sections are left in the mixture for 2 hours, and are then mounted in balsam. The parasites are extremely small, and sporulate in the cytoplasm, a point which distinguishes them from the sporozoon of foot-and-mouth disease, which sporulates in the nucleus.

AMBRONN, H. — **Ueber pleochroitische Silber-Kristalle und die Färbung mit Mitallen.**

[With suitable treatment, anistropic and pleochroic crystals are formed from solutions of silver nitrate ; hence there exists a labile form of silver the crystals of which do not belong to the regular, but to another (possibly the rhombic) system.] *Zeitschr. wiss. Mikrosk.*, xxii. (1905) pp. 349–55.

HEIDENHAIN, M.—**Ueber die Massenfärbung Mikroskopischer Schnitte auf Glimmerplatfen.**

[Treats of the author's method of staining numerous sections on mica plates for class purposes.] *Tom. cit.*, pp. 330–6 (2 figs.).

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* Ann. Inst. Pasteur, xix. (1905) pp. 673–98 (2 figs..)

† Abhandl. k. Preuss. Akad. Berlin, 1905. See also Brit. Med. Journ. (1905) ii. Epit. 260.

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

Parallel Brass Rings.—A series of six parallel brass rings, for mounting specimens parallel with plasticin, is shown in fig. 20. The specimen is laid flat surface downwards on a plate of glass or other

Fig. 20.

flat surface, and a ring somewhat deeper than the specimen placed around it. A 3 by 1 in. glass slip with a small piece of plasticin is then pressed upon the specimen till it touches the brass ring. The rings are made by R. and J. Beck.

(6) Miscellaneous.

New Method of Obtaining Anti-Bodies.*—E. Loeffler recommends, after many years extensive research, that the specific material (albumen, blood, bacteria, or tumour) be heated to dryness at a temperature sufficiently sustained to kill all living matter without injuring the anti-bodies' activity, and then powdered and inoculated into animals. Fowl albumen, blood, and spore-bearing bacteria are heated for half-an-hour at 150°, non spore-bearing bacteria for 2–3 hours at 120°. Albumen- and blood-precipitins, agglutinins, bactericidal and bacteriolytic material, were thus obtained. A similarly obtained mammary carcinoma serum (asses' serum) precipitated not only carcinoma cells, but also normal gland-cells; and, further, its inoculation into cachectic patients produced a visible improvement of the general condition and a local reaction, but without any retrogression of the malady.

Methods of Microscopical Research: Vegetable Histology.†—This work, by Abraham Flatters, is of inestimable value to the student of practical botany. It is no mere compilation of untried methods, but bears throughout the impress of experience. The author has selected for description a few, but yet sufficient, methods which in his hands have proved successful, and adequate attention is given to the technical minutiæ on which good results so much depend; thus saving the student who follows out the instructions much tentative labour and bad results.

The first part deals with technique generally applicable. After mentioning the importance of collecting specimens at proper times and under suitable conditions, the author dwells at some length on the methods of fixation, the object of which is "to preserve dead tissues in as nearly as possible their natural conditions in the living state." And to emphasise still further this important preliminary to all satisfactory and correct work, two illustrations show the marked contrast between good and bad fixation.

Chapter II. treats of apparatus and methods of work. The author's

* Deutsche med. Wochenschr., 1904, No. 52. See also Centralbl. Bakt., 1te Abt., xxxvii. (1905) p. 265.

† London and Manchester: Sherratt and Hughes (1905) 4to, x. and 116 pp., 23 pls. and 29 figs.

microtome, ingenious and simple, with its ready method of calculating the thickness of sections, is illustrated and described in detail even to the often difficult setting of the knife. Terse but adequate instructions for imbedding in paraffin and celloidin are given, and the art of cutting sections in three planes, viz. transversely, radial-longitudinally, and tangential-longitudinally, in order to obtain a solid picture, illustrated.

"Staining consists in differentiating the various composing tissues . . . and is governed by the chemical affinities of tissues which vary with age." With this introduction the art of staining is explained, and in Chapter III., instead of a bewildering list of innumerable stains, 13 stains and counter-stains are described, with their formulæ and full details for manipulation—"a list which is very limited, but one which will be found sufficiently extensive for the general worker."

The technique is completed by formulæ of mounting media and cements, and illustrated descriptions of mounting cells and an ingenious turntable for ringing ovals.

Chapter IV. systematically deals with type preparations selected to show plant structure from root to flower, including the growing cell and its contents, and every preparation has its corresponding illustration in the plates.

These plates still further enhance the value of the text, and consist of 100 beautifully coloured microphotographs specially prepared for this work. One misprint occurs in the text of fig. 35 (7).

When we recall the pitfalls of laboratory work and the days when tissues were cut by hand, held in a piece of pith, and the attempts at elucidating sections, which varied considerably with the operator's skill, by the aid of text or diagrams, we can only put down this work in full agreement with the author's prefatory remark that "had such a work been at my disposal twenty years ago, I feel sure that I should have been spared years of persistent hard work and many disappointments."

Clinical Diagnostic Bacteriology.*—A. C. Coles' work on the blood is so much appreciated that his recent excursion into bacteriology insures a respectful consideration. After dealing with technique, the author treats of the various acid-fast bacteria in respect of their morphological characters and their degree of resistance to acid, alcohol, and other decolorisers, and then describes his method of differentiating the tubercle bacillus from all other acid-fast tubercle organisms. The method amounts to this: stain with hot carbol fuchsin for about 7 minutes, and decolorise for about 4 hours or more in Pappenheim's solution, or the author's modification thereof, or in 25 p.c. sulphuric acid for 16–24 hours.

Other organisms treated of are the Gonococcus, Ducrey's bacillus, Pneumococcus, the microbes of influenza, meningitis, diphtheria, plague, actinomycosis, anthrax, relapsing fever, and parasitic fungi affecting the skin and hair. The last 20 pages are devoted to serum and cyto-diagnosis. Most of the work is given up to discussion on the acid-fast, and more or less acid-fast red staining bacteria, about which the author gives evidence of much practical knowledge and experience. The work will be found to be extremely helpful to those who are anxious to obtain an insight into the difficult questions discussed and explained.

* London: J. and A. Churchill, 1904, viii. and 237 pp., 2 col. pls.

Nature through Microscope and Camera.*—This admirable introduction to the marvels of microscopy and photomicrography is the work of R. Kerr and A. E. Smith, the former contributing the descriptive portion, and the latter being responsible for the illustrations and the chapter on photomicrography. There are two Introductions, one by Professor Sims Woodhead, the other by the author. In the latter Mr. Kerr wisely remarks, that the more our young men take up intellectual pastimes the better it will be for the nation. After discussing the illustrations and high possibilities with the Microscope, and giving practical hints on photomicrography, the rest of the volume is devoted to describing and illustrating Radiolaria, Foraminifera, Insecta, Diatoms, botanical specimens; human hair, skin, bone, muscle, lung, and blood; mites, bacteria, hooklets of tapeworm, and silk.

Most of the illustrations are extremely good, but exception must be taken to Plates 47 and 51, which do not fairly represent the human skin or the blood-corpuscles. The former gives only a rough idea of structure, and the latter shows an early stage of degeneration. Notwithstanding such trivial blemishes, the work must be described as being admirable in respect of general get-up, description, and illustration.

Bacteriological Technique.† — "Bacteria in Relation to Plant Diseases," by Erwin F. Smith, is a notable example of how thoroughly the American Government appreciates the value of scientific work.

The first volume, which deals with methods of work and general literature of Bacteriology, exclusive of plant diseases, is one of the most complete and practical treatises that have been published on bacteriological technique. It would be beyond the limits of our space to enumerate even the outline of methods of work as given in this volume. It must suffice to say that every aspect of a bacteriological examination has been considered, and every phase of the routine of laboratory work mapped out in such a way that almost a neophyte could, with the aid of this text-book, conduct a bacteriological inquiry with hope of success.

The volume is copiously illustrated, and the bibliography extensive.

Methods in Plant Histology.‡—This work, the first edition of which was noticed in this Journal, 1901, p. 604, has been much improved and augmented by the author, C. J. Chamberlain. More attention has been given to collecting material, and the chapters on the paraffin and Venetian turpentine methods have been revised and much enlarged. Other new chapters deal with micro-chemical tests, freehand sections, special methods, and the use of the Microscope. This volume, which is half as large again as its predecessor, should be highly esteemed by botanists.

DREYER, G., & JEX-BLAKE, A. J.—**On the Agglutination of Bacteria.**
Mém. Acad. Roy. Sci. et Let. Danemark, i. (1905) pp. 219–60.

RICHTER, O.—**Die Fortschritte der botanischen Mikrochemie seit Zimmermanns "Botanischer Mikrotechnik."**
[An exhaustive review of the progress in vegetable microchemical technique, to which is appended a very copious bibliography.]
Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 369–411.

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* London: Religious Tract Society, 1905, 194 pp., 65 pls.

† Carnegie Institution, Washington, D.C., U.S.A., Publication No. 27 (1905) 4to, 285 pp., 31 pls. and 146 figs.).

‡ Univ. of Chicago Press, 2nd ed., 1905, x. and 262 pp., 87 figs.

Metallography, etc.

The Quenching of Steel.*—Semozay gives a lengthy account of his investigations into the effect upon the hardness of steel and the position of the critical range, caused by varying the conditions of quenching, such as temperature, duration of heating, rapidity of cooling, and dimensions of the mass quenched. Hardness was measured by the Brinell method. The critical temperatures were determined by taking cooling and heating curves, the junction of the thermocouple being inserted in a central hole. In the first series of experiments the samples (40 mm. by 10 mm. by 10 mm.) were heated in an electric furnace to the required temperature, and quenched. In the second series the steel was heated to a temperature above the critical range, cooled slowly to the required temperature, and quenched. Curves showing the relation between quenching temperature, and hardness are given. In the third series the length of time during which the steel had to be maintained at a given temperature to produce the same degree of hardness on quenching was determined. In the experiments upon the effect of variation in the size of the specimen, heating was carried out in a lead bath of large capacity. The steel was quenched in air, in oil, or in water. The author gives his conclusions at considerable length. A notable omission from the data given is the analysis of the steels employed in this research.

Corrosion Grooves in Boiler Plate.†—C. Frémont and F. Osmond point out that the existence of local corrosions in boilers can only be accounted for by irregularities either in original structure or resulting from conditions of construction or service. Corrosions have been classified according to form, (1) in spots ("pustulaire"); (2) in grooves. The former are probably due to original non-homogeneity of the metal, such as inclusions of slag, sulphides, etc. It might be supposed that the mechanical stresses to which a boiler is subjected when in service cause local strains which lead to irregular oxidation. The authors show how maximum stresses are localised at certain points and lines owing to the method of construction of a boiler. It is along these lines that corrosion grooves are found. The authors advance arguments which tend to show that strain effects in the metal do not account for the grooves. A much more probable explanation is that the plate first becomes covered with a layer of oxide; this oxide is not deformable, i.e. is brittle, and the slight elastic bending of the plate causes the oxide to crack along the line of maximum stress. A clean surface of steel is thus exposed, and oxidation goes on more rapidly. The small corrosion groove thus set up is a line of weakness: stresses are still more localised along it, the re-formed oxide is cracked, again exposing a line of bright metal for oxidation. Corrosion grooves are much more dangerous in plates of poor quality than in good material. The authors give an account of the investigations, carried out on four old locomotive boilers, which led to the above conclusions, and illustrate their paper with a number of photomicrographs.

* Rev. Metallurgie, ii. (1905) pp. 737–74 (46 figs.).
† Tom. cit., pp. 775–88 (25 figs.).

Effect of Chromium in Steel.*—F. Osmond criticises Carpenter's statement that chromium does not confer upon steel the property of being self-hardening.† After re-stating his former results which led to the opposite conclusion, the author points out that the temperature to which his chromium steels were heated when the self-hardening effect was obtained, was considerably higher than that employed by Carpenter. Either this fact, or a difference in the rate of cooling, may account for the discrepancy in the conclusions reached by Carpenter and the author.

Mechanical Properties of Single Crystals of Iron.‡—F. Osmond and C. Frémont obtained some iron in abnormally large crystals, from an old steel rail which had been in use as a guide for a damper in a furnace-flue for 15 years, and had thus been subjected to thermal conditions favourable to the development of crystallisation. The metal contained 0·06 p.c. carbon. A tensile test-piece was obtained, the effective portion of which was constituted almost entirely by two crystals. Two compression test-pieces were cut from a single crystal. Stress-strain diagrams are given. Brinell hardness-tests were made on different faces of a crystal, giving somewhat different results. Statical bending and shock tests showed that the angle made by the cleavage-plane with the axis of the test-piece had great influence on the results, and that brittleness only appeared under impact.

Nickel-Manganese Steels.§—Having completed a general investigation of the ternary steels (alloys of iron, carbon, and a third element), L. Guillet has taken up the study of the quaternary alloys, starting with nickel-manganese steels. Assuming the possibility of deducing their properties from those of nickel steels and manganese steels, the author gives equations from which the constitution (whether pearlitic, martensitic, or containing γ-iron) of a steel of given analysis, may be calculated. Three series of alloys were prepared, the first containing 0·15 p.c. carbon, nickel 2 p.c., 12 p.c., or 30 p.c., manganese 5 p.c., 7 p.c., or 15 p.c.; the second containing 0·75 p.c. carbon, nickel and manganese both varying as in the first series. The members of the third series have analyses which cause them to be placed on the limit of two groups. Certain of the alloys could not be rolled. As in the author's former researches, the alloys were examined micrographically and mechanically in three states: (1) as forged (or normalised by slow cooling from 900° C.); (2) quenched; (3) annealed. Numerous tables of the results of tensile, shock, and hardness-tests are given. As in nickel steels, etc., alloys containing γ-iron are transformed by cold working, the γ-iron changing to martensite in a greater or smaller degree. Similar effects result from cooling in liquid air. The author considers that his deductions as to the constitution and properties of these alloys, taking the properties of the nickel steels and the manganese steels as data, are fully borne out by the results of his experimental work. Nickel-manganese steels may for many purposes replace nickel steels.

* Rev. Metallurgie, ii. (1905) pp. 798–9.
† See this Journal, 1905, p. 776.
‡ Rev. Metallurgie, ii. (1905) pp. 801–10 (12 figs.).
§ Tom. cit., pp. 825–41 (1 diagram, 20 photomicrographs).

Papers read at the Metallurgical Congress, Liége.*—L. Descroix gives a summary of these papers and the discussion which followed their reading.

"*Effect of Liquid Air Temperature upon Iron, etc.*"—A further contribution by R. A. Hadfield to the study of this subject.†

"*Influence of Titanium upon Cast Iron and Steel.*"—P. Delville gives an account of the work of previous investigators, and describes his experiments in which titanium thermit (a mixture of oxides of iron and titanium with aluminium) was added to liquid metal in the ladle. The oxides are reduced, titanium passing into the metal, the temperature of which is raised by the reaction. Blowholes are diminished and sounder castings obtained. The effect on the chemical composition of the steel is slight; mechanical tests appear to be somewhat improved. A notable result of the addition is the elimination of nitrogen, which passes into the slag as cyanide. The presence of some form of carbon favours this reaction.

"*Influence of Arsenic on Cast Iron and Steel.*"—P. Delville concludes that arsenic resembles sulphur in its effect upon iron and steel. In basic steel 2 As+S should not exceed 0·1 p.c.

"*Technique of Microscopic Metallography*"; "*Metallographical Examination of Iron and Steel.*"—The first of these articles by H. le Chatelier has been noticed previously.‡ In the second the author points out the value of metallography to the metallurgical industry. In steel of good quality very little can be seen by microscopical examination. It is in defective metal that the most definite structures are developed.

"*Special Steels*"; "*Metallic Alloys.*"—Two papers by L. Guillet, summarising his extensive researches.

ARTH, G., AND LEJEUNE, P.—**Sur un mêtal préhistorique trouvé dans les environs de Nancy.**
[Analysis, photomicrographs, etc., of a mass of steel weighing about 300 kg., found in the earth. Carbon 1·2 p.c., silicon 1·7 p.c.]
Rev. Metallurgie, ii. (1905) pp. 789–92 (4 figs.).

ARNOLD, J. O.—**Steel as an Igneous Rock.**
Iron and Steel Mag., x. (1905) pp. 408–13.

BEILBY, G. T.—**Crystalline and amorphous states of metals.**
Tom. cit. pp. 419–25.

GUILLET, L.—**A practical and scientific study of the properties of bronzes, brasses, and special copper alloys.** *Eng. Mag.*, xxix. (1905) pp. 940–2.

PORLIER, A.—**Sur la composition d'un boulet en fonte des fossés de la Bastille.**
Rev. Metallurgie, ii. (1905) pp. 793–4 (1 fig.).

PRICE, M.—**Frictional characteristics of bearing metal and their relation to microstructure.** *Eng. Mag.*, xxix. (1905) pp. 592–4.

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* Rev. Metallurgie, ii. (1905) pp. 846–58.
† See this Journal, 1905, p. 775. ‡ Tom. cit., p. 669.

III.—*On an Improved Form of Metallurgical Microscope.*

By Walter Rosenhain, B.A. (Cantab), B.C.E. (Melbourne).

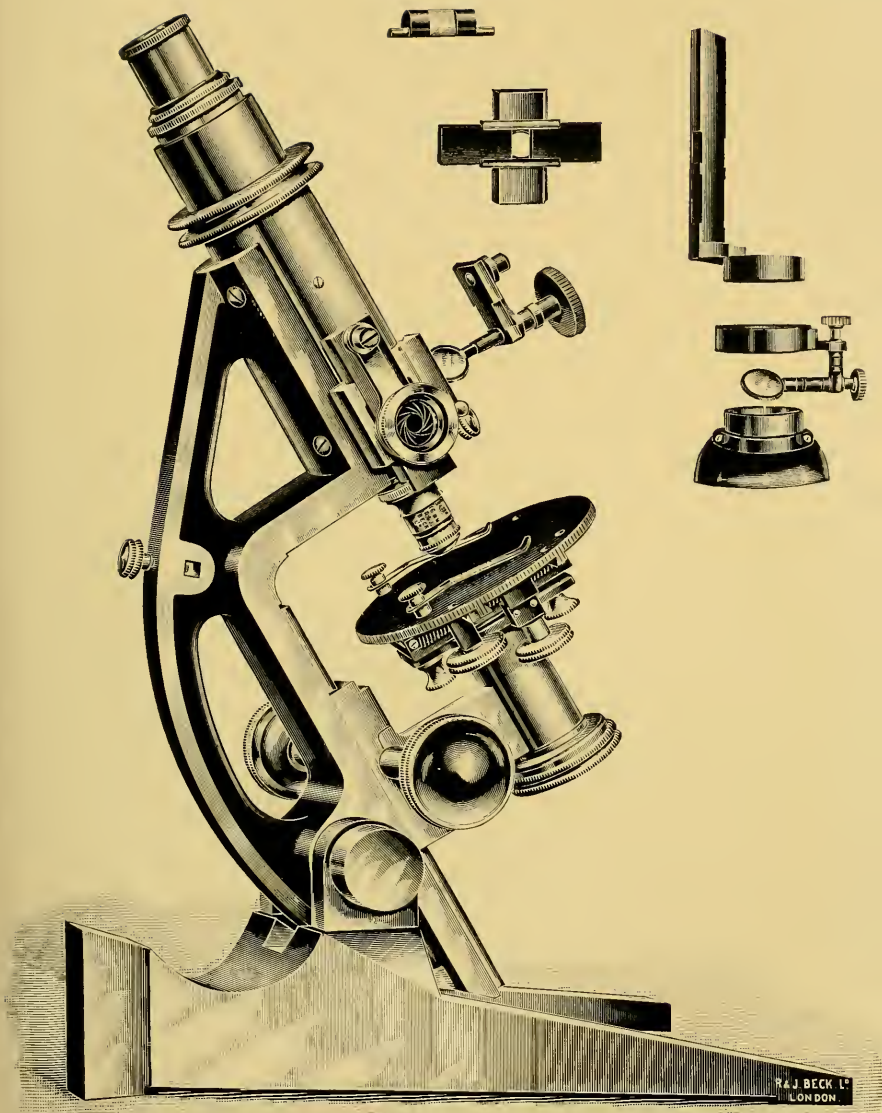
(*Read February* 21, 1906.)

Plate VI.

The importance which the microscopic study of metals has steadily acquired during the past ten years has led to the development of a special form of Microscope suited for the requirements of this class of work; the development of these instruments has, however, been almost entirely confined to progressive modifications of the standard type of Microscope as used for other purposes. While it is undoubtedly possible to obtain very satisfactory results in the study of metals by means of a good Microscope of the ordinary type, provided with certain special attachments, limitations and disadvantages soon become evident, and even the most specialised metallurgical Microscopes hitherto available do not overcome the most serious of these difficulties. On the other hand, as the author has endeavoured to show elsewhere,* the design of the standard Microscope does not, in certain respects, satisfy the demands of correct mechanical design; and while it may, perhaps, be fairly urged that the optical requirements necessitate the sacrifice of mechanical perfection, such a contention does not apply to the metallurgical Microscope, which is intended primarily for the examination of opaque objects by reflected light. These considerations have led the author to design the instrument here to be described, on lines which differ very considerably from those of the standard type of Microscope.

The main differences between the requirements of the ordinary Microscope and the instrument intended for metallurgical purposes, arise from the fact that the apparatus for the use of transmitted light, which is so important in the former, is not required at all in the latter, while, on the other hand, the appliances known as vertical and oblique illuminators are essential for metallurgical work, and are rarely used for other purposes. Further, the specimens to be examined with the metallurgical instrument are sometimes of considerable weight and size, and it may be desirable to examine them by means of long-focus lenses (3-inch), so that a very wide range of separation between stage and objective is required. In the older metallurgical Microscopes this last requirement has

* "The Mechanical Design of Instruments," by W. Rosenhain, Proc. Optical Convention, London, May 1905.



Rosenhain Metallurgical Microscope.

[*To face p.* 146.

been met by applying a rack-and-pinion focusing motion to the stage of a Microscope of the ordinary type. An additional advantage was also secured in this way by making it possible to keep the aperture of the vertical illuminator attached to the lower end of the body-tube in one position, for which the illuminant and condensers, or optical bench, had been properly and permanently adjusted. Taking a further step in the same direction, the author has designed the present instrument with a body-tube rigidly fixed to the limb of the Microscope, both the coarse and the fine adjustment being applied to the motion of the stage.

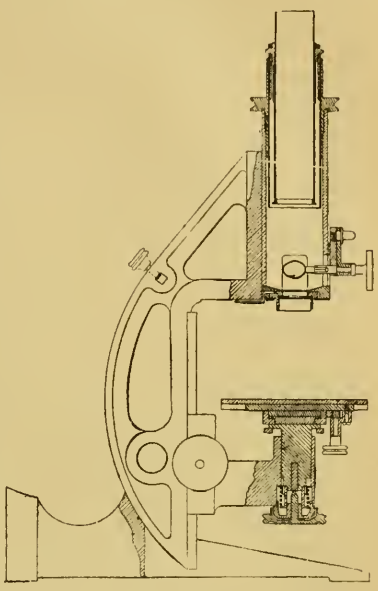


Fig. 21.

The general appearance of the instrument will be readily gathered from the illustrations, plate VI. and figs. 21 and 22, which show the Microscope in three positions; it will, therefore, only be necessary to describe the details of the various special features of the instrument.

Base and Limb.—The base is approximately triangular in plan, and has been designed to give the greatest possible stability with a minimum weight, while allowing perfectly free access to the milled heads attached to

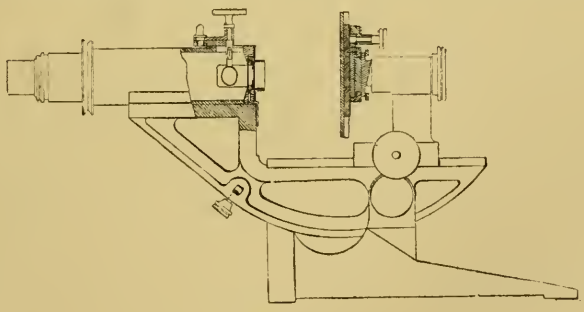


Fig. 22.

the stage, even when the latter is in its lowest possible position. A portion of the base projects, and is so shaped as to provide a firm bearing for the limb when the Microscope is being used in

a horizontal position, as for photography, a very great degree of rigidity being thereby secured in the position where it is most required. The height required for this foot or support is kept low by hinging the limb about an axis placed only 78 mm. (3 inches) above the base; this axis is made very massive, in order to secure both ample stiffness and to provide a large bearing surface, so that, with a good fit, the friction is sufficient to sustain the limb at any angle, more especially since the position of the axis is such as to bring the centre of gravity of the inclinable portion of the instrument vertically above the axis at an inclination which only differs slightly from 60°, according to the position of the stage. In the vertical position, the limb itself bears against a recess suitably formed in the base. In practice, the entire instrument may be readily carried about by means of the handle provided in the limb, without fear of displacing anything—even with a high-power objective, the focus remains in adjustment. The limb itself is made of a deep T-girder section, the broad flange of the T forming the bearing for the large dovetailed slide which carries the stage, and also providing a rigid attachment for the tube. The depth of the T is proportioned to the bending stresses likely to be developed by the weight and manipulation of the instrument, the back of the limb thus assuming a curved outline. The web of the T section is cut away in two large openings, thus saving weight and reducing the whole limb to a close approximation to a rigidly braced girder, while one of the openings provides a most convenient handle, by which the entire instrument may be safely lifted.

The Stage.—The stage is carried by a stiff bracket attached to a massive slide, moving, by rack and pinion, along the broad flange of the limb; the milled heads attached to the pinion—which constitutes the coarse-adjustment of the Microscope—are carried on long stout stems, so as to clear the base when the stage is racked down; in the vertical position the separation available between the end of the body-tube and the stage surface is 95 mm. ($3\frac{3}{4}$ in.), while if the instrument be slightly inclined, this may be increased to 120 mm. ($4\frac{3}{4}$ in.). An important advantage of the construction here described lies in the fact that the relative position of stage and tube is as rigidly secured with the largest separation as when the stage is close up to the tube; in the older instruments, as soon as the body-tube is racked up to any considerable extent, the bearing between tube and limb is reduced, and a serious amount of looseness results.

The stage bracket carries at its outer end, concentric with the optic axis of the instrument, the fine adjustment. The details and construction of this portion of the instrument are exactly similar to any good fine-adjustment, except that the whole arrangement is inverted, and the moving plunger carries the stage direct. The great advantage of this arrangement is that all the weight that

comes upon the fine-adjustment is carried centrally, while any slight irregularities of bearing surfaces or motion are not magnified, as in the ordinary construction, by a considerable overhang of the moving parts; the resulting fine-focusing motion is consequently remarkable for a crisp decisiveness and absence of all wavering which is most refreshing in use, while the favourable conditions of wear under the circumstances described should go far to lengthen the life of the more delicate parts.

The stage itself combines all the advantages of a simple flat stage, free from all encumbrances upon its surface, with complete mechanical movements and complete rotation about the optic axis. This result is secured by placing the mechanical stage movements below the stage plate itself; the movements themselves consist of two broad dovetailed slides, at right-angles to one another, actuated by rack-and-pinion movements controlled by milled heads fixed below. Even when an inch of mechanical movement has been used, the stage may still be completely rotated. The author regards a stage capable of such complete rotation and free from all encumbrances upon its surface as almost essential to the better class of metallurgical work; the interpretation of the microscopic images is often only possible by the use of various forms of oblique illumination, some of which will be mentioned below, and when these are applied it is usually necessary to test the effect of varying orientation of the specimen by rotating the stage; under such circumstances it leads to much annoyance and loss of time to find that the rotation is blocked, or the light obscured by a projecting fitting on the stage, just at the point which it is most important to observe. Another advantage of the arrangement of movements adopted in the present instrument is to be found in the fact that all the milled heads regulating the focus and the position of the specimen lie within easy reach of one hand; thus it is quite easy to use one of the mechanical movements of the stage with the thumb and one finger, while keeping the object in focus by moving the fine-adjustment with the little finger of the same hand, particularly as the wrist may rest comfortably on the table if the instrument is not too much inclined.

In the instrument as at present constructed the rotation of the stage is provided with neither centring screws nor mechanical movement, a firm clamp, acting in any position, being alone provided. The centring screws have been omitted in order to economise space, a centring nose-piece being provided as an integral part of the body-tube, while the author does not consider that mechanical rotation of the stage is essential for metallurgical purposes.

The Body.—As has already been indicated, the tube of the Microscope is rigidly attached to the limb, all focusing motions being carried out by means of the stage. A considerable increase of

rigidity results from this arrangement, and it is particularly convenient that manipulations at the eye-piece end of the tube may be carried out freely without fear of disturbing the focus of the objective or even—as sometimes happens—accidentally pushing the body-tube bodily down upon the specimen; where it is desired to attach a small camera to the Microscope body direct, this rigidity would also be a great advantage.

In the present instrument the body is made of unusually thick tube, and thus serves to support the necessary illuminating apparatus by means of slides placed outside three apertures opening at the front and both sides of the lower end of the tube.

The Illuminator.—In all metallurgical Microscopes hitherto constructed, with the exception of a peculiar instrument designed by H. Le Chatelier, the illuminator has been employed as a detachable fitting; in the present instrument, the illuminator is an integral part of the body-tube. The advantage secured by this means lies in the absence of a movable attachment intervening between the objective and the tube and inevitably introducing a certain amount of looseness. In the present instrument the objective is screwed direct into the lower end of the body-tube, or into a centring nose-piece directly placed in the end of the tube. In addition to the gain in rigidity, this arrangement makes it easy to interchange one illuminating appliance for another without in any way disturbing the focus of the objective, while with the older arrangement a change could only be made by removing the illuminator and objective; the new instrument thus provides a valuable facility for investigating the effects of different methods of lighting upon the microscopic appearance of various structures—a process likely to lead to valuable results in interpretation.

The illuminator proper consists of a short slide fitting into any of the three sets of dovetails corresponding to the three openings of the tube; to the slide itself is attached a short swinging arm carrying a spindle capable of rotation with slight friction. When the slide is in position, the spindle projects horizontally into the tube, the outer end being furnished with a substantial milled head. The inner end of this spindle is provided with an axial hole, into which the small holders with various reflectors fit interchangeably. By moving the slide up and down, by moving the swinging arm backwards or forwards, and by rotating the milled head, the reflector may be placed in any position or at any desired angle. These adjustments are of the greatest value in securing uniform illumination and the suppression of undesirable internal reflections, while special modes of illumination, corresponding somewhat to the dark-ground effects with transmitted light, may be obtained. For the most brilliant and uniform illumination, with a minimum of internal reflections, the author finds a reflector of thin silvered glass, placed so as to cover a little less than half

the aperture of the objective, by far the best, giving decidedly better results than the prism illuminator which is so much employed. In order, however, to enable the observer to study the effects of oblique lighting with high-power wide-angle objectives, a whole series of reflectors of different shapes and sizes is provided for the instrument; these are illustrated in fig. 23.

It has already been pointed out that the illuminator slide fits into the dovetailed grooves provided outside each of the three openings in the body tube, so that the Microscope can be placed in any of the three positions relatively to the source of light; once the relative position of Microscope and illuminant has been properly adjusted, no change will be required when objectives of different foci, or specimens of different thickness, are used. Interchangeable with the illuminator slide, a series of other slides is provided. One of these carries an iris diaphragm on a swinging arm; this is inserted on the side facing the illuminant, and serves

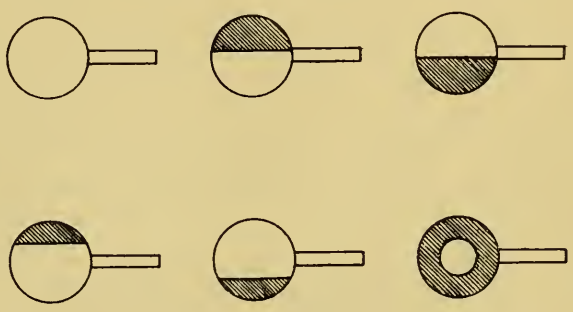


Fig. 23.

to stop down the incident beam, if required; the use of the slide and of the swinging arm making it possible to adjust the aperture of the iris to the position found most desirable for the reflector of the illuminator. The ring carrying this iris is also fitted with a standard objective screw-thread, by means of which lenses may be attached; perhaps the most important use of a lens applied at this point is the application of a negative lens for the purpose of producing critical illumination. In the ordinary course the best means of obtaining critical illumination for opaque objects, is to employ a source of light of considerable area, such as an incandescent gas burner with an opal chimney, and to place this source of light on a level with the aperture of the illuminator and at a distance from the reflector of the illuminator equal to the distance from the reflector to the back conjugate focus of the objective. Under these circumstances, the image of the source is formed by the objective itself upon the surface of the specimen. The image of the source, as formed by the objective at the eye-

piece end, is then the full natural size of the source, and is seen by the eye magnified by the eye-piece only. By using a large source as indicated above, the whole field can be uniformly illuminated, and in the author's experience such lighting is preferable to any other for all "vertical illumination" work on metals. If a small source of light is used, such as an electric arc, this direct method is not available, particularly as it would not be practicable to bring an arc so near the Microscope. One means of attaining the desired object is to utilise the light of the source, by means of a suitable system of lenses, to form a small bright disk of the required size, upon a translucent screen placed at the proper distance from the Microscope, and then to use the image of this screen for critical illumination. Another method is to throw a real image of the source to a point close to the illuminator aperture and then to interpose between the image and the illuminator a suitable negative lens giving an enlarged virtual image of the source at the proper distance from the illuminator; with a proper choice of foci for the various lenses, it is possible in this way to obtain a critical image of the arc large enough for the image of one crater to fill the field as seen by the eye or in the camera; but such spreading of the light necessarily entails loss of intensity, so that the use of critical illumination for photo-micrography of metallic specimens still entails some difficulties. For visual purposes, however, it not only yields the best results, but also furnishes the simplest method of illumination, no condensers whatever being required if a large source be used.

With objectives of focal lengths up to about 25 mm. (1 in.) the use of the internal reflector or "vertical" illuminator furnishes the most satisfactory results; but from that focal length onwards the distance between objective and specimen is large enough to allow of the use of external reflectors. If normal illumination is required it can be obtained by interposing a reflector between the objective and the specimen. The advantage of doing this is that all internal reflections are avoided, and a beam of wider angle can be condensed on the specimen by suitable condensers than could be obtained from these long-focus objectives. The external reflector may take the form either of a thin glass slip covering the entire field of view and inclined at about 45° to the optic axis, or it may take the form of either a metallic reflector (Sorby), or a silvered glass reflector covering about half the aperture of the objective. So far as the author's experience goes, the thin glass reflector gives the most uniform illumination, but its presence distinctly interferes with the definition. In the present instrument any of these reflectors may be carried on the lower end of a long slide which fits into the grooves outside the illuminator openings of the body-tube; the lower end of this slide carries a wide ring completely surrounding the objective, but out of contact with it, and upon

this ring the mountings of the various reflectors can be slipped; the reflectors are thus held independently of the objective, so that the fitting of adapters to various objective mounts is obviated, while the height and position of the reflectors can be varied at will. For general oblique illumination a silver parabolic Lieberkuhn is frequently used, and this is mounted to fit upon the outside of the ring at the lower end of the slide just described. With this Lieberkuhn in position, a fitting for other reflectors may be placed inside the ring carried by the slide, and to this fitting any of the reflectors already described for use above the objective, may be readily fitted.

Although the parabolic Lieberkuhn is much used for general oblique illumination, and certainly gives some very pleasing effects, the author regards it as a somewhat undesirable form of illuminating appliance, because its indications are very difficult to interpret; the light is focused upon the object from a great number of directions, and all surfaces inclined in such a way as to throw any of this light into the objective accordingly appear more or less bright. For this reason the author prefers to employ oblique light falling upon the specimen—if not as a strictly parallel beam, yet at least from one general direction. Rotation under such lighting frequently enables the observer to form correct judgments as to the relative heights and inclinations of various portions of the field. Sometimes the relative orientation of different crystals, or other surface markings, may be shown in a very striking manner by the simultaneous use of three beams of oblique light incident upon the specimen from three different directions, and distinguished from one another by their colour. For this purpose beams of light from three sources may be focused upon the specimen and coloured glasses interposed; in the present instrument this is facilitated by means of three slides for holding the coloured glasses or films, these slides again fitting the three sets of dovetail grooves in the body-tube.

Eye-piece Focusing Attachment.—When a visual eye-piece is used for purposes of photo-micrography, it is usual to focus the objective on the field visually, the objective being arranged to work at its proper tube-length under those conditions; the alteration of focus which is required to yield a real image on a screen is then obtained by altering the distance between the objective and the object, thus tending to throw the primary image formed by the objective to a point further from the eye-piece end of the tube. In doing this the objective is caused to work at a tube-length which is considerably shorter than that for which it is best corrected, so that its optical performance is impaired to some extent. If the eye-piece in question is of such a construction that the real image from the objective is actually formed in the tube outside the eye-piece, then the proper method of changing the focus

from that required for direct vision to that required for photographic projection, will obviously be to move the eye-piece outwards until the image formed by the objective lies sufficiently far beyond the principal focus of the eye-piece. Some eye-pieces are constructed in this way, being simply aplanatic magnifying glasses; in the commonest case, however, of the Huyghenian eye-piece, the rays from the objective pass into the collecting lens of the eye-piece before actually coming to a focus, and for these eye-pieces the rational mode of focusing for photography would be to move the back lens of the eye-piece only, provided that this lens were individually corrected adequately as a photographic lens. A near approach to this state of affairs is attained in the projection eye-pieces supplied with a focusing scale, but even with these, the use of the fine-adjustment is still required for focusing accurately. In order to obviate the derangement of the objective when the

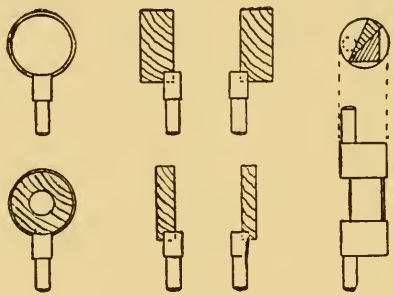


Fig. 24.

instrument is required for photography, the present Microscope is fitted with a spiral focusing motion which enables the operator to focus by moving the eye-piece alone—a process which makes it possible to use ordinary eye-pieces for photographic purposes in a much more rational manner. The movement of the eye-piece is actuated by the rotation of a milled collar at the upper end of the fixed body-tube, and this collar is grooved for the reception of a driving band, whereby the operator can focus while observing the ground glass screen of the camera.

While the design of the instrument here described has been arrived at entirely with the aim of providing an instrument specially perfected for metallurgical purposes, it is recognised that it may be desired to use the instrument for the examination of sections or other objects by transmitted light. For this purpose a special attachment is provided, consisting of a bracket which can be attached to the stage bracket, carrying a right-angled reflecting prism, iris diaphragm, and a swing-out condenser, with spiral focusing motion, together constituting a high-class illuminating

system. Upon the stage itself, and therefore partaking of its mechanical movements, is fixed a second or raised stage with apertures to fit over the condenser just described. With this attachment the only disadvantage is that the range of separation between tube and stage is diminished by about 50 mm. (2 inches), but since the maximum separation is still 70 mm. ($2\frac{3}{4}$ inches) this diminution will hardly be felt for work with transmitted light. All the advantages of extreme rigidity and concentric fine-adjustment are of course retained when the instrument is used for transparent objects, so that where one instrument is to be used for both classes of work, the considerable gain for the study of opaque objects which this Microscope is believed to afford, would more than outweigh the slight disadvantages, if any, which will be found in using it for transparent objects.

In conclusion, the author would express his indebtedness to Messrs. R. and J. Beck, Ltd., for the skilful manner in which they have worked out all the details of the instrument from the sketches and specification supplied to them.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Watson and Sons' Club Microscope.†—In appearance this instrument (fig. 25) is very similar to the Van Heurck model manufactured by Watson and Sons, but the idea has been to simplify the general details, and to provide in it such mechanical conveniences as are desired by an amateur, omitting the refinements that are only required by and of importance to the expert and critical worker.

The tripod foot has a spread of 9 in.; the stage is 5 in. in diameter, and has mechanical and rotary movements; the substage has rackwork to focus and screws to centre, and can be turned aside from the optic axis with the apparatus contained in it when desired. The instrument is of full size, measuring in height $12\frac{7}{8}$ in. when racked down.

Watson and Sons' Praxis Petrological Microscope.‡—This is a Petrological Microscope (fig. 26) of continental model, with the horseshoe foot and the upright pillar cast in a solid piece. The body contains an analyser prism and a Klein's quartz plate. The polariser, which is carried in a plate beneath the stage, can be turned aside from the optic axis when desired. The coarse-adjustment is by diagonal rack-and-pinion, and the fine-adjustment is Watsons' standard lever pattern.

Watson and Sons' School Microscope, 1905 Model.§ — Several modifications have been made in this instrument (fig. 27). The foot and the upright are cast in one solid piece, also the stage and the limb are cast solid. The stage has been fitted with an ebonite covering, and although the instrument is made with a coarse-adjustment by diagonal rack-and-pinion only, provision has been made for the subsequent addition of fine-adjustment should it be desired.

Reichert's New Large Mineralogical Stand.‖—This instrument (fig. 28) differs from the one described in the Journal, 1905, p. 245, in that the limb is altered to the handle form, and the fine-adjustment located therein for greater security.

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

† W. Watson and Sons' Catalogue, 1906, p. 36.

‡ Tom. cit., p. 84.

§ Tom. cit., p. 68.

‖ Reichert's Special Catalogue, 1905–1906, p. 11.

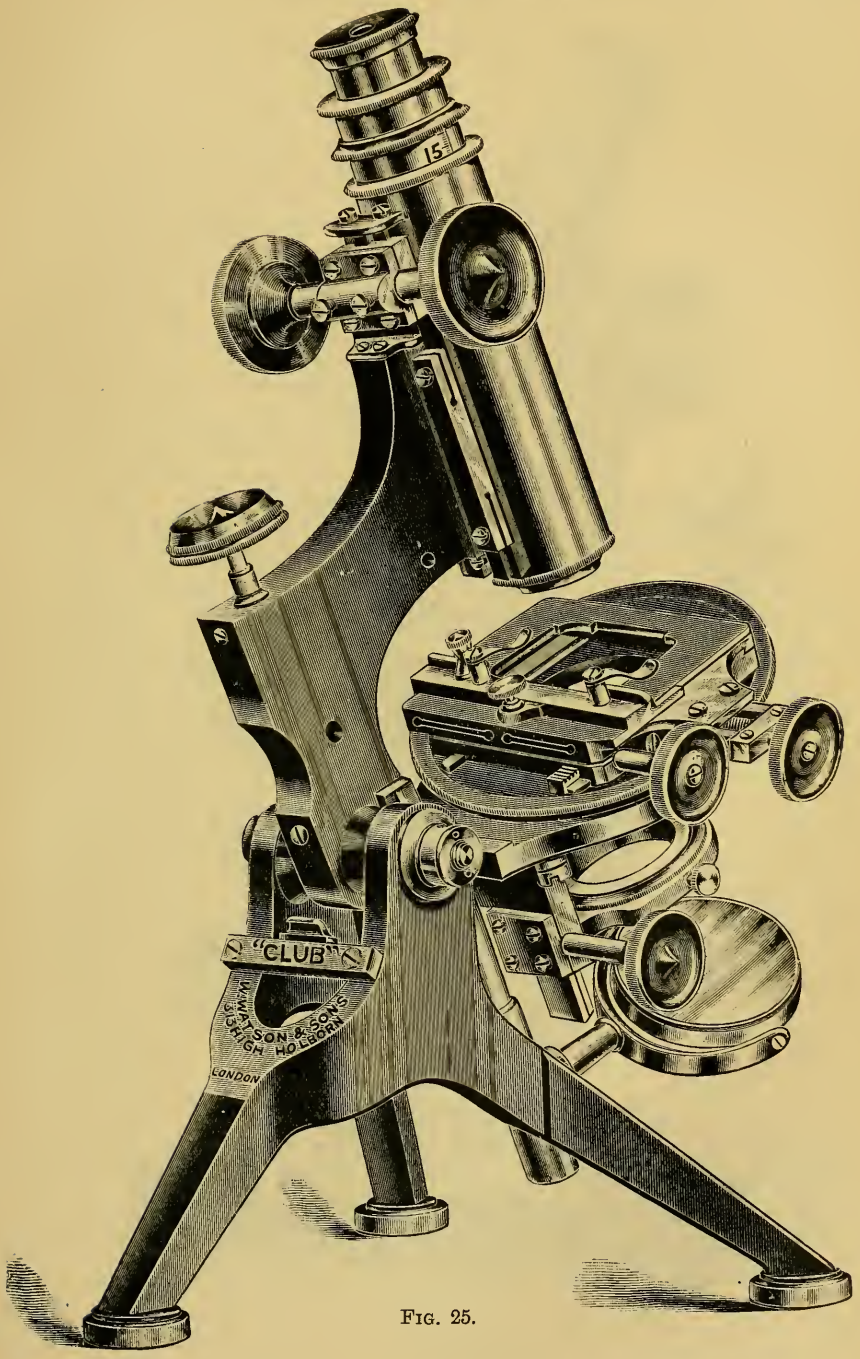


FIG. 25.

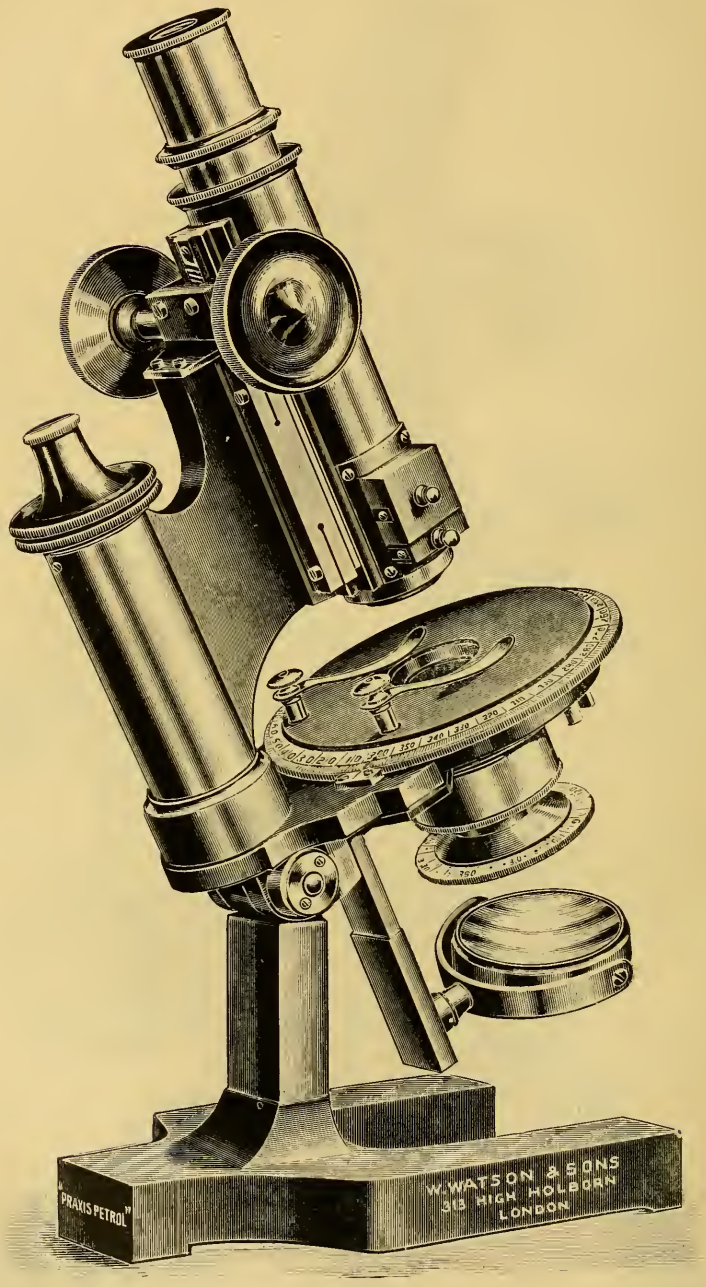


FIG. 26.

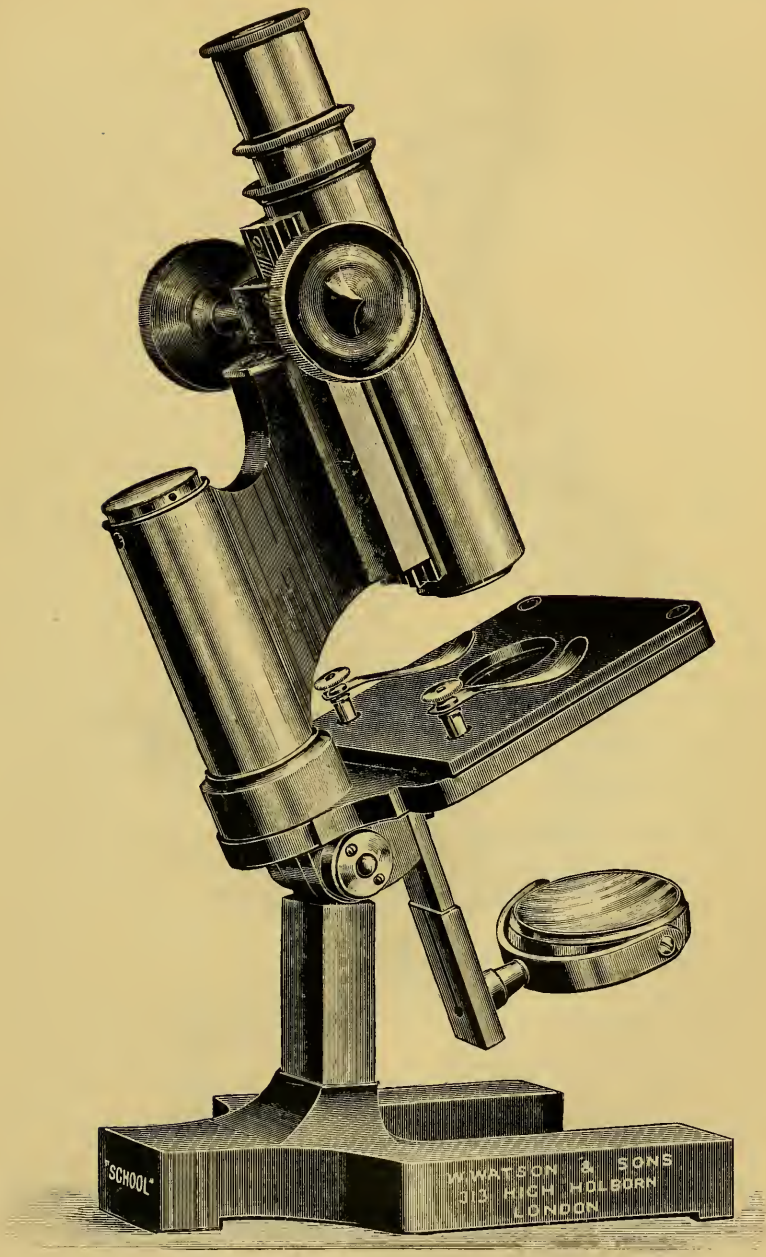


Fig. 27.

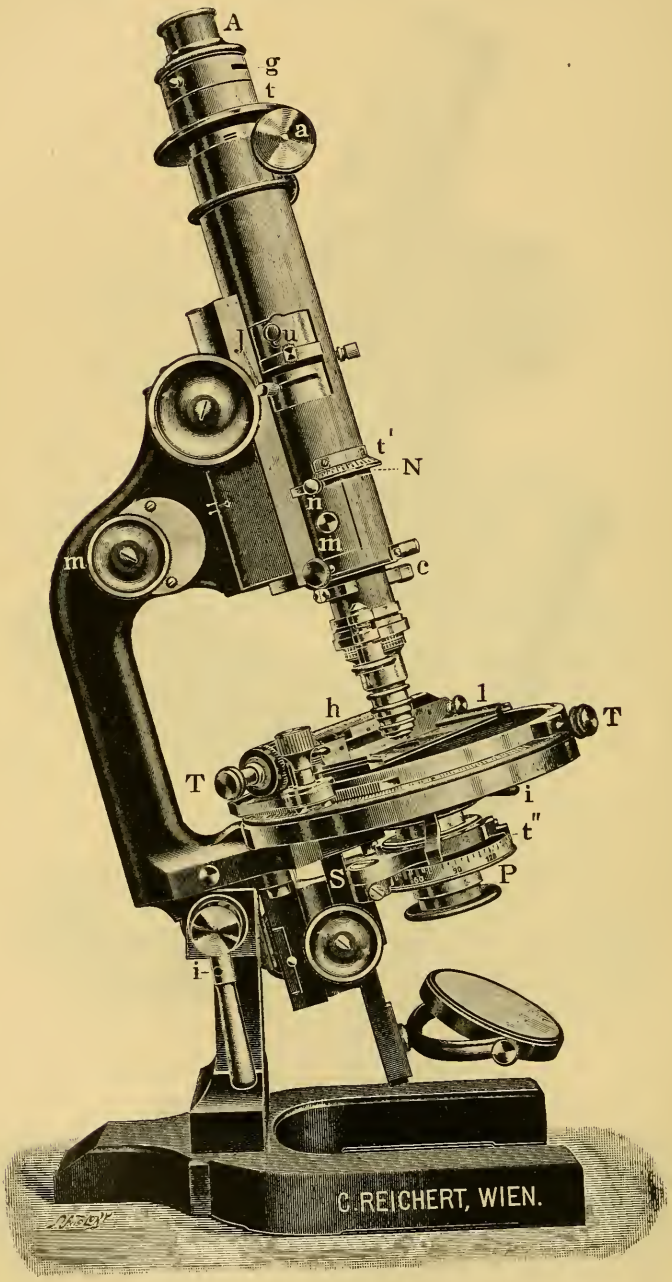


Fig. 28.

(2) Eye-pieces and Objectives.

Dry and Water Immersion $\frac{1}{5}$ Objective by Ross.—At the February Meeting R. G. Hebb exhibited an old lens, the property of the Westminster Hospital (fig. 29). Mr. E. M. Nelson kindly examined the objective, and reports as follows :—

This $\frac{1}{5}$ is an example of a lens made by Ross upon a formula by Mr. Wenham.

Fig. 29.

In June 1871, Mr. Tolles, of America, made a $\frac{1}{5}$ which could be adjusted by means of its screw collar for either wet or dry use, and Mr. Woodward said that this lens would resolve *Amphipleura pellucida*.

When this report was received in England it made a great stir, and opticians were most anxious to equal, if not excel, this result. Hence the origin of the lens.

It is of a peculiar construction, having a single front and back, and a triple middle. This triple has a central biconcave dense flint lens which corrects the aberration of the entire lens. The plan of this lens is figured on the right-hand half of fig. 6 on page 163 of the "Monthly Microscopical Journal," vol. ix., 1873, which appears to be an abstract of the Proceedings of the Royal Society, 1873, No. 141.

The present example differs slightly from the figure inasmuch as it has its back lens turned round the other way, so that its flat side is next the object.

These lenses did not prove successful, and were soon given up. Similar objectives were made by Powell and Lealand, but they discontinued their production after they had brought out their "new formula" which had separate fronts for dry and water immersion work.

This Ross lens is a $\frac{1}{6}$ by measurement; its aperture is 0·81 dry, and 0·83 wet, so that it would be quite incapable of resolving *Amphipleura pellucida*.

The figure attached is not to scale, but is given to show the form of the lenses.

Howland's Instrument for Centring, Marking, and Testing Lenses.*—C. W. Howland has patented this instrument, which is intended to centre, or decentre lenses, as desired. It also axis-marks cylindrical lenses, so that they can be cut to any axis without adjusting the lens-cutter. The instrument also shows the strength of prismatic lenses, and it tests finished prescriptions, indicating whether they have been filled correctly.

The frame of the instrument comprises a stand with a bed, on which are three brackets (fig. 30). At one end is a fixed bracket with a sight tube, and a blinker for the eye not in use. The standard at the other end carries a protractor, in which is a target revolvable by turning a rod at the right-hand side of the bed, looking towards the target. The same serves as a push-and-pull rod to adjust the position of the target along the bed, according to the focus of the lens. At the left side is a link, pivoted to

* Optical Instrument Monthly (New York) i. No. 3 (Aug. 1905) pp. 24-6 (1 pl. and 8 figs.).

the middle bracket, or lens rest, and containing one or more notches, intended to engage a pin and hold the target-carriage at a fixed distance when testing prismatic power. The lens rest comprises a ring carrying a glass plate, against which the lens to be tested, marked, etc., is held by hand or otherwise on the optical axis extending from the sight tube to the target centre. Pivoted to the bottom of the middle bracket is an arm holding a little shaft placed at right angles to the vertical plane, through the axis of the instrument. This shaft carries three marking

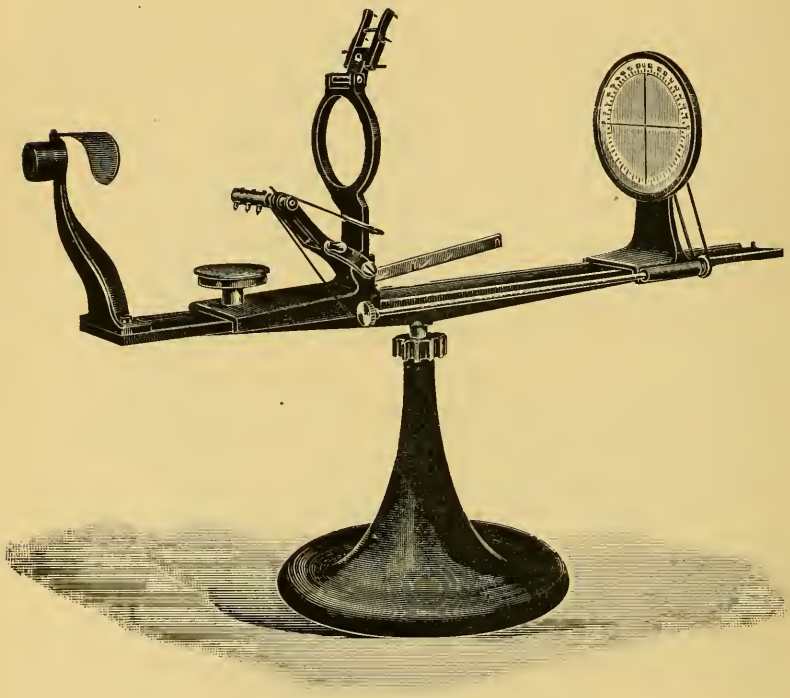


Fig. 30.

pins, which, when the arm is lowered, strike an ink-pad, and, when the arm is raised, stamp the lens at three points in the same straight line coincident with the horizontal major axis of the lens. During the swing of the arm the shaft carrying the ink-pins executes a quarter-turn, under the influence of a cord which passes over a drum on the shaft and is kept taut by a spring. The rotation of the shaft is limited by stop-fingers. The marking pins are yielding, so as to compensate for the amount of projection of different parts of the surface of the lens.

Detailed descriptions of the use of the instrument are given.

(3) Illuminating and other Apparatus.

High-Angle Condenser Carrier for Petrological Microscopes.*—In connection with their Petrological Microscope, Watson and Sons have recently introduced a new arrangement for quickly removing the upper portion of the condenser from the field of view without the removal of the polariser or other apparatus.

The upper portion of the condenser mount, containing the lens which produces the high-angled convergence, is carried on a holder which is fitted into the stage itself. This holder can be immediately turned on a pivot so as to bring the condenser into the optical axis, or remove it therefrom. When high-angled convergent light is required, the holder is turned so as to bring the condenser to the centre of the stage—it is then just below the surface. The polariser is then pushed upwards, and in so doing lifts the condenser from its holder and carries it upwards to the surface of the stage. When the condenser is not required, the polariser is lowered until the condenser rests once more on its holder, when it can be at once turned aside.

Miller Sub-Stage Spark-Gap Lamp for the Microscope.†—T. I. Miller has arranged this apparatus (fig. 31) for photographing thin sec-

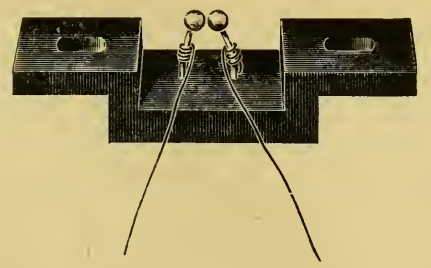


Fig. 31.

tions of minerals while fluorescing. It is not possible to give exact dimensions of the apparatus, because these must vary with the requirements of the Microscope selected. A piece of vulcanite $\frac{5}{8}$ in. thick and about 1 in. wide, is made with a base for two metallic terminal balls each $\frac{3}{16}$ in. in diameter, and mounted on pins having a tapered point. These pins are driven into holes drilled in the vulcanite. Two wires of thin copper are then wound around the pins, and connected to the secondary of a $\frac{1}{2}$-in. induction coil. This "lamp" is fastened to the sub-stage of the Microscope by machine screws, which loosely fit through the slots. By this construction it is quite easy to adjust the spark to the centre of field, or entirely out of field. The balls may be made of various metals, and provided with tapering holes to fit the pins, thus making it easy to use various metals whose spectra and effect on the mineral section are

* W. Watson and Sons' Catalogue, 1906, p. 79.

† Optical Instrument Monthly (New York) i. No. 3 (Aug. 1905) pp. 13–14 (3 figs).

known to be quite different. The balls must be mounted just high enough to be a little below the level of the top of the Microscope stage. The secondary of the induction coil is stepped up with a half-pint Leyden jar. An ordinary telegraph key was found most convenient for making and breaking the current. The mineral sections are ground as thin as possible, washed free of balsam, and then cemented around the edges to ordinary slides. The slides are reversed when placed on the Microscope stage, and the section should lie just clear of the balls.

Some Notes on Laurent Polariscope Readings.*—G. W. Rolfe and C. Field have made two series of rotation measurements of two standard quartz plates on a Laurent polariscope, one set with the light designed to be used by the Laurent polariscope, sodium-chloride light filtered through a section of bichromate crystal; the other set with sodium-chloride light passed through a Lippich ray filter. The instrument used was a Laurent "large model," made about 1888 by Léon Laurent, of Paris.

The authors conclude that it is imperative, in stating that the light factor of a saccharimeter is a certain value, that reference should be made (1) to the exact nature of the light used in the rotation readings; (2) the saccharimetric standard of the scale of the quartz-wedge instrument; (3) the nature of the substance measured; and (4) obviously, the temperature at which the comparisons are made.

Quartz-Plate Readings in Saccharimetry.†—G. W. Rolfe gives his reasons for considering that the Landolt-Lippich polariser is not as satisfactory for instruments for general laboratory use as the Laurent, because the former requires that all extraneous light be rigidly excluded, and seems much more sensitive to small variations in intensity of the sodium flame than does the Laurent. Only under constant conditions of temperature and light intensity, and with a rigid exclusion of all extraneous light, can good results be obtained with the Lippich polariscope.

A New Spectrometer: its Uses and Advantages.‡—V. H. Mackinney has designed a new form of spectrometer, whose main features may be tabulated as follows:—

(*a*) Both tubes are auto-collimating telescopes, and both are made to rotate in the horizontal plane.

(*b*) The illuminant is central above the prism table, and hence, once set, is constant on the slits whatever position they may occupy round the circle. There is a shade below to prevent stray light from interfering with the observations.

The advantages gained by these new features may, to start with, be briefly tabulated as follows:—

(*a*) The refractive index of a prism can be determined whatever its angles may be, for the new instrument adapts itself for determining it by any of the following methods:—(1) position of normal incidence; (2) minimum deviation; (3) critical incidence; (4) return path (Abbe) method.

* Technology Quart. Proc. Soc. Arts, Massachusetts, xviii. (Sept. 1905) pp. 219–93. † Tom. cit., pp. 294–9.

‡ Paper read before Optical Society, London (Feb. 1906) 8 pp., 13 figs.

(*b*) By having two auto-collimating telescopes, not only is a check obtained by taking an observation through one eye-piece and then through the other, but a further check is readily obtained by passing the light through the prism in a similar but opposite manner.

(*c*) The error due to auto-collimation is eliminated when method (1) (normal incidence) is employed, by taking the mean of two observations—with illuminating prism and cross-wires to right and left, or *vice versa*, of field respectively. The same applies to the "critical incidence" method, which, however, is not apt to produce such accurate results, owing to the difficulty met with in placing the cross-wires to exactly cut the half-light and half-dark field.

Optical Bench for Illumination with either Ordinary or Monochromatic Light.—The firm of R. and J. Beck has designed a small optical bench for microscopical illumination, which is suited for use with the Rosenhain Microscope, as well as for other purposes, and has a series of very handy adjustments (fig. 32).

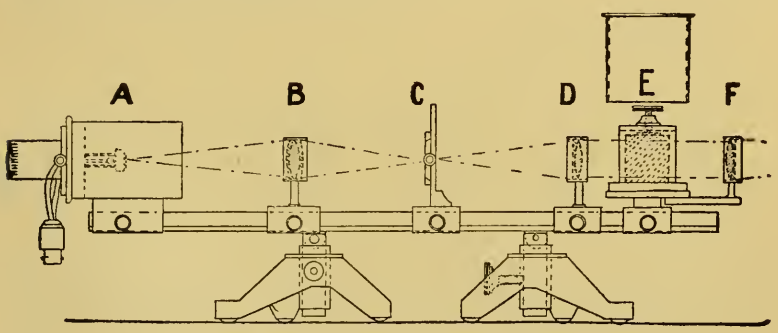


Fig. 32.

It consists of a 30-in. steel bar mounted on two strong tripod feet by means of two sliding uprights which can be raised or lowered and clamped at different heights, in fittings carried in the tripod feet, so that the bar can be placed at different heights above the table, or can be pointed either upwards or downwards.

All the pieces of the apparatus slide along the steel bar, and are accurately aligned to the same centre or axis. Each piece can be clamped in any position.

At one end A is a Nernst lamp with a single upright filament giving from 100–230 candle-power. It can be used with a slight modification in the burner on any current from 110–220 volts, but to give the highest candle-power should be used with the highest current. Next to the lamp is an achromatic and aplanatic condenser B, $1\frac{3}{4}$ in. diameter, which is corrected to give a well-defined image of the filament on the slit C; this is adjustable by means of a screw.

An achromatic collimating lens D collects the light from the slit C and emits it in a parallel bundle to a Thorp's diffraction grating on a prism, with rotating adjustment and brass cover, which transmits a

normal spectrum, which is again focused by means of an achromatic condensing lens F upon either the vertical illuminating apparatus of the Rosenhain Microscope, upon the surface of an object, or upon the mirror of an ordinary Microscope. It is generally advisable to interpose a screen with a broad slit in the focus of this lens if but one coloured light is required, especially if the bench is being used to illuminate a substage condenser for transmitted light. Such a screen is most conveniently carried on the Microscope itself, but in the case of the vertical illuminator of the Rosenhain Microscope it is made to slide into the fittings of the body.

The above describes the bench as used for monochromatic illumination, but for ordinary illumination the diffraction grating and prism E, with the condenser F and the slit C, are removed. An iris diaphragm and a water cooling chamber G may be used, and if desired a 4-in. lantern condenser may be used instead of the condenser B. A mirror on carrier H may be supplied to fit the bench. A lantern carrier and projection lens convert the whole apparatus into a most convenient and serviceable optical lantern.

An incandescent gas lamp may be supplied in place of the Nernst lamp.

(4) Photomicrography.

Method for Determining the Exact Colour for Light Filters.—E. Moffat communicates the following easy method for determining the exact colour of screen required to photograph successfully a faintly stained slide of Bacteria, etc. Place some crystals of chlorate of potash or salicin (the crystals of which give a good range of colour) under a Microscope, and examine by polarised light. Revolve one of the prisms till any one of the crystals matches exactly the stained preparation : now turn the prism round 90°, when the complementary colour will appear. This will show the exact tint required for the screen, and will produce the greatest amount of "darkness" or contrast, e.g., bacilli stained faintly blue will require a very dark orange screen, or if stained faintly red, a dark green will be required ; the lighter the stain, the darker must be the screen, and vice versa, in order to produce a sharp image on the photographic plate. Hence the saving of time in using the polariscope to determine the required depth of tint. Isochromatic plates must be used in conjunction with these screens. To prepare the screens fix unexposed dry plates in the dark room and stain with any suitable dye.

(5) Microscopical Optics and Manipulation.

Artificial Double Refraction, due to Ælotropic Distribution, with Application to Colloidal Solutions and Magnetic Fields.*—T. H. Havelock, after reviewing the methods of artificially obtaining double refraction, and after investigating the theory of their formation, summarises the sections of his paper thus :—

1. The formal investigation of artificial double refraction in colloidal solutions as due to a deformation of the medium, consisting of a change in the packing of the colloidal particles.

* Proc. Roy. Soc., Series A, lxxvii. No. A 515 (Feb. 1906) pp. 170–82.

2. The possibility that such deformation may be produced by mechanical stress as arising from the possession of a certain amount of rigidity by such solutions.

3. The analogy between the effects so produced, and the double refraction due to a magnetic field.

MAILLARD, L.—**Le Loi de la Réfraction et le principe de la moindre action.** [An interesting historical review of the theories of refraction.] *Bull. de la Soc. Vaudoise des Sci. Nat.* (*Lausanne*), xli. (Sept. 1905) pp. 173–95 (7 figs.).

MUNSELL, A. H.—**On a Scale of Colour-Values and a new Photometer.** *Technology Quarterly*, xviii. (1905) pp. 60–72 (10 figs.).

ROHR, VON M.—**Die Optischen Instrumente.** Leipzig: B. G. Teubner (1906) v. and 130 pp.

SCHNEIDER, J., & J. JUST—**Ultramikroskopie der Oleosole.** [On the application of ultramicroscopy for testing the purity of oils and oleaginous mixtures.] *Zeitschr. Wiss. Mikrosk.*, xxii. (1905) pp. 481–530.

THORP, T.—**Replicas of Diffraction Gratings.** *Nature*, lxxiii. (1905) p. 79.

WALLACE, R. J.—Ditto. *Astrophysical Journal*, xxii. No. 2. See also *Nature*, lxxiii. (1905) p. 21.

ZSIGMONDY, R.—**Zur Erkenntniss der Kolloide. Ueber irreversible Hydrosole und Ultramikroskopie.** (An account of the nature and properties of colloid solutions or hydrosols, and of the investigation by the method of ultramicroscopy.) Jena: Gustav Fischer (1905) vi. and 185 pp.

(6) Miscellaneous.

Advances in Microscopy: The Microscope at Work.* — J. W. Gordon dealt first with the subject of metallography, which he traced to Dr. Sorby's work in Sheffield in 1864, illustrating its use in engineering by a number of lantern slides lent for the purpose by Mr. J. E. Stead, F.R.S., exhibiting the microscopic structure of steel.

From this topic an easy transition served to introduce the subject of the changes which the surface of a polished piece of metal undergoes in the process of polishing. This part of the lecture was illustrated by photographs lent by Mr. G. Beilby, of Glasgow, who has made a special study of the physical condition of metals as affected by heat, and particularly by the treatment which they undergo in the polishing process. His inquiries show that enormous forces, comparatively speaking, are brought to bear upon the exquisitely thin film of metal which is directly affected by the polishing operation in the act, for instance, of knife cleaning ; and as the result of the hard usage to which this surface film is subjected it carries permanent traces of having been spread like a fluid over the solid foundation of underlying metal. A very remarkable series of photographs illustrated this point, and showed how a polishing tool left the surface of a piece of brittle metal like antimony in streaks like the brush marks of paint.

The next topic dealt with was the application of the Microscope to the healing art—and here the lecturer selected for special notice the

* Lectures at the Royal Institution, Feb. 1906.

work recently accomplished by Professor A. E. Wright. This relates to the employment of the Microscope as a part of the physician's equipment in the ordinary work of treating such diseases as arise from microbic invasion. It is well known that nature's remedy for such diseases is found in the activity of a certain type of white blood corpuscle, itself a microbe of a very militant order, which voraciously devours the smaller microbes of the morbid kinds. It is found, however, that this phagocyte is not always on the alert, and Professor Wright's investigations have led him to the conclusion that the secret of the phagocyte's activity is to be sought in the composition of the blood serum. He has, accordingly, devised a system of measurement for the stimulating property of the blood fluids. A minute sample of the patient's blood furnishes the required specimen of serum, and to this serum is added a pure culture of the noxious bacterium. This mixture being placed in an incubator, a certain number of phagocytes are let loose, and allowed to play in it for a regulated period of time. A sample of the mixture is then withdrawn and examined under a Microscope, and some 50 or 60 specimen phagocytes are taken, from which an average is deduced of the amount of execution which the phagocyte can do in that medium. If the result of that examination is satisfactory, then the patient's blood is in such a condition that inoculation treatment can be successfully applied. If, however, the phagocytes prove not to be very keen in seizing and appropriating their destined prey, then the system of treatment has to be directed to improving the condition of the patient's blood before commencing the inoculation treatment. A photograph of a phagocyte with ingested tubercle bacilli, enabled the audience to appreciate the precision of this method.

The Microscope adapted to Special Duty.*—In his second lecture Mr. Gordon referred first to a topic which, under pressure of time, was omitted from the previous lecture, that is to say, the limit of visibility. This subject has been much under discussion in recent times, and Lord Rayleigh has of late investigated it with very remarkable results. It now appears that objects such as a bacterium or that minute appendage called a flagellum, which many bacteria carry, may be seen although attenuated much beyond the point hitherto commonly supposed to be the inferior limit of microscopic vision. The importance of this fact lies in the circumstance that many bacteria are so minute that it is difficult to make out their distinctive features, and the study of these delicate but vitally important forms of life, taxes our present Microscopes to the limit of their capacity.

The lecturer next demonstrated by means of a Microscope, lent for the purpose by Mr. C. Baker, the appliances which are employed in the metallographer's Microscope to illuminate the surface of an opaque object such as a polished slab of metal, describing particularly the construction of the vertical illuminator and the method of focusing adopted under these conditions. He then passed to consider modifications directed to improving the resolving power of the instrument, and showed by a very striking experiment how a thin film of some transparent body, such as

* Lectures at the Royal Institution, Feb. 1906.

a drop of water hanging upon the surface of a glass plate, can be rendered conspicuously visible by cutting down the image-forming beam in a particular position. The experimental result goes somewhat beyond the theoretical explanation at present available. The experiment itself had been designed with the idea of introducing a diffraction fringe into the field of the instrument and utilising the high resolving power which such a fringe is, on grounds of theory, supposed to possess. But the increased visibility of the image shown up in this way is so very pronounced that there is reason for thinking that the diffraction fringe does not completely explain it. The result is to exhibit a transparent object under the aspect known to microscopists as dark field illumination, but without any of the appliances commonly employed for bringing about that result.*

Another appliance directed to the same general object of improving the resolving power of the Microscope is the apparatus devised by Dr. A. Köhler for utilising ultra-violet light having a wave-length of about $\frac{1}{30000}$ in. A description of this apparatus has already appeared in this Journal, 1905, pp. 103 and 513. The exclusion of glass from the optical system makes it impossible to obtain the ordinary corrections for chromatic aberration, and the objectives prepared for use with this instrument are accordingly designed as monochromatic, that is to say, they are correct for one particular wave-length only. This elaborate instrument is at present in the probationary stage, and it does not seem possible to speak as yet with confidence of its capacity for high-power work. But its use at moderate magnifying powers has shown that light of the particular wave-length mentioned is arrested by certain tissues which are quite transparent to ordinary visible light, and in that way structure can be demonstrated in unstained specimens by the aid of colour reactions by latent stains, as we may say, to reveal which ordinary light would be wholly inoperative. Special attention was drawn by the lecturer to this very notable property of monochromatic light and to the simplification of the correction problem accomplished by the production of monochromatic objectives. In both these particulars he thought that the principles exemplified by Dr. Köhler's design might usefully be extended to instruments designed for working with monochromatic light within the range of the visible spectrum.

The last subject dealt with was a photomicrographic apparatus recently introduced by Messrs. Beck. This is designed to meet the requirements of practising engineers and doctors, and reduces the apparatus and procedure employed in the production of a photograph of a microscopic object to extreme simplicity.

A full description was given at a recent meeting of the Society, and may be found in the Journal, 1905, p. 651.

Quekett Microscopical Club.—At the Meeting held on Jan. 19, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair, the Hon. Sec. announced that two papers had been communicated by Mr. T. B. Rosseter, F.R.M.S., on "*Drepanidotœnia undulata*," and on "*Drepanidotœnia sagitta*."

* This experiment forms the subject of a Note on p. 157 of this Journal.

Mr. R. T. Lewis, F.R.M.S., delivered a lecture on "The Senses of Insects," dealing more especially with sight and hearing.

The 40th Annual General Meeting was held on Feb. 16. The President delivered the Annual Address, taking as his subject "The Relative Merits of the Short and Long Tube for Microscopes." The short tube was probably introduced by Oberhäuser, certainly before 1857. The advantages claimed for each form were dealt with, and the President, in conclusion, said he considered the short tube to be the ideal stand, as it could quickly be converted to the long form, and objectives corrected for either tube-length alternately employed if desired.

The 429th Ordinary Meeting was held on March 16. Mr. C. D. Soar, F.R.M.S., delivered a lecture on "The Life-History of Freshwater Mites (*Hydrachnidæ*)." The various stages—ovum, larva, nymph, and adult, were described and illustrated with the aid of the lantern. Of the sixty genera known, we have information regarding the life-history of only five.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Differentiation of the Bacillus putrificus.†—A. Rodella discusses the results obtained by Achalme and others in the differentiation of *B. putrificus* and allied anaerobic organisms by their ferment action on certain hydrocarbons. He finds that the fermentation of hydrocarbons does not alone serve to differentiate either the nine bacilli studied by Achalme, nor the other anaerobic micro-organisms that have the property of fermenting albuminoid substances; that in the classification of these anaerobes the fermentation of hydrocarbons is to be considered, but especially the fermentation of proteid substances. The author found that in nearly all milk cultures lactose remained unaltered even after four weeks, and he considered that the fatty acids that were formed were derived from the fermentation of the casein. Some bacilli form with casein only butyric acid, others valerianic acid, and others caprionic acid.

Culture of Bacillus lepræ.‡—P. Emile Weil finds that for the cultivation of the *Bacillus lepræ*, it is necessary to select exclusively cases of tuberculous leprosy, and especially those that show recent tubercles. The surface of a tubercle being first washed with ether, is abraded with a sterile scarifier, and into the leprous mass is introduced a fine sterile pipette, which removes a short cylinder of yellow matter containing the bacilli. From this the culture tubes are inoculated; the media employed being glycerin glucose agar in various proportions, but always rendered neutral or alkaline, to which was added human pleuritic serum. Egg agar was also found especially useful. The tubes were incubated at 39° C. Growth appeared in about 15–20 days.

* 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, xix. (1905) p. 804. ‡ Tom. cit., p. 793.

Magnesium Phosphate in the Preparation of Media.*—A. Cache recommends the following method for the preparation of bouillon. Take 250 grm. of meat, 500 grm. of water, and 1 grm. of $MgNH_4PO_4$, and allow the mixture to stand in a flask for 24 hours in the cold. On filtering, 500 grm. of meat extract are obtained, the alkaline reaction of which is then estimated. Add 1 p.c. of pepton and 0·5 p.c. of NaCl, thoroughly shake the mixture, and place in autoclave for 2 minutes at 120° C. After filtering, when cool, there is obtained a clear fluid slightly alkaline to litmus. In this medium the author finds that micro-organisms develop better and retain their virulence longer than in media prepared after the usual method.

Early Diagnosis of Typhoid Fever.†—H. Conradi has devised a method by which a diagnosis of the presence of *Bacillus typhosus* in the blood can be demonstrated in not more than 32 hours. It is based on the observation that the blood *in vivo* is less bactericidal than *in vitro*, under which latter condition substances are developed which exert a disinfectant action as a result of coagulation. Coagulation is prevented by the use of bile, the important components of which in respect of this action are due to glycocholate and taurocholate of sodium. The medium consists of bile, 10 p.c. pepton, and 10 p.c. glycerin. The blood is obtained by pricking the ear, and allowing it to pass into a capillary pipette containing a small quantity of bile fluid. From the capillary pipette the mixture is transferred to a small glass tube containing 2–3 c.cm. of the pepton-glycerin-bile medium. The process of transference is continued until the ear ceases to bleed. The proportion of blood used must be as 1 to 3 of the medium. The tube is incubated at 37° C. for 10–16 hours, and cultures are then made on the Drigalski-Conradi agar plates.‡

New Method of Differentiating Bacillus typhosus and Bacillus coli.§—L. S. Dudgeon read a preliminary communication before the Pathological Society on the use of urotropin medium as a means of diagnosis between *B. typhosus* and *B. coli*. From a series of experiments he found that the most suitable strengths of urotropin were 0·1 p.c., 0·5 p.c., and 1·0 p.c., more especially in a broth medium. He had also employed the same strengths of urotropin in agar, both for slants and for plating. He had experimented with cultures of *B. typhosus* obtained from two cases of bone abscesses, and stock cultures isolated from the spleen in cases of typhoid fever. The results were constant. *B. typhosus* grew well in 0·1 p.c. urotropin broth, fairly well in 0·5 p.c., but the growth was delayed; 1 p.c. urotropin broth was always sterile, whereas *B. coli* obtained from cases of peritonitis and cystitis gave an abundant growth in 0·1 p.c. and 0·5 p.c., and a fair growth in 1 p.c. If a tube of 1 p.c. urotropin broth were inoculated with the typhoid bacillus and incubated at 37° C. for 24 hours, and then considerably diluted (twice and three times), and then reincubated, no growth resulted in any case. A paratyphoid bacillus (Kràl) was found to grow well on

* Centralbl. Bakt., Orig., 1te Abt., xl. (1905) p. 255.

† Deutsche. Med. Wochenschr., Jan. 1906. See also Brit. Med. Journ., 1906, i. pp. 339–40. ‡ See this Journal, 1902, p. 371; 1904, p. 369; 1905, p. 259.

§ Brit. Med. Journ., 1906, i. pp. 143–4.

0·1 p.c. urotropin agar, a very slight and delayed growth occurred in 0·5 p.c., while only one colony was obtained on 1 p.c. at the end of 11 days' incubation at 37° C. A paratyphoid bacillus (L.) gave a good growth in 0·1 p.c. urotropin broth, a fair growth in 0·5 p.c., and a faint growth in 1 p.c., which was considerably delayed. A paratyphoid bacillus (S.) gave a similar result in 0·1 p.c. and 0·5 p.c., but failed to grow in 1 p.c. urotropin broth. *B. pyocyaneus* gave an abundant growth in all three strengths of the urotropin medium. The author stated that these experiments were being continued and various modifications were being tried.

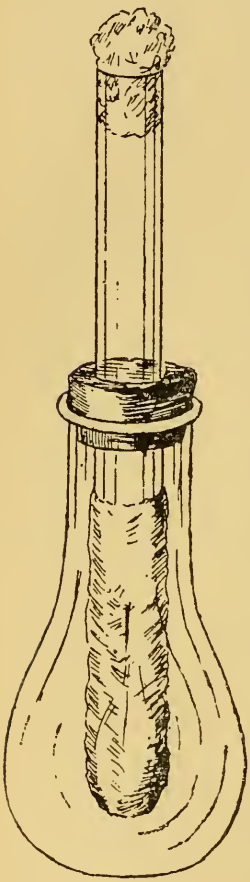


FIG. 33.

New Method of Isolating Bacillus typhosus from Infected Water.*—H. S. Willson's method is as follows. A stock solution of alum in distilled water, 10 grm. to 100 c.cm., is used; 0·5 grm. alum is added to each litre of infected water. The whole is well stirred, and a known quantity withdrawn and centrifuged for 15 minutes at 2000 revolutions, the supernatant fluid save 1 c.cm. poured off, the residue stirred and plated on the Drigalski-Conradi medium and incubated at 42° C. for 24 hours, the resulting colonies being tested by the agglutination method and subcultures. Numerous experiments were performed with water infected to a known amount, and some on a large scale in galvanized iron tanks. In these tanks the bacilli died out in 6 days, owing to the action of the zinc-iron coating.

In conclusion, the author advocates the conversion of the suspected water into a nutrient medium (water + 1 p.c. nutrose + 0·5 p.c. caffeine + 0·001 p.c. crystal violet) by the caffeine method, which enriches the *B. typhosus* at the expense of the other organisms; but on account of the variability in action it should be supplemented by the precipitation process.

Method for keeping Cultures Alive indefinitely.†—P. Murillo records the following method for keeping cultivations of bacteria alive for protracted periods. A collodion sac made in the usual way is fitted over the lower end of a piece of glass tubing. The tube is adjusted in the neck of an Erlenmeyer's flask by means of a perforated rubber stopper. The tube and the flask are then filled with a suitable quantity of broth, and after the tube has been plugged with cotton wool the whole apparatus (fig. 33) is sterilised. Inoculations are then made in the usual way. The appa-

* Journ. Hygiene, v. (1905) No. 4.

† Bol. Inst. Alfonso XIII., i. (1905) pp. 180-91 (5 figs.).

ratus was originally devised for keeping diphtheria bacilli alive, but it was found that the broth in the flask soon became highly virulent owing to diffusion from the sac, and that bacteria remain alive much longer in this apparatus than had been anticipated.

GAGE, STEPHEN DE M.—**The Bacteriolysis of Peptones and Nitrates.** [Deals with the biochemistry of sewage purification.] *Technology Quarterly*, xviii. (1905) pp. 5–39.

(2) Preparing Objects.

Demonstrating the Structure of Corals.*—F. Menneking, in his research on certain Corals, used material which had been preserved in spirit and decalcified with sulphuric acid. The material was then hardened in graded alcohols and imbedded in paraffin. The sections were stained with hæmalum.

Besides the ordinary paraffin imbedding, the author also adopted Schœnemann's method † for bone, with good results.

Trichloracetic Acid as a Fixative.‡—M. Heidenhain recommends the use of trichloracetic acid for fixing tissue. From an experience of ten years he has found its action very satisfactory in from 5–10 p.c. solution. Its one defect is that it makes connective tissue swell up, but this inconvenience is obviated by after-treatment with absolute alcohol, which should be frequently changed and allowed to act for a considerable period.

Presence of Negri's Bodies in Rabies.§—A. Bongiovanni obtained negative results when experimenting on rabbits with fixed virus; in the controls with street virus Negri's bodies were always present. The parts examined were cornu ammonis, cerebellum, Gasserian and spinal ganglia. The pieces were fixed in Zenker's fluid, and the sections stained by the methods of Fasoli,‖ of Mann, with Ehrlich's acid-hæmatoxylin, and with Heidenhain's iron-hæmatoxylin.

Part of the research was to ascertain the effect of radium. The results show that the action of the rays delayed the activity of the virus and postponed the inevitable termination.

Demonstrating the Phenomena of Maturation in Oogenesis and Spermatogenesis.¶—P. Lerat used *Cyclops strenuus* only in his researches, obtaining the specimens chiefly from pools and puddles. The water was filtered, and after the removal of such animals and plants as could be descried, the *Cyclops* were found in the stem of the funnel. These were killed by immersion in Gilson's fluid for about 10 minutes and afterwards washed in water for about half-an-hour. *Cyclops strenuus* was then picked out under a Microscope. Fixation and imbedding were performed in test tubes, a procedure which lent itself to an easy change

* Archiv Natur., lxxi. (1905) p. 246.
† See this Journal, 1903, pp, 107 and 371.
‡ Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 321–4.
§ Atti R. Accad. Lincei., xiv. (1905) pp. 454–62.
‖ See this Journal, 1905, p. 386.
¶ La Cellule, xxii. (1905) pp. 163–98 (4 pls.).

of fluids and also prevented loss of the animals. When this manipulation was finished the test tube was broken and the paraffin block extracted. It was found to be important to keep the animals in one-third alcohol for 10 minutes, and for 6 hours in 50 p.c. alcohol, and to carry the imbedding through slowly. Some difficulty was experienced in making sections, as the carapace was easily fractured though the internal parts were easily manipulated. The best stain was Heidenhain's iron-hæmatoxylin.

Demonstrating the Presence of Indigo.*—H. M. Leake, for his investigation on indigo-yielding plants, placed pieces of the material in the following mixture : acetic acid 2 c.cm., sulphuric acid 1 c.cm., ammonium persulphate 0·5 grm., water 100 c.cm. According to size the pieces remained in the fixative for from 4–12 hours. They were next placed for 3–4 days in 50 p.c. alcohol, changed daily. The sections varied from 4–12 μ in thickness. They were stained in Delafield's hæmatoxylin and decolorised with hydrochloric acid alcohol. They were next placed for an hour or so in 1 p.c. Grübler's water-soluble eosin ; then absolute alcohol, xylol, and balsam. The indigo contents of the cells were clearly shown.

Demonstrating the Structure of Nucleoli and Chromosomes.†—T. Martins Mano used *Phaseolus vulgaris* and *Solanum tuberosum*, the grains and tubercles of which were germinated at different temperatures. The material was fixed in Hermann's, Bouin's, or Perenyi's fluid, the first mentioned giving the best results. Sections from 5–7½ μ thick were stained with Heidenhain's hæmatoxylin, either alone or with Congo or Bordeaux red, with light green and safranin, with Delafield's hæmatoxylin and picric acid, and other dyes.

Heidenhain's hæmatoxylin gave the details of nuclear structure more clearly than other solutions.

Studying the Nervous System of Asterias rubens.‡—R. Meyer obtained the best staining results from the use of molybdic acid hæmatoxylin and Malory's hæmatoxylin after fixation in sublimate acetic acid (saturated solution of sublimate in hot sea-water, 100 parts, and 2 parts of acetic acid). An excellent fixation and staining reagent was found in a mixture of 1 part of 1 p.c. osmic acid and 3 parts of the above-mentioned sublimate acetic acid. After 12–15 hours the objects were washed in sea-water for 6 hours and then for a similar period in pyroligneous acid, followed by another course of sea-water. The sublimate was removed in iodine alcohol, and after dehydration in alcohol the material was passed through chloroform to paraffin.

Observations on the Structure of Pleistophora periplanetæ.§—W. S. Perrin examined the living plasmodia inhabiting the malpighian tubules in normal salt solution. Films were prepared by cutting the tubules into small pieces and spreading them on a coverslip. After

* Ann. Bot, xix. (1905) p. 297.
† La Cellule, xxii. (1905) pp. 57–76 (3 pls.).
‡ Zeitschr. Wiss. Zool., lxxxi. (1906) pp. 96–144 (2 pls.).
§ Quart. Journ. Micr. Sci., xlix. (1906) pp. 615–33 (2 pls.).

drying and fixation in alcohol they were stained with Giemsa's modification of the Romanowsky-Nocht stain. The best results were obtained by leaving the films overnight in a mixture of an aqueous solution of eosin and azur ii. (10 parts of a solution of 1 grm. eosin B.A. in 1000 c.cm. water and 1 part of a solution of 0·8 grm. azur ii. (Grübler) in 1000 c.cm. water.)

After staining, the coverslips were washed in tap water, then dipped in alcohol, washed again in water, dried, and mounted in cedar-wood oil. A second method was to cut up the tubules in a very small drop of filtered egg-white and fix with osmic acid vapour, or with a mixture of boiling sublimate and alcohol in the proportion of 2 to 1. After osmic the film was washed in water, after sublimate in the water plus iodine, the film being in each case previously passed through graded alcohols, or stained straightaway in Delafield's hæmatoxylin. The excess of stain was then washed out in acid alcohol and the film mounted in balsam.

Preparing Unfertilised Eggs of Tenthredinidæ.*—L. Doncaster obtained eggs of different ages, noting the time when any row of eggs was laid. In this way series of eggs of all ages up to about 4 hours were preserved. In most cases a row of eggs was imbedded entire, and the eggs cut one after another still attached to the leaf. The best fixative was found to be Petrunkewitsch's modification of Gilson's solution (water 300 c.cm., absolute alcohol 200 c.cm., glacial acetic acid 90 c.cm., nitric acid 10 c.cm., sublimate to saturation). The difficulty of saturating the eggs with paraffin was obviated by transferring the eggs from absolute alcohol to cedar oil, where they were allowed to remain for a considerable time, and then passing through xylol, xylol-paraffin, to paraffin.

The only stain that gave satisfactory results was Heidenhain's iron-hæmatoxylin.

Studying Bucephalus Haimeanus.†—D. H. Tennant found that the best fixative for *Bucephalus* was Flemming's chrom-osmic-acetic mixture (weaker formula). Tissues were allowed to remain in this reagent for 24 hours, and were then washed in running water for a similar period. For *Gasterostomum* a cold saturated aqueous solution of sublimate, warmed to 35°, was the most satisfactory. The most successful stains were Flemming's triple stain (safranin, gentian-violet, and orange G), and Heidenhain's iron-hæmatoxylin and eosin.

Demonstrating the Development of the Oculomotor Nerve of the Chick.‡—F. W. Carpenter first opened the orbital cavities and placed the whole head in vom Rath's mixture. After 3–5 days the material was carried through several changes of 70 p.c. alcohol, and then the head preserved in a mixture of alcohol and glycerin. Certain portions of the orbit were also fixed in Zenker's fluid or in osmic acid. These were dehydrated in alcohol and paraffin-sections made, and when Zenker's fluid had been used, were stained in acid fuchsin. The ciliary gasserian, and sympathetic ganglia were treated with 0·05 p.c. chromic

* Quart. Journ. Micr. Sci., xlix. (1906) pp. 561–90 (2 pls.).
† Tom. cit., pp. 635–90 (4 pls.).
‡ Bull. Mus. Comp. Zool. Harvard, xlviii. (1906) pp. 141–230 (7 pls.).

acid for 2 or 3 days. They were then dissociated with needles, and stained with acid fuchsin.

The most satisfactory results were obtained from vom Rath's fixative, and the Heidenhain iron-hæmatoxylin stain. The formula for vom Rath's fluid is 200 c.cm. saturated solution of picric acid, 1 grm. platinum chloride dissolved in 10 c.cm. of water, 2 c.cm. glacial acetic acid, 25 c.cm. of 2 p.c. osmic acid. In this mixture embryo chicks were kept for 3 days or more, the fluid being once changed. They were then washed for a minute in two changes of methyl-alcohol, and placed for from 24–48 hours in a 0·5 p.c. solution of pyrogallic acid. They were then passed through graded alcohols up to absolute, cleared in xylol, and imbedded in paraffin. No further treatment was required for the sections, though it was found advisable to leave the balsam uncovered.

The iron-hæmatoxylin was used after fixation in Zenker's fluid, or in saturated corrosive sublimate to which 1 p.c. glacial acetic acid had been added.

Other stains used were brazilin and Delafield's hæmatoxylin. Golgi's impregnation method and *intra vitam* staining with methylen-blue were not successful. Van Gieson's was used for studying the formation of the sheath of Schwann. A combination of iron-hæmatoxylin and van Gieson brought out the cytoplasmic processes of the cells accompanying the nerve-fibres, as well as those of the mesodermal cells.

Demonstrating the Connection between Epidermis and Cutis in Saurians and Crocodiles.*—F. Krauss fixed pieces of skin in Carnoy's fluid, saturated solution of sublimate, picro-sublimate-acetic acid, Flemming's fluid, and Zenker's fluid. Decalcification was effected with 5 p.c. trichlor-acetic acid, or with nitric acid alcohol (1–4). The fixed material was imbedded in celloidin or in celloidin-paraffin. To obtain thin sections (3–4 μ) it was necessary to brush the section-surface over with mastic. This procedure could be used only with the paraffin sections; for the celloidin-paraffin, thick gum arabic solution was used. When gum was used, the sections stuck on the slide had to remain in water a long time to remove the gum completely.

The sections were stained with alum-carmin-hæmatoxylin, by van Gieson's, Unna's, and Weigert's methods. The following modification of Weigert's method gave good results: alcohol-methyl-violet solution and anilin-water, 15–30 minutes; wash in salt solution, then iodo-potassic iodide solution for 30 seconds or 15 minutes, according to the effect desired (epithelial staining or collagen), 10 p.c. aqueous solution of tannin for 3–5 minutes; dry on blotting-paper, and decolorise in a mixture of xylol, 4 or 5 parts, and anilin oil, 1 part.

The foregoing procedure may be preceded by alum-carmin.

The elastic fibres were stained by Weigert's, or by the Unna-Tänzer method.

Studying Sperm-Cells of Decapods.†—N. K. Koltzoff found that the best preservative fluids were sublimate-acetic acid (5 p.c.), or sublimate alone. Fresh and salt water were used as solvents. Satisfactory

* Arch. Mikrosk. Anat., lxvii. pp. 319–63 (2 pls. and 14 figs. in text).

† Tom. cit., pp. 364–572 (5 pls. and 37 figs. in text).

results were also obtained with Zenker's and Bouin's fluids. Solutions containing osmic acid were found to be unsuitable. For staining the sections, Heidenhain's iron-hæmatoxylin or Benda's modification thereof, were mostly employed; previous treatment with Bordeaux red was sometimes satisfactory. The Biondi-Heidenhain triple stain gave beautiful results, but the colours faded in about a year.

Cover-glass preparations were made by mixing a small quantity of sperm taken from the testis, or from the receptaculum seminis, with a little sea-water, and fixing for several minutes in osmic acid vapour. These were stained by the Biondi-Heidenhain triple stain, or by Ranvier's gold and formic acid method.

The author strongly recommends that the living cells should be examined in serum, sea-water, or other isotonic fluid, as thereby important details are easily seen, the which are lost by fixation. The figures given on the plates were drawn with the Zeiss apparatus under magnifications of 1400 and 3500.

Fixing Pyrosoma.*—A. Korotneff treats the eggs and embryos of *Pyrosoma* for a good half-hour with half saturated solution of sublimate in sea-water. After careful washing, the material is immersed in Perenyi's fluid for an hour, and is then transferred to alcohol. Staining with alum-carmin was found to be useful, and immersion of the material in 5 p.c. formalin occasionally had the effect of completely dissolving the yolk and setting free the embryo.

Demonstrating Structure of Nephridia of Arenicola.†—R. S. Lillie fixed adult material for 15–30 minutes in Hermann's fluid, and then transferred to Whitman's modification of Merkel (equal parts of 1 p.c. chromic acid and 0·25 p.c. platinum chloride) for 1–3 hours. The material was next washed, and then transferred to alcohol as usual. The treatment with Hermann's fluid prevents excessive blackening, and the reduced osmium may be further removed by immersing the sections for some hours in a mixture of 1 part hydrogen peroxide and 3 parts alcohol. The most satisfactory stain was Heidenhain's iron-hæmatoxylin countered with erythrosin. The best mounting medium for examination with oil-immersion objectives was found to be inspissated cedar-oil.

Larvæ were best fixed by immersing them for 2–5 minutes in Hermann's fluid, followed by Merkel's fluid for 1–3 hours. Young larvæ of the swarming stage were treated with Hermann's fluid for two minutes, followed by Merkel's for 1 hour. Such larvæ should be imbedded as soon as they are fixed, otherwise the yolk becomes very brittle.

Demonstrating the Endings of the Auditory Nerve in Petromyzon fluviatilis.‡—R. Krause fixed the material in Flemming's, Hermann's, Zenker's and Carnoy's fluids. Exposure to the vapour of a mixture of equal parts of 4 p.c. osmic and acetic acids was specially favourable, the preparation being transferred after 10 minutes to 40 p.c. alcohol.

* Mitth. Zool. Stat. Neapel, xvii. (1905) pp. 295-311 (3 pls.).
† Tom. cit., pp. 341–405 (4 pls.).
‡ SB. k. Preuss. Akad. Wiss., xlviii. (1905) pp. 1017–19.

Sections were stained with the Ehrlich-Biondi triple stain, with Heidenhain's iron-hæmatoxylin, and those that had been treated with osmic acid fixative were previously bleached with peroxide of hydrogen (5–10 p.c. in 70 p.c. alcohol).

Staining the tissue en masse was simple and satisfactory. The pieces fixed in Zenker's fluid were washed in running water for 24 hours and then immersed for a like time in 0·2–0·5 p.c. hæmatoxylin solution, which contained about 50 p.c. alcohol. After frequent washing the pieces were transferred to graded alcohols. For the finer details this procedure was especially effective. Pieces fixed in Carnoy's fluid may be treated in a similar way. They are transferred from the alcohol-chloroform-acetic acid mixture to absolute alcohol and then through down-graded alcohols to distilled water. The pieces are then stained in the previously described iron-hæmatoxylin solution for 24 hours, after which they are transferred to a solution consisting of 0·25 grm. potassium monochromate and 0·25 grm. potassium bichromate, dissolved in 100 c.cm. distilled water.

(3) Cutting, including Imbedding and Microtomes.

Reichert's New Microtome, with Double Bearings.*—The advantage claimed for this instrument is that the bearings of the knife-carrier

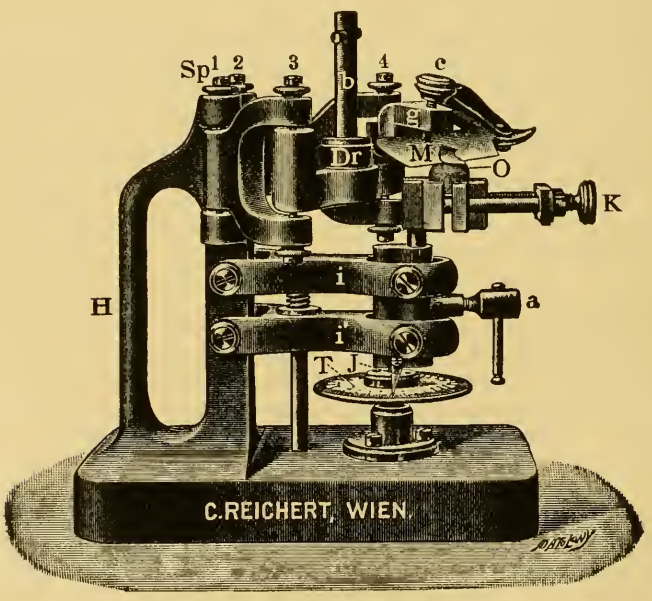


Fig. 34.

are double and are of a trapezium shape, owing to the different lengths of the four arms forming the bearings. In consequence the knife or

* Reichert's Catalogue, French edition, 1905–6, p. 15.

razor has an almost straight movement, a great advantage for sectioning delicate objects. The direction of the knife movement is indicated by

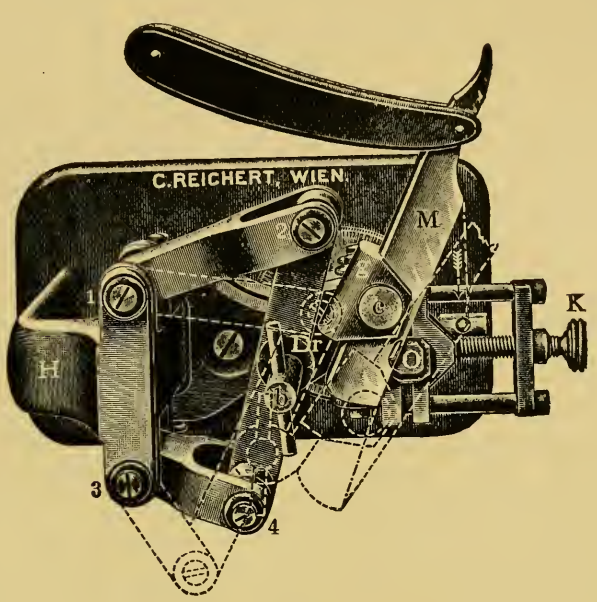


Fig. 35.

the dotted lines (fig. 35). The instrument (fig. 34), like that shown in the December Journal, 1905, p. 766, has a handle and a heavy base.

Preparing Liver for Demonstrating Hepatic Ferments. *—E. W. Carlier killed the animals (white rats) with coal-gas, and then washed out the blood vascular system very thoroughly with normal saline solution. The injection vessel was then filled with picro-corrosive formalin warmed to body temperature, and about half a litre passed through the animal. When the animal was cold the liver was dissected out, cut up into small pieces, placed in graded alcohols, beginning at 50 p.c. to chloroform and paraffin.

The most useful staining methods were Mann's methyl-blue-eosin, toluidin-blue-eosin, MacAllum's method for unmasking albuminoid iron, and Heidenhain's iron-alum-hæmatoxylin. The sections were cleared in inspissated turpentine and mounted in turpentine balsam.

(4) Staining and Injecting.

Demonstration of the Flagella of Motile Bacteria.†—E. W. Duckwall, after describing the necessary refinements he employs in the making of suitable cultures, according to the variety of motile organism under

* La Cellule, xxii. (1905) pp. 431-56 (17 figs.).
† Centralbl. Bakt., 1te Abt., Ref., xxxvii. (1905) p. 360.

examination, advises the following method. Round cover-slips thoroughly cleaned are preserved ready for use in absolute alcohol. A mordant is composed of 2 grm. of dry tannic acid, 5 grm. cold saturated solution of sulphate of iron, 15 c.cm. of distilled water, 1 c.cm. saturated alcoholic solution of fuchsin, and to these he adds ½–1 c.cm. of a 1 p.c. solution of sodium hydroxyl; the mixture after filtration being of a red-brown colour, and to be used within 5 hours after its preparation. A stain of carbol-fuchsin, prepared by adding to 1 grm. of granular fuchsin in a flask 25 c.cm. of warm alcohol, shake, allow to stand for several hours, and then dilute 4 or 5 times with a 5 p.c. solution of carbolic acid.

A small loopful of previously boiled distilled water made cloudy with the culture of the organism is placed on a cover-slip, which is held culture-side upwards in forceps and passed through a Bunsen flame; sufficient mordant is then poured on it to cover the surface; after ½–1 minute the mordant is washed away with tap water; a small quantity of alcohol is dropped on to the surface and again washed away; then pour on the stain and allow it to remain about ½ a minute, then warm until it steams; when the slip is completely dry, treat with xylol and mount in xylol-balsam.

Demonstration of the Indol and Cholera-red Reactions.*—W. B. Wherry finds that nitrites and also probably nitrates gain entrance to artificial media from various sources—certain waters, "peptones," and filter papers; and that a sufficient quantity of nitrites may be absorbed from the air of the laboratory to yield a distinct indol reaction on the addition of 0·5 c.cm. of chemically pure sulphuric acid. He therefore recommends that media used in testing for indol or cholera-red reactions should be examined for nitrates and nitrites before use. The author finds that the cholera spirillum does not produce nitrites in nitrate- and nitrite-free "peptone" solutions. The cholera-red reaction is not specific; it must be distinguished from the purple-coloured indol reaction.

Method of Producing Chromatin Staining in Sections.†—W. B. Leishmann recommends the following method for staining chromatin in sections. The sections (5μ) being fixed in the usual manner, are well washed, after the final alcohol bath, with distilled water to remove all traces of the alcohol, the excess of water being blotted away, and whilst the section is still moist a drop of fresh blood serum is placed on it and allowed to soak into it for 5 minutes; the excess of serum is then blotted away and the remainder is allowed to dry as a film on the section.

A mixture of 2 parts of Leishmann-Romanowsky stain and 3 parts of distilled water is poured on to the section and allowed to stain for 1–1½ hours, the stain being renewed from time to time, and is finally washed off with distilled water. For purposes of decolorisation and differentiation two solutions, freshly prepared with distilled water, are used: (*a*) acid solution, 1 : 500 acetic acid, which removes excess of blue and brightens the red tint of the chromatin; (*b*) alkaline solution, 1 : 7000 caustic soda, which dissolves out the excess of eosin from the

* Bureau Gov. Lab. Manila, No. 31, May 1905, p. 17.
† Journ. Hygiene, iv. (1904) p. 434.

tissue. These two solutions are used alternately, commencing with the acid, the section being frequently observed under a low power until the desired colour contrasts are obtained; the cell nucleus being seen of a deep Romanowsky red colour, and the rest of the tissue pale pink or a light blue; the section is washed in water and rapidly dehydrated, and then mounted in balsam.

Glycogen Staining.* — L. F. Driessen stains the glycogen in animal tissues by the following method. Celloidin or paraffin sections are transferred from alcohol to an alcoholic cochineal solution or to Mayer's carmin solution. They are next treated with 95 p.c. alcohol and absolute alcohol (3 minutes) after which they are placed in iodin-carbol-xylol solution for 3–5 minutes. If overstained, they are washed in carbol-xylol. The preparations are mounted in balsam.

The iodin-carbol-xylol mixture is prepared by placing equal parts of Lugol's solution and carbol-xylol in a test tube and shaking vigorously. Some few drops of the supernatant iodo-xylol are pipetted off and placed on the section, by which it is cleared up and the glycogen stained. The section is then mopped up with blotting paper, and mounted in balsam.

Section Staining by Romanowsky's Method.†—K. Sternberg fixes the material in alcohol and stains the paraffin sections with Giemsa's modification of the Romanowsky method. Immediately before use, the 0·4–0·5 c.cm. of the solution is diluted with 20 c.cm. of boiled distilled water. After a lapse of 20–24 hours the sections are washed in water and differentiated with 0·5 p.c. acetic acid. They are again washed and then treated with alcohol, and finally passed through xylol and mounted in balsam.

Staining and Mounting Ossifying Cartilage.‡ — M. Heidenhain, when demonstrating the ossification of cartilage, fixes, and at the same time decalcifies, small pieces in 5 p.c. trichlor-acetic acid, and after-hardens in absolute alcohol, which must be repeatedly changed. The pieces are imbedded in celloidin, and sections 20–25 μ thick are cut.

The sections are stained with Delafield's hæmatoxylin, and afterwards with borax-carmin. The preparations are best mounted in glycerin jelly made as follows:—Gelatin 45, water 210, glycerin 35, absolute alcohol 70 parts. The gelatin is first dissolved in the water, the glycerin is then added, and the mixture filtered out at a temperature of 56°. To the clear filtrate the absolute alcohol is added drop by drop, the solution being vigorously stirred the while. Air-bubbles may be avoided by fishing the sections out of the warm and liquefied medium, and placing one on a cover-glass and pressing this firmly down on the slide.

Staining the Chromophilous Cells of the Hypophysis cerebri.§—G. Cagnetto gives the following procedure. Fix one half of the hypophysis in 10 p.c. formalin for 3–4 days. Transfer to chromic acid

* Centralbl. allgem. Pathol. u. pathol. Anat., xvi. (1905) pp. 129–31.
† Tom. cit., pp. 293–4.
‡ Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 325–30.
§ Tom. cit., pp. 539–43.

solution 0·1 p.c. for 2 days, and then for 2 days more to 0·25 p.c. On removal wash for a long time in running water. Follow this by graded alcohols to dehydration; xylol; paraffin. The sections, after removal of the paraffin, are to be treated hot for 5–10 minutes with an anilin-water solution saturated with acid-fuchsin. This solution is made by dissolving at a temperature of 70°–80° C. 3 c.cm. of anilin oil in 100 c.cm. of distilled water. When cold, 2 grm. of finely powdered acid-fuchsin are slowly added. After standing for 24 hours and then filtering, the mixture is ready for use. The stained sections are then washed in running water, after which they are differentiated for 4 or 5 minutes with a saturated aqueous solution of picric acid. Differentiation is followed by washing again in running water, then rapid dehydration in absolute alcohol; xylol; and balsam.

This method is very successful for thyroid and pancreas, as well as for the pituitary body.

Intra-vitam Stains for Nervous Tissue.*—A. Leontowitsch finds that Thiopyronin, a rose-coloured pigment with bluish fluorescence, stains Remak's fibres well, and suggests that a combination with methylen-blue might prove useful.

Gentianin and thionin blue, G_7O extra, gave results comparable with those of methylen-blue.

The commercial articles must be purified before use by crystallising out two or three times from hot 90 p.c. ethyl-alcohol.

Stain for Photomicrography.—E. Moffat recommends the following stain for photomicrography: fuchsin 0·06 grm., methylen-blue 0·04 grm., alcohol (90 p.c.) 5 c.cm. Add aqueous solution of carbolic acid 5 p.c., to make up to 25 c.cm. Make films from cultures in the usual way and flood with the filtered stain; warm gently, wash well, dry in air, and mount in balsam.

This solution is a very powerful stain, and used as above gives excellent results with diphtheria, anthrax, cocci, and other bacteria, rendering these organisms very easy to photograph when the film is prepared from a pure culture. The solution when diluted is serviceable for section staining.

New Method of Demonstrating Spirochæta Pallida in Hereditary Syphilis.†—C. Levaditi proceeds as follows. Pieces about 1 mm. thick are fixed in 10 p.c. formalin for 24 hours. They are then washed and hardened in 90 p.c. alcohol for 24 hours. The alcohol is next removed in distilled water, after which the pieces are impregnated in from 1·5–3·0 p.c. silver nitrate. The impregnation is carried out at 38° C. for from 3–5 days. After removal the pieces are washed in distilled water and thereupon placed for 24–48 hours at room temperature in the following reducing mixture: pyrogallic acid 2–4 p.c., formalin 5 c.cm., distilled water 100 c.cm. On removal the pieces are washed, dehydrated in alcohol, and paraffin sections made.

The sections are stained (1) by Giemsa's method and differentiated

* Physiologiste Russe, iv. (1905) pp. 5–8.

† Ann. Inst. Pasteur, xx. (1906) pp. 41–68 (2 pls.).

in absolute alcohol, to which a few drops of oil of cloves are added; they are then cleared up in oil of bergamot and xylol and mounted in balsam; or (2) they are stained with a saturated solution of toluidin blue and differentiated in alcohol, to which a few drops of Unna's ether-glycerin mixture are added. They are then cleared in bergamot oil and xylol, and mounted in balsam.

By this method the spirochaetæ are stained black or almost black. The illustrations show very clearly the effect of the procedure, and also that the organisms are extremely numerous.

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

Clockwork-driven Turntable.—This ingenious instrument, which was exhibited at the November Meeting, 1905, is the invention of A. Flatters and W. Bradley (fig. 36). It is driven by a simple clockwork

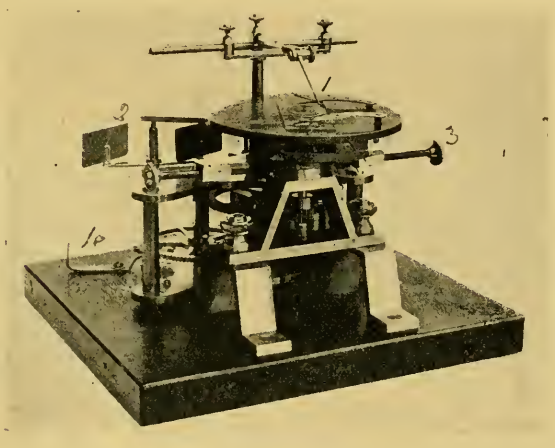


FIG. 36.

arrangement, and one of its interesting features is that it is capable of turning rings of any proportions from 0 to 3 by $1\frac{1}{4}$ in.

On its under surface the turntable has a pair of dovetails, which slide in a dovetail fitting attached to the top of the vertical spindle, rotating with it and causing the turntable to rotate also.

Below the dovetailed fitting is a small steel disk attached to a sliding piece that can be moved to the right or left out of the centre of the vertical spindle by means of long set-screws. The distance the steel disk is moved out of the centre line of the vertical spindle determines the length of the oval. Attached to the under-side of the table are two studs projecting downwards, each having a small roller on its lower end that is in contact with the steel disk. When the latter is moved to the right or left it presses against a roller, and shifts the table out of the

centre to the same extent. The disk also acts as a guide to the rollers, and thus controls the movement of the table.

Standing on the clockwork behind the turntable, and parallel to the front, is a sliding-bar carrying a pointer that can be adjusted to any required position. This pointer acts as a guide for the brush, and the distance the point is placed from the long axis of the oval determines the width of the oval. It is necessary to place the guide for the brush opposite the point at the long axis. An arm-rest is placed in position for the brush-hand.

By the use of this instrument it is possible to run round a needle point or strike a straight line, besides making circles and ellipses. A diamond may be attached to the pointer for cutting cover-glasses.

To set the apparatus to turn any oval:—(1) Let the end of the pointer rest over the centre of the table when it is in mid-position; (2) turn the table half round so that a glass slip is end-on to the operator; then (3) shift the pointer to the right until it is over the end of the short axis of the oval; (4) turn the table back to its original position; (5) decentre the disk on table, moving it to the left by means of the long set-screws until the pointer is over the end of the long axis of the oval.

Mounting Diatoms.*—H. v. Schönfeldt has used syndeticon (the best Norwegian isinglass) with gratifying results. The medium is composed of acetic acid (64 p.c.) 25 grm., syndeticon 4 grm., absolute alcohol 5 grm., isobutyl-alcohol 3 grm. The isinglass is first mixed with the acetic acid and the other ingredients added afterwards gradually. The mixture is then filtered. With a glass rod drawn to a fine point a minute drop of the fluid is deposited on a perfectly clean cover-glass, on which it at once forms a perfectly transparent layer. After the diatoms are oriented it is merely necessary to breathe on the surface of the film. This firmly fixes the Diatoms, and the rest of the procedure is well known.

(6) Miscellaneous.

Measurement of Trypanosomes.†—A. Lingard has adopted the following system for measuring Trypanosomes for a number of years. The fixed points selected between which measurements have been carried out are the following (fig. 37):—

1. Between the posterior extremity of the parasite and the centre of the blepharoplast.
2. The centre of the blepharoplast to a point corresponding with the posterior edge of the nutritive nucleus.
3. From the posterior to the anterior edge of the nutritive nucleus.
4. From the anterior edge of nucleus to the anterior end of the body.
5. The length of the free flagellum.
6. The maximum width of the body.

* Zeitschr. angw. Mikrosk., xii. (1906) pp. 247–50.
† Journ. Tropical Vet. Sci., i. (1906) pp. 5–14 (1 pl.).

The result of the first five measurements added together give the length of the parasite. For the sake of comparison the mean of each of the above five measurements of *Trypanosomata* of any one species

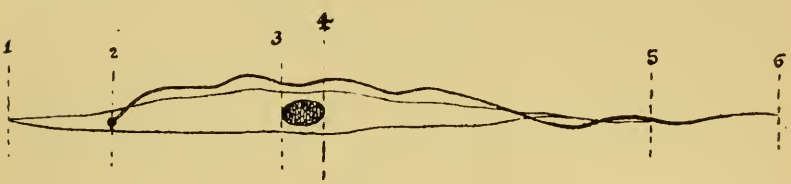


FIG. 37.

are first taken, and then the percentage value of each measurement is calculated, taking the mean total length as 100.

This method affords a basis for the comparison of the various species.

Metallography, etc.

Pressure and Percussion Figures on Plastic Crystalline Metals.* It is known that figures of definite form, related to the orientation of the crystal, are developed by forcing a sharp point into brittle crystalline substances. F. Osmond and G. Cartaud have employed the same method on metallic crystals. The point of a sewing-needle was pressed by means of a lever into the faces obtained by cutting a crystal of iron in different planes. The pressure employed was 1600 grm. The figures were examined microscopically, and are described by the authors, with diagrams and photomicrographs. The method may be put to practical use in determining the orientation of crystals, sections of which are exposed in a polished metallic surface.

Nickel-Vanadium Steels.†—L. Guillet has examined 32 steels containing 2–30 p.c. nickel, 0·2–7·5 p.c. vanadium, 0·14–1·2 p.c. carbon. He classifies them in six groups : (1) pearlitic ; (2) containing carbide and ferrite ; (3) martensitic ; (4) containing martensite and carbide ; (5) containing γ-iron ; (6) containing γ-iron and carbide. Vanadium exhibits the tendency, previously observed in vanadium steel, to combine with the carbon, forming a carbide. The effect of vanadium upon mechanical properties is beneficial only in the case of pearlitic steels, in which the maximum tensile stress and elastic limit are raised. The favourable effect is intensified by suitable heat treatment. Addition of vanadium to γ-iron steels diminishes their capacity of resisting shock.

Nitrogen in Steel.‡—In view of the interest aroused by H. Braune's recent researches, translations or reprints of three papers are here given. In the first, by H. Tholander, originally published in 1888, differences

* Rev. Metallurgie, ii. (1905) pp. 811–15 (9 figs.).
† Tom. cit., pp. 870–81 (16 photomicrographs).
‡ Tom. cit., pp. 882–99.

between Bessemer and open-hearth steel are ascribed to the higher percentage of nitrogen in the former. In the second (Boussingault, 1861) methods of estimating nitrogen in iron are given. The third (Allen, 1880) gives some results of analyses. H. Le Chatelier (editorial note) states that the variations in percentage of nitrogen in steel are now proved to be due to the processes of manufacture.

Overheated Steel.*—J. E. Stead and A. W. Richards distinguish between overheating and burning, the former merely resulting in the formation of large crystals, the latter producing incipient disintegration. Three steels, containing 0·06 p.c., 0·48 p.c., and 0·44 p.c. carbon, were selected for the author's researches. One-inch square bars of each were subjected to (1) overheating at 1300° C., (2) reheating after (1) to 880°–950° C.; (3) annealing at 850°–950° C.; (4) sorbitic treatment (0·44 p.c. steel only), which consisted of heating to 900° C., quenching in water, and reheating to 330° C. Mechanical tests (tensile, bending in various ways, and Wöhler reversal of stress tests) carried out on the normal steels and on each steel treated as described, indicated that "overheating reduces the power of the steel to resist fatigue, that reheating such steel more than restores the original good qualities of the rolled bars, and that when the steel has the carbon in the sorbitic condition its power of endurance is more than doubled." Portions of a wagon axle were also heat treated in different ways, the results of mechanical tests indicating that the fatigue-resisting properties of the steel could be greatly increased by suitable treatment. The authors advance the hypothesis that the weakness of overheated steel is due to the presence of large masses of ferrite, a constituent which has a low elastic limit. The good qualities of sorbitic steel appear to be due to the absence of ferrite.

Metallography applied to Foundry Work.†—A. Sauveur recommends a vertical photomicrographic camera. Details of manipulation are given.

The author also describes ‡ the microstructure of cast iron. Rate of cooling probably influences the size of the graphite particles in grey iron.

Corrosion of Condenser Tubes.§—Brass condenser tubes (70 p.c. copper, 30 p.c. zinc) frequently cause trouble through rapid corrosion. A. H. Sexton points out that in tubes which have a short life owing to this cause, the zinc has usually dissolved out much more quickly than the copper. Coarse crystallisation of the brass appears to have no effect on the rate of corrosion. The great variations in the rapidity of corrosion of tubes are not due to any differences in the tubes themselves, but to the conditions to which the tubes are subjected in use. The deposition of carbon or other electro-negative bodies on the surface of the tube sets up electrolytic action and leads to rapid corrosion by the sea water.

The Thermal Transformations of Carbon Steels.‖—The experimental work described in this paper, largely a repetition of that carried

* Iron and Steel Mag., x. (1905) pp. 385–404 (9 figs.).
† Tom. cit., pp. 413–19 (2 figs.).
‡ Op. cit., xi. (1906) pp. 119–24 (4 figs.).
§ Eng. Mag., xxx. (1905) pp. 211–25.
‖ Journ. Iron and Steel Inst., lxviii. (1905, 2) pp. 27–83 (17 pls.).

out some years ago by Osmond and others, was apparently undertaken by the authors, J. O. Arnold and A. McWilliam, with the object of verifying or disproving the conclusions then reached. The three steels employed contained respectively 0·21, 0·89, and 1·78 p.c. carbon, the total percentage of elements present, other than iron and carbon, being very small. The critical ranges of these steels, on heating and cooling, were determined. Samples were heated to different temperatures, quenched, and microscopically examined. By quenching a piece of the 0·89 p.c. C steel when it was passing through the Ac. 1-2-3 change, a section showing both pearlite and hardenite was obtained. Dark etching boundary lines between these two constituents are identified by the authors with Osmond's troostite. The authors give their reasons for declining to accept martensite, troostite, sorbite, and austenite as constituents; they do not object, however, to the terms "troostitic structure," "martensitic structure," etc. In an appendix, definitions of the constituents of steel are given. Fe_3C of cementite and Fe_3C of pearlite are stated to be physically different substances. Excellent micrographs, which have apparently been drawn and not photographed, illustrate the paper.

Important contributions to the discussion were made by J. E. Stead and H. le Chatelier. J. E. Stead expressed the opinion that the evidence in favour of the allotropic states of iron was now overwhelming. The term "eutectoid," as applied to steel of pearlite composition, was to be preferred to "saturated." Martensite, as a homogeneous solid solution of carbon or carbide of iron in iron, should be recognised as a constituent. H. le Chatelier accepted the authors' experimental results as being in harmony with previous observations, but disagreed with some of the theoretical explanations put forward. The alleged insolubility of cementite in hardenite up to 900° C. was improbable. The claim of troostite and austenite to be recognised as constituents is defended. The authors' assumptions as to the constitution of these bodies were purely gratuitous, and not supported by any evidence. The explanation of the separation of graphite in high carbon steel was contrary to well known facts of chemistry. An alternative explanation is advanced. The authors of the paper replied to these criticisms at some length.

The Presence of Greenish-coloured Markings in the Fractured Surfaces of Test-Pieces.*—H. G. Howorth has examined, microscopically and otherwise, a large number of defective test-pieces from gun forgings. The defects were due to the presence of foreign matter, resembling Siemens-Martin slag, usually yellow or green in colour. Two substances, which appear to be sulphide and silicate of manganese, were distinguished in the coloured matter.

The Nature of Troostite.†—C. Benedicks, regarding this constituent as a product of transformation of martensite, dismisses Boynton's hypothesis that troostite is β-iron, as untenable. Troostite appears to be a pearlite with ultra-microscopically small particles of cementite, containing also more or less hardening carbon, and offers an interesting analogy to the colloid solutions.

* Journ. Iron and Steel. Inst., lxviii. (1905, 2) pp. 301-19 (13 figs.).
† Tom. cit., pp. 352–70 (2 figs.).

The Influence of Nickel and Carbon on Iron.*—G. B. Waterhouse has investigated the properties of a series of ten steels, containing about 3·8 p.c. nickel, the carbon varying from 0·4–1·83 p.c. Cooling and heating curves were taken, and mechanical tests and microscopic examination were made on the steels heat-treated in various ways. The chief conclusions arrived at are—(1) nickel raises the tenacity of steel without materially lowering the ductility: the elastic ratio is only slightly greater than in carbon steels; (2) cementite of the formula $FeNi_3C$ occurs in these steels; (3) the eutectoid ratio appears to lie at about 0·7 p.c. C.

ANDREWS, T.—**Wear of Steel Rails on Bridges.**
Journ. Iron and Steel Inst., lxviii. (1905, 2) pp. 320–51 (23 figs.).

ARNOLD, J. O.—**The Department of Iron and Steel Metallurgy at the University of Sheffield.** *Tom. cit.*, pp. 13–26 (14 figs.).

BUMSTEAD, H. A.—**The Heating Effects produced by Röntgen Rays in different Metals, and their Relation to the question of Changes in the Atom.**
Am. Journ. of Sci., xxi. (1906) pp. 1–24 (5 figs.).

CARLISLE, S. F.—**Micrographic Examination of Steel, and Construction of Apparatus used.**
[A somewhat elementary account of the apparatus designed and fitted up by the author, and of the micro-examination of various kinds of iron and steel.] *Clarkson Bulletin*, ii. (1905) pp. 14–17 (6 figs.).

DESCROIX, L.—**Abstracts of Papers read at the Metallurgical Congress, Liége.**
Rev. Metallurgie, iii. (1906) pp. 24–47.

DILLNER, G., & A. F. ENSTRÖM—**Researches on the Magnetic and Electric Properties of various kinds of Sheet Steel and Steel Castings.**
[Some interesting photomicrographs of high silicon and aluminium steels are given.] *Journ. Iron and Steel Inst.*, lxviii. (1905, 2) pp. 408–46 (13 figs.).

DUMAS, L.—**Reversible and Irreversible Transformations of Nickel Steel.**
Tom. cit., pp. 255–300 (10 figs.).

GUILLET, L.—**The use of Vanadium in Metallurgy.**
[A summary of the available information on this subject, including a brief account of the author's previously published work on vanadium steel, nickel-vanadium steel, etc.]
Tom. cit., pp. 118–65 (23 figs.).

,, ,, **Steel used for Motor Car Construction in France.**
[The properties of numerous alloy steels are reviewed. Excellent photomicrographs illustrate the paper.]
Tom. cit., pp. 166–203 (10 figs.).

,, ,, **The Industrial Future of Special Steels.**
Iron and Steel Mag., xi. (1906) pp. 89–95.

LOUGUININE & SCHUKAREFF—**Étude thermique des alliages de l'aluminium et du magnésium.** *Rev. Metallurgie*, iii. (1906) pp. 48–60 (1 fig.).

OSMOND, F.—**Nomenclature of the Constituents of Steel.**
Tom. cit., pp. 101–3.

READ, T. T.—**Cooling Curves of Metallic Solutions.**
Iron and Steel Mag., xi. (1906) pp. 96–9 (3 figs.)

STANSBIE, J. H.—**Solutions of Solids and Solid Solutions.**
Iron and Steel Mag., xi. (1906) pp. 112–19.

TALBOT, B.—**Segregation in Steel Ingots.**
Journ. Iron and Steel. Inst., lxviii. (1905, 2) pp. 204–47 (6 figs.).

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* Journ. Iron and Steel Inst., lxviii. (1905, 2) pp. 376–407 (6 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Reichert's Dissecting Microscopes, with Handle.†—In fig. 42 is shown a simple dissecting Microscope with handle and sliding adjust-

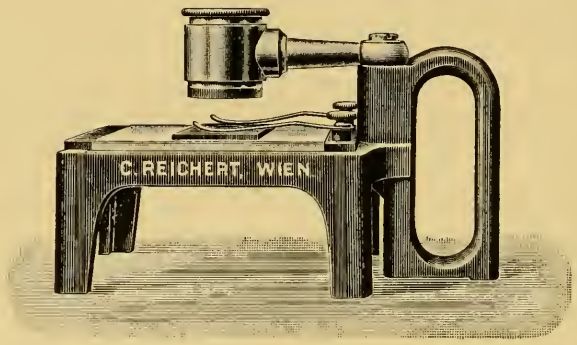

Fig. 42.

ment. A more elaborate variant is shown in fig. 43. This form has rack-and-pinion adjustment, the large stage and foot being made of

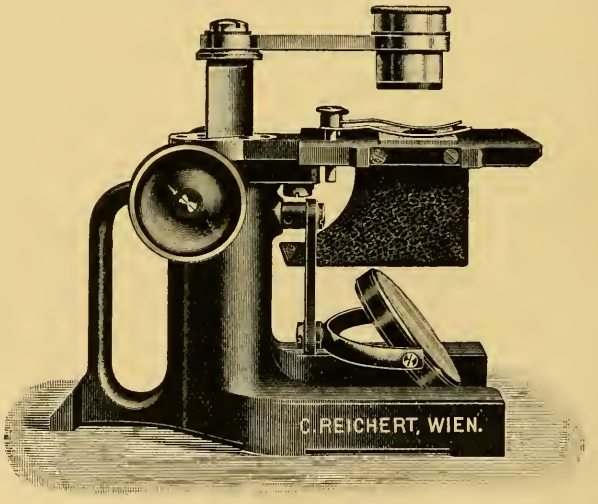

Fig. 43.

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

† Special Catalogue, 1905–6, p. 13.

brass. The mirror is flat, with lateral displacement. The hand supports are covered with leather. This model can be supplied with a glass cover to the stage, and a laterally movable arm for the lamp-holder.

A New Construction of the Preparation Microscope.*—F. K. Studnička shows how the usual Microscope-stage can be used with the preparation Microscope described in a previous abstract.† A reversed achromatic objective (Reichert's No. 2) is screwed on to a thread as near

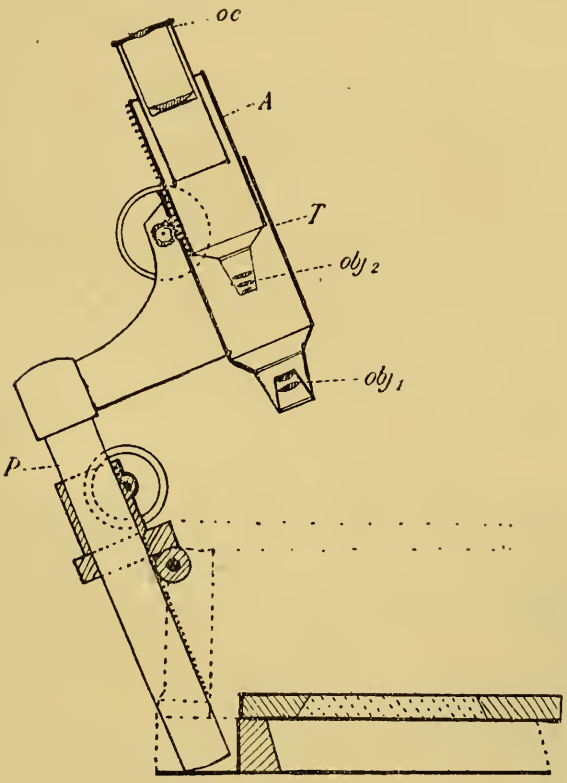

FIG. 44.

the bottom end of the tube as possible. The ordinary objective, which is intended for the magnification of the reversed image of the object, is fastened to the lower end of the draw-out tube. The ocular is placed as usual. The whole arrangement is thus combined and can be focused by rack-and-pinion. The application of the instrument is, however, controlled by the limits within which the rack-and-pinion admit the tube movements. In using weak magnifications the working distances

* SB. k. Böhm. Gesell. der Wiss., 1905 (v.) 4 pp., 1 fig.).
† See this Journal, 1905, p. 643.

of the lenses are not convenient for ordinary stands, and the author, therefore, proposes the modified design shown in fig. 44. The tube T is provided with a sufficiently long draw-out tube A, worked by rack-and-pinion. At the lower end of the whole tube is the reversed objective (*obj.* 1) and at the lower end of the draw-out the ordinary objective (*obj.* 2). The draw-out must be of such a length that the objective at its lower end, when the tube is completely inserted, does not reach the reversed objective. A further distinction from an ordinary stand is in the action of the prismatic bar P which, by rack-and-pinion, may be raised so as to bring the body to a greater height above the stage. The attainment of this increased working space is also effected by making the object stage adjustable in level.

Brunnee's Polarisation-Microscope-Polymmeter.*—This instrument of R. Brunnee's is distinguished from an ordinary mineralogical Microscope only by the kind of fine-adjustment used. The micrometer-screw is actuated by means of a drum applied to the tube, and in the drum is a circular wedge of weak obliquity. The fine-adjustment of the objective is attained through the sliding of a bar, connected with the objective, along this wedge, so that a simultaneous rotation of the objective takes place about the axis of the instrument during the fine-adjustment. This mechanism facilitates at the same time a rotation of the inner Nicol, which rotation is independent of the polariser, but can also engage with it by means of a toothed wheel over-movement.

RINNE, F.—**Le Microscope polarisant, trad. par L. Pervinguière, avec préface par A. de Lapparent.** Paris, 1904, 160 pp.

(2) Eye-pieces and Objectives.

New Form of Ehrlich Eye-piece for Counting Blood-corpuscles.—This apparatus, made by R. & J. Beck (fig. 45), is a Huyghenian eye-piece of the No. 1 R.M.S. standard size. It fits this firm's "London" Microscopes and those of Continental makers. It is provided with an adjustable square aperture, the size of which can be varied from 1 mm. to 8 mm, so that it can be easily set for any desired size.

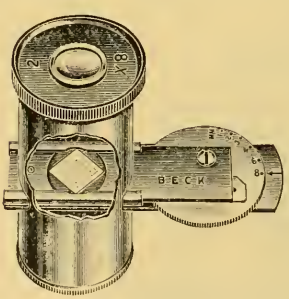

FIG. 45.

The actual area to which the size in use corresponds with any particular object-glass can be ascertained by slipping a stage micrometer on the stage of the Microscope.

Magnifying Power of Microscopical Objectives.†—L. Malassez points out that there is no precise definition of the phrase "magnifying power." He suggests that it would be advantageous to express the magnifying effect of a lens in terms of unit distance from its posterior face, and that the term "magnifying power" could be conveniently

* Zentralbl. Min. Geol. Paläont., 1905, pp. 593–5 (1 fig.). See also Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 586–7.

† Comptes Rendus, cxli. (1905) pp. 880–1.

restricted to this application. The term "power" should be reserved for the magnification produced at unit distance from the posterior focus and at each successive unit. This unit distance should be in each case the metre, or better, the decimetre, which corresponds more closely to ordinary microscopical working distances.

In a subsequent paper* the author discusses the methods of evaluating the magnifying power.

1. By direct measurement with a micrometer objective and a micrometer ocular, the latter being placed exactly at unit distances. The full details he has explained elsewhere.† The sole inconvenience is that a specially made tube is necessary, a decimetre tube not being of ordinary make.

2. By means ‡ of graphical curves a relation may be expressed between the power and the distance between the posterior face and the posterior focus. This method readily gives the magnifying power.

3. By calculation from the formulæ $P=(1-\phi'_p)\gamma$, or $P=(1+\phi'_a)\gamma$, when P= the magnifying power; γ, the power; ϕ'_a, ϕ'_p, the distance from the posterior face of lens to its posterior focus, according as the posterior focus is on the anterior or posterior side.

Evaluation of the Power of Microscope Objectives.§—L. Malassez gives three methods by which observers may determine powers for themselves in his proposed notation.‖

1. Let G be the magnification produced at a distance D, g that at a less distance d, and γ the power (i.e. the magnification produced at unit distance), then

$$\gamma = \frac{G-g}{D-d}.$$

In selecting the distances the tube should be completely extended for D and completely depressed for d.

2. Let g be the magnification produced by the objective at a distance d' from its posterior face and ϕ' its foco-facial posterior distance (i.e. the distance between its focus and posterior face), then

$$\gamma = \frac{g}{d'-\phi'} \quad \text{and} \quad \gamma = \frac{g}{d'+\phi'};$$

the first formula being applicable when the posterior focus of the objective is behind the posterior face; the second, when it is in front of it, which happens when the objectives are somewhat strong.

If the magnifying power P be defined as on a previous occasion,¶ these formulæ become

$$\gamma = \frac{P}{1-\phi'_p} \quad \gamma = \frac{P}{1+\phi'_a}.$$

* Comptes Rendus, cxli. (1905) pp. 1004–6.

† Archives d'Anatomie Micr., 1904, pp. 274, 285. See also this Journal, 1905, p. 500.

‡ Tom. cit., p. 298. See also this Journal, 1905, p. 500.

§ Comptes Rendus, cxlii. (1906) pp. 773–5.

‖ Soc. de Biologie, viii. (July 15 and Dec. 10, 1904). See also Archives d'Anatomie Micr., 1904, p. 270; and this Journal, 1905, p. 500.

¶ Comptes Rendus, Nov. 27 and Dec. 11, 1904. See also this Journal, 1905, p. 500.

3. Lastly, as the power is also the enlargement produced at unit distance from the posterior focus of the objective, it can be evaluated directly by determining the position of this posterior focus (i.e. the foco-facial posterior distance), then by measuring the enlargement produced at a decimetre further, or at any other unit of distance.

The author gives a sample table of results obtained with a certain number of objectives of different strengths.

Cheap Glass Lenses.*—A cheap and simple way of obtaining large lenses suitable for photographic and such-like work, is to form a combination of ordinary watch, or clock glasses, with water or other suitable liquid. Two glasses, whose edges must be well ground so as to fit well when placed in contact, are dipped into the liquid and removed, filled with it, as a whole. The edges are then wiped dry, and moistened with water-glass, which, helped with a little hydrochloric acid, sets quite hard, so that the "lens" can be freely handled. This process is assisted by the use of a peculiar brush, having two pencils on one shaft. As this brush is passed round the periphery, the front pencil wipes off the superfluous fluid, and the following pencil applies the water-glass. By means of a glass disk and a watch-glass, a plano-convex lens can be made, and several other forms are possible.

BERGER, E.—**Ueber das bei meiner binokularen Lupe verwendete Linsen-system.** *Deutsche Mech. Zeit.*, 1905, p. 155.

BRASS, A.—**Die Linsenfassungen.**
[Discusses several errors sometimes made in lens-mounts, and emphasises the necessity of lamp-blacking their inner surfaces.] *Central. Zeit. Opt. Mech.*, xxvii. (1906) pp. 15–17 (10 figs.)

" " **Die Zusammensetzung von Linsensystemen.**
[A popular explanation of certain principles.]
Tom. cit., Nos. 4–7, pp. 31–3 (2 figs.).

(3) Illuminating and other Apparatus.

A New Application of the Abbe Condenser.†—F. K. Studnička reminds his readers that the Abbe condenser presents a real, reversed image of the source of illumination. If an object, such as a micrometer scale, be suitably interposed, an image of this will be similarly formed on the stage, and may be applied to measuring an object there. In this way, by the help of a proportionately stronger objective, a series of magnifications can be obtained which are very convenient for drawing, and for the preparation of various objects. The size of the image formed above the front-lens (viewed from above) of the condenser depends on the distance of the object from the under-lens; the image is smaller as the distance is increased. Thus it will be seen that the series of magnified images thrown on to the stage will vary from zero to a maximum. This image can be combined with various powers of objective, eye-piece and tube-length, and thus the series of attainable effects is practically infinite—although only observations in the middle of the field will be free from sensible distortion. Instead of the condenser, weak achromatic objectives might be used. A difficulty would,

* Central. Zeit. f. Opt. u. Mech., xxvi. (1905) pp. 261–2.
† SB. k. Böhm. Gesell. der Wiss., 1905 (iv.) 4 pp.

no doubt, lie in the construction of a suitable adjustable stage for the object; the author, however, sees his way to a proper design. He summarises the advantages of this proposal as :—

1. The facility for orientating objects which can be afterwards examined in the usual way.

2. The formation of graduated magnifications by which an operator who wishes to draw from a weak magnification can easily select the most suitable power.

3. The property possessed by the Abbe (thus used) in combination with an objective of forming an *erect* image.

4. If a plane mirror be used, and the object inserted between the light-source and the mirror, an erect Microscope becomes virtually a horizontal one, and may thus be used, for example, as an aquarium microscope.

5. As the magnification may be zero, the arrangement may be applied to the drawing of objects in their natural size.

Post-Objective Stop.* — At the March Meeting, J. W. Gordon exhibited a new form of post-objective stop for the Microscope, an illustration of which is now given (fig. 46), together with a description of the various parts.

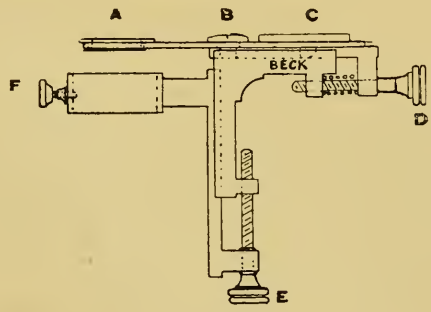

Fig. 46.

A. Cell carrying the mercury globule which forms the stop.
B. Pivot on which the cell-carrying arm swings.
C. Excentric for swinging the arm, and so giving a transverse traversing adjustment to the stop.
D. Propelling screw for giving a longitudinal traversing motion to the pivot B and so to the stop.
E. Supporting screw for adjusting the height of the swinging arm and of the stop carried by it.
F. Mounting ring, provided with a set screw, for clamping the fitting to the draw-tube of the Microscope.

Use of the Cooper-Hewitt Lamp as a Source of Monochromatic Light.†—C. Fabry and H. Buisson warmly recommend this lamp, which is on the principle of an electric arc in mercury vapour. Its spectrum resembles that of the older mercury vapour lamps. The light is fixed,

* See this Journal, 1906, pp. 157–60.
† Comptes Rendus, cxlii. pp. 784–5.

and of uniform intrinsic luminosity. The yellow and green rays are fine enough to give interferences observable to a difference in step of 22 cm.—i.e. in the neighbourhood of the number of order 400,000. The old form of mercury arc (Perot-Fabry model) gives almost the same result immediately after lighting. But, after a few minutes' action, probably in consequence of vapour-heating, the rays widen out, and the limit of interference falls almost to half of its primitive value. In the Cooper-Hewitt, on the contrary, the first state is indefinitely maintained. The yellow rays give especially clean interferences, and the phenomena of disparition, or of successive doubling when the two rays are simultaneously employed, are observable to very great differences of step. The fact that the lamp is constructed for industrial purposes is found to be an advantage.

Davis, D. J. A.—**A Method of Microscopic Observation by means of Lateral Illumination.** *Trans. Chicago Pathol. Soc.*, vi. (1904) p. 90.

Greil—**Beleuchtungsapparate mit Nernstchem Glühlicht.** *Anat. Anzeig., Ergänzungsh.*, xxv. (1904) p. 178.

Kalähne, A.—**Ueber das Woodsche Lichtfilter für ultraviolette Strahlen.** *Phys. Zeitschr.* v. (1904) p. 415.

Plüger, A.—**Die Quecksilberlampe als ultraviolette Lichtquelle.** *Tom. cit.*, p. 414.

Anon.—**Vorrichtung zum Wechseln der Bilder im Projektionsapparat.** *Deutsche Mechan. Zeit.*, 1905, p. 127.

(5) Microscopical Optics and Manipulation.

Ultramicroscopy of Oleosole.*—J. Schneider and J. Just have been investigating the appearances presented, when viewed by ultramicroscopic methods, by finely divided particles of gold and other noble metals in a viscous, yet completely homogeneous, transparent, and combustible fluid. For this purpose fats and ethereal oils were treated with chlorides of the metals, and the products of reaction ultramicroscopically studied. The authors summarise their conclusions as follows :—

1. The ultramicroscope is adapted to the determination of the identity and purity of oils and to the testing of oil-mixtures.

2. The oils are tested with the ultramicroscope after they have been surrounded with oleosole of the noble metals by means of their reactions with compounds of the latter.

3. In the ultramicroscopic study observation was made of the points and groups sparsely aggregated in the whole cone ; the determination of the diameter of the interference rings produced by any slight alteration of the fine-adjustment ; the especial examination of ringless or ringed points and groups, with and without the analyser.

4. In the examinations made of commercial oils the various forms assumed by the fat, as distinct from the oil, under the ultramicroscope were a distinct hindrance to the observation of the metal particles ; the use of ultramicroscopes with heating arrangements were necessary for further work.

5. The effect of the reaction is affected by many circumstances,

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 481–530.

especially by the solution-medium, temperature, movement, time, and quantity of oil. Light-influence was only observed in the case of silver.

6. The best results were obtained in the ultramicroscopical tests of oils after reaction with gold chloride. In the case of amicroscopic particles there was a reddening; a blue colouring resulted with submicroscopic and microscopic particles, combining into a blue-black precipitate; a yellow coloration followed with other submicroscopic and microscopic particles, which combined into a shimmering and gleaming golden mass. One form only, or two, or all three together can be met with.

7. From silver solutions either amicroscopic particles precipitated, causing a blue colour of the cone, or submicroscopic and microscpic particles. With the silver reduction, moreover, the reaction with the sulphur contained in many oils gives cone-coloration by reason of the amicroscopic particles.

8. In reactions with ruthenium chloride the result is either a yellow or a red cone-colouring with the amicroscopic particles, or the submicroscopic and microscopic particles segregate themselves.

9. Tests with osmic acid and with platinum chloride gave no practically useful results, and other more favourable conditions for reaction and test are to be sought.

10. The desired connection of the ultramicroscopical condition with a property expressible in figures or a quantitative reaction was not found, and the question, how fine is the emulsion of which an oil is capable with a given reagent under existing conditions, still remains open.

A Simple Method for the Determination of the Refraction-Index of Liquids.*—A. Pauly shows how this quantity can be found without costly apparatus and from a small quantity of fluid. The equation on which the calculation is based is:

$$n = \frac{w\xi}{\sqrt{\xi^2 \sin^2 V + w^2 \cos^2 V}}$$

where w and ξ are respectively the major and minor semi-axes of the ellipsoid of rotation, n the refractive index, and V the angle between the radius vector and the major axis. In calcite the principal refractive indices (with sodium light, w_{na}) are $w_{na} = 1{\cdot}6585$, $\xi_{na} = 1{\cdot}4864$; all indices between these values lie on the ellipse. If then a section be taken parallel to the principal axis, all intermediate indices can be calculated if the angle of inclination of the ray be determined. A drop of the fluid under investigation is placed on the calcspar plate and under a coverglass. The polariser is then applied to determine the angle of rotation. The ray through the Nicol now passes in a known direction, and only the refractive index parallel to this direction is effective, and, as the fluid is isotropic, it is the same in all directions. The object-stage with this preparation is rotated until the inequalities of the upper plane or the limits of the periphery disappear. Let A be the angle read off on the circumference of the object-stage at the disappearance of the inequalities, and let B be the reading when the inequalities again dis-

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 344–8 (1 fig.).

appear after continued rotation. Then $V = \frac{1}{2}(A - B)$ is the angle which the desired refractive index forms with the principal index. The index can also be found graphically when a series of determinations has been made. In this case a curve is drawn whose horizontal co-ordinates give n at intervals from 0·01–0·01, and the vertical co-ordinates give the angle V at intervals of 10°. Intermediate values would be read off in the usual way. The author gives some tables of results.

Microscopical Axial-angle Determination of very small Crystals.* E. Sommerfeldt, after describing some of the methods bearing on this subject, recommends as a simple mode the insertion of a scale in a suitable place under the object-stage and parallel to it. This should be used with Lasaulx method, and then both images and scale are well defined. The firm of Fuess has, at the author's suggestion, connected this scale with a condenser, which consists of three plano-convex lenses, the lowest of which carries the scale on its plane-face. The condenser is so calculated that a scale thus placed is sharply defined in the axial image.

Ultramicroscopical Investigations upon the Colours of Rock Salt.†—H. Siedentopf points out (1) that it is possible to colorise perfectly colourless specimens of rock salt by a process of heating in a vacuum tube in the presence of sodium or potassium vapour (Heraens), and (2) that it is possible by a process of ionisation to affect the colour of a coloured specimen, or impart a tint to a colourless one (Goldstein, Becquerel, Holzknecht, and others). This latter process, however, only seems to produce a surface effect. Siedentopf adopts the method of Heraens by which six or eight rectangular prisms of perfectly clear and clean rock salt, about 10 by 5 by 3 mm., were placed in a completely vacuous combustion tube, and heated for some time to 600° C., so as to render the crystal entirely water-free. By means of a distillation tube consisting of several bulbs united by capillaries, sodium or potassium was distilled over into the presence of the heated rock salt until about a cubic centimetre, with a bright gleaming surface, was adjacent to the crystals. Special care was taken that the surfaces of the crystals should not be soiled with alkali vapour. The evacuation was once more performed, hydrogen at reduced pressure introduced, and the special preparation tube melted off. Fig. 47 shows this preparation tube as supplied by Carl Zeiss.‡ Its use will be readily understood from the foregoing. The heating is most conveniently done in one of Heraens' vertical electric furnaces, which should be maintained at a constant temperature of about 50–80° below the boiling point of the alkali-metal. This would be about 680° C. in the case of sodium, and about 590° C. for potassium. This temperature is an optimum, for, at a lower temperature, too little alkali vapour would be produced, and, at a higher

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 356–62 (4 figs.).

† Ultramikroskopisch Untersuchungen über Steinsalzfärbungen. Verhand. der Deutschen Physikal. Gesell., vii., No. 1421 (1905); also as a separate tract under above title. Braunschweig, Vieweg & Sohn.

‡ Special circular, Präparatenröhre zur Herstellung optischer Resonatoren aus metallischen Natrium im Steinsalzkristallen.

temperature, the alkali vapour re-distils out of the salt whereby the crystal is decolorised. The temperature is also limited by the melting point of the salt (about 800°), and by the bending temperature of the combustion tube (about 700°). After the heating the preparation tube is taken out of the furnace and allowed to cool in a vertical position in order to avoid external smearing of the coloured crystals with alkali vapour. The excess of alkali settles down in the trough-shaped bottom of the tube. After cooling, the tube is carefully snapped off, without breaking the crystals, which are then rapidly rinsed with water and dilute hydrochloric acid and then dried. For microscopic examination, the preparation is then ready; but for ultramicroscopic investigation they must, on two adjacent surfaces, be polished as carefully as possible free from scratches and the polished surfaces made permanent by means of cover-glasses cemented on.

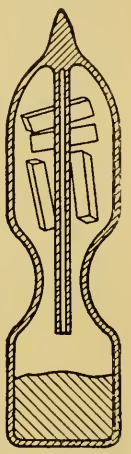

Fig. 47.

The ultramicroscopical examination is performed by the usual apparatus, and Siedentopf concludes that rock salt coloration is essentially due to separation of ultramicroscopic metallic sodium crystalline particles, mostly needle- or flat-shaped, and partly pleochroitic, which are irregularly distributed within the ultramicroscopic cleavage planes and which vary from cubic centimetre to cubic centimetre of the crystal.

He gives his reasons in full for his conclusions, rejects the hypothesis of sub-chloride formations, and refers to the phenomenon of electric resonance previously noted by W. Wood.*

The author adds a coloured plate comparing the results of artificial and natural colorisation as furnished by his ultramicroscopical analysis.

Some Simple Questions on the Images of Microscopes and Telescopes.†—At a recent meeting of the Physical Society, W. B. Croft stated that: "It may have been noticed that when a Microscope is focused visually, an image is formed on the focusing-glass of a camera, into which the microscopic eye-piece is inserted after removing the camera-lens. This image remains more or less in focus at variable positions of the camera-screen. Although it is not always perhaps true, yet it is surprising how often the pencil emerging from a Microscope eye-piece behaves like a single concentrated line of light. A mounting of the proboscis of a fly was focused visually, then a camera was put on the end of the Microscope, and the screen was racked out to six positions over a range of about 6 in. At these positions six photographs were taken, of which the two smallest pictures were inferior to the others. It was claimed that this defect was due to imperfect exposure and uneven illumination. If the visual focusing had made pencils slightly diverging instead of parallel, the larger pictures should have been the more imperfect. These pictures were obtained with a 1-in. objective.

* Phil Mag. (6) iii. (1902) p. 396.

† Proc. Phys. Soc. London, April 27, 1906.

Next, a diatom, *Ticeratium favus*, was photographed with a $\frac{1}{4}$-in.-objective. With a visual focusing two photographs at different distances were taken; these were similar to one another and to what was seen. The same diatom then had a slightly different visual focusing, with the same result as before in the two pictures. Finally, two diatoms with fine markings were focused visually and at two positions; the markings came out clearly in the photograph. The object of showing the results was not to make out that the emergent pencil was ever actually, or always approximately, a single line of light, but to intimate how often the author had found, when projecting from an optical eye-piece, that no change can be detected in the definition of the image as the screen of the camera is moved. If a camera-lucida is placed on the eye-piece, the image of a stage-micrometer can be thrown on a scale at 10 in. distance or at 40 in. distance. The parallel rays emerging from the eye-piece give the image of a point along a direction, at no definite position. The image can be imagined at 40 in. distance as easily as 10 in."

Mr. Croft also showed some photographs taken from sections of the human eye; he indicated that a divergent pencil from a small aperture or from a convex reflecting surface of large curvature will give the Purkinje figures as bright radiating lines, whereas the usual method of sending light through the side of the sclerotic gives them as shadows.

Brass, A.—**Grundesetze der Optik.**
[This treatise is continued and concluded.]
Central. Zeit. Opt. Mech., xxvi. Nos. 20–4 (Oct. 15 to Dec. 15, 1905).

Kerber, A.—**Zur Theorie der schiefer Büschel (Zweiter Beitrag).**
Zeit. f. Instrumentenk., xxv. (1905) pp. 342–3.

Meyer—**Das Ultramikroskop.** Band i., No. 1.

Prytz, K.—**Mikroskopische Bestimmung der Lage einer spiegelnden Fläche.**
[The principle of this method is optical contact. It was noticed in this Journal for 1905, p. 756.]
Tom. cit., pp. 386–7. See also *Ann. d. Physik*, xvi. (1905) p. 735.

Wilsing, J.—**Ueber die Zweckmässigste Wahl der Strahlen gleicher Breunweite bei Achromatischen Objektiven.**
[Discusses the theory of complete achromatism, and describes several kinds of glass whose constants would lend themselves to such a result.]
Tom. cit., pp. 41–8.

(6) Miscellaneous.

Quekett Microscopical Club.—At the 430th ordinary meeting of the Club, held on April 20, Mr. F. P. Smith brought forward two papers —"On the Spiders of the *Diplocephalus* Group" and "A Catalogue of the Literature dealing with Erigonine Spiders." A paper on "Stereo-photomicrography" was read by Mr. H. Taverner, F.R.M.S., and a paper on the same subject which had been communicated by Mr. W. P. Dollman, of Adelaide. Mr. J. Rheinberg, F.R.M.S., gave a résumé of a long and technical paper on "Stereoscopic Effect and a suggested improvement in the Binocular Microscope."

At the 431st ordinary meeting, held on May 18, Mr. A. E. Smith gave an account of the three methods he employed in stereo-photomicrography, and Mr. D. J. Scourfield, F.R.M.S., greatly interested the

meeting with his lecture on "Mendelism and its connection with Microscopy." Attention was drawn to the modification in current views on variation, the origin of species, etc., which seemed to follow an acceptance of Mendel's law.

Microscopy of Vegetable Foods.*—In collaboration with Josef Moeller, Andrew L. Winton has brought out what is probably the first work in an English dress which deals exclusively with the microscopy of vegetable foods. It has special reference to the detection of adulteration and the diagnosis of mixtures, and has been designed for the use of the food analyst, the agricultural chemist, the pharmacist, and others engaged in the examination of foods, as well as the physician who may be called upon to identify vegetable substances in stomach contents and fæces.

The work is divided into 10 parts, which deal with: (1) Equipment methods and general principles; (2) grain, its products and impurities; (3) oilseeds and oilcakes; (4) legumes; (5) nuts; (6) fruit and fruit products; (7) vegetables; (8) alkaloidal products and their substitutes; (9) spices and condiments; (10) commercial starches. At the end is a useful glossary; the bibliography is copious, and is both general and special. The volume is excellently got up; it is profusely illustrated.

The work has evidently been prepared with great care, and the names of the authors are sufficient guarantee for the contents.

MICHAELIS, L.—**Ultramikroskopische Untersuchungen.**
[This is an abstract of the author's article in Virchow's Arch., clxxix. (1905) heft 2, pp. 195–208, 1 pl.]
Zeitschr. wiss. Mikr., xxii. (Dec. 1905) p. 423.

ZSIGMONDY, R.—**Zur Erkenntnis der Kolloïde. Ueber irreversible Hydrosole und Ultramikroscopie.** Jena: G. Fischer (1905) 8vo, vi. and 186 pp., 6 figs. and 4 pls.

ZETZSCHE, F.—**Das Mikroskop, seine Entwickelungsgeschichte. Mit Faksimile-portrait Lieuwenhocks und Zahlreichen Textabbildungen.** Kötzschenbroda and Leipzig: Thalwitzer.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Collecting Rotifera.‡—P. de Beauchamp recommends the following method and procedure for the wholesale preservation of Rotifera for study of the fauna of a lake or district, or for making collections when travelling in new or distant countries, when an examination on the spot is impracticable. After collecting the small plankton in the usual way, he places the condensed material in a bottle, and allows it to stand for half an hour or an hour, at the same time subjecting it to a one-sided illumination. As a result of this, all large floating debris will settle at the bottom, while the Rotifera will mostly congregate in the illuminated portion near the top of the water, where they can be seen with the naked eye like a white cloud. From this region a tube full of

* New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1906, xvi. and 701 pp., 589 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.

‡ Arch. Zool. Expér., Notes et Revue, iv. (1906) pp. xxvii.–xxxiii.

water with the animals is removed by means of a pipette, and treated as follows :—1 drop of the narcotising fluid, consisting of hydrochlorate of cocaine 1 grm., methyl-alcohol 10 c.cm. Distilled water 10 c.cm. is added at intervals of five minutes and mixed, until it is seen that most of the rotifers have fallen to the bottom of the tube. Then they are immediately killed and fixed by adding as many drops of 1 p.c. osmic as the tube contains c.cm. of fluid, and mixed. After ten minutes the animals are removed with a pipette and washed in 1 or 2 p.c. commercial formalin, and finally preserved in the same fluid. The non-pelagic rotifers, creeping and living upon aquatic plants, are obtained by placing a quantity of the plants in a large jar or bucket with just enough water to cover them, and leaving them there for several hours. Asphyxiation will soon drive the animals to the surface film and near the light, where they are collected and treated as before. The author considers that this method, which in its main features is that of Rousselet, will preserve a large number of rotifers in a fairly extended condition, and suitable for systematic study.

Cultivation of Anaerobic Organisms applicable to Water Analysis.* A. Guillemard employs the following method (fig. 48) : a large Pasteur

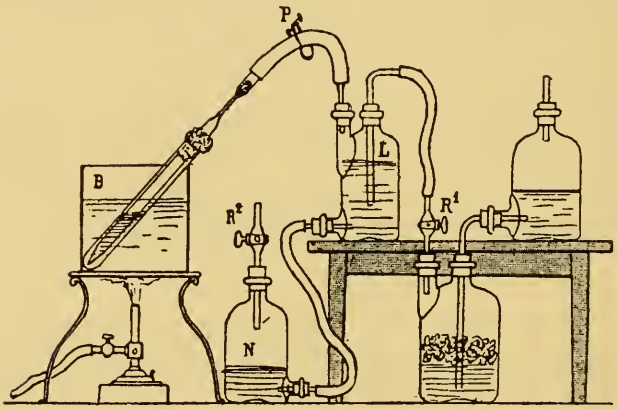

Fig. 48.

pipette, with a content of 9–10 c.cm., pointed at its lower and narrowed at its upper part, to which is attached the hydrogen apparatus, which serves to replace the air of the pipette and the culture tube by hydrogen, and also to aspirate the culture into the pipette. The medium being liquefied and inoculated with the water to be tested, the pipette is flamed and attached to the hydrogen apparatus, from which a rapid current of gas is passed ; after closing the cock P, the pipette is placed in the culture tube and wedged in with wool ; the cock P is then opened gently, and a continuous current of hydrogen is passed for a few minutes, when the cock R^1 connecting with the gasometer is closed, and the cock R^2 on

* Ann. Inst. Pasteur, xx. (1906) p. 155.

the levelling flask is opened ; thereupon the culture is drawn up into the pipette, which, when filled is sealed in the flame and placed in the incubator at 37° C.

Vessel for receiving Blood.*—J. Bronstein describes the following apparatus (fig. 49). It consists of a cylinder provided with two small tubes (*a* and *b*) carrying short rubber tubing, and closed with wool plugs ; the upper opening of the cylinder has a wool plug and a rubber cap. In this state the whole is sterilised in an autoclave. Into the jugular vein of a horse is introduced the hollow needle, provided with a rubber tube and a glass end-piece, and this is attached to the lowest tube (*a*) of the cylinder, the wool plug being removed, and the blood is allowed to flow in up to the mark 1 L ; the rubber tube is then closed by a clamp, and the cylinder is disconnected ; the separated serum is removed by the upper tube (*b*).

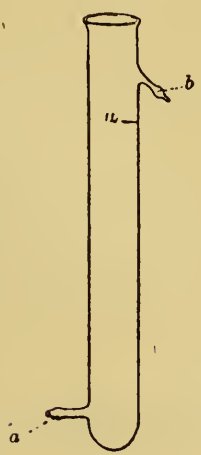

Fig. 49.

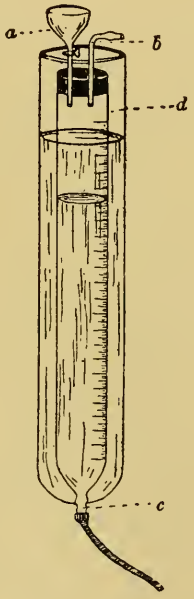

Fig. 50.

Apparatus for Intravenous Injection.†—J. Bronstein describes the annexed arrangement (fig. 50) for intravenous injection. The culture fluid or emulsion to be injected is passed through a filter (*a*) provided with a stop-cock ; the tube (*b*), plugged with wool, conveys a current of air ; the lower part of the vessel ends in a bulb, to the open end of which is attached a rubber tube carrying a hollow needle ; the outer cylinder (*d*) contains warm water, whereby the culture fluid during the process of injection is kept at the body temperature.

* Centralbl. Bakt., Orig. 1te Abt., xl. (1906) p. 583. † Loc cit.

Detection of Bacillus Coli in Water.*—A. T. Venema uses the following method for detecting *B. coli* in water. To 50 c.cm. of acid bouillon (ordinary sterile broth that has not been made alkaline) is added 5 c.cm. of water ; the mixture is then kept for 24 hours at 37° C. From this culture fluid, plates on Drigalski-Conradi-lackmus agar, and on Endo's fuchsin agar, are prepared ; the colonies of *B. coli* which appear within 14–24 hours, are subjected to morphological and cultural tests. By this method the author has succeeded in detecting this organism in water, when other methods have failed to demonstrate its presence.

Rapid Filtration of Nutrient Agar.†—Babucke employs the following method :—30 grm. of meat extract and pepton (Witte) is added to 300 c.cm. of boiling water, and stirred at boiling point until dissolved ; the solution is then made up to 3 litres by addition of water, and the whole heated to 100° C. ; 90 grm. of finely divided agar is then added, and, when dissolved, the mixture is steam-sterilised for an hour. The filter, previously sterilised, consists of a zinc funnel 21 cm. diameter at the top and 3 cm. at the neck ; the top is covered with a four-fold layer of fat-free wool, which, after soaking in water, is pressed down into the funnel, though still extending over the rim. The prepared nutrient agar is then poured out from the steamer in small quantities, on to the wool filter. The filtration takes at slowest 20–25 minutes. By this arrangement it is possible to obtain 3 litres of a 3 p.c. nutrient agar within at most 2 hours.

Cultivation of Bacillus Tuberculosis on Potato.‡—J. Anzilotti advocates the cultivation of *B. tuberculosis* on alkalin potato, using Roux's tubes, in the bulb of which is 6 p.c. alkalin solution of glycerin. The author finds that growth is more rapid and more vigorous than on other media ; that the cultures retain their vitality longer without loss of virulence, and possess a higher virulence and toxicity ; and are very suitable for research purposes and for establishing homogeneous cultures for the estimation of agglutination properties.

Cultivation of Azotobacteria.§—R. Perotti has detected the presence of an azotobacterium morphologically and culturally resembling the *Azotobacterium Chroococcum* of Beijerinck, in ten different soils obtained from various and widely separated districts of Italy. He pours into an Ehrlenmeyer flask of 250 c.cm. content, 25 c.cm. of Beijerinck's solution, and adds 0·2 grm. of the soil to be examined ; the whole is shaken and allowed to stand at a temperature of 28° C. for 10 days, when it is examined macroscopically and microscopically ; agar plates are made, and sub-cultures are prepared on nutrient media containing greater or less amounts of nitrogenous substances.

Method of detecting Bacillus Anthracis in the Blood and Tissues.§ J. Forster spreads plaster-of-paris plates moistened with Loeffler's bouillon with a thin layer of the blood or material ; he finds that spore

* Centralbl. Bakt., Orig. 1te Abt., xl. (1906) p. 600.
† Tom. cit., p. 607. ‡ Tom. cit., p. 765.
§ Atti R. Accad. Lincei, xv. (1906) p. 295.
‖ Centralbl. Bakt., Orig. 1te Abt., xl. (1906) p. 751.

formation occurs within a much shorter period than on ordinary culture media—viz. at 37° C. within 8–9 hours.

Isolating Intestinal Bacteria.*—H. de R. Morgan, in a research on the bacteriology of the summer diarrhœa of infants, took a small portion of fæces, or scrapings, from the mucous surface of the intestine, and made an emulsion thereof with pepton beef broth. From this the bile-salt neutral-red lactose-agar plates of MacConkey were inoculated, and incubated for 24 hours at 37°. Next day the colourless colonies (i.e. non-lactose fermenters) were picked off and put into tubes of lactose broth. After 3 days' incubation, those which had not produced acid and gas were used to inoculate gelatin tubes. The presence of the bile salt was found to exclude all except intestinal bacteria, and after a lapse of six weeks all the cultures which had not liquefied the gelatin were further examined with a view to determine their morphological and pathological characters.

Studying the Histology of the Pancreas.†—S. Tschassownikow, in a study of the histological changes in the pancreas after ligature of the duct, found that the best fixatives were 10 p.c. formalin and Podwyssotzki's fluid, though neither of these sufficiently differentiated the islands from the cells with zymogen granules. This requirement was fulfilled by first flushing the viscus through the cœliac artery with physiological salt solution, and then injecting with Hermann's fluid. This completed, the pancreas was cut up, and the pieces immersed in Hermann's fluid for about 24 hours.

Paraffin sections were stained by Reinke's modification of Flemming's orange method, but usually with safranin and methyl-green.

Apparatus for collecting Blood for Bacteriological Examination. At the April Meeting, R. G. Hebb exhibited an apparatus (fig. 51) for

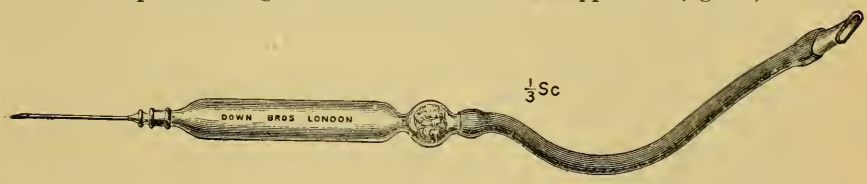

Fig. 51.

obtaining blood for cultivation purposes. It is very simple, and consists merely of a piece of glass tubing and a canula needle. The tube, which holds about 10 c.cm., has its front conical end accurately ground so as to fit the canula. The other end is constricted in two places, so as to form a small bulb, which is stuffed with cotton wool. To this end is attached a piece of rubber tubing with a glass mouth-piece for the purpose of exerting suction if necessary. The syringe has been found to work well, and is easily cleaned and sterilised. It is made by Down Brothers.

* Brit. Med. Journ., 1906, i. pp. 908–12.
† Archiv Mikrosk. Anat., lxvii. (1906) pp. 758–72 (1 pl.)

Studying the Cell-Forms of Connective Tissue.*— A. Maximow obtained good results from supra-vital staining with neutral red. A saturated solution of neutral red in physiological salt solution was injected into the intramuscular tissue of an animal just killed, and after 1–2 minutes the piece of swollen tissue was snipped off and examined under the Microscope. Bone marrow, spleen, and blood were examined by Jolly's method.

For permanent preparations the tissue was fixed in Zenker's fluid, in formol-Zenker, or in alcohol, and then imbedded in celloidin or paraffin, mostly the former. The sections were stained with polychrome methylen-blue, iron-hæmatoxylin and van Gieson, or with hæmatoxylin-acid-fuchsin and aurantia.

For "mast" cells, celloidin sections of alcohol fixed material were stained with a saturated solution of thionin in 50 p.c. alcohol for 24–48 hours, followed by alcohol ; xylol ; balsam.

The author makes a clear distinction between mast cells and plasma cells ; the former are distinguished by the granules in the cytoplasm ; the latter are round or polygonal, and their protoplasm stains deeply with basic anilin dyes.

Collecting Material for Study of Sargassum filipendula.†—E. B. Simons collected the material near the shore of Woods Hole late in July and during August. Plants, both in vegetative and reproductive conditions, were abundant. Flemming's weak solution (1 p.c. chromic acid 25 c.cm., 1 p.c. acetic acid 10 c.cm., water 65 c.cm.) proved a satisfactory killing and fixing reagent. Sections 5 μ thick were stained either with iron-alum-hæmatoxylin, or with safranin and gentian-violet.

Studying the Morphology and Development of Empusa.‡—E. W. Olive found in horse-dung cultures a fly belonging to the genus *Sciara*, which was infected with an *Empusa*. This fly has, since March 1904, been propagated along with its attendant disease, and many generations have furnished material for the cytological and developmental study of *Empusa*. The material was killed and fixed with a variety of agents, mostly with varying strengths of Flemming's chromic-acetic-osmic acid mixture. The insect body was generally cut in two, or pricked, to allow direct contact of the fixative and the fungus hyphæ in the body cavity. The sections, 3–6 μ thick, were stained with Flemming's safranin-gentian-violet-orange G. solution, or with Heidenhain's iron-hæmatoxylin.

"Blowing" of Condensed Milk Tins.§—G. H. Pethybridge finds that the "blowing" of condensed milk tins is due to small yeasts, or torulæ, which are present in large numbers. Unlike other organisms found in milk, these small yeasts are not inhibited by increasing the concentration of the cane sugar ; in fact, they are capable of fermenting saturated solutions of cane sugar in milk.

Cultivations from the clots were made in Pasteur's solution at 20°, and from these, plates and sub-cultures. The organism grew freely on

* Archiv Mikrosk. Anat., lxvii. (1906) pp. 680–757 (3 pls.).
† Bot. Gazette, xli. (1906) p. 163 (2 pls.). ‡ Tom. cit., p. 195 (2 pls.)
§ Economic Proc. Roy. Dublin Soc., i. (1906) pp. 306–20.

any medium which contained glucose or cane sugar, and abundance of gas was produced in cane sugar gelatin shake cultures.

Experiments with sound tins of milk were made for the purpose of proving that the blowing was due to the vital activity of the small torula. The results were positive.

Investigation of the cane sugar used in the manufacture of a batch of blown tins, proved the absence of the torula, though a gas-forming bacterium was isolated from some cultures. But though this organism had the power of forming gas, it was shown that this activity was inhibited by increase of sugar in the medium.

(2) Preparing Objects.

Demonstrating Life-Cycle of Cystobia irregularis.*—H. M. Woodcock, when examining *Holothuria* and *Cucumaria* for "*Cystobia*" *irregularis* (Minch), stupefied the hosts by placing them in sea-water, to which a few crystals of menthol had been added. In *Holothuria* the parasites are seen as white oval spots in the lumen of vessels, or as spherical cysts attached to the wall. In *Cucumaria* the parasites are found in the respiratory trees, or attached by a stalk to the cælomic epithelium. The latter are adults, and enveloped by a double layer of epithelium.

The adults were usually fixed on the slide with osmic acid vapour (5 min.). After washing with water, the preparations were stained with dilute picrocarmin (Ranvier), and afterwards mounted in balsam.

Another method was to fix in saturated aqueous sublimate, to which 5 p.c. glacial acetic acid had been added. Such preparations were stained with carm-alum, or with alcoholic paracarmin.

For gregarines and for cysts, the sublimate acetic solution (20–40 minutes), or Flemming's fluid (2–4 hours), gave the best results. By the former method the material was stained in bulk with borax or paracarmin, by the latter on the slide. Sections of cysts were stained with iron-hæmatoxylin, followed by orange or eosin, with thionin and orange, with Kleinenberg's hæmatoxylin, and with other solutions, but those mentioned gave the best results.

Fixation Method for demonstrating Bacterial Capsules.†—H. Kayser exposes the films to the action of the vapour arising from 5 c.cm. 1 p.c. osmic acid, to which have been added 10 drops of acetic acid for about 2 or 3 minutes. After drying in the air, the film is washed for 1 minute with a dilute aqueous solution of permanganate of potash (a small crystal to 50 c.cm. water), and then washed in water.

Staining of the capsule may be done by the method of Klett, Johne, Heims, or others.

Demonstrating the Structure of Cladosphora Membrane.‡—F. Brand treated the material for at least 24 hours with acidulated dis-

* Quart. Journ. Micr. Sci., l. (1906) pp. 1–100 (6 pls.).
† Centralbl. Bakt., 1te Abt., Orig., xli. (1906) pp. 138–40.
‡ Ber. Deutsch. Bot. Ges., xxiv. (1906) pp. 64–70 (1 pl.).

tilled water, which had a softening and decalcifying effect. This was followed by Schultze's maceration fluid, and afterwards for a few minutes with very strong chromic acid solution. As the objects are brittle, and are rendered still more fragile by the reagents, much care must be taken during the manipulation. After washing out the chromic acid the preparation should be stained with a weak solution of Ruthenium red. No definite rule could be given for the action of the various reagents, as the different resistances of the various samples could not be previously estimated.

Studying the "Islets of Langerhans" in the Pancreas.*—H. H. Dale fixed the pancreas of dog, cat, rabbit, and toad in a mixture of sublimate and formalin. This was made fresh as required by mixing three or four volumes of a saturated aqueous solution of sublimate with one volume of formalin. In some cases sublimate alone was used. The pancreas of dog or cat was cut into thin slices; the rabbit's pancreas, being spread out into a thin layer in the mesentery, needed no such section; the toad's pancreas was fixed entire. After an immersion of 24 hours the tissue was washed for 24 hours in running water, passed through upgraded alcohols to xylol, and imbedded in paraffin in the usual way. Sections of toads' pancreas were made 5 μ thick, while those of the mammals varied from 2–4 μ.

The sections were stained with eosin and toluidin-blue (1 p.c. aqueous solution). The sections, freed from paraffin, were passed from alcohol to dilute tincture of iodine, to remove the sublimate. The iodine was washed out in 60 p.c. alcohol, and after passing through water the sections were stained with eosin. Excess of eosin was removed with 60 p.c. alcohol, until the zymogen granules could be seen under a low power stained more deeply than the rest of the tissue. The eosin was then fixed with dilute acetic acid, and after washing with distilled water the sections were stained with toluidin-blue. After the ordinary treatment the sections were mounted in balsam.

Fixing and Staining Cells of Embryo-Sac.†—J. Perriraz tried 17 different fixatives for his study of the directing spheres in the cells of the embryonic sac. The directing sphere is a term which includes the centrosome, the attraction sphere, and the aster. The author mixes solutions of silver nitrate, and mostly used the following: 1 p.c. osmic acid 4 c.cm., 1 p.c. nitrate of silver 35 c.cm., saturated aqueous solution of picric acid 25 c.cm., absolute alcohol 25 c.cm. The nitrate of silver is first mixed with the water, and then hot picric acid is added, and after this the osmic in absolute alcohol. The mixture is then heated for a few minutes in a water bath at 45°–50°, after which it is allowed to cool in a dark chamber.

The material is fixed in the dark at from 25°–30°, and then passed through graded alcohols. Then follows a graduated series of alcohol

* Phil. Trans., Series B., No. 197 (1905) pp. 25–46 (2 pls.). See also this Journal, 1904, p. 296.

† Bull. Soc. Vaudoise Sci. Nat., xli. (1905) pp. 213–56.

and xylol and of xylol and paraffin. In the first series are 4 gradations up to pure xylol; in the second series 6 gradations up to pure paraffin.

The ovaries are placed in the first series for 8 hours a stage. In the second series the melting point of the paraffin ranges from 35°–150°.

Staining was performed in three ways: (1) by staining in paraffin; for this methyl-green, methyl-blue or orange G., were mixed with liquefied paraffin; (2) staining *en masse* with some preparation of hæmatoxylin or of safranin; (3) staining of sections; for this safranin, gentian-violet and orange G., or Delafield's hæmatoxylin with safranin, were chiefly used.

Demonstrating Phagocytosis and Excretion in Branchiopods.*—L. Bruntz used in his researches *Chirocephalus diaphanus*. He injected filtered solutions of carminate of ammonia, anilin dyes and Indian ink, by means of a glass tube, one end of which was drawn out to a fine point. The tube was filled by capillarity, and then the point plunged into the pericardial sinus, care being taken not to damage the dorsal tube or the nerve chain. The fluid is then blown in, and as the circulation is very active the animals stain uniformly. The different dyes are eliminated at intervals varying from 10 minutes (indigo-carmin) to several hours (carminate of ammonia).

Demonstrating Reproduction in Gregarines.†—L. Brasil, for his researches on the reproduction of Gregarines, fixed the vesiculæ seminalis of *Lumbricus herculeus* in the following fluid: picric acid 1 grm., glacial acetic acid 15 c.cm., formalin 60 c.cm., alcohol (80 p.c.) 150 c.cm. The vesiculæ, cut up into small pieces, were immersed in the fixative for 24 hours, and on removal were washed, dehydrated in alcohol, and imbedded in paraffin. The sections were stained with iron-alum-hæmatoxylin; 24 hours in a 5 p.c. solution of iron-alum, and then for 36–48 hours in 0·5 p.c. solution of hæmatoxylin. The sections were after stained with an alcoholic solution of eosin and orange G., or of light-green and picric acid.

(3) Cutting, including Imbedding and Microtomes.

Studying the Development of the Ascocarp of Humaria granulata.‡—V. H. Blackman and Helen C. Fraser, in their research on the sexuality and development of the Ascocarp of *Humaria granulata* Quél. (= *Peziza granulata* Bull.), fixed the material chiefly in Flemming's weak fluid, which was allowed to act for 24 hours, or for 1 hour, fixation being completed in the latter case with Merkel's fluid. Either safranin, gentian-violet and orange, or Benda's iron-hæmatoxylin, were used for staining. Sections of the very youngest stages of the apothecia were secured by removing and fixing the superficial layers of the substratum on which apothecia were just visible. The behaviour of the closely packed nuclei of the ascogonium was best followed in sections 4 μ thick.

* Arch. Zool. Expér. et Gén., xxxiv. (1905) pp. 183–98 (1 pl.).
† Tom. cit., pp. 69–99 (2 pls.).
‡ Proc. Roy. Soc., lxxvii. (1906) pp. 354–68 (3 pls.).

Demonstrating the Structure of Mollusca.*—R. Anthony, in his study on the morphology of the acephalous Mollusca, made casts of the shells and of the palleal cavity by means of plaster, wax, or gelatin. For obtaining a cast of the cavity, two holes were made in the shell, and the plaster poured in through one hole by the aid of a funnel.

The mould set in a few hours, and then the shell and soft parts were removed, sometimes with the aid of acid.

Fixation was effected in a mixture of formalin 4 and alcohol (70 p.c.) 100. The material was imbedded in paraffin or collodion. Staining was sometimes effected *en masse*, at other times in sections. The usual tinctorial solutions were employed. Teasing out the muscle and dissociation were found to give better and more instructive results than sections. 20 p.c. nitric acid, allowed to act for 12–24 hours, was used.

For luting down the preparations, caoutchouc dissolved in benzin or sulphide of carbon was used. The caoutchouc dissolved in benzin was found to be specially useful for fixing up preparations mounted in aqueous media.

Marking the Directing Plane on Blocks for Reconstruction.†—K. Peter finds that Nubian waterproof blacking makes an excellent overlay for marking out the directing plane of blocks used for reconstruction models. The embryo is first imbedded in paraffin, and then the blacking is painted on with a brush. In a few minutes the surface dries, and then the block is covered with another layer of paraffin. It is equally suitable for paraffin and celloidin imbedding, and is applicable to all the usual procedures.

(4) Staining and Injecting.

Demonstrating the Presence of Spirochæta pallida.‡—E. Bertarelli and G. Volpino adopt the following method for staining *Spirochæta pallida* in tissues. Very small pieces, 0·6 to 0·7 mm. thick, are fixed in alcohol. They are then immersed in the silver solution for 3–4 days (silver nitrate 1·5, distilled water 50, alcohol (96 p.c.) 50, glacial acetic acid 4–5 drops). This fluid must be renewed as soon as a precipitate forms. The pieces are then frequently washed in distilled water, after which they are placed for 24 hours at room temperature in Van Ermengeum's reducing medium (tannin 3, gallic acid 5, sodium acetate 10, distilled water 350). This fluid must be changed as soon as it becomes cloudy. After a thorough wash in water the material is passed through alcohol chloroform to paraffin. The sections should be from 0·3 to 0·7 μ thick.

Simplified Method of Staining Blood Films.§—R. Lenzmann stains air-dried blood films by the following method. Solution 1 consists of eosin 1·2, absolute alcohol 100, formol 5, sublimate 0·3; filter. To 10 c.cm. of this solution is added 1 c.cm. of the following methylen-blue solution: methylen-blue 0·8, absolute alcohol 100, 3 p.c. acetic

* Ann. Sci. Nat. Zool., sér. 9, i. (1905) pp. 165–396 (57 figs. and 3 pls.).
† Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 530–8 (2 pls.).
‡ Centralbl. Bakt., 1te Abt. Orig., xli. (1905) pp. 74–8 (1 pl.).
§ Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 431–3.

acid 20 drops ; filter. After the two solutions have been mixed, the staining solution is filtered again. Solution 2 consists of methylen-blue 2·4, borax 2·5, absolute alcohol 100 ; filter.

The procedure is simple. Drop on the film solution, and after about a minute add five times the quantity of distilled water ; allow to act for about 1½ minutes, then wash in tap water. Next stain with No. 2 solution for some 20–30 seconds, wash again, dry on blotting paper, and mount in balsam.

For filtration thick papers are required, especially for No. 2 solution ; for this 589 Schleicher and Schüll is recommended.

Azocarmin and Chromotrops as Contrast Stains.*—M. Heidenhain has obtained good results from the use of Azocarmin B. This pigment is an amido-acid, is easily soluble in alcohol, and imparts a beautiful ruby-red hue. It acts more powerfully when the material has been treated with some chromic acid salt.

The advantages of the chromotrops appear to be more numerous, and the author believes that they have a great future, and will supersede eosin. He has experimented with four kinds of these azo-derivatives of chromotropic acid, viz. 2 R, 2 B, 6 B, 7 B. The first two impart a yellowish-red hue, the latter pair a bluish tone. The procedure for staining is as follows : Hæmatoxylin-stained sections are transferred to 96 p.c. alcohol, and then treated with ammoniacal-alcohol (1 c.cm. ammonia to 1 litre of absolute alcohol). This turns the sections blue, and when this stage is arrived at they are placed in absolute alcohol again. From the latter they are transferred to an alcoholic chromotrop solution, which may be strong or weak.

After washing with absolute alcohol, the sections are passed through xylol and mounted in balsam.

Demonstrating Cytoryctes luis.†—G. Siegel, after alluding to the observations of Klebs in 1879, and of Döhle in 1892, states that he has found in the body-juices and cells of syphilis a motile parasite which he believes is a flagellate protozoon.

The parasites are demonstrable in films of blood or tissue-juice, by first staining with Grenacher's hæmatoxylin, and after differentiating with acid alcohol, contrast-staining with azur ii. (1 : 1000). The flagella are stained for 3 days in Giemsa's solution, which should be frequently changed, and warmed each time.

In sections, which should be very thin (2μ), the parasites are found within connective-tissue cells.

Inoculation experiments on monkeys and rabbits were successful.

Staining Spirochæta pallida.‡ — Davidsohn recommends Kresyl-violet R. extra for staining *Spirochæta*. As much as will go on the end of a knife-blade (? size) is dissolved in 100 c.cm. water.

* Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 337–43.

† Münch. med. Wochenschr., 1905, Nos. 28, 29. See also Centralbl. Bakt., 1te Abt. Ref., xxxvii. (1905) pp. 480–2.

‡ Berlin Klin. Wochenschr, 1905, p. 985. See also Centralbl. Bakt., 1te Abt. Ref., xxxviii. (1905) p. 50.

Slide-Basket for Staining Twelve Sections Simultaneously.* — Kjer-Petersen mentions a basket (fig. 52) which he has had constructed for the purpose of facilitating the staining, etc., of films of tuberculous sputum. Though the method of using the apparatus is obvious, no directions are given, and no details as to its construction.

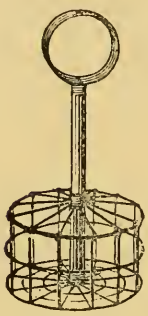

Fig. 52.

Staining Bacillus typhosus in tissues.†—P. Foa fixes the pieces in the following fluid :—sublimate 2 grm., Müller's fluid 100 grm., followed by alcohol, and then stains with a mixture of methyl-green and pyronin (Pappenheim's formula). In about 5 minutes the bacilli are stained deep red.

Modification of Flemming's Triple Stain.‡—V. Bonney has devised the following easy process of triple staining for cytological and histological purposes. It is based on the method of Flemming, a method which has received praise and blame. The pieces, which should be small, are fixed in acetic alcohol (glacial acetic acid 1 part, absolute alcohol 2 parts, or in Hermann's or Flemming's fluid. Imbed, and section in the usual way. Stain for 1 hour in saturated aqueous solution of safranin. Wash in water. Stain for a quarter of an hour in an aqueous saturated solution of methyl-violet. Wash in water, and wipe the slide dry, except the part occupied by the section. Flood the slide with the following solution : To 20 c.cm. of acetone add drop by drop a saturated aqueous solution of orange G. until the precipitate which appears on shaking is just dissolved in excess of the aqueous solution, then filter. Run off the fluid and flood again with the same solution, and when the section has assumed a faint brownish-pink colour, pour off the orange-acetone solution. Wash in acetone for a few seconds. Wash in xylol. Examine under a low power to see if the proper result has been attained. Then wash in two fresh changes of xylol. Mount in xylol-balsam.

Chromatic elements stain a rich violet ; spindle fibres of mitosis a faint pink ; cytoplasm a rose pink ; intercellular tissue a pale yellow.

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

Demonstrating Pollen Grain Variation.§ — J. B. Pollock placed anthers, which were almost dehiscing, in Kleinenberg's hæmatoxylin for 24 hours. They were then washed in alcohol, and changed very gradually from 96 p.c. alcohol to clove oil. In this medium the pollen sacs were broken up, and the pollen grains thus set free were examined by mounting a drop of the oil containing them.

Method for making Permanent Preparations of Amyloid Degeneration.‖—P. Meyer finds that permanent preparations of tissues affected

* Centralbl. Bakt., 2te Abt., xvi. (1906) pp. 191–2 (1 fig.).
† Giorn. R. Accad. Med. Torino, 1905, Nos. 5–6. See also Centralbl. Bakt., 1te Abt. Ref., xxxviii. (1906) p. 50. ‡ Lancet, 1906, i. p. 221.
§ American Naturalist, xl. (1906) pp. 253–86 (16 figs.).
‖ Virchow's Archiv, clxxx. (1905) pp. 359–61.

with the lardaceous change can be obtained by merely drying. The preparations are stained with methyl-violet, differentiated with very dilute acetic acid, washed in water and dried in the air. They are then cleared up in xylol, and mounted in balsam. This method, which, of course, is only applicable to paraffin sections, does not succeed with iodine.

(6) Miscellaneous.

New Method of enumerating Leucocytes.*—W. B. Leishman, at a meeting of the Pathological Society of London, held March 20, 1906, described a method of enumerating leucocytes, by which it was possible to dispense with the use of expensive apparatus, of a special diluting fluid, and of a mechanical stage. Two pipettes are required, one an ordinary 1 c.cm. pipette graduated to 0·01 of a c.cm., and the other a capillary pipette to deliver 5 c.cm. Five (5) c.cm. of the blood to be treated is taken into the capillary pipette and at once diluted 200 times by being blown into 995 c.cm. of water, previously measured by the larger pipette. The mixture is well stirred and shaken, and two successive volumes of 5 c.cm. are taken and discharged side by side on a slide. The drops are allowed to dry, and then stained with Leishman's stain. The whole number of the leucocytes are then counted by the aid of a ruled cover-glass in the following way :—A drop of Leishman's stain is allowed to evaporate on the surface of a cover-glass ; a thin film is left, insoluble in water or cedar-oil, in which is ruled a series of parallel lines, with the point of a needle. A drop of cedar-oil is then placed on the film, and on it is dropped the cover-glass, ruled surface downwards. Both drops are then counted. In this way the whole of the leucocytes in 10 c.cm. of the diluted blood are enumerated, and the number in 1 c.cm. of blood is obtained by multiplying the result by 20. In dealing with leukhæmic, or with leucopenic blood, the dilution is readily altered to facilitate counting. As compared with Gower's hæmocytometer, the readings by the author's method underestimates by about 5 p.c.

Böhm, A. A., & Davidoff, M.—**Textbook of Histology, including Microscopical Technics.** Translated by H. A. Cushing.
Philadelphia : 2nd revised and enlarged edition, 1904, 8vo. 528 pp., and plates.

Hall, Walker J., & G. Herxheimer—**Methods of Morbid Histology and Clinical Pathology.**
London and Edinburgh : Green and Sons (1906) 8vo, xvi. and 290 pp.

Moller, J.—**Mikroskopie der Nahrungo-und Genuszmittel aus dem Pflanzenreich.**
Berlin : Jul. Springer (1905) xvi. and 599 pp., 599 figs. ; 2nd edition, revised and enlarged with the collaboration of A. L. Winton.

Senft, E.—**Mikroskopische Untersuchung des Wassers mit bezug auf die in Abwässern und Schmutzwässern vorkommenden Mikro-organismen und Verunreinigungen.**
Wien : Jos. Šafár (1905) 196 pp., 180 figs. in text and 10 plates.

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* Brit. Med. Journ., (1905) i. p. 680.

Metallography, etc.

Measurement of Stress by Thermal Methods.*—It has long been known that a thermal effect is produced when bodies are subjected to stress, and formulæ expressing the relation between change of temperature and stress have been worked out. E. G. Coker has experimentally investigated this relationship for tension and compression stresses on metals. As the coefficient of expansion enters into the equation, it was considered necessary to determine if variation of stress had any effect upon the coefficient. Steel and brass tubes were subjected to definite tension stress, and their expansion on heating measured by means of a Ewing extensometer, alteration of temperature being effected by circulation of water through the tube. It was found that there was no difference in the linear expansion of brass and steel within the range of stress up to the yield point. In the determination of the relation between thermal change, stress, and strain, bars were loaded in a testing machine, elongation being measured by an extensometer, and temperature variations by a thermopile connected with a galvanometer. The cooling effect caused by tensile stress could thus be measured with extreme delicacy. Similar determinations were made of the heating effect, stress, and strain in test pieces subjected to compression. The author concludes that the thermal change is very nearly proportional to the stress, in the same way as the strain. The directions in which the methods employed are capable of practical application are indicated.

Overstraining of Iron by Tension and Compression.†—When iron is overstrained in tension, its elastic limit in tension is raised, if recovery from the temporary effects of overstrain be allowed to take place. The elastic limit in compression, however, is lowered, according to some authorities, while others appear to take the view that it also is raised. J. Muir gives an account of some tests bearing on this question. A test piece was stressed in compression beyond its yield point. It was then placed in boiling water for ten minutes. A second compression test gave a yield point higher than the maximum stress applied in the first loading. Test pieces were then cut from bars which had been overstrained in tension; they were warmed to effect recovery from overstrain, and subjected to compression stress. It appeared that the compression yield point had been raised by the overstrain in tension, but not to the same extent as the tension yield point. The author suggests that overstraining hardens the material, both as regards resistance to tension and compression, but that the process of recovery from tensile overstrain raises the tension yield point above the overstraining stress, and lowers the compression yield point below the overstraining stress, by approximately an equal amount. The author points out that his experiments were not satisfactory in some respects, and that further research is desirable.

* Trans. Roy. Soc. Edinburgh, xli. (1905) pp. 229–50 (11 figs.).
† Proc. Roy. Soc., Series A, lxxvii. (1906) pp. 277–89 (5 figs.).

Manufacture of Cartridge Cases for Quick-firing Guns.*—L. Cubillo and A. P. Head describe the properties of the brass (Cu 67 p.c. Zn 33 p.c.) used for this purpose. An examination of the cooling curve of this alloy leads to the conclusion that it is a eutectic. The cold-drawing operations to which the metal is subjected necessitate frequent annealing; the most suitable temperature is 620°–650° C. The value of microscopic examination of metals is pointed out, and five photomicrographs of brass, both in the annealed and cold worked states, are given. The processes of manufacture of cases are described in detail.

Iron-Carbon Alloys with high percentages of Carbon.†—Recognising the unsatisfactory character of the theory of iron-carbon alloys, elaborated by Roozeboom, as applied to high carbon alloys, F. Wüst determined the cooling curves of a series containing 2·56–4·82 p.c. carbon. The percentage of elements present other than iron and carbon was very small. The curves relating to eight of the alloys are given. According to the theory, graphite should be the first constituent to separate during solidification of the 4·82 p.c. alloy, and should rise to the surface owing to its relatively low specific gravity. This was not found to be the case. The lower freezing point varied from 1112°–1149° C. No thermal change was detected between this point and the evolution of heat caused by the formation of pearlite at about 700° C. The author's work supports the conjectures of Osmond and Heyn, that the formation of cementite takes place at 1135° C. The structure of many of the alloys, illustrated by photomicrographs, is described in detail. The non-reversible change (cementite = ferrite + temper carbon) occurring when alloys containing free cementite are heated at a high temperature, is held to uphold Heyn's assumption that the system ferrite + carbon is stable, the other systems being phenomena due to rapid cooling.

A Defective Bar of Tool Steel.‡—C. E. Corson gives a number of interesting photomicrographs of a bar of crucible steel containing 1·72 p.c. carbon. A finishing tool made from the steel failed after being in use a very short time. The fracture at one place in the bar was fine grained, while at another point it was coarse. The author concludes that the steel had been slowly cooled from a temperature varying considerably in different parts of the bar.

Liquid Crystals and Plastic Crystals.§—Certain organic bodies on melting yield a liquid which is not clear, and has the property of double refraction, indicating a decided orientation, though no indication of crystalline structure is afforded by external form. At a somewhat higher temperature the liquid becomes clear, and loses its abnormal optical properties. Other substances, of great viscosity, exist as soft crystals, frequently having rounded extremities. These plastic crystals are deformed by the application of very slight forces. An account of these singular phenomena is given by Etienne, who points out that

* Engineering, lxxx. (1905) pp. 548–75 (47 figs.).
† Iron and Steel Mag., xi. (1906) pp. 185–211 (27 figs.).
‡ Tom. cit., pp. 281–6 (10 figs.).
§ Rév. Metallurgie, iii. (1906) pp. 129–36 (6 figs.).

metals of undoubted crystalline structure are plastic within certain ranges of temperature. If a plastic crystal be cut in two, each portion assumes the form of the original crystal. Two plastic crystals in contact frequently combine to form one crystal. It is possible to deform a plastic crystal without changing its orientation. The theories of Lehmann, Tammann, and others, as to the nature of doubly-refracting liquids, are briefly stated.

H. le Chatelier * points out that the growth of metallic crystals at certain temperatures, and also the capacity exhibited by some metallic crystals of being deformed without change in crystalline orientation, are exactly the same phenomena as those observed in the plastic crystals referred to above. As the method of examination by polarised light cannot be employed for the study of metals, since they are not transparent, it is hoped that the researches now being conducted upon soft crystals of organic bodies may throw light on the constitution of malleable metals.

Recent Researches upon Industrial Alloys.†—L. Guillet reviews the work carried out on alloys during the last few years. A classification of binary alloys is given, based upon the capacity of the two metals to form either definite compounds, or solutions of one metal in the other, both in the liquid and solid states. The importance of solid solutions is insisted upon. A concise account of methods used in the investigation of alloys is given. The most important of these methods is microscopical examination of prepared sections, which has the advantages of being rapid and inexpensive. Information of great value may be obtained by a study of a complete freezing point curve. The author proceeds to deal with a large number of alloys in some detail; among those considered are the iron-carbon series and the special steels, the alloys of copper with tin, phosphorus, aluminium, nickel, silicon, vanadium, chromium, tungsten, etc., the antifriction alloys, and the aluminium-manganese alloys, some of which are magnetic. The refinement of methods of determining thermal changes upon heating or cooling, has led to the discovery of transformation points in the bronzes and other alloys.

Quenching of Steel.‡ — A. le Chatelier discusses a theory of the hardening of steel by quenching, published by him in 1895, and recently revived by Grenet, in which the effects were ascribed to deformation (*écrouissage*) of the metal. The change in volume accompanying the transformation of steel on cooling, causes internal stresses of great magnitude when the metal is quenched from a temperature above the change point. The author considers that the deformation caused by these stresses hardens the steel, while Grenet's view is that the hardness is due to a change of texture. Arguments tending to show that the two views are in essential agreement, are advanced.

Cementation.§—Ledebur combats the theory of cementation of steel advanced by Guillet, and takes the view that the solid carbon is directly

* Rév. Metallurgie, iii. (1906) pp. 105–6.
† Tom. cit., pp. 155–79 (28 figs.).
‡ Tom. cit., pp. 211–16.
§ Tom. cit., pp. 222–6.

absorbed by the iron. Experiments in which iron was carburised by heating in contact with sugar charcoal, and wood charcoal, showed that the formation of gaseous compounds was not necessary for cementation to take place.

L. Guillet * replies to Ledebur's criticisms. He has shown that the active agent in cementation is always a cyanide or a carbide, and that carbon alone is not absorbed when heated in contact with iron. Ledebur's proofs to the contrary are inconclusive.

Andrews, T.—**Microscopic Observations on Naval Accidents.**
Engineering, lxxix. (1905) pp. 563–6 (16 figs.), and lxxx. (1905) pp. 235–9 (24 figs.).

Berthelot & G. André—**Recherches sur quelques métaux et minerais trouvés dans les fouilles du Tell de l'Acropole de Suse en Perse.**
Comptes Rendus, cxlii. (1906) pp. 473–80.

De Fréminville, C.—**Influence des vibrations dans les phénomènes de fragilité.**
Rev. Metallurgie, iii. (1906) pp. 109–21 (3 figs.).

Sankey, H. R.—**Impact Testing.** *Eng. Mag.*, xxx. (1906) pp. 913–14.

Waterhouse, G. B.—**Nickel Steel, and its Application to Boiler Construction.**
[Nickel steel, especially that containing about 30 p.c. nickel, has properties which render it highly suitable for boiler construction.]
Iron and Steel Mag., xi. (1906) pp. 301–7.

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* Rév. Metallurgie, iii. (1906) pp. 227–8.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Zeiss' Large Mechanical Stage.†—This stage (fig. 54) has a range of 50 mm. (2 in.) in one direction, and 35 mm. ($1\frac{3}{8}$ in.) in the other;

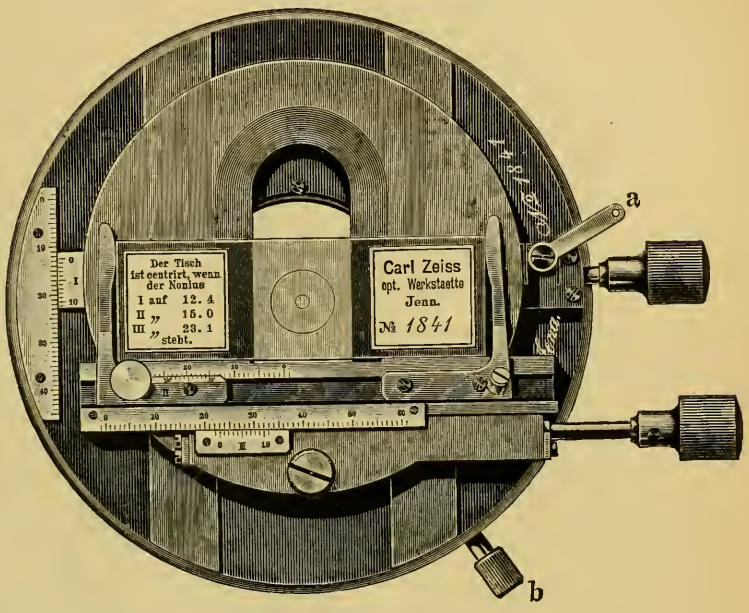

Fig. 54.

vernier scales record the variations in either direction. A third vernier scale enables the portions of the movable cheek-piece which secures the object-slide to be recorded. This arrangement facilitates the use of the apparatus as a "finder," while the process of centring is much simplified by the use of a centring glass, i.e. a slide with a cross ruled on it.

Zeiss' Stand for Crystallographic and Petrographic Work.†—This instrument (fig. 55) is an example of a medium sized stand, and is so

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

† Carl Zeiss' Catalogue of Microscopes and Microscopical Accessories, 33rd ed. 1906, p. 36 (fig. 14). ‡ Tom. cit., pp. 50–1 (fig. 22).

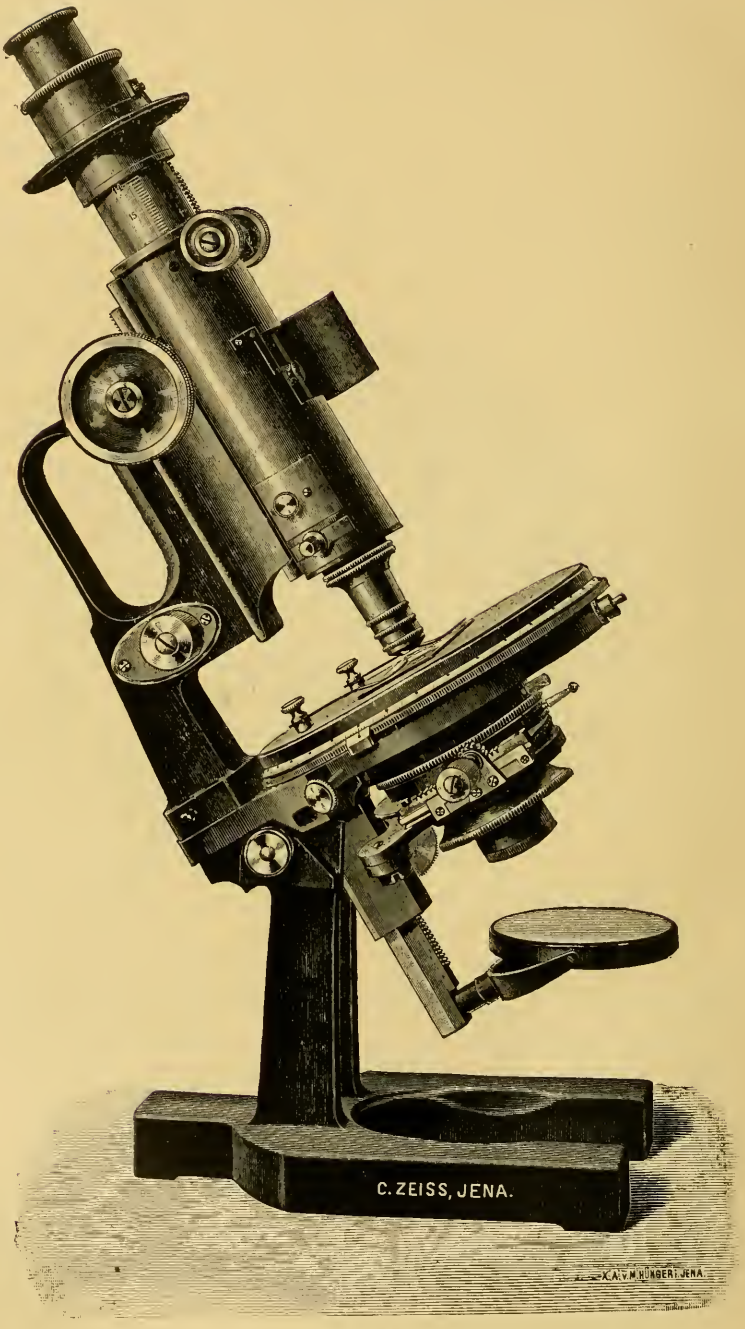

FIG. 55.

constructed as to allow of subsequent additions to the stage and sub-stage equipment. The body is fitted with Berger's micrometer movement, and the draw-tube is at its lower end provided with a slide to admit a mounted Amici-Bertrand lens through an opening in the outer tube. The instrument is furnished with analysers and polariser, with selenite, mica, and Biot-Klein quartz plates—suitable arrangement being made for inserting these plates in a sliding carrier above the objective. The revolving vulcanite stage is graduated at the circumference, and has a line index. The two upper lenses of the swing-out condenser, N.A. 1·40, are easily detachable, as their mount is not screwed but slipped on over the lowest lens. Additional accessory apparatus can be supplied.

(2) Eye-pieces and Objectives.

Zeiss' Compensating Ocular 4* with Iris Diaphragm.*—Messrs. C. Zeiss have modified one of their series of compensating oculars by fitting it with a collecting-lens of large diameter (fig. 56). As compared with its predecessor 4, its field is considerably enlarged, though only adapted for use with objectives of 16 mm. and 8 mm. The ocular is fitted with a revolving collar, and can be fixed in any desired position by means of the clamping-screw K. An iris diaphragm supersedes the ordinary fixed diaphragm. The eye-lens is mounted in a sliding sleeve, so that a scale can be used if required.

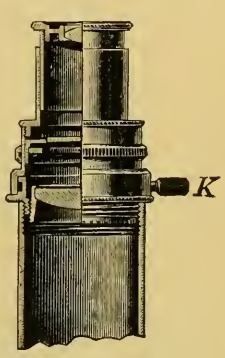

Fig 56.

Fluid Lenses.† — W. A. Rublee, U.S. Consul-General at Vienna, states that a Hungarian chemist has succeeded in producing optical lenses by a simple and cheap process that are not only quite as good as the best massive glass lenses at present used, but that can be manufactured of a size three times as great as the largest homogeneous glass lens heretofore made. Though the invention is more important for astronomical work, lenses of smaller diameter for photographic purposes, for opera glasses, reading glasses, etc., can be produced at correspondingly smaller cost. The lens consists of a fluid substance inclosed between two unusually hard glass surfaces, similar to watch crystals, in which the refractive power and other characteristic properties are so chosen that the glass surfaces not only serve to hold the fluid, but also combine with the fluid to overcome such defects as are scarcely to be avoided in ordinary lenses. It is for this reason that the lens is achromatic. The fluid contained in the lens is hermetically closed in, so that no air can enter and exercise a damaging influence. The fluid does not evaporate, and its composition is such that its properties are not affected by time or temperature. The coefficient of expansion, both of the glass and of the fluid, is approximately the same between the temperatures of

* Carl Zeiss' Catalogue of Microscopes and Microscopical Accessories, 33rd ed., 1906, p. 18 (fig. 5). † English Mechanic, lxxxiii. (1906) p. 473.

15° of cold to 60° of heat. Another advantage of the lens is that on account of the fact that the fluid is not dense, and the glass crystals are thin, the whole lens combination through which the light penetrates is very slight.

MALASSEZ, M. L.—**Évaluation des distances fcco-faciales des Objectifs.** [The substance of this treatise has already appeared in the Journal: 1905, p. 500, and 1906, pp. 362–3]. *Comptes Rendus*, cxlii. (1906) pp. 926–8.

(3) Illuminating and other Apparatus.

Zeiss' Centring Achromatic Condenser.*—In this condenser (fig. 57), N.A. 1·0, and equivalent focal length 14 mm., the stopping down

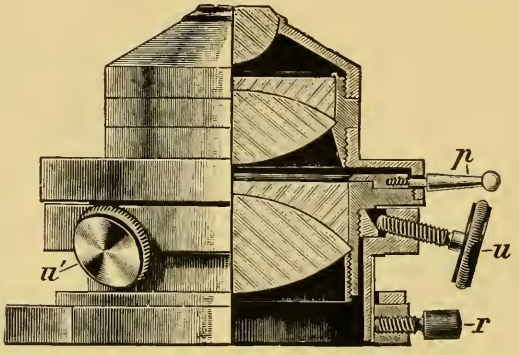

FIG. 57.

of the illuminating rays is effected by means of an iris diaphragm situated between the lenses. This entails a full opening of the diaphragm of the illuminating apparatus.

Spectrohelioscope (A. Sauve).—New Arrangement for procuring a Monochromatic Image of a Light-Source (A. Nodon).†—Both A. Sauve and A. Nodon, under the above dissimilar titles, have independently studied the improvement of spectroheliographs for photographing the sun's image with light of definite wave-length. Both authors have endeavoured to find means whereby the heavy spectrograph itself should be at rest during use, and whereby all adjustment should be attained by movement of the mirror which reflects the light on to the slit. In Sauve's arrangement, the light which at first falls on the front of the mirror is, after a series of reflections and refractions, made to fall on the back of the same mirror before the final reflection into the observation tube.

Nodon attains the same object by the use of two simple mirrors

* Carl Zeiss' Catalogue of Microscopes and Microscopical Accessories, 33rd ed. 1906, p. 31 (fig. 11).

† Mem. della Soc. degli Spettroscopisti Italiani, xxxiiii. (1904) p. 54. See also Comptes Rendus, cxli. (1905) p. 1010; and Zeit. f. Instr., xxvi. (1906) pp. 129–30.

which can be clamped together on the same axis at any desired angle. The first mirror throws the beam of light, issuing from the projection-lens, direct on to the first slit of the spectral apparatus. The light emergent from the second slit is then reflected by a fixed mirror on to the second adjustable mirror, and thence into the observation tube.

Spectroscope with Adjustable Dispersion.*—P. Krüss found that the desirability of this instrument was suggested by the requirements of the dyeing industry. Most colouring materials have characteristic spectra, and it is, therefore, obviously necessary to make the spectrum as clear and as perfect as possible. It is found, however, that the spectrum is dependent on several factors, e.g. the most suitable solvent, the proper degree of concentration of that solvent, and the thickness of the layer placed before the slit of the instrument. But, in addition to these fairly obvious factors, the spectrum of a dye usually requires a suitable dispersion. A dispersion suitable for one medium may be so unsuitable for another that the absorption bands may be indistinct and quite unrecognisable. At present the operator keeps several spectroscopes of various dispersive powers ready, but this inconvenience the author seeks

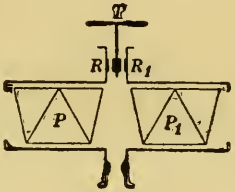

Fig. 58.

to remedy by the design of his instrument. He places two direct-vision prisms behind one another, and rotates them equally in opposite directions about their common optical axis. This arrangement is similar to that adopted by Abbe for his refractometer. The two opposed rims R, R_1 (fig. 58) of the tubes carrying the prisms P and P_1, are provided with engaging toothed wheels, and between these wheels is a driving wheel T, by which the two tubes are rotated through exactly equal angles in opposite directions. The two prisms P and P_1, are perfectly similar to one another, and are direct-vision for a ray of medium wave-length. If one prism has a dispersion D, then the total dispersion will be 2 D. If each is rotated through 90°, then the total is zero. Thus the limits lie between 2 D and 0. If ϕ be the angle of rotation, measured from the position in which the refracting edges of both prisms are perpendicular to the direction of the slit, and if d be the length of the spectrum measured, from the ray which passes without deviation to a ray of desired wave-length, then the combined dispersion parallel to the slit is zero, and perpendicular to the slit $2\,d \sin \phi$: hence only the latter has to be measured. If the absorption-band attained in a single-prism

* Zeit. f. Instr., xxvi. (1906) pp. 139–42 (2 figs.).

spectrum has a breadth $b = d\ d_1$, then the breadth with two-prism spectrum will be $2\ b \sin \phi$.

Fig. 59 represents a spectroscope equipped with such a direct-vision prism combination. The sleeve-collar of the one prism is provided with an external drum graduated in degrees.

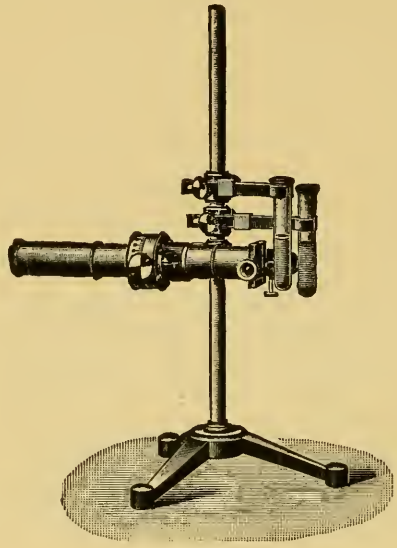

Fig. 59.

Tutton, A. E. H.—**Das Elasmometer, ein neuer Interferenz-Elastizitätsapparat.** [Full details and diagrams of this elaborate machine are given.]
Zeit. f. Krystallogr. u. Miner., xxxix. (1904) p. 321.
See also *Zeit. f. Instr.*, xxvi. (1906) pp. 163–7 (2 figs.).

(5) Microscopical Optics and Manipulation.

Interferences produced by a Network limiting a thin Lamella.* G. Meslin gives an explanation of the rings observed when a network is placed on the convex surface of a lens of weak curvature, the strands of the net being perpendicular to the plane of incidence. Such rings are distinguished from Newton's rings by the following properties :—

1. They are much wider and much further apart.
2. They are visible in white light, even if network and lens are not only not in contact, but several millimetres apart.
3. They are scarcely iridescent, and when viewed at an angle of 45° they are sensibly achromatic.
4. The diameter of these circles diminishes when the incidence increases : with Newton's rings the opposite effect holds.

The author attributes the phenomenon to the interference of the

* Comptes Rendus, cxlii. (1906) pp. 1039–42.

two beams which, although having been both reflected in the thin lamella, have undergone diffraction by the net, one at its entrance into the lamella, and the other at its emergence. These fringes can be rendered more brilliant by increasing the reflecting power of the lower surface, e.g. by employing a metallic surface, a condition unfavourable for Newton's rings. The fringes can be used with white light for conveniently verifying the form of the lower surface, whether it be of glass, of metal, or of mercury.

Entoptic Vision and the Entoptiscope.*—If a pinhole perforation through a card, or similar opaque object, be turned towards the light and held close to the eye, a circular disk is seen, which is the shadow cast by the circular aperture of the iris. By such means small opacities in the path of the rays in the eye are projected on the retina and become visible. This method of self-examination of obscurities within the eyeball is termed entoptic. A casual experiment of this kind led W. F. Barrett to the unwelcome discovery that he had incipient cataract of both eyes. The entoptiscope is an instrument which he has invented for viewing, delineating, and measuring entoptic objects. Pl. XVII., fig. 1, shows the first form of the designer's entoptiscope. It consists of a pair of vertical brass pillars supporting a head rest, which can slide from side to side so as to bring either eye vertically over the pin-hole contained in the revolving diaphragm of the eye-piece. This diaphragm has pin-hole apertures varying in diameter from 0·1 to 2·5 mm., and a pair of pin-holes each 0·1 mm. diameter, and 2 mm. apart, so that by revolving the diaphragm either a single aperture of any given size, or a double aperture, can be successively brought before the eye. Below the pin-hole eye-piece is a transparent scale divided into fractions of a millimetre; the shadow of this scale falls upon the eye of the observer, and is thence projected, much magnified, upon the ground-glass stage below, along with the shadows of any opacities seen in the eye. At the base of the instrument is a concave mirror, which can be adjusted so as to illuminate the eye-piece brilliantly, using the light of the sky or that of a lamp. A sharply-pointed and hard pencil is used by the observer to trace the image seen on the ground-glass stage. The image of the pupillary disk, the projected shadow of the opacities in the eye, and the pencil point, are all seen in the same plane with perfect clearness. After the drawing has been made the ground-glass can be removed and photographed for future comparison. A later form of the instrument is shown in Pl. XVII. fig. 2. The vertical pillar P is hinged so that the observer may incline it to suit himself; a single pillar is used so as to leave the hand free to draw on the ground-glass stage G, which carries a supporting hand-rest R. The eye-pieces E E have cups shaped to fit the eye and bring the cornea within a definite distance of the pin-hole. In this way the pin-hole can be placed at the anterior focus of the eye (above half an inch from the cornea), and the stage is placed at a fixed distance so as to give a definite magnification. It is important that the observer in using the entoptiscope should be comfortably seated and completely at ease; he should have his hands

* Scientific Proc. Royal Dublin Soc., xi., Nos. 7-8, March and May 1906.

free and not be troubled to keep one eye closed—it is much better, in fact, to keep both eyes open. This is done in using either of the instruments; in the smaller one the shaped sliding head-rest keeps all light from reaching the eyes except through the single revolving diaphragm; in the larger one there are two revolving diaphragms, one (shown at D) for each of the eye-pieces E E. The eye that is not under observation is kept in complete darkness by turning D until the index marks zero; at this position there is no aperture in the diaphragm. Thus either eye can be occluded with ease. The mirror M is plane and not concave, and made sufficiently large to cover the whole of the ground-glass G with a flood of light reflected from a neighbouring incandescent gas lamp or other source of light. As the mirror is carried by the stage and moves with it, the illumination of the field remains unaltered in adjusting the inclination of the pillar. The pillar, stage, and mirror move with stiff friction round the centre A, and can be clamped in any position. In order to avoid any shifting of the observer's head, and also to avoid fatigue, a hinged and padded head-rest H is fixed in such a position that the forehead rests comfortably upon it. The head-rest is also made to rise and fall, and there is an arrangement for accommodating the diaphragms to the distance between the eyes.*

WILSING, J.—**Über die Bildebenung bei Spektographen-Objektiven.**
[Shows how H. Hartmann's equations and conditions can be almost exactly satisfied by choice of certain kinds of glass.]
Zeit. f. Instr., xxvi. (1906) pp. 101–7.

(6) Miscellaneous.

Construction and Fittings of a Microscope Room.†—The following extracts are taken from the report of N. A. Cobb, who describes very fully the construction and fittings of his Microscope room at Honolulu. The report also deals with the illustration room, dark room, and the camera-lucida.

THE MICROSCOPE ROOM.

For many years it has been customary in the best laboratories to mount various instruments of precision upon pillars of stone or masonry deeply imbedded in wells in the ground and passing upward through the floors of the laboratory without contact. The object of this arrangement is to prevent tremors. It is not often that the Microscope has received such special attention, but wherever high powers are used and especially when photo-micrographs are being prepared, or whenever high-power camera-lucida drawings are being made, the reduction of vibration is an important factor in the success of the work. For many years the writer has had Microscopes mounted in this way, and hereby testifies strongly in favour of this method of using the Microscope.

The plan is carried out in cement and steel (see fig. 60). Below the

* For the loan of the blocks in this Plate we are indebted to the courtesy of the Royal Dublin Society.

† Rep. Exper. Stat. Com. Hawaian Sugar Planters' Assoc., 1905, pp. 39–59.

FIG. 1.

FIG. 2.

[To face p. 496.

building is a large block of cement weighing several tons. In this block of cement three T-girders, two of which are approximately 8 in. in each dimension, are imbedded vertically to the depth of about 4 ft. The central one of the girders carries the Microscope, together with certain accessory apparatus connected with the illumination of the object. This girder is much smaller and shorter than the other two, extending only about 18 in. above the floor of the Microscope room. The other two girders are mates and extend to within about 18 in. of the ceiling of the room; in other words, project upward into the room about 11 ft.

Needless to say, the object of these girders is to afford attachment for all the necessary apparatus connected with the Microscope. The girders at every part clear the walls of the building by a fair margin. It is, however, best to place all the girders as close to the Microscope window as is convenient. The reason for this will be explained on a subsequent page. In the present instance the distance between the girders and the window casings is about 1 in. The general principle on which the accessory apparatus is attached to the girders is that of sliding metal sleeves that may be clamped in any desired position. A sleeve of $\frac{1}{16}$ in. sheet metal surrounds the small central girder and projects outwards—that is, towards the observer—sufficiently to form a base on which the Microscope may rest. This base is from 1–2 times larger than the horse-shoe base of the Microscope. This gives a sufficient amount of space, so that the Microscope can be readily arranged for different classes of work, moved sidewise in either direction, or forwards or backwards. The sleeve carrying the Microscope is clamped to its pillar by 3 set-screws, and by means of this simple arrangement the Microscope can be raised and lowered to suit different operators and different classes of work. When, for instance, micro-photographs are being taken, it is most convenient to drop the sleeve to its lowest limit, so that the Microscope will rest on a base about 15 in. above the floor. For most photo-micrographic work this will enable the operator to bring the focusing plate of the camera (Fig. 60, *19*) low enough to render it unnecessary for the operator to have any special step-ladder to assist him in obtaining an accurate focus. On the other hand, when it is necessary to place the Microscope high and the camera-lucida table low, one can obtain a distance as great as $2\frac{1}{2}$ ft. between the level of the eye-piece of the Microscope and the drawing table. This, together with the peculiar camera-lucida, which will be described later on, enables one to make his original sketches of such a size as to allow for that liberal reduction in the subsequent photographic process which gives the best results for book illustrations. The sleeve which carries the Microscope also carries a wooden front as wide as the Microscope window and about 2 ft. deep —in other words, about 3 ft. by 2 ft. This screen, which of course slides up and down with the Microscope and its sleeve, carries two apertures. One of these apertures is in front of the Microscope mirror, and is designed to allow the light from the special out-door illuminating screen to strike the mirror and pass through the Microscope. The second aperture is of much larger size, and is glazed with ground glass and opened or closed as desired by means of a hanging slide worked by foot-power. The object of this second opening is to secure a correct

illumination on the drawing board when the camera-lucida is in use (see fig. 60, *32*, *36*).

We will next pass to a description of the Microscope window. This faces the sun, and preferably faces precisely south. It is so fitted with light-proof roller blinds that the light may be entirely shut off, or may be allowed full access. The roller blinds slide in lateral grooves 10 in. deep. The depth of these grooves must be sufficient to prevent the blinds bellying through the action of the wind. It is found when a window is tightly closed with flexible blinds, as is the case in this special Microscope window, that the pressure of the wind is sufficient to cause considerable inconvenience, unless the edges of these roller blinds are held in deep grooves. Should it be necessary to make a further provision against the bellying of the blinds, they may be stiffened from place to place with $\frac{1}{16}$ in. wooden laths ; or wires may be strung across the window. The blinds may be of any opaque material, but if they

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Explanation of Fig. 60.

1, 1, 1, Pulleys for the sash cords 2; 2, 2, steel sash cords for the slides 12 and 21; 3, 3, two vertical steel girders passing through the floor without contact, imbedded in several tons of cement under the building; 4, 4, steel sash cords, same as 2; 5, wooden frame-work to stiffen the girders 3, 3; 6, 6, the two upper opaque sashes to the side windows of the bay; 7, 7, sash weights counterbalancing the cross-arms 12 and 21; 8, one of the two similar light-proof roller blinds; 9, 9, Anti-friction bearing for the arms bolted to the cross-piece 12; 10, anti-friction bearings for the arms of the cross-piece 21; 11, lower opaque wooden sash of the left hand window; 12, cross-piece for the attachment of the camera 18 and the camera lucida prism 24; 13, screw clamp to cross-piece 12; 14, lower opaque wooden sash to right hand bay window; 15, slot in which the camera lucida arm 17 slides horizontally; 16, clamp to the cross-arm 21; 17, arm for the support of the camera lucida prism 24: 18, ordinary camera attached to arm 12; 19, Microscope camera attached to arm 21; 20, vertically sliding head-rest; 21, wooden cross-arm supporting Microscope camera 19, and head-rest 20, and drop slide 32; 22, battery of Microscope, using direct sky-light; 23, screw clamp to cross-arm 21; 24, large 45° camera lucida prism; 25, location of the camera lucida drawing, vertically adjustable by means of steel cord and sash weights similar to 7; 26, pillow to head-rest; 27, wide thin metal curtain stick to the inside roller blind 8; 28, ways for the horizontal thin metal slide 29; 29, thin metal slide with diamond shaped opening 31; 30, small camera lucida prism of the usual pattern; 31, diamond-shaped opening in the slide 29; 32, thin opaque drop slide adjustable vertically through foot power, by means of simple pulleys located behind 17 and the foot power 40, 41, and 42; 33, left-hand adjustable leg-of-mutton shaped table; 34, right-hand adjustable leg-of-mutton shaped table; 35, opaque dark cloth enclosing sub-stage of Microscope, preventing access of extraneous light; 36, aperture for the admission of light, glazed with ground glass, and opened and closed by means of slide 32 and foot power 40, 41, and 42; 37, steel sleeve carrying Microscope, and vertically adjustable on the pillow 38; 38, steel pillar for support of Microscope, passing through floor without contact, and imbedded in several tons of cement under the building; 39, aperture in floor for the passage of girder 38; 40, spring-roller foot power for the control of drop slide 32 by means of the string passing around the pulley 42; 41, spring roller of ordinary pattern, covered with sand-paper to give sole of foot efficient grip; 42, pulley turned by foot power, and winding or unwinding the string which raises or lowers the drop slide 32—the weight of drop slide 32 exactly counteracts the spring of the roller 41; 43, left-hand steel girder at height of floor; 44, steel sleeve sliding vertically on left-hand girder and affording attachment for table 33; 45, steel sleeve sliding vertically on right-hand girder and affording attachment for table 34.

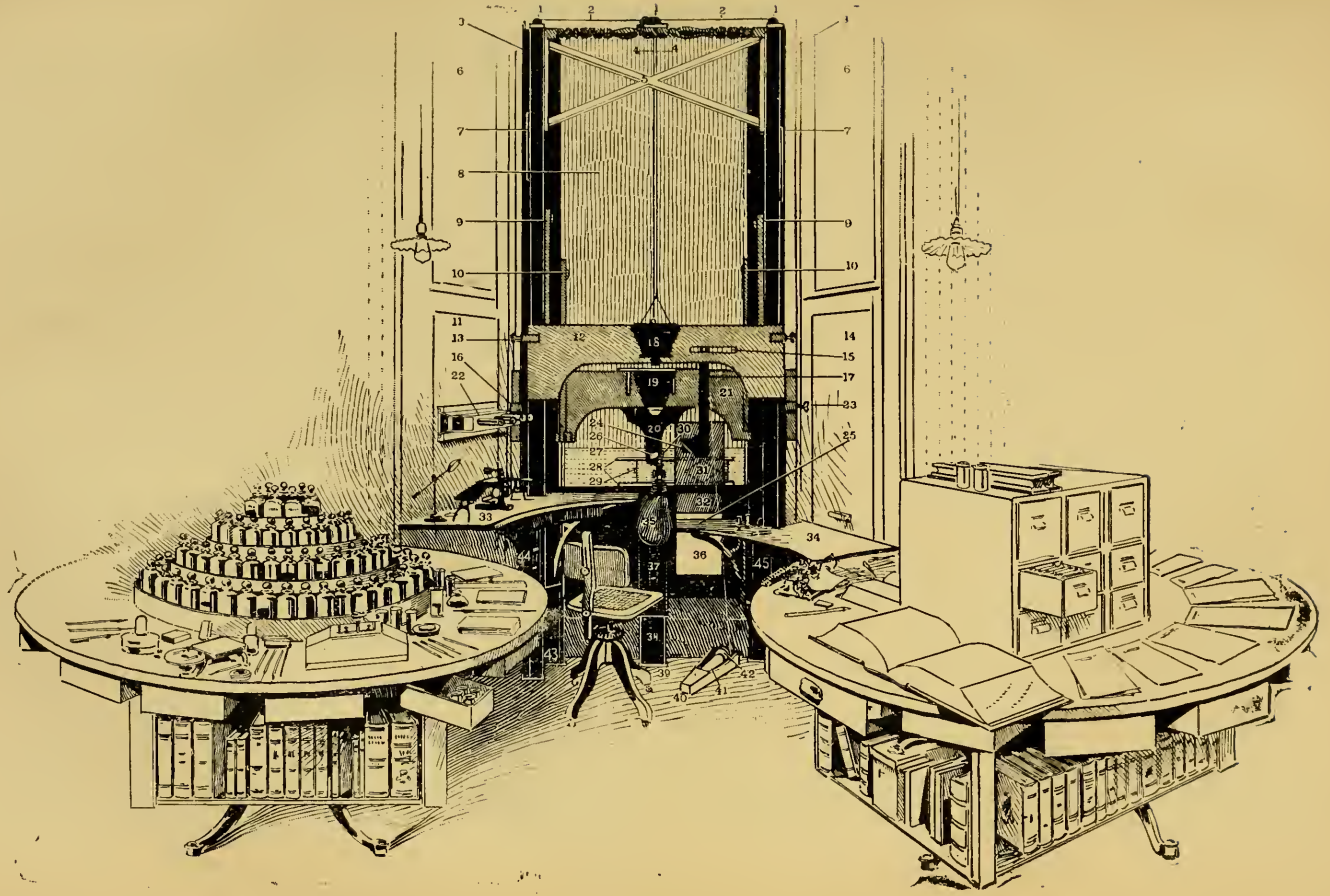

FIG. 60.

are very long, preferably of some thin material. The writer has found that ordinary green opaque window blinds can be sized black, so as to become practically light-proof, and as it is advisable in constructing a light trap to have two blinds, he finds that with two such blinds the light is wholly excluded, and, if necessary, the room can be used as a photographic dark-room. The wooden rollers used are of the ordinary pattern, and present no special peculiarity. They are built in, or boxed in, at the top in a light-tight manner.

We turn next to the various sleeves sliding on the long, upright girders. Of these one of the most important is the right-hand lower sleeve, which carries a leg-of-mutton shaped table for use in connection with the production of camera-lucida drawings. This sleeve, as well as all the others, is balanced with a sash-weight, so that it moves with the utmost freedom either up or down through a space of about 4 ft. The table may, therefore, be placed within 15 in. of the floor, or it may be raised to a distance of 3 ft. This adjustability is found to be highly convenient in the production of camera-lucida drawings of definite magnification. The peculiar shape of the table has been evolved from practical experience during many years. In general, its form is such that, when taken together with its mate on the other side of the Microscope, it presents a semicircular curvature, which gives the investigator a free play for hands and body. This table is painted black, as are all the other accessories used in this system (see fig. 60, *33*, *34*).

Turning to the left-hand side of the Microscope, we find an entirely similar and symmetrical sleeve and table, which, however, is used for a very different purpose. This sleeve carries the mate to the camera-lucida table, and, of course, in the case of a left-handed operator, could be used in the same way as the right-hand table would be used by a right-handed operator. The usual position for the left-hand table is about on a level with the Microscope stage. This height is found to be convenient for several reasons ; first, under ordinary circumstances, it is about ordinary table height, and is convenient for supporting dissecting Microscope, which, as explained later on, has a special illumination of its own. Thus, in the preparation and examination of objects, the dissecting stand is as close as possible to the examination stand, and the objects may be transferred from one to the other with the greatest convenience ; a second reason for having the left-hand table on a level with the stage of the Microscope, is that the preparations may be moved on and off the stage of the Microscope with the least danger and with the greatest facility. A third reason is that, in this position, the left forearm finds it a most convenient rest in working the fine-adjustment screw. In addition to the three sleeves already described, the long girders carry two cross-pieces for the attachment of various accessories. These wooden cross-pieces slide up and down, and are weighted with sash-weights, so that their adjustment may be quickly and easily accomplished. In order that the friction on the girders may not cause any inconvenience, arms extend upward from these cross-pieces for the purpose of carrying pulleys which are in contact with the edges of the girder, and so reduce the friction. These cross-pieces are clamped in position by set-screws at the side. It will be at once evident that these

cross-pieces may be used for the attachment of a variety of accessories. Among the more important of these is the Microscope camera (see fig. 60, *19*). This hangs above the Microscope, and is ever in readiness for instant use. The camera itself presents no very peculiar features. It is, of course, a vertical pattern, carrying the exposed photographic plate in a horizontal position. It cannot be used in a horizontal position. Experience has shown that the vertical position has very many advantages, and that if one is confined to a single outfit, the vertical outfit is the better, providing its attachment can be of the nature here described. In obtaining the focus, the cross-piece carrying the camera is loosened by unclamping the side screws, and is then moved upward and downward against the sash-weights, which counterbalance it. A scale is marked on the girders, so that the various magnifications are at once obtainable, or they may be obtained by special measurement in each case. The apparatus never needs any levelling, being, as before said, constantly ready for use. The operator loosens two hooks, and the camera drops instantly into position. The whole is ready for use in a few seconds' time. If the photograph is being taken with a high power, and the illumination is, therefore, weak, and the exposure consequently long, one leaves his instrument during the exposure with the greatest confidence that nothing can disturb it. Any tremors in the building will not be received either by the Microscope or the photographic plate. A second attachment of great importance for the production of illustrations is the

CAMERA LUCIDA.

This presents a number of peculiarities (fig. 60, *17*, *24*).

Any form of camera-lucida is an instrument well calculated for the destruction of eyesight. The writer has during many years of experience been endeavouring to reduce the injury to the eyesight in connection with the use of the camera-lucida, and the following suggestions, embodied in the outfit here described, are the result of his experience. In the first place, he has substituted for the ordinary mirror a 45° prism (fig. 60, *24*). The advantages obtained by this substitution are as follows:—(1) The prism may be of any desired size, so that it may be mounted at a considerable distance from the eye-piece of the Microscope. This secures an increased magnification of the drawing, and the advisability of this increased magnification will be dwelt upon on a subsequent page; (2) a second advantage in the use of the prism as a reflector is the disappearance of the double reflection, and the securing of a total reflection. The light passes from the drawing-point through the lower face of the prism in a nearly perpendicular direction, and with very little loss. It is then totally reflected from the oblique face, and passes outward at nearly right angles to the vertical face, again with very slight diminution. The loss of light is, therefore, considerably less than in the case of the usual mirror, in addition to the securing of a total reflection destitute of doubles; (3) a third advantage, and one of considerable importance, is the stability of the apparatus here described; it rarely gets out of register.

The second modification is the blind worked by foot-power (fig. 60, *32*). The object of this blind is to illuminate the drawing with any degree of light at an instant's notice, and to do this without in any way disturbing the adjustment of any part of the Microscope or camera-lucida. This is a matter of very great importance in the rapid production of good camera-lucida drawings. It often happens that the light coming through the instrument is so faint that it is only by shutting the light quite off from the drawing that the investigator can see the details of the structures to be sketched. With the foot-power arrangement, the light is shut off or let on without the operator's disturbing the position of his body or his drawing-point. Moreover, the light can be so modified as to instantly bring about that adjustment which is most favourable for any particular part of the sketch. To describe the whole operation briefly, we may say that the operator's left hand rests on the left-hand leg-of-mutton table on a level with the fine adjustment of the Microscope. His left hand, therefore, is in a position to work the fine-adjustment screw with the greatest ease and facility, and the most careful adjustments of focus can be easily accomplished. His right hand, carrying the drawing-point, rests on the drawing-board, and is engaged in the production of the sketch. As the light required for the various portions of the drawing varies, he can, by a slight movement of his right foot, which in no way disturbs either of his hands, and in no way disturbs the equilibrium of the instruments, effect the desired illumination of the drawing. It is found that the drawing suface best adapted to the production of camera-lucida drawings, is a dark, and preferably black, surface. On this surface a white drawing-point should be used. For most objects this is a considerable improvement over the ordinary pencil used on white paper, as will be at once admitted by

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Explanation of Fig. 61.

Solar Camera, as used to facilitate the production of illustrations from negatives and from transparent objects.

1, steel girder to left of window affording part of the support to the ordinary camera 3; cross-piece supporting camera 3; 4, support for camera lucida, same being here represented as attached to an ordinary lens carrier; 5, vertically adjustible horizontal platform; 6, drawing board; 7, horizontal ways for 6; 8, object in position to be drawn natural size; 9, mirror of ordinary camera lucida; 10, 11, camera lucida support; 12, light-tight roller-blind used, when unrolled as a diaphragm for the cone of light from the projector; 13, solar projector set in special window casing near floor; 14, the negative being projected at 23; 15, 15, uprights carrying the adjustable sheet of glass on which the drawing 23 is being produced from the negative; 14, 16, wooden frame for sheet of glass 18; 17, metal braces by which the frame 16 may be clamped at the required angle; 18, sheet of glass through which, as well as through the paper 22, the image is viewed; 19, roller blinds to shut off extra light; 20, 21, sticks to which the drawing paper is attached with drawing tacks, these sticks being easily adjustable under the sand-paper-lined wooden spring-bars 24; 22, drawing paper; 23, image being drawn; 24, wooden bar lined with sandpaper and hinged at 25 and constantly pulled inward by a spiral spring at 26, so as to lightly but firmly grip the sticks 20, 21; 27, screw legs on which, after the apparatus has been adjusted, it can be raised so as to remain firm during the subsequent operations of focusing and drawing; 28, one of the four castors on which the whole apparatus is adjustable back and forward on the floor to vary the magnification.

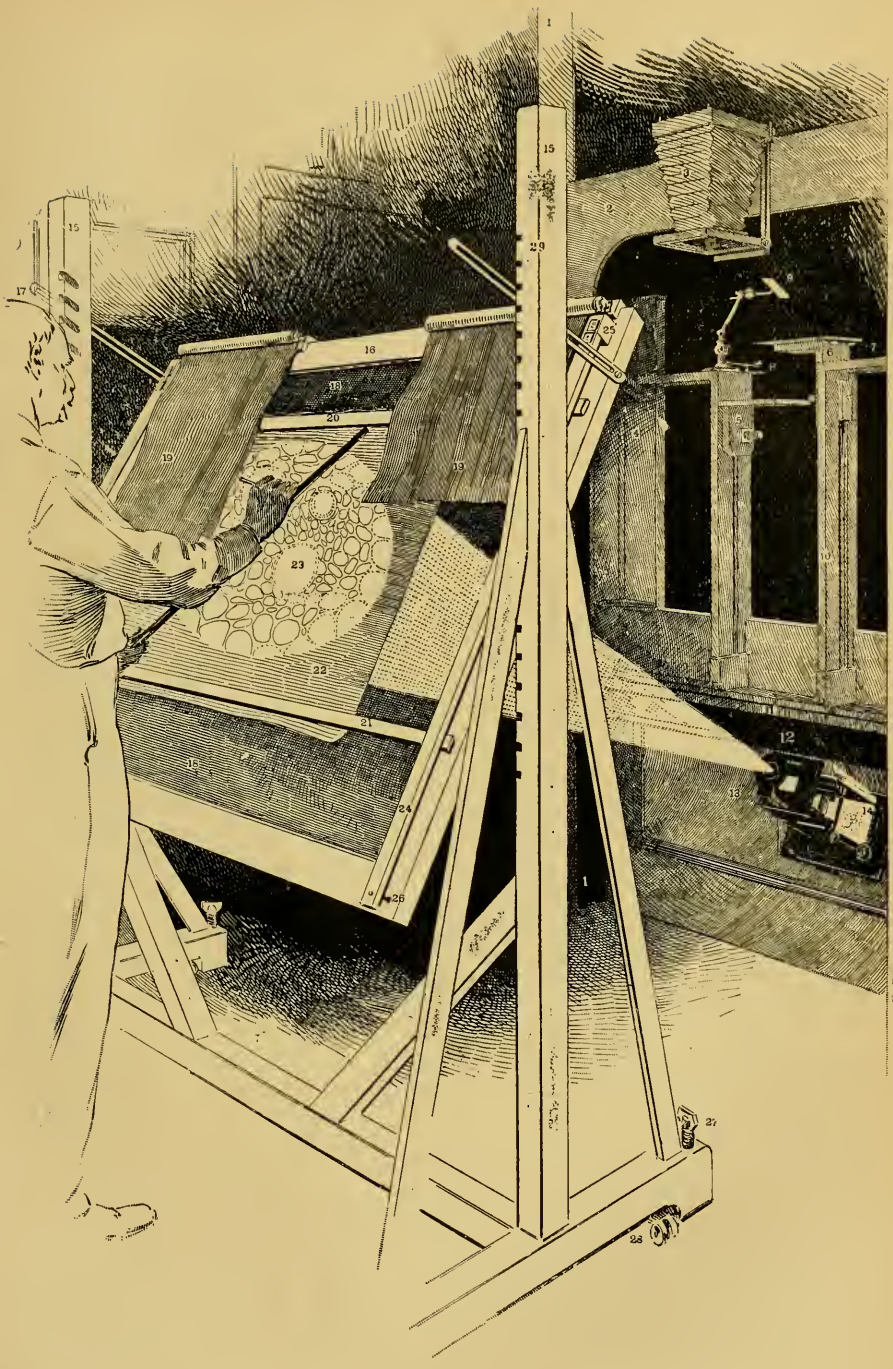

FIG. 61.

anyone who makes a trial. The method found most effective in this laboratory is that of using a thin black tissue-paper, which is blued on the under side. A piece of enamelled board of suitable size for the drawing is placed on the drawing board—i.e. the right-hand leg-of-mutton table—and it is then covered with the black tissue-paper, with the blue side down. A tracing is now made with a white ivory point. This results in the production of a blue outline drawing on the enamelled board. This sketch is put aside for further reference, or for the production of a finished drawing whenever necessary, or may be finished up at once. The object to be secured in this blue sketch is a sufficiently good representation of the object to be illustrated, which shall have sufficient size to admit of a liberal reduction when the drawing is photographed on metal preparatory to etching. Thus, if it is desired to publish an illustration having a magnification of 500 diameters, it is advisable to produce a blue sketch at from 1000 to 2000 diameters. This is easily accomplished with the apparatus that has been described. By placing the prism reflector at a considerable horizontal distance from the eye-piece of the Microscope, say 1 foot, and lowering the right hand leg-of-mutton shaped table sufficiently, magnifications of liberal dimensions are easily secured. Needless to say, the production of a large coarse drawing is an easier matter than the production of the same drawing on a smaller scale ; so that the operation is not only better, but considerably easier if carried out in the manner described. It is unnecessary to go into the details of converting the blue sketch into a pen-and-ink drawing. These present no peculiarities. It ought, perhaps, to be mentioned that the object of using the blue colour is to avoid trouble through the alterations that may be necessary in finishing the drawing. Any light blue lines which are left on the enamelled board need not be removed, as they do not affect the sensitive photographic film sufficiently to cause any inconvenience in the production of an etched block. The black tissue-paper mentioned is produced by inking ordinary tissue. The ordinary blue carbon paper gives too dark a blue to meet the requirements. The blackened tissue is rubbed on one side with dry Prussian blue powder. This gives a light blue tracing.

At an earlier stage it has been mentioned that all the accessories in connection with the Microscope are painted black. In addition to this precaution, such arrangements are made that the room itself can be darkened, in fact, converted into a photographic dark-room at will. This object is secured by having all the window blind connections light-tight. The oblong aperture, about 5 in. by 8 in., through which the Microscope receives its light, is screened by means of several thicknesses of flexible black cloth made into the form of a sleeve. This cloth sleeve attached around the perimeter of the opening, is notched above, so that it surrounds the Microscope just beneath the stage, and buttons on to one of the screws at the back of the Microscope. No light reaches the eye except that which comes through the instrument. If, now, the slide in front of the large glazed aperture be closed and the room be darkened, the operator sits in absolute darkness. Any one who has had experience with a photographic dark-room, must have observed how, after a period of from five to ten minutes therein, the eye becomes accustomed to the

darkness of the room, and is able to distinguish objects much more readily than at first. This is a principle which can be utilised to very great advantage in connection with high-power Microscope work. In fact, the writer is of opinion that it is this contrast between the external and internal illumination which leads so many operators to use artificial light, and even in some cases to prefer working in the evening. Certain it is that if the surrounding light is dim, and the eye is allowed to adjust itself to this dimness, then on looking through the Microscope details may be seen much more clearly than in any other way. With the present apparatus the room is darkened. All light which could possibly get to the operator's eye is excluded, except that which comes through the Microscope. There is no light coming upon the top of his object to cause confusing reflections in the Microscope. The image is as clear as it can be made, and the eye is given every facility to see this image, and is distracted by no others. The following contrivances are such as experience has shown the writer to be very useful for this purpose, especially in sunny climates. Outside of the Microscope window a universally adjustable white screen is placed in a sunny position, preferably not more than 10 ft. away. The surface of this screen may be of any white material. It can be made of wood, painted white, or lined with plaster of Paris, or, what to the writer seems almost equally good, a plain wooden screen covered with several thicknesses of bleached cotton cloth. It is better if this screen can be adjusted from the interior of the Microscope room, but this is not essential. If a small mirror be attached to the screen, it will indicate the position of the screen that will reflect to the Microscope mirror a maximum of white light. Place the screen so that the flash of sunlight from the mirror strikes in the vicinity of the Microscope. Then, of course, the whole of the screen will be in a corresponding position, and will be reflecting a maximum of light. It is found that if the screen be placed in this position for several hours, the light from it remains practically constant, so that while an adjustment by cords from the interior is a convenience, it is not a very great necessity. If an adjustable screen is not available, it is generally best to arrange one or two fixed screens, and thus accomplish the same object—one screen for morning, and another for afternoon. The light from a blue sky is not a satisfactory light. A white cloud gives a very good light, but clouds are such fickle things that it is not wise to rely upon them where the Microscope is in constant use. It is much preferable to construct a screen that will be available in a fixed position whenever the sun shines. When the sun does not shine the sky must serve.

CAMERA LUCIDA FOR NATURAL SIZE OR REDUCED DRAWING.

Ever since the introduction of the camera lucida, it has been more or less used for the production of natural size and reduced drawings; in other words, it was soon seen that its application went beyond the instrument for which it was primarily designed. The writer has used the camera lucida to a greater or less extent in this manner for twenty-five years, and has seen plenty of evidence that others have

used it in the same way. The following notes relate to a piece of apparatus which has been gradually developed during several years, and which has as its object the application of the ordinary Microscope camera lucida to the purposes we have mentioned. It is a piece of apparatus which in use is placed in front of a window, in fact, is usually attached either to the window, the window casing, or to special uprights near by. As exemplified in this laboratory, the apparatus is attached to two upright girders, the same two that carry the ordinary photographic camera. Both these attachments are slung on sash weights, and can be moved up and down, so that either may be brought into play while the other is raised out of the way. The camera lucida attachment consists of two distinct frames, which are separated near the middle of the window by a distance of 8–10 in. The left-hand frame is designed mainly to support the camera lucida; the right-hand frame to support the drawing board. Both frames carry adjustable brackets, and each bracket carries a horizontal shelf. The left-hand frame, therefore, has a horizontal shelf carrying the Microscopes, and this shelf is adjustable in the vertical direction, and can be clamped in any desired position. In a similar manner, the right-hand frame carries a horizontal shelf, or drawing board, also adjustable in the vertical direction. The drawing board presents the peculiarity of being also adjustable in the horizontal direction, and of rotating about a horizontal axis so as to pass the opposite shelf—it is required sometimes above that shelf and sometimes below it. The size of the apparatus is determined by that of the human body. The greatest distance that can be comfortably reached by an ordinary artist for drawing purposes is about 30 in.—i.e. when gazing through the camera lucida he cannot comfortably produce a drawing at a distance of more than 30 in. from his eye as the light travels. The camera lucida is usually carried on a piece of tubing clamped

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Explanation of Fig. 62.

Sketch of the arrangement of a camera lucida for the production of drawings of objects at nearly the natural size. The apparatus is attached to upright steel girders, one at each side of a window. The artist faces the light.

1, 2, the two steel girders, which are imbedded in several tons of cement beneath the building, and pass through the floor without contact; 3, cross-piece to carry an ordinary camera 4, this cross-piece being hung on sash-weights, and sliding in the vertical direction and readily clamped by the side screws shown; 4, ordinary camera pushed up out of the way, but easily brought into use, as shown in fig. 60; 5, anti-friction arms of the cross-piece 3, which roll against the edges of the girders 1, 2; 6, left-hand box of roller blinds; 7, right-hand box of roller blinds; 8, light-tight vertically acting roller blind of the window; 9, 10, horizontally acting roller blinds from the boxes 6, 7; 11, object to be drawn, held in stage forceps; 12, mirror of ordinary camera-lucida; 13, horizontal stage, adjustable in the vertical direction, designed to support the object 11, which in this case is supported on the stage of a Microscope carrying no objective or eye-piece; 14, horizontal stage, adjustable in the vertical direction, designed to support the drawing board, which tips out to pass 13, and is also adjustable in the horizontal direction; 15, 16, framework supporting all the apparatus 6–14, and slung on sash-weights so as to be easily pushed up out of the way when the window is used for other purposes; 17, screw clamp to stage 14; 18, roller blind acting as a light trap and diaphragm when the window is used with the solar projector, as shown in fig. 61.

FIG. 62.

to an ordinary lens-holder, or empty Microscope barrel. The object to be drawn is placed below, without a lens, or with a reducing lens, or in some cases with a lens which slightly enlarges the object. The drawing board is then lowered or raised until the drawing to be made will have the necessary size. It will be observed, therefore, that the whole arrangement is a three-fold one. There is a support for the object, a support for the camera, and a support for the drawing board, and these must be adjustable within the limits of the artist's reach. It will be seen, however, that if two of these are adjustable, the whole system is, for all practical purposes, the same as if all three were adjustable. We now come to the most important matter in connection with the use of this apparatus—namely, the illumination of the object and the illumination of the drawing board. It is possible that it is in this respect that the apparatus hitherto put on the market fails to meet the requirements of the case. It is very desirable to fully control the illumination. Sometimes the object has to be strongly illuminated, and the drawing board weakly illuminated ; sometimes the reverse is the case, the object has to be weakly illuminated, while the drawing board has to be very strongly illuminated, and the variation in illumination should be as great as possible—from strong sunlight to absolute darkness, if possible. This is the main point in the successful use of the camera lucida for this class of work. This object is attained in the present piece of apparatus by placing the whole at a sunny window and modifying the light by a series of seven roller blinds. One of these, and one of the most important, is the blind attached to the window itself. This does not differ from those elsewhere described in this report. The other blinds for this piece of apparatus have the peculiarity of working in the horizontal direction, the rollers being placed vertically side by side, and enclosed in a light-tight box at the side of the window. The box on the right carries three of these rollers, and that on the left carries a corresponding set of three. These blinds are of varying nature. One of each set is white, another is nearly translucent, and a third is somewhat opaque. By placing these blinds one over the other—that is, by adjusting them properly in the horizontal direction—the light may be varied in any degree required. No way has yet been found by which the light both upon the object and upon the drawing board can be fully controlled by foot-power, as in the case of the Microscope window previously described ; but it is believed that if sufficient thought were given to the subject, such a device might be evolved. In the meantime, the present arrangement works fairly satisfactorily, and avoids the use of complicated apparatus between the eye and what it is looking at, in the same way as does the apparatus previously described in connection with the Microscope window.

Quekett Microscopical Club.—The 432nd ordinary meeting of the Club was held on June 15, the President, Dr. E. J. Spitta, F.R.M.S., etc., in the chair. Mr. A. E. Hilton read a paper "On the Study of the Mycetozoa." The names by which this group has been known were mentioned, and their distribution, habitat, and life-cycle, together with the method of classification, were described. The literature dealing

with the subject was referred to, and some useful hints were given for the collection and cultivation of these interesting organisms. The lecture was illustrated by a series of coloured drawings and a large number of preparations of Mycetozoa under Microscopes. Mr. J. Burton showed some active swarm-cells of *Brefeldia maxima*.

B. Technique.*

(1) Collecting Objects, including] Culture Processes.

Cultivating and Preparing Hypotrichous Infusoria.†—L. L. Woodruff cultivated these organisms on slides, having a central circular concavity with a capacity of about 5 drops of water. Cover-glasses were not employed. The slides were kept in moist chambers to prevent evaporation of the preparations. These were dishes about 10 in. in diameter and 3 in. deep. In the bottom of the dish was placed about 2 in. of wet sand. Over the sand was placed a glass plate, on which rested 4 parallel strips of glass, and on these the slides with the Protozoa were arranged. The whole was covered with a ground-glass top. The Infusoria were handled with a pipette drawn out to a fine point; each pipette was used for one purpose, and one only. For detecting the Infusoria, a simple lens with a magnification of about ten diameters was used.

The culture medium was made from infusions of hay or fresh grass, and was prepared as follows:—about 3 grm. of grass or hay were washed in tap-water, and then placed in a beaker containing about 200 c.cm. of tap-water. This was boiled for 1 minute. In most cases the infusion was used shortly after it had cooled, but occasionally was allowed to stand for 24 hours.

One individual from each line of the culture was removed daily, in order to prevent the possibility of endogamous conjugation. The maximum and minimum temperatures of the laboratory in the vicinity of the culture were recorded daily.

For the purpose of following the changes in cell-structure during the life of the cultures, permanent preparations were made from time to time. The specimen to be preserved was isolated by means of a pipette, and deposited on a slide, and then 3 or 4 drops of a saturated solution of sublimate with 5 p.c. acetic acid added. After about 5 minutes the specimen was transferred to another slide, and a few drops of 75 p.c. alcohol deposited thereon. The specimen was next removed to a third slide already smeared with egg albumen. When the albumen has coagulated and fixed the specimen, the slide is transferred to agar of 75 p.c. alcohol, and afterwards treated by ordinary methods.

For staining, Ranvier's picrocarmin was used, though Delafield's

* 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, etc.; (6) Miscellaneous.

† Journ. Expér. Zool., ii. (1905) pp. 585–632 (3 pls.).

hæmatoxylin gave quite satisfactory results. The preparation was cleared with xylol, and mounted in dammar.

Rapid Filter for Agar.*—Drigalski uses the following form of filter for his agar media. It consists of two superposed cooking pots (fig. 63). The upper (F) has a perforated bottom ; it overlaps the side of the lower vessel (U), and holds a 4-fold layer of yellow, unsized, raw cotton wool. In the lower vessel is placed the nutrient solution with agar. The two pots being fixed, the whole is placed in a steamer, where the agar is dissolved ; the wool becomes saturated with steam, and, together with the upper vessel, is sterilised. When the solution is complete, usually within 3 hours, the whole is taken out from the steamer, the upper vessel with the filter is separated, and the contents of the lower vessel is poured into it, and in the course of a few minutes 3 litres of a clear solution are obtained.

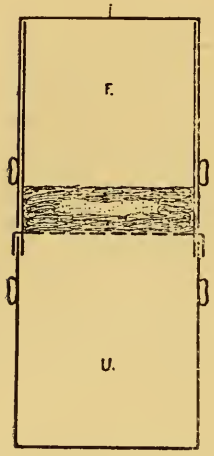

Fig. 63.

Apparatus for Culture of Bacteria at High Oxygen Pressure.†—A. Meyer's apparatus consists of a steel flask filled with compressed air, and fitted with a special reducing valve actuated by screws and levers, by which the pressure of the air emitted from the flask is varied and regulated ; the pressures in the flask and in the reducing chamber being indicated by spring tube manometers. The compressed air is passed from the reducing valve, by a connecting tube, into the pressure chamber which is also provided with a manometer and a safety valve, and in which is a vessel for holding the cultures to be examined. The author supplies photographs and diagrams, and a minute description of his apparatus.

Method for the Bacteriological Examination of Soil.‡—Buhlert and Fickendey advocate a modification of Remy's method for the bacteriological examination of soil. With a clean spade a hole is dug the depth of a furrow, and with sharp cut perpendicular sides, and from this a spadeful of the soil is removed. The upper surface of this is cleansed by scraping with a flame-sterilised iron spatula ; with a second sterilised spatula the earth is put into a sterilised glass vessel ; 300–500 grm. of the soil are now added to 300–500 c.cm. of sterilised tap water in a glass vessel with a wide mouth and a ground stopper ; after the mixture has been thoroughly shaken for five minutes, a known amount of the washed soil is drawn up in a pipette and inoculated into media. For nitrification and nitrogen fixing 20 c.cm. are employed ; for denitrification and peptone disintegration, 5 c.cm.

* Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 298 (1 fig.).
† Op. cit., 2te Abt., xvi. (1906) p. 386 (9 figs.).
‡ Tom. cit., p. 399.

Cultivation of the Leprosy Bacillus.*—C. Nicolle remarks that all his endeavours to cultivate *B. leprœ* on artificial media failed, though in some cases there was evidence that growth had begun. These abortive attempts invariably occurred in the condensation water, and only when the sowing had been copious. Egg cultures also were failures. The only occasions when there was distinct evidence of growth occurred on pieces of leprous tissue used for inoculating.

Cultivation of the Spirillum of Tick-fever.†—C. Levaditi makes collodion sacs with a capacity of about 2 c.cm., and sterilises them in tubes filled with distilled water. The sac, emptied of water, is still kept in the tube while being filled with serum of *Macacus cynomolgus* or *M. rhesus*, animals sensitive to the infection of tick-fever. The test-tube and sac are then placed in a water-bath at 70° for a quarter of an hour. When cold the serum is inoculated with defibrinated blood of a monkey previously infected with spirillosis, and when sealed up is placed within the peritoneal cavity of a rabbit or a rat. The sac is opened in from 5–7 days, and advantage is then taken to make a sub-culture.

In this way the spirillum of human relapsing fever may be cultivated in a semi-solid medium.

(2) Preparing Objects.

Studying Yellow Fever.‡—E. Marchoux and P. L. Simond fixed pieces of the viscera in Borrel's fluid (water 350, chloride of platinum 2, osmic acid, 2, chromic acid 2, acetic acid 20) or in saturated solution of acid sublimate. The nervous system was, however, fixed in equal parts of the two fluids, and after 3 days washed in running water for 54 hours. The stains used for pieces fixed in Birrel's fluid were magenta-red and picro-indigo-carmin. Unna's polychrome-methylen-blue also gave good results. Pieces fixed in sublimate were stained with hæmatein and orange G.

The authors confirm the statement of A. Sodre and M.Conto that yellow fever must be regarded as a generalised steatosis.

Studying Development of Pollen and Tapetal Cells in Ribes.§—G. Tischler fixed the buds with Flemming's fluid (chromic acid 1·8 grm., osmic acid 0·5 grm., acetic acid 12 c.cm., water 420 c.cm.). Paraffin sections 5–7·5 μ were made in the usual way. Staining was almost exclusively done with iron-alum-hæmatoxylin, and the differentiation of each preparation was controlled under the Microscope. The preparations were after-stained with light-green, or with acid-fuchsin.

Studying the Microscopical Anatomy of the Vagina and Uterus of Mammals.‖—K. Beiling fixed the fresh material in hot saturated sublimate-salt solution, or in 5 p.c. potassium bichromate, and then hardened in upgraded alcohols. Excess of sublimate was removed by

* Ann. Inst. Pasteur, xx. (1906) pp. 389–406 (1 pl.).
† Comptes Rendus, cxlii. (1906) pp. 1099–1100.
‡ Ann. Inst. Pasteur, xx. (1906) pp 161–205 (20 pls.).
§ Jahrb. wiss. Bot., xlii. (1906) pp. 545–78 (1 pl.).
‖ Archiv Mikrosk. Anat., lxvii. (1906) pp. 573–637 (1 pl.).

frequent changes of alcohol, to which tincture of iodine had been added. The material was then imbedded either in paraffin or in celloidin. For staining, Böhmer's hæmatoxylin and eosin, picrocarmin, or iron-alum-hæmatoxylin were used.

Demonstrating Chromosome Reduction in the Microsporocytes of Lilium tigrinum.*—J. H. Schaffner killed stamens of various ages in weak chrom-acetic acid (chromic acid 0·3 grm., glacial acetic acid 0·7 c.cm., water 99 c.cm.). The material was then passed through graded alcohols up to 70 p.c., imbedded in paraffin, cut to 10–18 μ thick, and stained on the slide. Delafield's hæmatoxylin was found to be the best stain for the chromatin network, and granules and saffranin-gentian-violet for the nucleoli.

Demonstrating the Development of Dentine.†—L. Fleischmann examined the tooth-germ of a lower middle incisor of an eight months' human embryo preserved in alcohol. The specimen was prepared by Schaffer's method, being decalcified for several hours in 5 p.c. nitric acid and then imbedded in celloidin; a radial longitudinal section exhibits the dentine in all stages of development, the earliest traces being at the bottom, whilst on the top is fully developed dentine. The sections are stained after the method of Zachariades with safranin and subsequent treatment with warm 40 p.c. solution of caustic potash, on the slide, until the ground substance is dissolved.

Studying the Organogenesis of Ovary and Testicle.‡—G. Sainmont used a complete series of embryos and ovaries of the cat. The animals were narcotised and then the uterus and adjacent parts were rapidly removed and placed in artificial serum previously heated to 37°. The embryos were then extracted and placed in the fixative; the larger were sliced into to allow more ready penetration. In embryos 40 days old or so the sexual eminences were removed and fixed separately. The fixative solutions used were the strong Flemming, 24–48 hours, and acetic-sublimate solution, 1–7 hours; after the latter the objects were washed in iodine-alcohol 40 p.c. for 4–8 hours and then passed through upgraded alcohols. Objects fixed in Flemming were submitted to prolonged washing in running water for from 8–36 hours according to size. After dehydration in up-graded alcohols paraffin sections were made. The stains used were iron-hæmatoxylin, Flemming's triple stain, and occasionally gentian-violet used hot. It was found that embryos would require 4 or 5 times as much orange as was necessary for the young or adult animal. Good differentiation was obtained by washing the stained sections with alcohol acidulated with 2 or 3 drops of hydrochloric acid.

Studying Cytological Changes in the Nectar Glands of Vicia Faba.§—C. R. Stockhard cut the glands from the stipules with a border of non-glandular tissue and immersed in various fixatives, the most

* Bot. Gazette, xli. (1906) p. 184 (2 pls.).
† Arch. Mikrosk. Anat., lxviii. (1906) p. 297.
‡ Arch. Biol., xxii. (1905, published 1906) pp. 71–162 (6 pls.).
§ Bull. Torrey Bot. Club., xxxiii. (1906) pp. 247–62 (2 pls.).

satisfactory being Gilson's fluid, though picro-acetic, chrom-acetic, and picro-corrosive gave favourable results. Auerbach's methyl-green and acid-fuchsin stain was used for studying cell-contents. Heidenhain's iron-hæmatoxylin and Congo-red was found to be most valuable, and eosin-toluidin blue was also successful.

(4) Staining and Injecting.

New Microchemical Tests for Wood.*—V. Grafe adds to a solution of vanillin some drops of isobutyl-alcohol, and lets a little sulphuric acid (sp. gr. 1·84) run down the side of the test tube. After heating, the mixture turns dark-red, with a shade of blue. On diluting with alcohol and repeated additions of acid, it changes through blue-green to pale green. The author recommends as a standard reagent the following: 30 c.cm. isobutyl-alcohol plus 15 c.cm. sulphuric acid. When wood-mash is treated with this reagent the wood turns black; if now diluted with a little alcohol and the test tube be shaken, the wood turns blue or blue-green, while the fluid becomes red-violet. Sections of ligneous tissue treated with this fluid are at first red-violet and after a time blue. The sections should remain in the reagent for about an hour, and then be mounted in glycerin. Apparently the stain is not very permanent.

A mixture of isobutyl-aldehyd and sulphuric acid also forms a useful reagent. A drop of the mixture placed on a micro-section gradually turns it red, and if after the lapse of about an hour it be placed in glycerin it assumes a wine-red or red-violet hue.

Demonstrating Fat-Cells in Glandulæ Vesiculares of Cattle.†—G. Illing found that the best fixative for demonstrating the fat in the cells of the glandulæ vesiculares ‡ was Podwyssozki's fluid (1 p.c. chromic acid 15 c.cm., ½ p.c. sublimate 15 c.cm., 2 p.c. osmic acid 4 c.cm., acetic acid 6–8 drops). This showed the fat as black globules.

The special fat stains, Scharlach R, sudan iii, and indophenol, were also used. For Scharlach R the pieces were fixed for 24 hours in 10 p.c. formalin, and after having been washed in running water for some hours were sectioned with a freezing microtome. The sections having been washed first in water and then in 70 p.c. alcohol, were immersed for 2–3 minutes in Herxheimer's solution (absolute alcohol 70, 10 p.c. caustic soda 10, distilled water 10, Scharlach R. to saturation). The sections were then washed in 70 p.c. alcohol, and next after-stained with dilute aqueous hæmatoxylin solution, toluidin-blue, or methylen-blue. Having been washed with water, they were mounted in lævulose or in glycerin.

Studying the Connective-Tissue Framework in Lymphatic Glands.§—J. Bartel and R. Stein fixed the material in Zenker's fluid and made paraffin sections in the usual way. The sections were first stained with 0·1 p.c. aqueous acid fuchsin for 2–3 minutes. After washing in water they were immersed in a 1 p.c. solution of phospho-molybdic

* Oesterr. Botan. Zeitschr., lv. (1905) p. 174. See also Zeitschr. wiss. Mikrosk., xxii. (1905) pp. 581–2.

† See also this Journal, 1905, p. 683.

‡ Arch. Mikrosk. Anat., lxvi. (1905) pp. 121–7 (1 pl.).

§ Arch. Anat. Phys., 1905, pp. 141–58 (1 pl.).

acid for 5–7 minutes. They were then washed in water, and afterwards transferred to the following staining solution: anilin-blue 0·5 grm., orange G 0·2 grm., oxalic acid 2·0 grm., distilled water 100 c.cm. After 20 minutes or so the sections were washed quickly in water, dehydrated in alcohol, differentiated with a couple of drops of anilin oil, cleared up in xylol, and mounted in balsam.

Staining Capsules of Pneumococcus and Streptococcus.*—P. H. Hiss, jun., uses a half saturated aqueous solution of gentian-violet. Air-dried and heat-fixed films are stained for a few seconds with the solution. Water must not be used in making the films, but serum, or some similar fluid. After staining, the dye is washed off with 0·25 p.c. potassium carbonate solution, and the film examined in this fluid.

Another method is to treat the film with a 5 or 10 p.c. solution of gentian-violet or fuchsin (5 c.cm. saturated alcoholic solution to 95 c.cm. H_2O). Heat to vaporisation, and wash off with 20 p.c. solution of copper sulphate. Dry, and mount in balsam.

The author confirms the observations of Ortmann (1888) and others that pneumococcus regularly develops capsules when cultivated in blood serum. From his own experience he finds that one of the most favourable media for the development of capsules consists of 1 p.c. starch-bouillon and serum (serum 1 part, bouillon plus 1 p.c. starch 2 parts), and sterilised at 65°–70°.

Metallography, etc.

Influence of Velocity on the Law of Deformation of Metals.†—The pressures developed by explosives in guns are measured by the compression of small copper cylinders placed in crusher gauges. The accuracy of the measurement depends on the calculation of the pressure corresponding to a definite compression. The stress-strain relation for the cylinders is determined by submitting them to definite pressures applied much more slowly than under ballistic conditions, and measuring the compression. It has been established that the resistance of a rapidly compressed cylinder is greater than that of a cylinder slowly compressed to the same form. P. Vieille and R. Lionville point out that the resistance cannot be calculated from the amount and velocity of compression. Two cases are to be considered: (1) the measurement of maximum pressure; (2) the determination of the law of increase of pressure. The errors appear to be much greater for (2) than for (1). The authors promise an account of their work on the subject.

The Equilibrium Curves of the System Iron and Carbon.‡—H. v. Jüptner reviews the determinations of freezing point curves made by Mannesmann and Osmond, Roberts-Austen, Carpenter and Keeling, and Wüst. Selecting those points which appear to be the most trustworthy, the author has plotted a diagram showing the probable equi-

* Journ. Exper. Med., vi. (1905) pp. 317–45 (12 figs.).
† Comptes Rendus, cxlii. (1906) pp. 1057–8.
‡ Iron and Steel Mag., xi. (1906) pp. 377–82 (1 fig.).

librium curves. The end of the eutectic line lies at 2·07 p.c. carbon; the eutectic composition is 4·3 p.c. carbon. A calculation of the molecular weight of carbon dissolved in iron, based on Rothmund's equation

$$\Delta t = \mathrm{E}\frac{c_1 - c_2}{m}$$

is given, but the results are doubtful owing to the uncertainty which exists as to the value of the latent heat of fusion of iron. Assuming it to be 20, the molecule of carbon dissolved in iron appears to contain 2 atoms.

An Etching Method.*—J. A. Aupperle points out that determinations of silicon and oxygen in steel, supposed to distinguish crucible steel from that made by other processes, cannot be relied on to do this. He has employed the following etching method: Specimens of the steel 1½ in. square are placed in dilute sulphuric acid containing permanganate of potash (90 c.cm. water, 10 c.cm. 1·84 s.g. acid, 3 grm. permanganate, for each specimen). The action is allowed to proceed over night; if the solution becomes coloured it is boiled until clear, more acid being added if necessary. The pieces are washed in water, and carbonaceous matter is wiped off. By this treatment open hearth and Bessemer steel are deeply etched in grooves: the edge is honeycombed and rough to the touch. Crucible steel is not etched in grooves but shows a close structure: the edges are smooth.

Solidification of Copper.†—P. Dejean has studied the freezing point of copper with the object of deciding as to its suitability as a fixed point for the calibration of thermo-couples. Platinum, platinum-iridium couples were used, standardised daily by determining the melting point of a small quantity of gold wire, this being taken as 1065°. Other fixed points taken were the boiling point of sulphur 445°, and the solidifying point of aluminium 655°. The cooling curves were photographically recorded, three galvanometers being used on the induction system previously described by the author.‡ About 100 grm. pure copper, deoxidised by hydrogen, was melted under wood charcoal, and a cooling curve taken. Similar determinations of freezing points were made on 10 samples containing varying quantities of oxide, which was subsequently estimated. Each of these samples gave two freezing points until the eutectic composition was reached. As a check, the solidifying points of several copper-aluminium alloys were determined. The results given by the author are:—

Freezing point pure copper, 1085°.
Freezing point eutectic (copper, copper oxide), 1065°.
Composition of eutectic, 4·5–5·0 p.c. oxide.

The freezing point of the eutectic is somewhat lower when it is present only in small quantities. Its composition was verified by microscopic examination. The lower freezing point of copper containing 2–3 p.c.

* Iron and Steel Mag., xi. (1906) pp. 383–5 (2 figs.).
† Rev. Metallurgie, iii. (1906) pp. 233–42 (10 figs.).
‡ See this Journal, 1905, p. 777.

oxide, prepared by melting copper in an open crucible so that it oxidises freely, is recommended as a fixed point for calibrating thermocouples, and may be taken as 1062°.

Rail Corrugation.*—G. Moyle discusses the singular phenomenon of roaring rails, i.e. rails which in use develop furrows across the running head, causing a deafening noise when a train passes over. The ascertained facts are briefly stated, and a list is given of the numerous causes suggested. A report on three "roarers," drawn up at the Cooper's Hill laboratory, states that the unevenness of surface is not due to the chemical composition or physical state of the rail but to some local cause. The author considers that the results of investigation are meagre and unsatisfactory. Microscopic examination appears to throw no light on the cause.

Copper Steels.†—P. Breuil has investigated two series of steels containing copper, the carbon in the first being about 0·15 p.c., in the second about 0·35 p.c. The copper in the members of each series was 0·5, 1, 2, 4, 8, 16 and 32 p.c. Analyses of the top and bottom of the ingots showed that the copper was uniformly distributed, except in the ingot of the second series containing 32 p.c. copper. This practically consisted of two portions. The copper content varied from 21–75 p.c. The fractures of the ingots with 8 p.c. or more of copper showed a red coloration. The hardness of the steels increased with increase in copper content. Peculiarities in the position of the critical points were noted.

The Crystallography of Iron.‡—F. Osmond and G. Cartaud put forward an explanation of the structure of martensite. When a small piece of ordinary steel containing manganese is quenched from about 1100° in cold water, cracks may be developed. Around the cracks are very fine twin crystals. The microstructure of a polished section is exactly similar to that of martensite in carbon steels. The partial transformation of γ iron into β iron occurring during quenching produces stresses, owing to change of volume. These stresses cause the formation of twin crystals in great numbers, parallel in any one grain to the four pairs of faces of the octahedron; whence the frequency of square figures and equilateral triangles. The marked resemblance between the structures of martensite and of meteoric iron is pointed out.

Critical Points of Steel.§—P. Fournel has succeeded in detecting A_1 and A_2 as well as A_3 by the variation of electrical resistance of steel with temperature. Wires 0·3 mm. diam. 30 cm. long were wound on mica and heated *in vacuo* in an electric resistance furnace. In series with the wire was a standard 1-ohm resistance; a current of a few hundredths of an ampere was passed through, and the difference of potential between the two ends of the wire, and of the two ends of the standard resistance, measured by a potentiometer. Temperatures were measured by a thermocouple. Figures and curves for five steels are given by the author.

* Tramway and Railway World, xix. (1906) pp. 558–61 (9 figs.).
† Comptes Rendus, cxlii. (1906) pp. 1421–4.
‡ Op. cit., cxliii. (1906) pp. 44–6. § Tom. cit., pp. 46–9 (1 fig.).

Aluminium Zinc Alloys.*—E. S. Shepherd determined the densities of 11 alloys of aluminium and zinc, and from the form of the specific volume curve concluded that the phases present were approximately pure zinc, and a solid solution of zinc in aluminium with a limiting concentration of about 50 p.c. Cooling curves of the alloys containing 60 and 50 p.c. aluminium did not indicate any evolution of heat at the solidifying point of the eutectic, while the 50 p.c. alloy gave an evolution of heat. Alloys with more than 60 p.c. aluminium are microscopically homogeneous. At 60 p.c. some intercrystalline material is present: this disappears on annealing. A true eutectic is present in the 40 p.c. alloy. The author holds that the pyrometric and microscopic data are in perfect agreement with the deductions based on the specific volume relations. This series of alloys presents no definite compounds; there are two solid solutions, zinc in aluminium (maximum 50 p.c.) and aluminium in zinc (4 p.c.), which form a eutectic containing about 5 p.c. aluminium.

ANON.—**Metallurgical Research at the National Physical Laboratory.**
Engineering Times, 1906, p. 218.

,, **Rusting of Iron.**
[A brief account of the theories of Dunstan, Moody, and others, as to the chemical reactions which take place when rust forms on iron.] *Nature*, lxxiv. (1906) pp. 116–17.

ARNOLD, J. O.—**The Internal Architecture of Metals.**
Engineering, 1906, pp. 278–9.

ANDREWS, T.—**Microscopic Observations on Naval Accidents.**
Tom. cit., pp. 331–2.

BACH, C.—**Strength of Mild and Cast Steel at High Temperatures.**
Tom. cit., pp. 401–4 (7 figs.).

DIXON, E.—**Nickel and Carbon Steels.** *Tom. cit.*, pp. 22–3.

HADFIELD, R. A.—**Unsolved Problems in Metallurgy.**
Engineering Times, 1906, p. 312.

LONGMUIR, P.—**Manganese Bronze.**
[Describes the properties of a number of alloys, and points out that iron, aluminium, and manganese each have the effect of raising the tenacity of copper-zinc alloys (brasses). High casting temperature has an injurious effect upon manganese bronze.]
Foundry, xxvi. (1905) pp. 116–18.

OLSEN, T. Y.—**Fragility of Iron and Steel.**
[The Frémont method of determining brittleness is described, with full details of the construction of the machine, and a discussion of the advantages offered by the impact test.]
Tom. cit., pp. 125–33 (8 figs.).

PEAKE, A. H.—**A Novel Instrument for Illustrating the Magnetic Properties of Iron.** *Proc. Camb. Phil. Soc.*, xiii. (1906) pp. 250–7 (7 figs.).

SMITH, J. K.—**Vanadium and its Services to Steel Manufacture.**
Engineering Times, 1906, p. 218.

STEINHART, O. J.—**Notes on Metals and their Ferro-Alloys used in the Manufacture of Alloy Steels.** *Iron and Steel Mag.*, xi. (1906) pp. 394–400.

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* Journ. Phys. Chem. x. (1906) pp. 504–12 (2 figs. and 5 photomicrographs).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Old Microscope by Pritchard. — This Microscope (fig. 64) was exhibited at the June Meeting by Mr. J. T. Holder. It was made for T. N. Ray in 1846, and now belongs to Mr. W. R. Reeves, of Liverpool, who kindly lent it for exhibition. It appears to be a modification of Pritchard's "Solid Tripod-stand Achromatic Microscope and Engiscope," described and figured in his "Microscopic Illustrations."

As may be seen from the figure, it consists of a telescopic pillar, the outer tube of which is screwed into a solid tripod-foot; the inner tube is surmounted by a rule-joint, to which is attached a hollow tail-piece upon which slide the stage and mirror. A triangular bar, with a rack cut on its posterior edge for the coarse-adjustment, passes down the inside of the tail-piece, and a short arm for carrying the body is attached to the top of the triangular bar by means of a screw, about which the arm with the body can be rotated and secured in any required position.

The body is about $7\frac{1}{8}$ in. long and $1\frac{1}{4}$ in. diameter inside. The fine-adjustment is very simple, consisting of a micrometer screw having a conical point which acts on the nose-piece against the pressure of a spring.

It may be mentioned that there is no difficulty in focusing the $\frac{1}{8}$-in. and the $\frac{1}{8}$-in objectives by the coarse-adjustment, and this was done at the Meeting, the fine-adjustment then being detached.

The stage is mechanical, and has a transverse movement effected by a screw, and a movement in arc at right angles to the transverse one. Each motion is limited to half an inch.

The stage is composed of three plates, the lowest being fixed. The middle plate carries the upper plate and its traversing screw, and is pivoted on the fixed plate at the left-hand side. The milled head of the traversing screw projects on the right-hand side and serves as the handle of a lever, consisting of the traversing screw and the upper plates, to give the movement in arc. It is thereby easy to give the stage the two motions simultaneously. A so-called "safety slider-holder" is mounted on the mechanical stage: it can be removed when using low powers, but it is necessary when using the higher powers for focusing the objective upon the object, as the body cannot otherwise be racked down sufficiently.

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

The stage can be moved up or down on the tail-piece, and can be turned to one side for various purposes, the chief apparently being that of using the "spring-phial-holder"—a device of Varley's for retaining a phial in an upright position when examining objects under water.

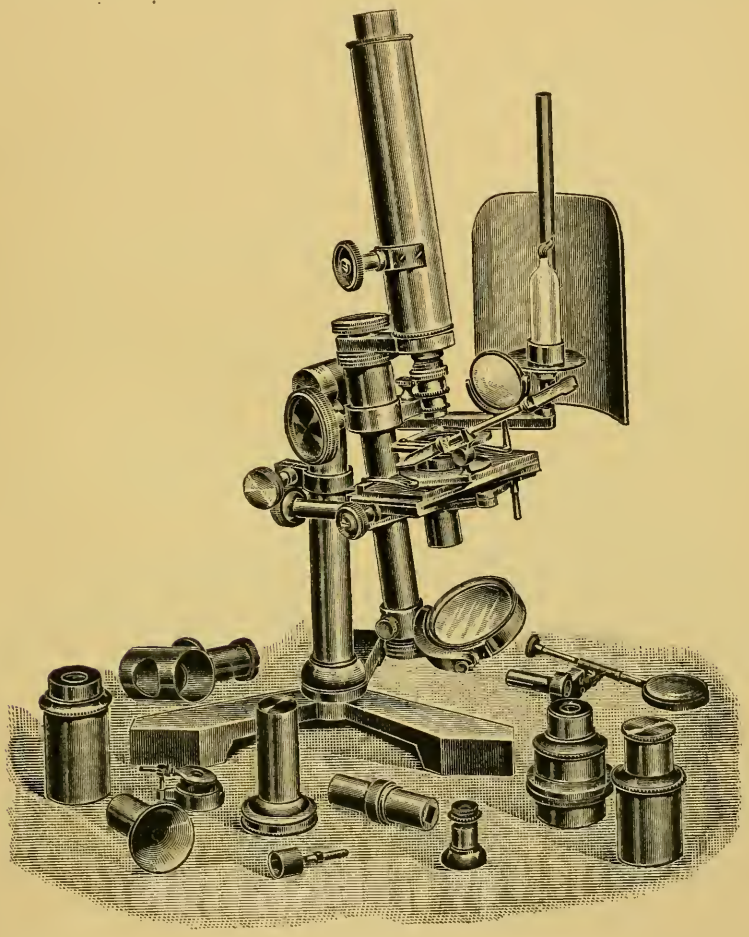

Fig. 64.

There is a sub-stage fitting for carrying a polariser, and there is also an adapter for carrying an analyser over the eye-piece.

There are eight objectives—2 in., $1\frac{1}{4}$ in. (?), 1 in., $\frac{1}{2}$ in., $\frac{1}{4}$ in., $\frac{1}{8}$ in. with collar adjustment, $\frac{1}{10}$ in., and $\frac{1}{18}$ in. The 1 in. and $\frac{1}{2}$ in. are marked A, the $\frac{1}{4}$ in. is marked B, and the $\frac{1}{10}$ in. and the $\frac{1}{18}$ in. are

marked C. In reference to this Pritchard says ("Microscopic Illustrations"): "The above sets may be divided into three classes—the shallow, medium, and deep; which, like the eye-pieces, I shall particularise by the letters A, B, C." From the above marks it may be concluded that $\frac{1}{10}$ in. and all above are classed as C, from $\frac{1}{10}$ in. to $\frac{1}{2}$ in. as B, and $\frac{1}{2}$ in. and below as A. The 1 in., $1\frac{1}{4}$ in. (?), and 2 in. have lieberkuhns.

According to a table in "Microscopic Illustrations," the working distance of the objectives is: for the 2 in. = $2\frac{1}{3}$ in.; 1 in. = $1\frac{1}{8}$ in.; $\frac{1}{2}$ in. = $\frac{3}{8}$ in.; $\frac{1}{8}$ in. = $\frac{1}{20}$ in.

There are five oculars, two having micrometers, one being a simple scale engraved on a thin slip of mother-o'-pearl. There is an arrangement for focusing the eye-lens on the micrometer scale. The other micrometer eye-piece is ruled in squares for use in making drawings.

Among the apparatus is a camera-lucida, a dark well, some live boxes (one with a scale engraved on the bottom of the cell), and a candlestick or lamp-holder, shade, and brackets. Of the candle-holder Pritchard seems to have been rather proud.

There is an additional body, about 8 in. long and about $1\frac{7}{16}$ in. internal diameter, but there is neither fine-adjustment nor any means of fixing the body to the stand, though at one time there was doubtless either another arm, or an adapter, to enable it to be screwed into the existing arm.

There are three oculars belonging to this body, one having a micrometer ruled in squares, with a collar arrangement for focusing it to the eye-lens, another ocular has a double eye-lens, the outer one being a meniscus.

There is also an adapter for applying the analyser above the objective.

The figure shows the stand with the candlestick and shade in position. To the left at the back is the "spring-phial-holder," and just in front of the foot is the camera-lucida; near the middle in the foreground is a dark-well and the polarising apparatus—polariser and analyser screwed together; near the point of the right foot is the micrometer ocular belonging to the large body; the other items are a selection of the objectives and oculars.

Mr. Nelson is of opinion that the instrument was undoubtedly made by Hugh Powell for Pritchard, and he calls attention to the spring joints to the mirror. This device for spring joints was used by Powell as early as 1831, and is still used by Powell and Lealand.

Zeiss' Martens Stand.—The special Microscope (fig. 65) for metallurgical work, constructed by Messrs. Carl Zeiss, Jena, in accordance with the suggestions of Professor Martens and Engineer E. Heyn, of the Königliche technische Versuchsanstalt, Berlin, consists of a solid base so arranged that it can be fastened to a sole-plate on an optical bench. The stand is chiefly constructed for photomicrography, and is not inclinable. The mechanical stage is attached to a movable dovetailed slide provided with a rack-and-pinion and a micrometer screw for fine-adjustment, by means of which the objects can be focused

without altering the position of the body-tube of the Microscope, thereby not disturbing the adjustment for illumination with the vertical illuminator for various powers. A Hooke's key is attached to the micrometer movement, so that it can be worked from behind the camera. The upper portion of the Microscope carrying the wide body draw-tube is also of special construction, to insure rigidity. It is provided with

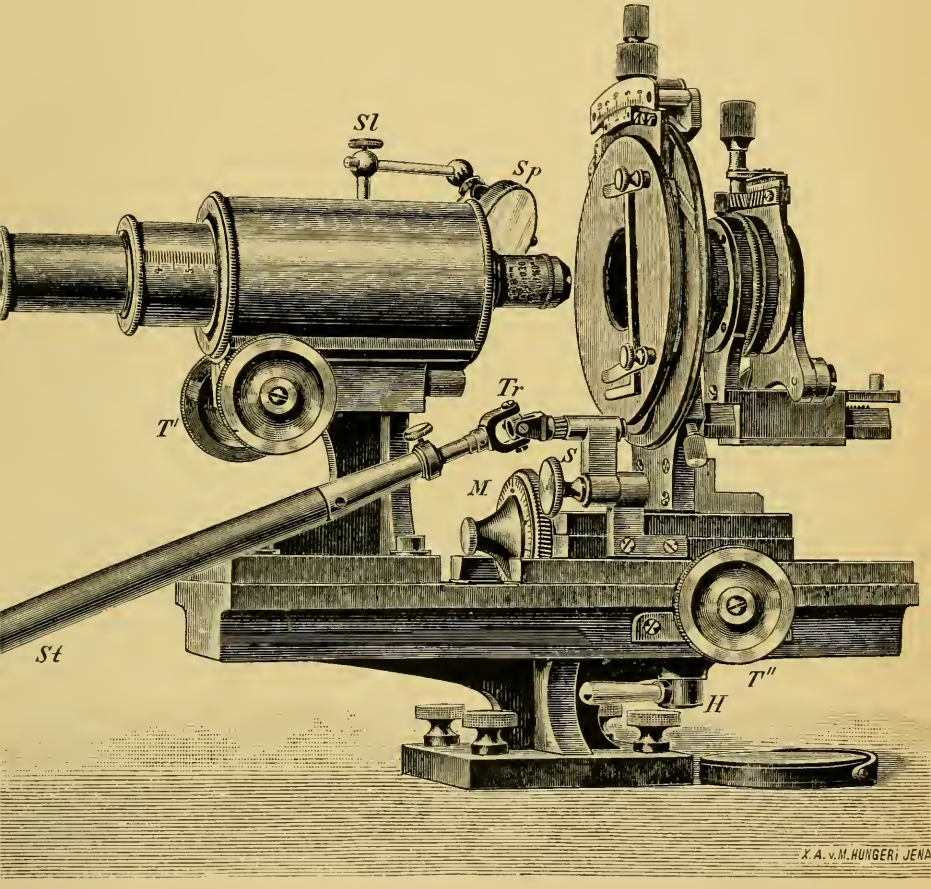

Fig. 65.

rack-and-pinion and clamping screw, and also with an illuminating device facilitating vertical illumination for very low-power work. For high-power work, a vertical illuminator is supplied, consisting of a totally reflecting prism specially mounted and fitted with an iris diaphragm. The vertical illuminator is so arranged that it can be rotated round the axis of the Microscope, and as the totally reflecting

prism can also be rotated round its own axis, vertical illumination with high powers is greatly facilitated. The iris diaphragm, which is mounted in front of the totally reflecting prism, serves for the purpose of excluding stray light. As the body-tube of the Microscope, as well as the stage, can be moved, an extremely wide space between the objective and the stage is available. No screws of the mechanical stage project above the level of the stage, so that the objects can be illuminated with extremely oblique light. The tube is of extra width, to allow the use of very low powers without cutting down the field. An Abbe substage condenser can be fitted to the stage if required. Plate-glass reflectors, as well as mirrors of different diameters for various kinds of illumination, are provided for.

R. and J. Beck's "Class" Dissecting Microscope.—This is a strong and convenient instrument of great rigidity, specially adapted for use in the laboratory (fig. 66). It is made in mahogany, with a rack-and-pinion focusing adjustment and a double mirror; the sides form substantial hand rests; the lenses fit into a double-jointed arm, so that a large

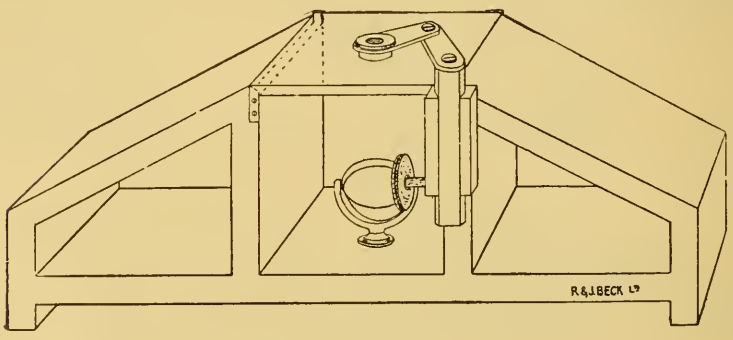

Fig. 66.

area of surface can be examined; a glass plate 4½ by 4½ in. forms the stage, and this can be replaced by an opal or vulcanite plate if required. The length of the instrument is 15 in., breadth 5 in., height to stage 5½ in. A complete set of lenses and achromatic triplets—and also a small compound Microscope magnifying about 30 diam., which can be dropped into the arm for detailed examination of an object—is supplied if required.

Gaidukov, N.—**Die neue Zeisschen Mikroskope.**
[A review of the instruments in Catalogue No. 33, 1906, of Carl Zeiss, Jena.]
Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 59–67 (4 figs.).

(2) Eye-pieces and Objectives.

Simple Compensator Ocular.*—A. Pauly points out that a compensating ocular suitable for most practical requirements can be easily

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 38–41.

constructed out of a Huyghens' ocular. For this purpose a glass micrometer is to be placed on the diaphragm, the divided face being underneath. A selenite or quartz wedge is attached to the micrometer with Canada balsam. This wedge, which affords an easy means of obtaining the colours of higher order, is compensated by a selenite plate of such a kind that the iron-grey of the first order, the zero value of the interference colours, overlaps an initial point of the micrometer scale. It is necessary to take care that the wedge has a uniform constant inclination angle of 1° to 2°, and that in the combination of the two selenite plates the axes of elasticity are accurately perpendicular to one another: thus a_1 of the wedge is parallel to c_2 of the plate, and c_1 of the wedge is parallel to a_2 of the plate. The wedge must be so cemented to the glass micrometer that the interference bands are parallel to the scale divisions. The whole is covered with a circular cover-glass of such a size that it will go into the ocular. The test is made with sodium light, and the operator reads the number of micrometer divisions from one dark band to the next. The wave-length (0·000575 mm. for Na) is divided by the number of divisions observed. This calculation gives the value of the phase-difference for one division of the scale. In order to measure the double refraction of a given body placed on the object-stage, an ocular of suitable strength, equipped as already described, is inserted in the ordinary way in the tube and the analyser applied over it. The object is then pushed along the scale until it has compensated any particular position of the interference bands. It is necessary then to bring the object into just such a position that the axes of elasticity form 45° with the Nicol sections, which is easily controlled by the adjustment of the micrometer scale, and then to rotate through 90° so that the a axis of the selenite wedge lies over the axis of less elasticity (c) of the object. The position, as found for compensation, is read off on the divisions of the micrometer scale, and the number of divisions (from zero of the interference colours) is then multiplied by the phase-difference for one division. It is possible to compensate approximately with ordinary light and then accurately for monochromatic. The author gives some numerical examples.

(3) Illuminating and other Apparatus.

New Projection Drawing Board.*—A. C. Pohlman's arrangement consists of an upright frame surmounted by three axles, each carrying a reel of paper. The gearing is such that one or all of the reels may be in action, and a crank in the lower part of the machine actuates a roller for rolling up the paper wound off the reels. The paper in its descent lies flat against a vertical board and receives the projected image. Means are provided for keeping the paper taut. A brass bar acts like a knife edge, and thus single drawings can be removed. If a series is required the lower roller winds up the drawings. There is an arrangement by means of which two sheets of double-sided blue copying paper can be

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 41–44 (3 figs.).

introduced between the layers of drawing paper : it is then possible to get three normal and three right for left drawings at one operation.

Leppin and Masche's Mirrormegascope.*—The intention of the

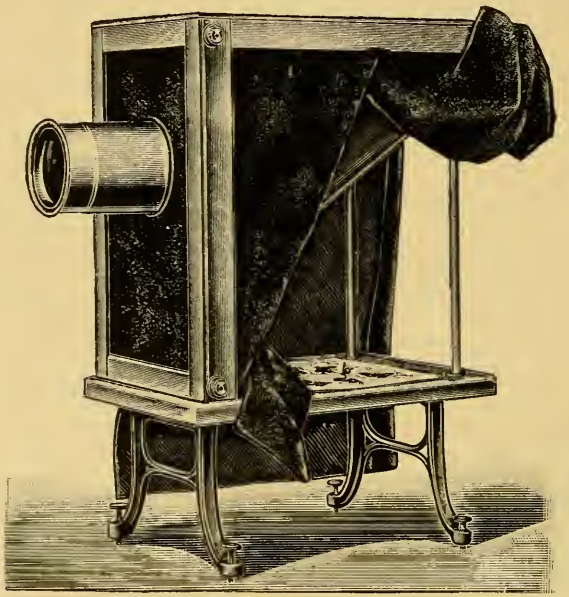

Fig. 67.

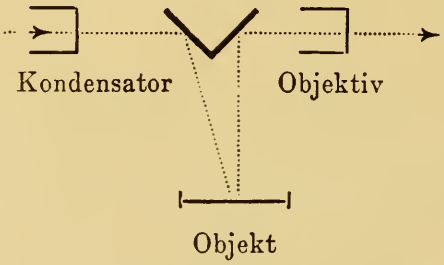

Fig. 68.

designers was to produce an inexpensive portable apparatus for the projection of opaque objects (fig. 67). The light from a suitable strong source falls on a mirror, silvered on face, set at 45° to the optical axis,

* Zeit. f. ang. Mikrosk. u. klin. Chemie, xii. (1906) pp. 1–5 (2 figs.).

and is thence reflected on to the object beneath it. The strongly illuminated object is now reflected on to a second and similar mirror likewise at 45° to the optical axis but at right angles to the first (fig. 68), and after incidence on the objective is projected on to the screen. The objective has a diameter of 120 mm. The whole apparatus is inclosed in a frame with plush curtains resembling a camera. The designers say that it is very suitable for projecting drawings, insects, butterflies, or for such an object as a live fish in water.

Simple Illuminating Apparatus for Loup Preparations and for Microscopy.*—O. Bender has found his contrivance (figs. 69 and 70)

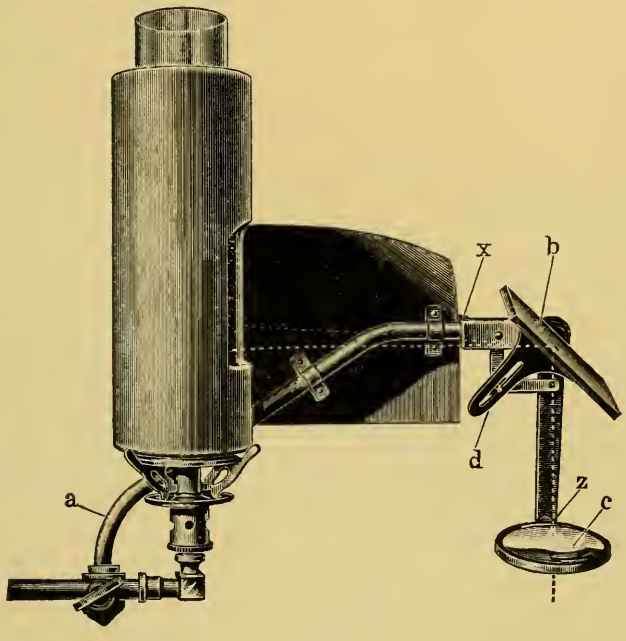

Fig. 69.

very useful, as it enables an operator to be independent of variable daylight. He fits a bent metal arm to the rod of an ordinary Microscope lamp (or incandescent gas jet) with opaque cylinder. This metal arm carries a plane mirror inclined at 45° to the path of the beam emergent from the orifice of the cylinder. The light after reflection at the mirror travels down on to the loup, fixed in a ring jointed on the arm, and thence impinges on the object. The arm carrying the ring can also be

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 36–38 (2 figs.).

inclined to the vertical so that oblique illumination of the object may be obtained. By using a cylinder with an interior white glazed surface the

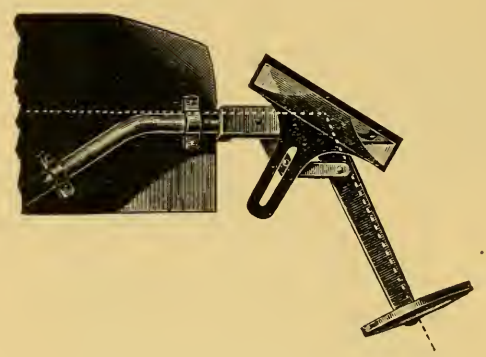

Fig. 70.

beam of light is intensified. A sheet-iron screen is also attached to the arm so that the operator's eyes are shielded from the rays.

(4) Photomicrography.

Interferential Photography; Variation of Incidence; Polarised Light.*—M. Ponsot has studied experimentally the interferences of polarised light reflected from a plane mercury surface, the interferences being produced in the thickness of a transparent layer of gelatino-bromide of silver in contact everywhere with the reflecting surface. He was, in reality, repeating Wiener's experiments with, as a variation, Lippmann's arrangement for interferential photography. His experiments were made with (1) non-polarised light; (2) polarised light; (3) without the mercury mirror.

1. *Non-polarised Light.*—Photographs of the spectrum were taken under normal incidence and under increased incidence, notably at 45° in air, which gives an incidence (i_1) of about 28° in the gelatin. To get an incidence of 45° in the gelatin a right-angled isosceles prism of crown-barium (1·55 for yellow light) was used. The examination in white light, under normal incidence, of the photographs shows that the spectrum colours are displaced towards the violet, and the more so as i_1 is increased. Under an increasing incidence the colours are displaced towards the red. These results are in agreement with theory, and bear upon the choice of objectives in interferential photography as regards regulating the working distance for getting the maximum effects with the active colours.

2. *Polarised Light.*—The results obtained are identical with the

* Comptes Rendus, cxlii. (1906) pp. 1506-9.

preceding, as far as the displacement of the colours is concerned. If the light is polarised in the plane of incidence, the colours observed are very brilliant, and purer than with white light. If the light is polarised in a plane perpendicular to the plane of incidence, the colours become more and more dull. For an angle of 45° in the gelatin they disappear entirely, and are replaced by a uniform yellowish tint due to the reflecting silver produced by the development.

3. *Without the Mercury Mirror.*—The results are, in all cases, analogous to the foregoing. For $i_1 = 45°$ there is total reflection at the gelatin-air surface; with light polarised in the plane of incidence the photograph gives beautiful colours in the region affected by the blue; in the other case there are no colours, but a reflecting surface of yellowish silver.

The author has noticed that under the same conditions of exposure and of light the colours seen at any point of a plate are not the same as with a reflecting mercury surface.

Photography of the Absorption Rays of the Colouring Matters of Blood.*—L. Lewin, A. Miethe, and E. Sterger have overcome the technical and experimental difficulties connected with this investigation. They have examined the blood of human beings, horses, pigs, rabbits, frogs, and of earthworms; also pure oxy-hæmoglobin and its products of transformation; also colouring matters derived from the blood. The apparatus used comprised a spectrograph with a Thorpe grating giving a a spectrum of 9 cm. long between wave-lengths 800 and 300. A quartz spectrograph was used for the ultra-violet to see if the absorption rays existed beyond 300. The luminous source was ignited threads of magnesium, which not only gave a very clear regular light, especially in the violet and ultra-violet parts of the spectrum, but also some very sharp lines serving to locate the absorption bands. In some experiments the oxy-hydrogen-zirconium light was used, and in the less refrangible parts a Nernst lamp. The liquids were contained in small vessels with parallel sides or in test-tubes of known diameter. These latter acted at the same time, if thought desirable, as convex lenses.

Production of Stereo-Photomicrographs.—W. P. Dollman writes that the following revision of his method† covers both high- and low-power work.

"The methods of producing stereo-micrograms are comparatively simple. In an article by the late Mr. J. Traill Taylor in the 'British Photographic Journal Almanac' for 1894 are described several methods of doing this work, one of the simplest of which is that of obscuring by a semicircular screen half of the objective in use, and using alternately the right and left hand (or upper and lower if the plate is upright in the camera) halves respectively for the two images required for the stereoscope. For this method may be substituted a plate with an eccentric circular aperture, as giving superior definition to a semicircular opening. Placing a plate in front of the

* Comptes Rendus, cxlii. (1906) pp. 1514–16.
† See this Journal, 1906, p. 257.

objective is inapplicable for any but opaque objects lighted in front, it being difficult to secure approximately even illumination by this means of transparent objects lighted from behind.

"In the case of photographic objectives—I have used these of from 2-in. to 6-in. focus—an eccentric diaphragm of thin blackened brass can be placed against the diaphragm between the combinations, and this is certainly the better place for the screen. I have used a 2-in. focus Dallmeyer portrait combination (which is specially good for this work), a 4½-in. Unar, and a 6-in. Goerz.

"Of course, for low magnifications of a rough object it is advisable to work with a low power—the 4½-in. focus lens was used for most of my earlier work — but for larger objects a 6-in. lens would define better. The little Dallmeyer is a marvel for definition and flatness over the small field used. I have had extra tubes made for my Microscope (a Van Heurck by Watson) to take the place of the lower rackwork tube and the upper sliding tube, which carry the photographic lenses—the Dallmeyer at the bottom of the draw-tube, the Unar (for which I had a new mount made so as to get it inside the tube) about 1½ in. down the tube from the top, and the Goerz outside at the eye-piece end of the Microscope. These adaptations enable the lenses to be carried at the suitable distance from the object on the stage, and allow sufficient rackwork for focusing. As the major conjugate focus of the objective is used in Microscope work, all non-symmetrical photographic lenses, such as 'Unars,' 'Stigmatics,' and portrait combinations, should be reversed on the Microscope (the front combination being presented to the plate) to enable them to perform at their best.

"When the distance is too great (as it will be in low-power work) for the hand to reach the focusing pinion, I use a Hooke's universal joint focusing rod, but for the higher powers I have a long rod on the other side (the right) with a pulley-wheel near the end, over which and the fine-adjustment screw-head runs a cotton-thread loop, which is quite effective even with a $\frac{1}{12}$-objective.

"In photographing transparent objects, and for high-power work, I use light of varying obliquity for the two halves of the plate, and the getting the two halves into proper position on the plate is a rather complicated business, as I use two different methods of obtaining oblique light (each of which necessitates a different position of the plate in the slide), and sometimes dispense with the eye-piece (which requires the reverse position of the plate to that when the eye-piece is used). I have to keep a memorandum sheet by me to prevent my making mistakes when at work. For high powers, less obliquity of the light is necessary than for medium or low powers, and in this case the condenser may be moved laterally, but for medium and low powers an eccentric diaphragm in the revolving cell under the condenser is a convenient mode. I have had five diaphragm-carriers made to fit the revolving cell under the substage condenser, with apertures at different distances from the centre—½, 1, 1½, 2, and 3 mm. Into these apertures drop plates, ten in number, with openings from 1¾–20 mm. Thus there are fifty changes of aperture and distance from centre, which will meet all demands for high- and low-power work.

"The camera I use is a whole-plate one, with a long bellows, with, for long-distance work, a telescopic attachment in front (made of rolled brown paper). The upright position of the plate in the camera is the more convenient for photographing opaque objects requiring to be lighted from the front and side, and the objective should be divided horizontally. This also applies to the oblique light method.

"The reversal of the image on the plate—so that the print will not require to be divided, and simplifying the mounting—may be effected by using a carrier in the dark slide (the whole-plate slide allows this to be done) in which the plate (5 in. by 4 in.) can be placed $2\frac{1}{4}$ in. out of the centre, so as to receive the image from the right-hand (or upper) half of the lens on the left-hand (or lower) half of the plate.

"Where a diatom does not present its best aspect through being turned the wrong way, the images may be reversed, so as to get a pseudoscopic effect, which renders the object as though photographed from the other side by turning it inside out.

"The opening in the carrier should be $7\frac{1}{4}$ in. by 4 in., a piece of glass $2\frac{1}{4}$ in. by 4 in. filling the otherwise unoccupied end. A screen (of blackened card or thick paper) with an aperture in the centre of $2\frac{1}{8}$ in. by 3 in. should be placed in the carrier to protect one-half of the plate while the other half is being exposed. After exposing one side of the plate, the slide is taken into the dark room, and the plate moved to the other end of the carrier. Then the screen on the objective is moved half round, or the eccentric diaphragm under the condenser is given a semi-revolution (or, in the case of a lens in the draw-tube, the tube is given a semi-revolution without disturbing the focus), and the second exposure can be made.

"An important thing to remember when photographing opaque objects is that, to secure even illumination of the two halves, the illuminant must be on the same level as the centre of the objective—this is why the horizontal division of the objective and the upright position of the plate are recommended.

"For the lighting of large transparent objects, when using the lowest powers, I have had a cell, which carries a $4\frac{1}{2}$-in., 6-in., or 8-in. focus uncorrected condenser, fitted to the large aperture under the main stage of the Microscope, and brought as near as possible to the object. For the smaller objects I use an achromatic condenser of 1·0 N.A. This can be altered in power by removing the top combination, or, if necessary, using only the lowest of the three lenses. As illuminant, I use acetylene (the finest light for all ordinary work), from a special burner I had made, limelight, and sometimes sunlight (parallel rays) through a heat-absorbing medium. On the platform carrying the apparatus there is a scale from 0 to 49 in., with the zero in a line with the Microscope stage. This, with the aid of tables for the various lenses used, enables me to work to definite magnitudes.

"Exposure, of course, depends upon colour or brightness of object, illumination, and magnification, and may vary from a few seconds to an hour.

"I use ordinary developers—such as would give a hard result to accentuate feeble contrasts. Orthochromatic plates, with or without a

yellow screen, are used; and when monochromatic light is desirable, a suitable light-filter is utilised. I have used 'zenith' and 'imperial sovereign' plates for high-power work not needing an orthochromatic plate, and so reduced the exposures materially."

GLASENAPP, M.—**Die Bedeutung der Spitzertypie für die Reproduktion von Mikrophotographien.** (An appreciation of the advantages of Spitzertype for the reproduction of photomicrographs.)
Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 174–82 (8 figs.).

(5) Microscopical Optics and Manipulation.

Ultramicroscopical Examination of Plant-cells.*—N. Gaidukov made an examination of the crushed-out contents of a *Vaucheria* cell. The object was placed between a glass slide and a cover-slip in the usual way, but great pains were taken to secure purity of the media and cleanliness of the glass. The apparatus was arranged according to Siedentopf's method. The result was a clear distinction between the corpuscles of chlorophyll and of plasma, the diffraction-disks of the former being usually red and green, those of the latter being white and blue. It was possible to watch the formation of a colloidal solution of chlorophyll with oil, for the drops of the former were attracted by, and seemed to disappear in, the oil-drops. Observations were also made on certain other plant-cells.

Dispersion in Electric Double Refraction.†—H. L. Blackwell, after an historical sketch of the labours of previous experimenters on this subject, describes the new results obtained by himself. Temperature and field-strength being kept constant throughout an experiment, the observed double refraction, or separation (δ), is proportional to the difference between the ordinary and electrically-produced extraordinary indices of the liquid ($\mu_\epsilon - \mu_\omega$). This quantity is the separation in centimetres introduced between the mutually perpendicular components of a wave of plane-polarised light in traversing 1 cm. of the substance in question—in this case carbon bisulphide—at a certain temperature in a field of certain strength. The double refraction of naturally uniaxial crystals is usually similarly expressed as the difference between the two indices. The factor necessary to reduce this value to absolute index of refraction was found to be about $7{\cdot}04 \times 10^{-7}$. Observations were terminated in the violet by the absorption of the liquid. At wave-length 4180 the spectrum was still very bright; at 4144 very faint. The experiments do not confirm Kerr's law, and it may be that the approach to an absorption band is the controlling factor rather than the change of wave-length.

Arrangement for Simultaneously Obtaining Minimum Deviation with Several Prisms.‡—P. Lambert, having had occasion to mount a spectroscope composed of three prisms and of two half-prisms in such a manner that the luminous ray after once traversing the system should return upon its path after incidence at a mirror, was led to study the

* Ber. Deutsch. Bot. Ges., xxiv. (1906) pp. 107–12.
† Proc. Amer. Acad. Arts and Sci., xli. (1906) pp. 647–67 (1 pl. and several figs.).
‡ Comptes Rendus, cxlii. (1906) pp. 1509–11 (3 figs.).

conditions necessary for obtaining minimum deviation. Although several mechanical arrangements have been designed for meeting the difficulty, none of them appeared applicable to his requirements, as they either require too much space or fail in precision. He believes that his method is novel. It is known that, if the prisms are once in the desired position, their edges being truly vertical, their bases will form the sides of a regular polygon inscribed in a circle. If one of the half-prisms be fixed, the author shows that the displacement of the centre of the circle is along a certain straight line, and that, corresponding to a displacement of the centre, the bases of the prisms must always be tangents to a circle of certain radius described with that centre. The author shows how, by means of pulleys and flexible cords, this adjustment can be readily obtained.

(6) Miscellaneous.

Gotch Ophthalmic Spinthariscope. — This instrument (fig. 71), which is made by the firm of R. and J. Beck, has been designed by Professor Gotch, of Oxford, its purpose being to afford a ready means of testing the retinal excitability of the dark adapted eye and the alterations in retinal sensitiveness which are produced by light. The instrument contains a small quantity of radium held on the further side of an adjustable opaque pointer, an adjustable fluorescent screen of zinc-blende, a series of diaphragms for limiting the field of view, and a lens for focusing the scintillating flashes which occur on the screen through the emanations from the radium. The main features of the instrument are as follows. A handle F allows the instrument to be held in the hand of the observer without danger of altering the adjustments. The lens A through which the fluorescent screen E is viewed is capable of being adjusted by revolving the milled collar B so as to secure accurate focusing. The pointer carrying the radium lies within the tube in front of the screen E, and is fixed upon a graduated slide C, by means of which it can be withdrawn from the centre of the tube to any desired distance up to 20 mm. Between the pointer and the focusing lens is a second graduated slide D, which is provided with a series of circular apertures of different sizes, so that the visual field can be varied in size. When the slide D is pushed quite in, the fluorescent screen is completely covered, so that when not in use it is protected from light entering the tube through the eye-piece. The fluorescent screen E can be

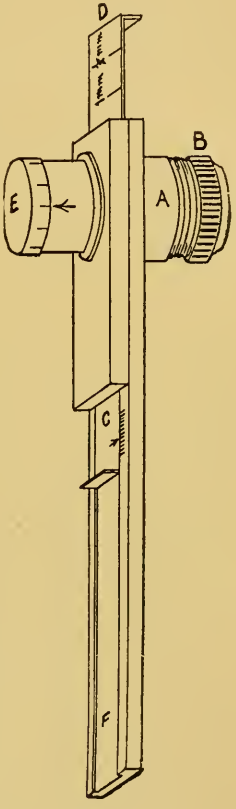

FIG. 71.

removed further from or brought nearer to the radium by means of the milled head on its circumference; each complete turn of the screw removes the screen 1 mm., and the head being marked in tenths of its circular distance allows a variation of tenths of a millimetre; the screen, when placed its nearest position, is 1 mm. from the radium.

Brass, Dr. A.—**Der Scheiner'she Versuch.**
[An historical article on the optical work of Professor Scheiner, S.J., of Ingolstadt, who lived at the beginning of the seventeenth century.]
Central.-Zeit. f. Opt. u. Mech., xxvii. (1906) pp. 163–5 (1 fig.).

Weinschenk, E.—**Anleitung zum Gebrauch des polarisationsmikroskops.**
Freiburg: Herder, 2nd ed., enlarged and revised, 1906, viii. and 148 pp., 135 figs.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Anaerobic Nitrogen-fixing Organisms.†—E. Haselhoff and G. Bredemann have examined various soils and leaves of different trees—birch, oak, beech, etc.—and found anaerobic nitrogen-fixing organisms in almost every case. The material was placed in water, heated for three minutes at 80° C., and then placed in Winogradsky's nitrogen-free medium in a nitrogen-containing atmosphere, and incubated at 28° C. From these rough cultures pure cultures were obtained. Cultures were also obtained in flasks through which nitrogen was conducted, the amount of the nitrogen fixed being estimated by comparing the nitrogen content of the flask before and after the fermentation produced by the organism. The five different *Clostridia* cultivated from the soil and foliage were very similar, but none were identical with *C. pasteuri*.

Use of the Sodium Salt of Nucleinic Acid in Bacteriological Diagnosis.*—A. Pepere finds that the solid media of liver-broth gelatin, to which has been added the sodium salt of nucleinic acid, affords a certain means for the differential diagnosis of *B. typhosus* and *B. coli*. In the case of *B. coli* the medium is readily liquefied, whereas in the case of *B. typhosus* not the slightest peptonising action occurs.

Culture of Treponema pallidum.†—G. Leuriaux and V. Geets obtained cerebro-spinal fluid by lumbar punctures under strict asepsis, from cases of secondary syphilis, and, after adding neutral pepton broth, incubated the mixture at 37° C. for 3–4 days. Hanging drops from these cultures showed the presence of minute rapidly-motile corpuscles. The liquid was centrifuged for 20 minutes, and the deposit inoculated on solid pig serum. After 3–4 days there appeared on the surface of the medium an ivory-white moist sticky layer, with a strongly alkaline odour. Out of forty-two punctures three typical cultures were obtained. Cover-slip preparations from 5-day old cultures were stained by Giemsa's

* 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, etc.; (6) Miscellaneous.

† Bot. Zeit., 2te Abt., 1906, p. 234.

‡ Centralbl. Bakt., 1te Abt. Ref., xxxviii. (1906) p. 267.

§ Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 684.

method. The authors consider that the organism is derived from an oval globule which corresponds to the *Cytorrhyctes luis*, passes through a phase resembling a trypanosome, and subsequently attains the form of a *Treponema* as the result of an agamous multiplication of the macrogamete (trypanosome).

Cultivation of Glanders.*—M. Nicolle made a nutrient agar of the following composition. 500 grm. of finely chopped meat were macerated for one night in 1 litre of water. 500 grm. of coarsely cut potato were macerated for a similar time in 1 litre of water. The two fluids were mixed, and 20 grm. of Chapoteaut's pepton, 10 grm. salt, 20 grm. glycerin, and 20 grm. agar added. After sterilisation and alkalisation the condensation water is removed by placing them in the incubator before capping. This medium is suitable not only for glanders, but also for any organism that is cultivable in agar. The growth therein is infinitely richer than on ordinary agar, but dies much more rapidly.

The author then goes on to describe the procedure by which he obtains large masses of bacteria. The method is essentially the same as the foregoing, and consists in cultivating in Petri capsules containing glycerin-potato-agar, the condensation water being removed by means of blotting-paper.

Collecting and Studying Flustrella hispida.† — R. M. Pace collected the material from places on the South Coast, where it was found abundantly between tidemarks on *Fucus*, and occasionally on other algæ. The colonies form dark mossy-looking patches, encrusting the algal fronds.

For the study of larval development, colonies of one or two seasons' growth taken close to low-water mark proved the most suitable. Such colonies contain abundance of spermatozoa or of ova and larvæ, according to the season. The reproductive period commences early in February and continues till the beginning of August. In pure running water *Flustrella hispida* may be kept alive in tanks for an indefinite period, but usually only for a few days to a week.

The larvæ were examined in the living state and after fixation; the fixatives used were (1) saturated sublimate with 5 p.c. acetic acid; (2) 5 p.c. chromic acid 100 parts, with 5 drops acetic acid; (3) Flemming; (4) Hermann; (5) chromo-nitro-osmic mixture; (6) acetic alcohol with sublimate to saturation; (7) Kleinenberg. After fixation the material was removed to 70 p.c. alcohol. Chrom-acetic acid and corrosive acetic gave the best results for fixation in bulk. Larvæ were isolated by slicing off the front wall of the colony with a razor; the larvæ lie just below this wall, enclosed in the tentacle-sheath. For isolated larvæ the best fixatives were corrosive acetic and acetic alcohol saturated with sublimate.

Entire eggs and larvæ were examined during life and after fixation. The latter were stained with borax-carmin or with safranin. In some cases the nuclear spindles and the yolk-nucleus were clearly brought out.

Sections were made from isolated larvæ and of colonies containing

* Ann. Inst. Pasteur, xx. (1906) pp. 625-64.

† Quart. Journ. Micr. Sci., l. (1906) pp. 435-78 (66 figs.).

larvæ. Groups of 20–30 isolated larvæ were imbedded together, the sections thus obtained being in a variety of planes. In order to determine the direction of unorientated larvæ, a set of standard sections was prepared by carefully orientating single larvæ which had been first studied entire.

To insure thorough impregnation of colonies with larvæ *in situ*, the material was left in xylol for about a week before being passed through xylol-paraffin to paraffin. This material is difficult to imbed and section owing to the presence of chitinous spines, which are sufficiently hard to notch the razor.

The most useful stain for sections was Heidenhain's iron-hæmatoxylin, followed by eosin in 90 p.c. alcohol. Other stains were used, among which was Mayer's mucicarmin for detecting the presence of mucin.

Differentiation of Bacillus typhosus.* — Loeffler advocates the following medium for the differentiation of the *Bacillus typhosus*. 100 c.cm. of distilled water containing 2 p.c. of peptone, and 1 p.c. of nutrose, are neutralised by the addition of 1·06 c.cm. of normal potash; to this is added 5 p.c. of lactose and 1 p.c. of glucose; after boiling and cooling, 3 c.cm. of a 2 p.c. solution of malachite green are added to the mixture. When tubes of this medium are inoculated with *Bacillus typhosus*, a coagulum is formed and a clear green liquid separates out; with other organisms, such as those of the *Coli* group, *Bacillus enteriditis* Gaertner, and paratyphoid bacilli, active fermentation occurs, the precipitated nutrose adhering as dirty green flakes to the wall of the tube, or carried to the surface of the liquid by the gas that is formed. When glucose is omitted from the medium, only the *Coli* group cause a fermentation. Other organisms have a reducing action on the green, turning it a pale yellow colour. Paratyphoid A turns the liquid a pale blue colour.

Ability of Vibrio choleræ asiaticæ to Decompose Starch.†—M. H. Gordon cultivated a series of bacteria in the following medium: Lemco 1 grm., peptone 1 grm., sodium bicarbonate 0·1 grm., starch 0·5 grm., aqua dest. ad 100 c.cm. The medium is tinted with litmus. It has been found that *Vibrio choleræ asiaticæ*, when cultivated in this medium at 37° C., decomposes the starch with a strongly acid reaction within 24 hours, whereas the vibrio of Finkler and Prior produces no such reaction in this time, and only a feeble acid reaction by the third day. Staphylococci, streptococci, *B. diphtheriæ*, *B. coli*, *B. enteriditis* Gaertner, *B. typhosus*, *B. proteus*, all fail to produce an acid reaction in this medium. The rapid positive reaction of cholera, therefore, in this test has a differential value. It may be added that the acid reaction notifying decomposition of the starch is also produced by the cholera vibrio when cultivated in distilled water tinted with litmus, and containing 1 p.c. peptone, 0·5 p.c. salt, and 1 p.c. starch.

Cultivating Wood-Destroying Moulds.‡—B. Malenković finds that the destruction of wood is due to the action of one or more different

* Brit. Med. Journ. (1906) i., Epitome 328. See also Deutsch. Med. Woch., Feb. 22, 1906.

† Brit. Med. Journ., 1906, ii., p. 197.

‡ Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 405.

classes of moulds and not to one mould in particular, since the products of the destruction and decomposition of the wood are not always the same, and seem to be brought about by different enzymes. The author refers to the observations of Tubeuf on the mould of "dry rot"—*Merulius lacrymans*—which appears to grow best in a medium containing carbon in the form of pure cellulose, but grows badly with carbon in the form of pine shavings.

Coniophora cerebella is one of the most widely distributed wood-destroying moulds. The author obtained a fresh mycelium from a telegraph post; a fruit-bearing portion was placed on bread pap, and after a few days at 15° C., a mycelium grew, from which, by subculturing, a pure culture was obtained. It grows well on alkaline media; it can obtain its nitrogen from ammonia, but has no denitrifying action on nitrates; on pine or beechwood saw-dust moistened with water, it grows badly, but if moistened with a nutrient mineral salt solution good growth occurs at 15°–17° C. The author finds that the destruction of the wood is greater than that required as nourishment of the mould, since if wood totally destroyed by *Coniophora cerebella* is powdered and moistened with nutrient mineral salt solution, it forms a good medium for the growth of this mould. After the destruction of wood by a mould has proceeded to a certain degree, the destructive process ceases. The author thinks that this is analogous to the alcoholic fermentation of yeast, the products of the metabolism having a hindering effect on the growth of the mould. All the derivatives of dextrose, mannose, and galactose serve as good sources of carbon, but lævulose and arabinose are unsuitable.

Cultivation of Bacillus fusiformis.*—X. Lewkowicz finds that this organism, which is a normal inhabitant of the mouth, and a probable factor in the production of inflammation of the jaw, ulcerative stomatitis, etc., is best grown on glucose agar to which serum has been added, the colonies appearing after 24 hours, in the deep oxygen-free layers of the medium, about 12 to 15 mm. from the surface. The bacillus has a great tendency to polymorphism, and only quite young cultures show the regular round-ended rods in any proportion; spindle and thread forms are very common, the bacilli being often joined in pairs. Quite young cultures stain regularly, but never by Gram's method. The bacillus is non-motile, and does not form spores. Cultures have a characteristic nauseous odour. The microbe is pathogenic for laboratory animals. Introduction into the mouths of healthy children gave negative results.

Voges and Proskauer's Reaction for Certain Bacteria.†—A. Harden, from chemical examinations of the products formed by *Bacillus lactis aerogenes* and other bacteria from glucose medium, finds that Voges and Proskauer's reaction is due to acetylmethylcarbinol. This substance in the presence of potash and air is oxidised to diacetyl which reacts with some constituent of the pepton-water in the medium and gives the characteristic fluorescent colour.

* Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 153.
† Proc. Roy. Soc., Series B, lxxvii. (1906) p. 424.

Collecting and Preserving Volvox globator.* — F. St. J. Parker has discovered that *Volvox globator* can not only be kept alive, but also will multiply amazingly for months if vigorous specimens collected from a clean pond be placed in a glass bottle, and the bottle, fully exposed to the light, be laid on the meeting-rail of a window facing west. The bottle should be a clear glass, hand-made, round, wide-mouthed bottle, $5\frac{3}{4}$ in. high by $1\frac{3}{4}$ in. in diameter.

Studying the Development of Thelebolus stercoreus.†—G. Ramlow used sterilised dung or dung-agar (dung decoction + 1·8–2 p.c. agar) as cultivation medium. Pure cultures were obtained by inoculating the medium with spores. The growth was fixed with Flemming's fluid, Merkel's platinum-chloride-chromic-acid mixture, Keiser's 2 p.c. sublimate-acetic-acid, and with Hermann's mixture. Weak Flemming gave the most satisfactory results. The osmic acid mixtures blackened the mycelium, but this was obviated by after-treatment with hydrogen peroxide. The best preparations were obtained by fixing for from 2–3 minutes, except in the case of sublimate-acetic-acid, which required 15–20 minutes.

The agar pieces thus fixed were cut up into thin plates, and having been passed through chloroform, were imbedded in paraffin and sectioned.

The preparations were stained with Flemming's safranin-gentian-violet-orange solution, or with Heidenhain's iron-hæmatoxylin. The effect of the latter was increased by contrast-staining with orange G or with light-green (1 : 400 alcohol). The sections were mounted in balsam, and the agar pieces preserved in glycerin.

Cultivation of Gonococcus.‡—E. A. Rothmann, after reviewing the history of the cultivation of *Gonococcus*, remarks that media containing serum, and especially ascites-agar, are by far the most satisfactory for the artificial cultivation of this organism.

(2) Preparing Objects.

Studying Discomycetes.§—J. Lagarde examined the carpophore and hymenium in the fresh condition and also after treatment with a mixture of methylated spirit and formalin (75 parts 5 p.c. formalin and 25 parts alcohol 95°). The hymenium was examined by teasing out and by compression after treating the fragments with potash. Sections made by hand were treated for a long time with eau-de-favelle to get rid of their cell-content. On removal from the eau-de-favelle the sections were washed in water for at least 10 minutes, and then placed in 1 p.c. acetic acid or in 1 p.c. ammonia, according to the nature of the staining solution to be used. The dyes mentioned are anilin-blue, methylen-blue, "bleu Poirrier lactique," vesuvin, ruthenium red, and Congo red; stock 1 p.c. solutions were diluted for use with five to ten times their volume of water.

* English Mechanic, lxxxiii. (1906) p. 461.

† Bot. Zeit., lxiv. (1906) pp. 85-99 (1 pl.).

‡ Russki Vratch., No. 27 (1905). See also Centralbl. Bakt., Ref., xxxviii. (1905) p. 220.

§ Ann. Mycol., iv. (1906) pp. 125–201 (2 pls.).

For the cytology of these fleshy Discomycetes the strong Flemming's solution and Bouin's picroformalin and alcohol (picric acid 1, acetic acid 10, formalin 20, alcohol [70 p.c.] 70) were used, but the latter gave the best results. In this fixative the material was immersed for 24–48 hours, and then, after washing, was passed through up-graded alcohols to xylol or cedar oil preparatory to paraffin. The melting point of the paraffin was 42° and the temperature of the first bath 45°. In the second bath the melting point was 58° and the temperature 62°.

Sections 3–7 μ thick were made with a Minot microtome, and were freed from paraffin by immersing them in a bath of turpentine oil for 24 hours; the latter was got rid of with alcohol, and then the sections were hydrated in down-graded alcohols preparatory to staining.

The stains used were iron-hæmatoxylin, magenta-red, diamond-fuchsin, polychrome-blue.

The magenta-red procedure is as follows: After washing in water the sections are immersed for 10–20 minutes in 1 p.c. magenta-red in anilin water. After washing again they are stained for 3–5 minutes with picro-indigo carmin (0·5 grm. indigo carmin in 100 c.cm. of saturated aqueous picric acid solution). After a short wash in water the sections are differentiated and dehydrated with absolute alcohol, followed by oil of cloves, xylol, balsam.

Influence of Fixation on the Volume of Organs.*—Helene Stoltzner comes to the following conclusions. The fixatives in ordinary use have a greater or less effect on the volume of the organs. This effect varies with the organs; thus picric acid causes shrinkage of the liver, but increases the bulk of kidney, spleen, and brain. Some other and as yet unknown factors than the concentration of the fixative solution play an important part in the change of bulk of the material. In 4·5 p.c. cane sugar solution saturated with sublimate is found an isotonic fixative for warm-blooded animals, which leaves the volume of the organs unchanged.

Studying Spermatogenesis of the Earthworm.†— P. Depdolla, after trying several of the ordinary fixatives, finally adopted Benda's acetic acid chrom-osmic acid mixture. During the first half of the investigation the preparations were stained with iron-hæmatoxylin. The author then tried gentian-violet, and finally settled down to Benda's mitochondria stain, sulphalizarinate of sodium, and crystal-violet with iron mordant.

Studying the Segmentation of Siphostoma floridæ.‡ — Eug. W. Gudger obtained male pipe-fishes, opened the pouch, removed some eggs, and examined them under the Microscope. If they were in a stage wanted, the head of the fish was cut off and the eggs removed from the pouch. The best killing fluids were found to be Perenyi's 10 p.c. and 20 p.c. formalin, Gilson's and Worcester's fluids. This last consists of saturated sublimate in 10 p.c. formalin 90 parts, glacial acetic acid

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 14–25.
† Zeitschr. wiss. Zool., lxxxi. (1906) pp. 632–90 (1 pl.).
‡ Proc. U.S. Nat. Mus., xxix. (1906) pp. 447–500 (7 pls.).

10 parts. In this the eggs are left for from 30–60 minutes, and after washing in water are passed through alcohols up to 70 p.c., the excess of sublimate being removed with iodine.

Sometimes the eggs were next placed in 10 p.c. hypochlorite of sodium or potassium to soften the connective tissue and the egg membranes, but generally the shells were removed with needles after the alcohol stage.

The younger blastoderms were picked off the yolk and sectioned, but in later stages the eggs were cut whole, and in order to orient whole eggs in paraffin it is necessary to stain them, and best with borax-carmin. The sections were stained with hæmalum or with iron-hæmatoxylin. The former gave by far the better results.

Studying End-Organs of Rhynchobdellida.* — W. Mayer almost exclusively used *Clepsina sexoculata* in his research, the exceptions being *C. marginata* and *Piscicola geometra*. The material was fixed either in sublimate-acetic acid or in chrom-osmium-acetic acid, and then stained *en masse* with borax-carmin. Sections from these pieces were after-stained with Blochmann's solution. Other sections from material not treated *en masse* were stained with iron-hæmatoxylin, van Gieson, hæmatoxylin and acid fuchsin, and methyl-green. Special methods were also adopted for staining the nerves. For the intra- and supra-vitam methods, methylen-blue $\frac{1}{4}$ to $\frac{1}{8}$ p.c. solutions were used, the injected material being afterwards fixed with molybdenate of ammonium and then imbedded in paraffin. Golgi's rapid method was also used. For this the pieces were immersed for 4 or 5 days in potassium bichromate, then followed by $\frac{3}{4}$ p.c. silver nitrate, and imbedding in celloidin.

Studying the Vascular Endothelia and Blood of Amphibia.†— Kati Marcinowski fixed the material (embryos of *Bufo* and *Siredon pisciforme*), with a mixture of picric acid and sublimate for from 10–24 hours. After washing in water, the objects were dehydrated in up-graded alcohols and then transferred to cedar oil for preservation or direct imbedding in paraffin. The paraffin used was a mixture of hard superheated $\frac{1}{3}$ and an ordinary paraffin $\frac{2}{3}$. The imbedding temperature was kept as low as possible. The sections were mostly stained with borax-carmin.

Studying the Histogenesis of Cercariæum helicis.‡—C. F. Roewer fixed the material, kidneys removed from snails, in Rabl's sublimate-platinum-chloride mixture, in hot sublimate or in osmic acid. That fixed with osmic acid was afterwards treated with silver nitrate, while the material fixed in sublimate was stained with borax-carmin (in sections), or with carminate of sodium (in bulk). In the latter case the sections were contrast-stained with indigo-carmin-picric acid, or a mixture of bleu-de-Lyon and ammonium picrate. The formula for the latter is as follows: 25 c.cm. bleu-de-Lyon (1 p.c. in distilled water), 65 c.cm. ammonium picrate (saturated aqueous), 10 c.cm. picric acid (saturated

* Zeitschr. wiss. Zool., lxxxi. (1906) pp. 599–631 (3 pls.).
† Jena Zeitschr. Nat., xli. (1906) pp. 19–112 (5 pls.).
‡ Tom. cit., pp. 185–228 (2 pls.).

aqueous), 75 c.cm. distilled water, 50 c.cm. absolute alcohol. Several other staining methods were tried, among which may be mentioned the vital staining with methylen-blue followed by fixation with ammonium molybdate.

Demonstrating the Lymphatic Vessels of the Prostate.* — R. Caminiti, after recounting the methods of previous investigators, describes the procedure which has given the best results. After tying the ureters and urethra with silk thread, a 0·5–1 p.c. aqueous solution of silver nitrate is injected into the gland by means of a Pravaz syringe. Injections are made in numerous places and in all parts. The gland is then washed in distilled water, and afterwards placed in absolute alcohol, frequently changed, until it is sufficiently hardened. The sections (freehand or paraffin) are exposed for a few minutes to sunlight, and then transferred to a weak alcoholic solution of sodium hyposulphite (0·5–1 p.c.). After repeated washing in absolute alcohol, they are placed in bergamot-oil for some hours, and thence transferred to xylol and balsam. If the sections be over-blackened by the sun, they should be placed in 3–5 p.c. potassium iodide solution in 95 p.c. alcohol. From this they are transferred to 95 p.c. alcohol, and then to sodium hyposulphite.

In some cases Berlin blue was also injected through the aorta or iliac artery before the silver nitrate was used.

Investigating the Structure of Spinal Cord of Macaque Monkey.† Mabel P. Fitzgerald injected this monkey (*Macacus sinicus*) by Mann's method with picro-corrosive-formaldehyde solution. 2·5 grm. of sublimate were dissolved in boiling water, and then 1 grm. of picric acid added. When cold, and just before use, 10 c.cm. of formol were added. The cord was removed after about 24 hours, and then, together with the spinal ganglia, placed in 50 p.c. alcohol. It was next dehydrated in up-graded alcohols, and imbedded in paraffin (m.p. 52°). Serial sections, 20–20 μ thick, were cut, and, having been treated in the usual way to remove the mercury, were stained with eosin and toluidin-blue.

Studying the Structure of Visceral Ganglion of Anodonta.‡ — T. Freidenfelt first injected the fresh material with methylen-blue of various strengths, and after a preliminary examination to ascertain if the staining had been successful, fixed in Bethe's fluid. After hardening, the material was imbedded in soft paraffin, and coarse sections made. Good results were obtained by Lavdowsky's method, which consists in mixing fresh egg-albumen with about a similar quantity of 1 p.c. methylen-blue in physiological salt solution. Still better was to take some of the animal's blood and mix with methylen-blue diluted with ammonium chloride. The methylen-blue used was from 0·1–0·5 p.c., and the ammonium chloride about 0·1 p.c.

The author remarks that Bethe's method of after-treatment with potassium bichromate is not, in his opinion, altogether satisfactory.

* Anat. Anzeig., xxix. (1906) pp. 172–85 (4 figs.).
† Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 88–144 (numerous charts and figs.).
‡ Acta Univ. Lundensis, xl. (1904) received Aug. 1906, Afdeln 2, No. 5.

Studying the Epididymis.*—R. Ikeda followed the method recommended by Benda for examining the minute structure of the epididymis of man. (1) Fresh material was fixed for 2 days in 93 p.c. alcohol, to which 10 parts of formalin were added. (2) The material was next hydrated with dilute nitric acid (1 vol. officinal nitric acid to 10 vol. tap-water), 24 hours. (3) 24 hours in 2 p.c. potassium bichromate. (4) 48 hours in 1 p.c. chromic acid. (5) 24 hours washing in water. (6) Hardening in upgraded alcohols. (7) When the pieces are removed from absolute alcohol they should be placed in a mixture of equal parts of absolute alcohol and creosote before being saturated with paraffin.

The sections, which were not more than 5 μ thick, were stained by three different methods.

A. Modified Weigert's Glia-staining : (1) The sections were treated for 5 minutes with 0·5 p.c. potassium permanganate, followed by (2) Pal's reducer, sodium sulphite and oxalic acid, for about 3 minutes. (3) After drying with blotting-paper the section surface was flooded with Weigert's methyl-violet-oxalic-acid solution, or with Benda's crystal-violet-anilin-water mixture (1 vol. crystal-violet in 70 p.c. alcohol, 1 vol. 10 p.c. hydrochloric-acid-alcohol, and 2 vol. anilin-water). (4) Mop again with blotting-paper, and flood with Lugol's solution for about 1 minute. (5) Wash with water, differentiate with anilin-oil-xylol until no more colour is given off. (6) Dry ; flood with xylol several times, and mount in balsam.

B. Iron-hæmatoxylin method : (1) The sections are mordanted for 24 hours with 4 p.c. iron-alum solution, or with liq. ferri sulph. oxydat. diluted with 2 vol. distilled water. (2) Washed in running water. (3) Stained for 24 hours in dark-yellow aqueous hæmatoxylin solution, made by dropping strong alcoholic hæmatoxylin solution into water. (4) Washed in tap-water for ½ hour. (5) Differentiated with Weigert's borax-ferricyanide solution, until the sections are yellowish-grey. (6) Washed ; dehydrated ; mounted in balsam.

C. Alizarin staining : (1) Mordant for 24 hours with 4 p.c. iron-alum solution. (2) Wash in running water. (3) Stain for 24 hours in dilute amber-yellow solution of sulphalizarinate of sodium. (4) Wash, and mop up with blotting-paper. (5) Stain in 0·1 p.c. aqueous solution of toluidin-blue for 24 hours in cold solution, or for 15 minutes if heated to vaporisation. (6) Treat with 1 p.c. acetic acid. (7) Dry with blotting-paper, and flood with absolute alcohol. (8) Differentiate with creosote, examining under low power, until connective-tissue is red and the cell-nuclei blue. (9) Dry with blotting-paper ; treat several times with xylol, and then mount in balsam.

Demonstrating the Embryology of Amentiferæ.†—Margaret Benson, Elizabeth Sanday, and Emily Berridge, found that the fertilisation process took place chiefly between July 6 and July 10. The fixatives used were absolute alcohol and Flemming's strong and weak fluids. The ovaries were dissected immediately on gathering, the ovary wall being removed as far as possible so as to expose fully the ovules to the

* Anat. Anzeig., xxix. (1906) pp. 1–14 (1 pl. and 8 figs.).
† Trans. Linn. Soc. Bot., vii. (1906) pp. 37–44 (1 pl.).

action of the fixing agent. The absolute alcohol material was after 2 days transferred to methylated spirit for a week, and then preserved in a mixture of equal parts of absolute alcohol, glycerin, and distilled water. The material fixed in Flemming's fluid was placed after about 2 hours in 5 p.c. chromic acid for 16–18 hours, and then washed in running water for several hours. The material was finally passed through upgraded alcohols into methylated spirit, left there for a week, and afterwards transferred to the same preserving fluid as before. To prepare for sectioning, as much extraneous tissue as possible was removed from the ovules, which were then passed through absolute alcohol, bergamot-oil, to paraffin of various melting-points, being cut finally in 52° m.p. paraffin.

The sections, mostly 16 μ thick, were stained with Flemming's triple stain and Ehrlich's hæmatoxylin. The former was more effective for nuclear fusion, the latter for the pollen-tubes.

Demonstrating Life-history of Leucocytes.*—C. E. Walker fixed the material with Flemming's fluid (strong formula), Hermann's fluid, acetic acid and absolute alcohol, corrosive sublimate and acetic acid, and strong formic acid. The author remarks that the greatest care must be taken with the processes of fixation, dehydration, imbedding, staining, etc. Extremely small pieces of tissue should be placed in the fixative within about a minute of the death of the animal or removal from the living body. Dehydration should be carried out in short stages, an increase of 10 p.c. of alcohol being perhaps best. This does not apply to tissues fixed in acetic acid and alcohol or strong formic acid (40 p.c.), from which the tissues are transferred immediately to absolute alcohol. At the same time, it is necessary that the tissues should not be left in alcohol (under 80 p.c.) for more than two or three hours after fixation. In imbedding, no higher temperature than 45° C. should be used. Throughout the processes of staining and mounting, the greatest care must be taken that the sections do not become even partially dried upon the slides.

It is almost necessary to use a 10-inch tube Microscope with monochromatic light and apochromatic objective and eye-piece. With a monochromatic light it is possible to obtain excellent definition with a 27- or even 40-compensation ocular, and a 2 or 3 mm. apochromatic objective. Anything approaching this is impossible with the ordinary short tube.

In view of the advantage gained by using a monochromatic light, the stains must be chosen with regard to the colour of the light used. The part of the spectrum between the blue and green gives the shortest wave-lengths that can be conveniently used. As this gives a better definition than the parts of the spectrum with longer wave-lengths, red, yellow, and orange stains give the best results.

Studying the Spinal and Sympathetic Ganglion Cells of the Frog.†—E. Warfuringe fixed some of the material with 96 p.c. alcohol and 2 p.c. ammonia, the rest with 40 p.c. alcohol and 2 p.c. ammonia.

* Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 53–9 (4 pls.).
† Archiv Mikrosk. Anat., lxviii. (1906) pp. 432–40 (1 pl.).

This was followed by 1·5 p.c. silver nitrate solution for 6–12 days, with subsequent reduction with hydroquinone. In some cases the reduction was hastened with soda and sodium sulphite. The 40 p.c. spirit preparations retained the colour best, and it was afterwards found advisable to use 3 p.c. silver nitrate, as 1·5 p.c. was not strong enough. The paraffin sections were after stained with thiazin-red.

Moist Chamber for Studying the Thrombocytes of Salamanders' Blood.*—F. Meves, when studying the thrombocytes of salamanders' blood and their relation to coagulation, used the following apparatus (fig. 72). The moist chamber, made of tin, was 14 cm. long, 7½ cm. broad, and 5½ cm. high, and to one of the two long sides was soldered a thick metal plate. Halfway up, this side was traversed by a slit 8½ cm.

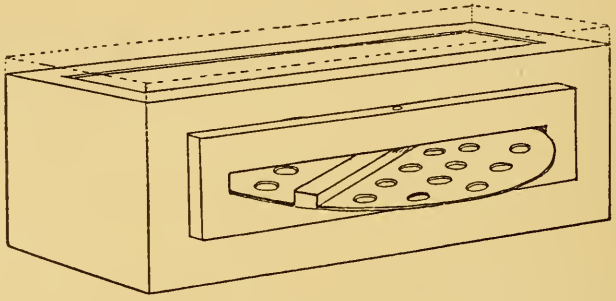

Fig. 72.

long and about 4 mm. thick. Into this slit fits a metal piece which carries a circular tray. The metal piece and the disk were able to revolve round a vertical axis passing through their centre. The chamber, which is open at the top, was filled to a depth of 1 cm. with 0·8 p.c.salt solution, and then covered with a glass plate made air-tight by means of vaselin. The slides, covered with a fresh film of blood, were placed on the outer half of the tray, and then, by giving it a turn through 180°, were quickly brought into the moist atmosphere.

As fixatives, 1 p.c. sublimate or Flemming's mixture (weak formula), both with 1 p.c. salt added, were employed. The sublimate-fixed preparations were stained with the Ehrlich-Biondi solution, while Flemming preparations were treated with safranin and Delafield's hæmatoxylin, or with Flemming's triple stain.

Studying Polysiphonia violacea.† — S. Yamanouchi fixed his material in Flemming's fluid, Hermann's fluid, and 1 p.c. picric acid. He found that chrom-acetic acid (1 p.c. chromic acid, 25 c.cm.; 1 p.c. glacial acetic acid, 10 c.cm.; sea-water, 65 c.cm.) was best suited for

* Archiv. Mikrosk. Anat., lxviii. (1906) pp. 311–58 (4 pls.).
† Bot. Gazette, xli. (1906) pp. 425–33.

study of spermatogenesis and the germination of carpospores and tetraspores. The material was left in the fixative for 5–40 minutes, and then washed in sea-water, after which it was passed through up-graded alcohols to 52° m.p. paraffin. The sections were stained with safranin-gentian-violet or with iron-hæmatoxylin, and these were sometimes followed by orange G, Bordeaux red, or Congo red.

Studying the Nutritive Relations of the Surrounding Tissues to the Archegonia in Gymnosperms.*—M. C. Stopes and K. Fujii found that the best fixative was 90 p.c. alcohol, and that Flemming's fluid was less satisfactory owing to the presence of some substance which reduced the osmium.

Sections were stained with Flemming's triple stain, acetic-methyl-green, Congo red, and various iodine solutions.

Studying the Larvæ of Bryozoa.† — O. Seeliger preserved the larvæ and embryos in sublimate, sublimate-acetic-acid, formalin, and osmic acid. *Pedicellina* larvæ treated with sublimate or formalin made excellent preparations after staining and clearing up in oil and balsam or in glycerin. *Alcyonidium* larvæ never cleared up sufficiently. Most of the staining was done with carmin and hæmatoxylin, but orange was used as an after-stain for yolk-masses. Larvæ which had been fixed in formalin were stained with molybdic-acid-hæmatoxylin or with phospho-molybdic-acid-hæmatoxylin. The shape of the individual elements of a section was more clearly brought out by tapping on the cover-glass so as to dissociate the cells, though this procedure was only partially successful.

Studying the Germ-Cells of Enteroxenos östergreni.‡—Kristine Bonnevie at first fixed this Holothurian parasite in sublimate-acetic-acid, picric-acid-sublimate, or in picro-acetic-acid, but found that Zenker's, Hermann's, and Flemming's fluids were more satisfactory. For the ovary Zenker's fluid gave the best results, while Hermann's was superior for the testicles, but was allowed to act for only 4 hours. The principal stain used was Heidenhain's iron-alum-hæmatoxylin, though special methods were adopted for nucleoli and mitochondria.

Demonstrating Spirochæta pallida in Bone.§ — E. Bertarelli describes three cases of syphilitic osteochondritis in various aged fœtuses. The tissues were fixed in formalin or alcohol and imbedded in celloidin —the bones being decalcified in 1·5 p.c. nitric acid—and were impregnated by an acid alcoholic solution of silver nitrate. In one case, in sections of the femur of a seven-months fœtus, many spirochætes were observed in the periosteum and in the layer of spreading ossification, but were not regularly distributed; endocellular forms were not seen, all the spirochætes lying between the connective-tissue bundles; some were very long, some with pointed ends, others showed a distinct bead at one or both ends.

In another case, from the femur of an eight-months fœtus, though

* Beih. Bot. Centralbl., xx. (1906) p. 1–24 (1 pl.).
† Zeitschr. wiss. Zool., lxxxiv. (1906) pp. 1–78 (4 pls.).
‡ Jena Zeitschr. Naturw., xli. (1906) pp. 229–420 (8 pls.).
§ Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 639.

there was marked osteochondritis, the spirochætes were not so numerous, but in the marrow were seen many badly stained and fragmented forms. In a third case, from a portion of a long bone, of probably a full-term fœtus, very few spirochætes were observed, and these were badly stained.

Studying the Development of Nebalia.* — Margaret Robinson fixed the eggs, removed from the pouches, in hot saturated sublimate solution, to which a little acetic acid had been added. After washing they were passed slowly through up-graded alcohols to 80 p.c. alcohol.

The shells of the early stages were removed by teasing with fine needles.

To obviate difficulties arising from the brittleness of the yolk, the material was either imbedded in celloidin, or each section was painted with a mixture of equal parts of gum mastic and celloidin. In the former case the material was orientated by cutting the celloidin to the required shape, and in the second by fastening the embryo in position on a piece of lardaceous liver before imbedding in paraffin. Sections 4 μ thick were stained with Kleinenberg's hæmatoxylin and orange.

Demonstrating the Structure of Erythrocytes of Siredon pisciformis.†—A. E. von Smirnow, in a research on the structure of the erythrocytes of *Siredon pisciformis*, followed the technique devised by Kopsch when investigating the protoplasmic reticulum in nerve-cells.‡ This method consists in submitting the material to the prolonged action of osmic acid. The author used various strengths of osmic acid, 0·5–2 p.c., in aqueous or in isotonic salt solution. The treatment lasted from $\frac{3}{4}$ day to 10 days, or longer.

Donaggio's Method of Staining Degenerated Nerve-Fibres.§—A. Veneziani employed Donaggio's methods for demonstrating the degeneration of nervous tissue in the tentacles of *Helix pomatia*. Three varieties are described. The fixatives used were Müller's fluid and sublimate.

A. 1. Sections 20–30 μ were transferred from the fixative to alcohol, and thence for a few minutes to water. 2. They were then stained with a hæmatoxylin-chloride of tin solution (aqueous solution of chloride of tin, 20 p.c. ; aqueous solution of hæmatoxylin, 1 p.c. ; equal parts of the two solutions are mixed and kept in a cool dark place) for 10–20 minutes. 3. Decolorised in permanganate of potassium 0·25 p.c., and then in an aqueous solution of 1 p.c. oxalic acid, mixed with an equal quantity of 1 p.c. aqueous sulphite of soda. 4. Wash for a few minutes in water. 5. Alcohol ; xylol ; balsam.

B. 1. Sections 20–30 μ are placed in aqueous 0·5–1 p.c. hæmatoxylin for 10–20 minutes. 2. Saturated aqueous solution of neutral acetate of copper 30 minutes, once renewed. 3. Decolorising, etc., as in A.

C. 1. The material was transferred from the fixative to 70 p.c. alcohol for 3 hours, and for a similar time to absolute alcohol. 2. Imbedding in celloidin. 3. Sections 30–40 μ were placed for 20 minutes

* Quart. Journ. Micr. Sci., l. (1906) pp. 383–433 (6 pls.).
† Anat. Anzeig., xxix. (1906) pp. 236–41 (5 figs.).
‡ See this Journal, 1902, p. 717. § Anat. Anzeig., xxix. (1906) pp. 241–8.

in 1 p.c. hæmatoxylin. 4. Decolorising in 15 p.c. aqueous solution of perchloride of iron for a few minutes. 5. Rapid washing in hydrochloric-acid-alcohol (0·75 HCl to 100 C_2H_6O). 6. Absolute alcohol, and removal of celloidin if necessary. 7. Clearing in xylol or cedar-wood oil, as the case may be.

(3) Cutting, including Imbedding and Microtomes.

Aceton-Paraffin Imbedding Method.*—A. E. Sitsen has tested this method, and finds that for diagnostic purposes it is of value, but for demonstrating the finer details there should be a preliminary fixation. Pieces 1–2 mm. thick are placed for 15–30 minutes in 10 p.c. formalin and then for 30 minutes in aceton. After this they are placed in paraffin for an equal length of time.

Material fixed in chromic acid salts requires to be soaked in water for 24 hours. The method is also available for alcohol-fixed tissues. For demonstrating glycogen the material should not be fixed before it is immersed in aceton; fat requires to be blackened by osmic acid, as it disappears if not previously fixed.

Rapid Method of Preparing Large Numbers of Sections.†—G. C. Huber, after alluding to the difficulties attending the preparation of sections for large classes, describes the procedure adopted by him, which is a combination of the warm water method of flattening paraffin sections and the Obregia-Gulland method.

The fixed and dehydrated tissues are impregnated with paraffin in partial vacuum. Serial sections are then made and flattened out in warm water contained in a tray specially devised for the purpose. While still in the water, or in a sugar-dextrin solution, the ribands are floated on to glass plates. On removal, the plates, covered with series of sections, are drained and dried. The paraffin is then removed in the usual way (heat and xylol), after which the plates are transferred to absolute alcohol. The next step is to cover the sections with the following solution: photoxylin 10, absolute alcohol 100, ether 500. When the photoxylin is set the film of sections is removed by immersing it in water. It may then be cut up into any desired lengths, and stained and mounted in the usual way.

If, however, the sections are required for future use, they may be removed by placing the plate in water, and then rolling the film round a glass rod, and afterwards storing the rolls in 80 p.c. alcohol.

For the minute details of the procedure, which are very clearly given, the original should be consulted.

(4) Staining and Injecting.

Staining Piroplasma Muris.‡—H. B. Fantham stained films of the blood and smears from the internal organs of the white rat by various modifications of the Romanowsky method, especially a combination of the methods of Laveran and Plimmer, using Bleu Borrel, erythrosin, and

* Centralbl. Allgem. Pathol. u. Pathol. Anat., xvi. (1905) pp. 774-5.
† Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 187-96 (2 figs.).
‡ Quart. Journ. Micr. Sci., l. (1906) pp. 493-516 (1 pl.).

tannin-orange. Good results were also obtained with Leishman's stain and with a modification of Giemsa's solution, using a 1 p.c. aqueous solution of azur ii. and 0·1 p.c. aqueous solution of erythrosin mixed on the slide after fixation with pure methyl-alcohol.

Other blood films and smears of organs were fixed with a mixture of sublimate 2 parts and absolute alcohol 1 part, or with osmic acid, and then stained with a dilute acidulated solution of Delafield's hæmatoxylin followed by eosin. The staining is slow, at least 24 hours being necessary.

Demonstrating Segmentary Organs of Polychæte Annelids.*—L. Fage attained the best results, in his researches on the Polychæte Annelids, by means of fine dissection under the Microscope. In order to facilitate the operation, the cœlom was injected with indian ink or carmin, or by treating the specimen from which the digestive tube had been removed with a very dilute solution of neutral-red in sea-water.

Control observations were made from sections of material fixed with a saturated solution of sublimate in sea-water, to which 5–10 p.c. acetic acid were added. Bouin's and Tellyesnicky's fluids gave equally good results. For special purposes, Lindsay's, Flemming's, and Merkel's fluids were used. Paraffin sections were made in the usual way, and stuck to the slide with a $\frac{1}{500}$ gelatin solution in water. The stains used were alum-carmin, iron-hæmatoxylin, and, after osmic acid fixatives, magenta-red or safranin. As plasma stains, light green and orange G were used.

Special methods were adopted to bring out the reticulum of the phagocytic organs and the secretory vesicles. For the former the pieces were macerated in a weak solution of bichromate of potassium, or in Merkel's fluid.

A selective staining of the secretory vesicles was obtained by treating the sections after the manner of Weigert.

Demonstrating Chromatic or Nucleoid Granules.†—N. Loewenthal fixes the material in Flemming's solution, and stains the sections with paraffin, afterwards decolorising with alcohol acidulated with hydrochloric acid.

Zenker's fluid followed by hæmatoxylin and eosin was also used, except for the cerebro-spinal ganglia, which were fixed either in chromosmic-acetic acid or in Erlicki's fluid ; staining in the former instance being effected with safranin, in the latter with picro-carmin or hæmatoxylin.

Part played by Sodium Chloride in the Silver Impregnation Method.‡—Ch. Achard and M. Agnaud support the view recently put forward by Quinton that the reduction of the silver in the tissues is due to the presence of sodium chloride in the intercellular spaces, and the formation of a precipitate of silver chloride, which turns black on exposure to the light. The authors find that if the sodium chloride be removed by immersing the membrane in a solution of sodium sul-

* Ann. Sci. Nat. Zool., iii. (1906) pp. 261–410 (2 pls.).
† Journ. Anat. et Physiol., xlii. (1906) pp. 305–56 (1 pl.).
‡ Comptes Rendus, cxlii. (1906) pp. 1571–2.

phate or of sugar, it is no longer possible to impregnate the tissue; and, per contra, if such a dechlorided membrane be treated with physiological salt solution, the tissue is then as effectively impregnated as is fresh membrane. These facts explain why nervous and other tissues often fail to become impregnated—they have been accidentally dechlorided.

Physiological Injection for Studying Development of Enamel.* H. Ganzer studied the histogenesis of enamel by means of injections of saturated solutions of sulphindigotate of soda. Results of several experiments are given in tabular form, the most satisfactory being: subcutaneous injection of 4 c.cm. for two successive days followed after an interval of a day by injection of a similar quantity into the peritoneal sac. The animal was killed after the lapse of three-quarters of an hour, and it was found that the non-calcified parts of the teeth were stained deep blue. The other result was obtained by injecting 4 c.cm. into the peritoneal sac, and killing the animal three-quarters of an hour after. In this case the non-calcified parts were of a sky-blue hue.

Demonstrating Nerves in Female Genital Tract.†—F. Worthmann studied the nerves and nerve-endings of the clitoris and vagina by the methylen-blue method. Pieces of quite fresh tissue were sectioned between slips of elder-pith. The sections, placed on a slide, were treated with $\frac{1}{500}$ p.c. methylen-blue in physiological salt solution and incubated for about 10 minutes at 35°. If, when placed between two slides, they showed, on inspection under the Microscope, a good staining of the coarser nerves, they were transferred to 7·5 p.c. aqueous solution of molybdenate of ammonia for 6–8 hours. If not properly stained, they were replaced in the methylen-blue solution for 5–10 minutes, and then if nothing were to be seen, they were rejected.

On removal from the molybdenate solution the sections were washed in frequently changed distilled water for 2–4 hours. Some sections were then very rapidly dehydrated in absolute alcohol, and, after xylol, mounted in balsam. Other sections were, on removal from water, cleared in glycerin, and then mounted in glycerin jelly (Beale's formula).

Demonstrating the Regeneration of Peripheral Nerves.‡—P. Krassin demonstrated the centrifugal course of regeneration of peripheral nerves after division by intra-vascular injection of 1 p.c. methylen-blue in physiological salt solution, or by immersing the preparations for a period in weaker solutions ($\frac{1}{10}$–$\frac{1}{16}$ p.c.) of the same pigment. The staining was fixed either by means of a saturated aqueous solution of ammonium picrate, or by a 5–10 p.c. aqueous solution of molybdenate of ammonium.

Simple Method of Staining Spores.§—O. Ország mixes up the bacteria in a drop of fluid composed of $\frac{1}{2}$ p.c. sodium salicylate 4 parts,

* Anat. Anzeig., xxviii. (1906) pp. 436–42.
† Arch. Mikrosk. Anat. u. Entwikl., lxviii. (1906) pp.122–36 (2 pls.).
‡ Anat. Anzeig., xxviii. (1906) pp. 449–53.
§ Centralbl. Bakt. Orig., xli. (1906) pp. 397–400.

and 5 p.c. acetic acid 1 part, on a clean cover-glass. The size of the drop must be small so that the film dries quickly, after which it is fixed in the flame. The film is then stained hot with carbol-fuchsin, after which it is decolorised with 1 p.c. H_2SO_4 until the preparation is of a pale rose colour.

After thoroughly washing with water, the film is stained with 1 p.c. aqueous methylen-blue, or malachite green, for 2 minutes. The washed and dried film is mounted in balsam. A variation of the method may be made by contrast-staining and decolorising at the same time with a saturated solution of methylen-blue in 1 p.c. sulphuric acid.

Demonstrating Negri's Corpuscles.*—Bohne removed from the cornu ammonis pieces $\frac{1}{2}$–$\frac{3}{4}$ mm. thick and placed them in pure aceton at 37° for 30–45 minutes, or longer if the brain were much decomposed, until they were firm. The pieces were then immersed in liquid paraffin (m.p. 55°) and kept therein at 60° for 60–75 minutes. The sections were removed to cold water to which some gum arabic had been added, and when placed on the slide were dried at 60°. After getting rid of the paraffin the sections were stained for $\frac{1}{2}$–4 minutes by Mann's method (35 c.cm. 1 p.c. aqueous methylen-blue solution + 35 c.cm. 1 p.c. eosin solution + 100 c.cm. distilled water). After washing in water and then in water and alcohol the sections were treated for 15–20 seconds with 30 c.cm. absolute alcohol + 5 drops of 1 p.c. caustic soda solution. The sections were then washed in absolute alcohol followed by tap-water (1 min.) and then by water slightly acidulated with acetic acid, after which they were rapidly dehydrated and mounted in balsam.

The author regards the presence of Negri's bodies as diagnostic of rabies, but expresses doubt as to their parasitic nature.

Demonstrating the Striated Membrane in the Erythrocyte of Salamander.†—F. Meves deposited thin films in a moist chamber for various times (a few minutes to half-an-hour) and then fixed them with weak Flemming's solution (1 p.c. chromic acid 25 c.cm., 1 p.c. osmic acid 10 c.cm., 1 p.c. acetic acid 10 c.cm., distilled water 55 c.cm.) to which 1 p.c. salt was added. After washing in running water the preparations were stained with safranin and Delafield's hæmatoxylin, or with Flemming's triple stain (safranin-gentian-orange). In the former case the films were treated for 24 hours with 1 p.c. aqueous solution of safranin followed by neutral alcohol, and finally by the hæmatoxylin for 6–12 hours. In the latter case the films were treated according to Flemming's directions, though the author differentiated for half-an-hour with oil of cloves previous to mounting in balsam.

Staining of Treponema pallidum Schaudinn.‡—B. Galli-Valerio recommends Giemsa's solution as supplied by Grubler. He uses solutions of 1 : 10 and 1 : 20 acting from 5–20 hours. The *Treponema* is coloured red, the bacteria and spirilla becoming deep violet.

* Zeitschr. f. Hygiene u. Infekt., lii (1905) p. 87 (1 pl.). See also Centralbl. Bakt. Ref., xxxviii. (1906) pp. 220–1.

† Anat. Anzeig., xxviii. (1906) pp. 444–7 (2 figs.).

‡ Centralbl. Bakt., 1te Abt. Orig., xli. (1906) p. 745.

Apparatus for Staining simultaneously numerous Microscopical Sections.*—N. P. Tischutkin describes with a wealth of detail an apparatus which he has devised for the simultaneous treatment of numerous microscopical sections, and of fine histological objects such as embryos, ova, etc.

The apparatus (fig. 73) consists of a couple of tubes, both having wide lips at their upper ends. The outer tube E has a circular aperture O in its bottom, the diameter of the aperture being less than that of the tube J. Between the lower end of J and the bottom of E is interposed a circular piece of mica. Around the neck of the inner tube J is a caoutchouc ring, which fits tightly and accurately into the outer tube E. The sections are placed in the inner tube, and the whole apparatus is immersed in the desired fluid. The fluid then finds its way into the inner tube, and never rises in the outer tube above 0·5–1 cm. The fluid can be removed by tilting up the mica disk with a needle. The apparatus is stated to have given satisfaction.

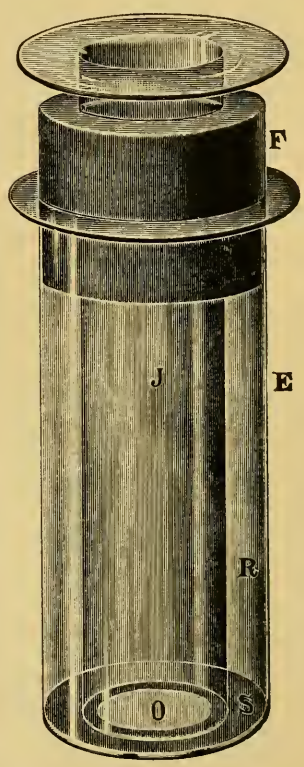

Fig. 73.

Ruthenium-red as Test for Pectin.†—F. Tobler, after alluding to the properties of ammoniacal ruthenium sesqui-chloride as as a staining reagent for pectic substances,‡ acknowledges its value in that capacity, but shows that as a microchemical test for pectin, its virtues have been over-rated, inasmuch as it is capable of dyeing other substances than pectin and its derivatives.

New Method of Staining Diphtheria Bacilli.§—P. Gălesescu finds that films of *B. diphtheriæ* can be easily stained so as to give a positive reaction in at least 80 p.c. of cases by the following method. Films from blood-serum cultures are stained for 1 minute with 1 p.c. gentian-violet solution, and then, after washing in water, are treated for 1 minute with an aqueous solution of Bismarck brown (0·2 p.c.).

Staining Blood and Bacteria with Eosin-Methylen-Blue.‖—O. Spiegel recommends the solution suggested by May and Grünwald for staining blood-films. He finds that the solution also answers well for bacteria of all sorts. It is made by mixing 1 litre of 1 per thousand

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 45–58 (1 fig.).
† Tom. cit., pp. 182–6.
‡ See this Journal, 1893, p. 563.
§ Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 67–9.
‖ Centralbl. Bakt., 1te Abt. Orig., xl. (1906) pp. 430–1.

eosin and 1 litre of 1 per thousand medicinal methylen-blue. The precipitate is carefully filtered and washed with distilled water, and then dissolved in 0·25 p.c. methyl-alcohol. The dried but unfixed films are stained for 2 minutes and then treated with distilled water for 1 minute, after which they are mopped up with blotting paper. The distilled water should be perfectly neutral.

A. Huisman * praises Jenner's stain, as it gives more reliable and satisfactory results than other methods. He has devised the following modification. He mixes equal parts 0·175 p.c. solution of solid azur-blue in absolute methyl-alcohol, and 0·825 p.c. solution of eosin B. A. Höchst in the same medium.

The mode of using the stain is the same as in the original method.

Staining Spirochæta pallida.†—F. R. M. Berger finds Dahlia a useful reagent for staining *Spirochæta pallida* (*Treponema pallidum*). He dilutes 4 c.cm. saturated alcoholic Dahlia solution with 20 c.cm. distilled water.

Very thin films are fixed for 5–10 minutes in absolute alcohol and then dried. The films are then treated with a few drops of Giemsa's azur ii. solution for a minute. After washing in water they are dried and passed through the flame. The films are next treated with a few drops of the above described Dahlia solution for 2–3 minutes. After this they are washed in tap-water, dried, rapidly passed through the flame, and mounted in balsam. Instead of Dahlia, gentian-violet may be used; in this case the staining is somewhat darker.

Balazsy, D.—**Zur Glimmertechnik.**
[Gives a modification of Heidenhain's method of treating sections for class purposes. See this Journal, *ante*, p. 110.
Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 12-14.

Prowazek, S.—**Technik der Spirochäte-Untersuchung.**
[A resume of the various methods employed for demonstrating the structure of *Treponema pallidum*.] *Tom. cit.*, pp. 1–12.

(6) Miscellaneous.

Modification of Schultze's Clearing Method.‡ — E. C. Hill, after describing Schultze's, Van Wijhe's, and Lundvall's methods for clearing embryos and other anatomical specimens, details the procedure adopted in the Johns Hopkins Anatomical Laboratory.

The specimens are first injected with Indian ink diluted to one-third its commercial strength. The addition of a small amount of weak ammonia obviates precipitation of the medium. The injection of small embryos should be carried out in warm water, with the membranes still intact. All unnecessary tissue should then be removed.

The specimens are next placed in 95 p.c. alcohol until completely shrivelled (3–7 days). They are then removed to 1 p.c. KHO until transparent (4–48 hours). After this they are placed in 20 p.c. glycerin

* Méd. et Hygiene, No. 4 (1906). See also Brit. Med. Journ. (1906) ii. Epit. 48.
† München. Med. Wochenschr., 1906, p. 1209. See also Zeitschr. wiss. Mikrosk. xxiii. (1906) pp. 224-5.
‡ Bull. Johns Hopkins Hosp., xvii. (1906) pp. 111-15.

for 48 hours more. If cleared, they are immersed in upgraded glycerins. If not clear, they are placed in a mixture of equal parts of 1 p.c. KHO and 50 p.c. ammonium hydroxide for 5–72 hours. Next they come into 20 p.c. glycerin for 48 hours or more, the treatment, as outlined above, being continued.

By following this method, the systems of bones, cartilages, arteries, veins, lymphatics, and various ducts, can be demonstrated in a transparent embryo, or in large sections of adult tissue, without distortion of the structures.

For staining the skeletal system, it is advised to place the fresh specimen in 95 p.c. alcohol, and then treat for 24 hours with alum cochineal, and then clear with 1 p.c. potassium hydrate.

Specimens may be mounted in the following way: Remove from pure glycerin, wipe, and quickly wash. Place in a little thick gelatin, and lay on a warm slide. When the gelatin has hardened, return to pure glycerin.

Microscopic Estimate of Bacteria in Milk.*—F. H. Slack advocates the following method for the bacterial estimate of milk. The sample is centrifuged, and the sediment of a known quantity of milk obtained is emulsified with a drop or two of sterilised water and spread into even smears on glass slides, previously correctly spaced with a blue pencil. The observer finds a representative field seen through a $\frac{1}{12}$th oil immersion, and regards it as a $\frac{1}{10000}$th dilution plate, each coccus, bacillus, etc., representing a colony on such a plate. The number of organisms in the field multiplied by 10,000 gives approximately the number of bacteria per c.cm. in the sample of the milk. The author claims that the method is practical for certifying milk as containing less than 50,000 bacteria per c.cm.; there is also advantage in the rapidity of the method, and in the possibility of examining large numbers of samples without delay.

Counting Bacilli.†—W. C. Oram writes that he has found an instrument, made for him by Alexander and Fowler, of Liverpool, very convenient in the operation of counting the bacilli engulfed by the white blood corpuscles when engaged in estimating opsonic indices by Wright's method. The apparatus consists of two dials—one for recording the bacilli and the other the corpuscles—the dial hand moving through one division of the dial for each depression of the attached pedal. The instrument is intended to be placed upon the floor and worked by the feet, thus leaving both hands free, the one for focusing, and the other for the manipulation of the slide. When the corpuscle register reaches 50, which is the usual number to observe, a bell sounds, indicating the completion of the count, and it only remains to take the reading of the other dial, which will give the number of bacilli found. The instrument, he thinks, might also serve for the taking of ordinary blood counts, one dial being used to register the squares of the hæmocytometer, and the other the corpuscles.

* Technology Quarterly, xix. (1906) p. 37.
† Brit. Med. Journ., 1906, i., p. 1534.

New Form of "Container" for Use in Museums of Economic Botany.*—G. L. Goodall gives the following details: "The materials are—1. Lantern-slide glass of best quality and of standard size. 2. Strips of hard wood of different widths, ranging from $\frac{1}{16}$ in. to 1 in., but of perfectly uniform thickness, namely $\frac{1}{16}$ in. for the widths below $\frac{1}{2}$ in., and $\frac{1}{8}$ in. for the widths above this. 3. Strong fish-glue in a liquid form—that which comes in Dennison's tubes has proved satisfactory. 4. A strong solution of potassium dichromate or a 20 p.c. solution of formalin. 5. Hard paraffin. 6. Strong binding strips well made with good glue.

"From three strips of the wood neatly fastened between two thoroughly cleaned glass slides, one procures a container of the desired thickness. This is filled with the specimen of seeds or other objects and then is closed by placing the fourth strip in position. All four edges are next dipped for an instant in the solution of potassium dichromate or of formalin, in order to render the glue, after drying and exposure to the sun, wholly unaffected by moisture. If preferred, these solutions may be put on with a brush. When the filled container is completely dry, the edges are placed in a thin layer of melted hard paraffin and quickly removed. On cooling, the excess of paraffin is carefully scraped off, and the binding strips are then applied. The prepared container is now ready for installation in any exhibition case. Its contents are proof against invasion by moisture or any museum pests. In the very few instances where insects have been subsequently detected in the container, a small hole was made in one side of the wood, and a little carbon disulphide or chloroform thrown in by a medicine-dropper, and then the hole was closed by a bit of soft wax. In no case has it been found necessary to repeat the dose.

"When the specimen is a powder which it is desired to show in a thin layer, it has been found well to proceed in a different manner. First, a flat cell is made by cementing with glue the thinnest strips of wood on all four sides, and then drying the whole. Into this cell the powder can be put in a perfectly even layer, and then covered carefully by the other slide.

"Among the advantages which this easy method possesses are the following: economy of material, absence of distorting refractions of the container, a convenient tablet form for any exhibition-case, and a free space for labelling. To these advantages may be added the slighter but not unimportant ones: exposure of both sides of the specimen, and security against damage when used as a hand-specimen for class-work."

New Method for Detecting Starch in Wheat Flour.†—G. Gastine has devised a sensitive and certain method for detecting the adulteration of wheat and other flours with rice. It consists of impregnating the suspected flour with a staining solution, drying the preparation slowly, and then heating it for a few minutes at a temperature of 110°–130°, after which it is examined under the Microscope in cedar oil or in balsam.

* Amer. Journ. Sci., xxi. (1906) pp. 451–2.
† Comptes Rendus, cxlii. (1906) pp. 1207–10.

Various pigments are enumerated, greens and blues (0·05 p.c. in 33 p.c. alcohol) being the most suitable. The actual stain, however, appears to be less important than the rest of the technique. By this method rice starch-grains are distinguished from those of wheat by the distinct, relatively large and reddish hilum.

Simple Formula for Mixing any Grade of Alcohol Required.*—E. W. Berger gives the following: Let P represent the grade per cent. of the alcohol on hand, P′ the grade per cent. required, v the number of volumes of water to be added to one volume of P to make alcohol P′, and x the number of volumes of P we desire to change to P′. Then

$$\frac{\mathrm{P}\,x}{x + v\,x} = \mathrm{P}'$$

From this we get

$$\mathrm{P}'\,v = \mathrm{P} - \mathrm{P}'$$

and

$$v = \frac{\mathrm{P} - \mathrm{P}'}{\mathrm{P}'}$$

Microscopic Slides in Drawers.†—R. Inwards writes: In taking slides from the drawers in which they are kept, there is often some difficulty in getting the finger under the edge of the slide so as to lift it

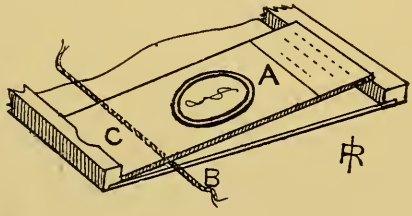

Fig. 74.

out. This is especially the case when the slide nearly fits its recess. The sketch (fig. 74) shows the plan I have adopted. A is the slide in its drawer; B is a piece of silk cord $\frac{1}{16}$ in. in diameter, fastened with seccotin to the bottom of the drawer inside and at $\frac{3}{8}$ in. distant from the front. A slight pressure at C raises up the other end of the slide, which can then easily be taken out. The sketch shows the slide tilted up ready for removal. At other times it lies nearly flat in the bottom of the drawer.

Apparatus for Rapidly Cleansing Sand and Gravel.‡—W. Lorch has devised an apparatus (fig. 75) for cleansing sand and gravel, material so often required in botanical researches. It consists of a

* Ohio Naturalist, vi. (1906) pp. 352–3.
† English Mechanic, lxxxiv. (1906) p. 18 (1 fig.).
‡ Flora, xcvi. (1906) pp. 525–6 (2 figs.).

strong zinc cylinder A, having funnels B, C, at the lower and upper ends. To the top of the cylinder is soldered a circular vessel E, with overflow pipe F. The lower funnel is fitted with a gas-tap D, and the whole apparatus rests by means of three legs on the top of a wooden box. Inside the box are fillets for the support of shelves, and in the top of the box is a large circular hole. The vessel having been filled with sand, the water-tube is connected with the gas-tap, and when the latter

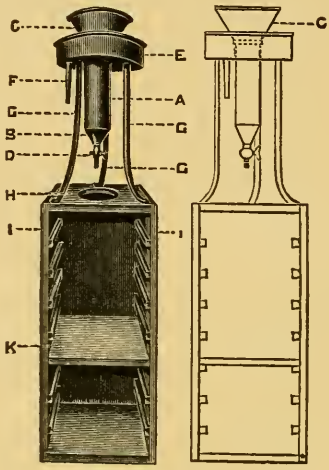

Fig. 75.

is turned the water bubbles up through the zinc vessel. When the sand is clean the water-tube is disconnected, and the clean sand drops through the hole into a suitable vessel placed on the shelf of the box.

New Method of obtaining Hæmin Crystals.*—Sarda and Caffart refer to the method of A. Lecha-Marzo for detecting blood. This method consists in treating the spots with a solution of iodin, pyridin, and ammonium sulphide. The authors modify the foregoing by substituting chlorin and bromin for iodin, and give the following procedure. Place on a slide a drop of blood solution, and evaporate slowly at a moderate temperature. Add successively a drop of chlorin-water, a drop of pyridin, and a drop of sulphide of ammonium, and then put on a cover-glass. With a magnification of 500, crowds of crystals of chlorohæmatin will be seen. The size is variable, the shape is rhomboidal, and the colour red or brownish-red. Exposed to the action of air the crystals do not keep long; the preparations should therefore be ringed round with balsam.

The authors explain the production of the crystals by supposing that the oxy-hæmoglobin is first changed into alkaline hæmatin, then into

* Comptes Rendus, cxliii. (1906) pp. 251–2.

reduced hæmatin or hæmochromogen, which by the action of the chlorin-water becomes chlorohæmatin.

Ammonium sulphide in excess was found to favour the production of hæmochromogen crystals.

Bouvier, E. L.—**Récolte et conservation des Diptères particulièrement des espèces qui piquent pour sucer le sang.**

[Gives a lucid account of how to collect, mount, and preserve biting and blood-sucking Diptera.]

Garner, J. B., & W. E. King—**Germicidal Action of Potassium Permanganate.**

[Experiments showing that this reagent is antiseptic and germicidal in less quantities than those given by Miguel and Jäger.]

Amer. Chem. Journ., xxxv. (1906) pp. 144–7.

Metallography, etc.

Special Brasses.*—This valuable contribution to the study of alloys of copper, zinc, and a third element, by L. Guillet, is a continuation of his previous work on brasses.† When the third element is introduced it first enters into solution in one or more of the constituents of the copper-zinc alloy. At a certain percentage of the added element saturation is reached and a special constituent is formed. Below this saturation point the third element may be considered as equivalent to so much zinc, the alloy formed having properties nearly the same as an alloy of a definite percentage of zinc with copper. The composition of the copper-zinc alloy to which any given ternary alloy is considered to be equivalent, can be determined by microscopic examination. From observations of this kind on alloys containing different amounts of the third element the coefficient of equivalence can be calculated. This is the percentage of zinc to which 1 p.c. of the added element is equivalent. As an instance, take an alloy, Cu 70 ; Zn 28 ; Al 2. The coefficient of equivalence of aluminium is 6. The alloy therefore may be considered as Cu 70 ; Zn 28 + 12. Reducing this to percentage composition, it becomes Cu 63·63 ; Zn 36·37. The properties of a ternary alloy are not identical with those of its equivalent copper-zinc alloy.

The author has worked out the application of this law in detail for a large number of brasses containing one or more of the following elements : aluminium, manganese, iron, tin, lead, silicon, magnesium, antimony, phosphorus, cadmium. More than 500 samples were examined. The practical work on the alloys included determinations of (1) microstructure—the etching re-agent employed was ferric chloride in hydrochloric acid ; (2) mechanical properties—tensile, shock, and hardness tests ; (3) forging qualities, hot and cold. The alloys were all examined as cast. For comparison the properties of the copper-zinc alloys were determined. Aluminium and manganese will dissolve in the α and β constituents of brass in large quantities. Coefficients of equivalence are as follows : Al = 6, Mn = 0·5, Fe = 0·9, Sn = 2, Pb = 1, Si = 10,

* Rev. Metallurgie, iii. (1906) pp. 243–88 (59 photomicrographs).

† Op. cit., ii. (1905) pp. 97–120.

Mg = 2. In general when several elements are added to a copper-zinc alloy, each acts as if it were the only one.

The Alloys of Antimony and Tin.*—F. E. Gallagher has investigated the freezing-point curve of the antimony-tin alloys, and finds that, contrary to Reinders' conclusions, there are no compounds between these two metals. The four solid phases are four sets of solid solutions. Sixty-three alloys were made, of different compositions. They were annealed at temperatures ranging from 218°–560° until equilibrium was reached, and examined microscopically. The nature of the phases was thus determined. The higher the temperature the more rapidly is equilibrium attained. The etching reagent most frequently employed was ferric chloride in alcoholic solution, which gave good preparations. Some of the alloys rich in tin were etched by being made the anode first in 1 p.c. nitric acid, then in an alkaline solution of sodium tartrate, the latter removing the black deposit first formed.

The Tensile Strength of Copper-Tin Alloys.†—E. S. Shepherd and G. B. Upton have studied the relationship between constitution and physical properties of the bronzes. The complex freezing point curve given is plotted from Heycock and Neville's data, modified by Shepherd and Blough. The only chemical compound in the alloys containing more than 50 p.c. copper is Cu_3Sn. Solid solutions, denoted by α, β, γ, and δ (formerly thought to be Cu_4Sn), are the other constituents. By chill casting an alloy, annealing at a given temperature for as long a time as may be necessary, then quenching, the structure and properties normal at that temperature may be determined. Tensile tests were made on the alloys (1) as cast, (2) heated for a week at 54°° and quenched in water, (3) heated for a week at 400° and furnace cooled, (4) heated to about 650° and quenched. The test pieces were cast to shape in moulds of artificial graphite, which give an excellent surface on the casting. Melting was carried out in an atmosphere of illuminating gas. Occlusion of gas and oxidation are both much more serious in the alloys with more than 90 p.c. copper than in those richer in tin. A lengthy table of results of tests is given. Among the authors' main conclusions are (1) the tensile strength of bronzes consisting of pure α (87–100 p.c. Cu) is little affected by heat treatment, and increases with increased tin content: (2) bronzes with 74–87 p.c. copper are much stronger if annealed above 510° than if annealed at a lower temperature; (3) prolonged annealing tends to make the crystalline structure coarser, to decrease tensile strength and to increase ductility: (4) the strongest bronzes contain 78–81 p.c. copper and are mixtures of α and β crystals; (5) the stress strain diagram of a bronze tensile test piece shows no falling off when the maximum stress is reached. Stress increases steadily till the piece breaks. The stretch takes place along the whole length of the test piece: there is no local contraction as with iron and steel.

The paper is of value not only for the facts brought to light but also

* Journ. Phys. Chem., x. (1906) pp. 93-8 (2 figs.).
† Op. cit., ix. (1905) pp. 441-76 (7 figs.).

as a statement of the general principles which govern the relationship of constitution to physical properties of alloys.

The Iron and Steel Magazine.*—This Journal (formerly the "Metallographist") has ceased to be issued as a separate publication, having been taken over by "Electrochemical and Metallurgical Industry," with which it is now incorporated. It is a matter for regret that a journal which has rendered such excellent service in the advancement of metallography should no longer be published separately. The back volumes, all of which we believe may still be obtained, contain much of the valuable literature dealing with the application of microscopy to metals.

Measurement of the Elastic Limit of Metals.†—Guillery describes a method by which the variations in electric resistance of a test-piece are recorded during a tensile test. A current of 25–30 amperes per square centimetre of section is passed through the test-piece and a compensating resistance. A galvanometer is so connected with the test-piece and resistance that its deflections indicate variations of resistance in the test-piece. The galvanometer deflections are plotted against the loads, the elastic limit being indicated by a break in the curve. Considerable differences were found to exist between the results obtained in this manner and the figures given by the direct measurement of strain in the usual way. H. le Chatelier comments on the results.

Nickel-Chromium Steels.‡—The twenty-nine alloys examined by L. Guillet had the following analyses (approximately).

First series (9 steels):

Carbon 0·2 p.c.

Nickel 5 p.c., chromium 3, 10, 20 p.c.
„ 12 „ „ 3, 10, 20 „
„ 30 „ „ 3, 10, 20 „

Second series (9 steels): carbon 0·8 p.c., nickel and chromium as in first series.

Third series (5 steels): carbon 0·3 p.c., nickel 2·5 p.c., chromium 0·5–5 p.c.

Fourth series (6 steels): carbon 0·2 p.c., nickel 5–6 p.c., chromium 0·5–6 p.c.

The microstructure and mechanical properties of these steels are generally such as might be inferred from the properties of nickel steels and chromium steels, both of which have been investigated by the author. The effect of the chromium is added to that of the nickel. The following percentages are equivalent: 1·65 carbon, 29 nickel, 18 chromium. Pearlitic nickel chromium steels are harder when quenched than pearlitic nickel steels in the same state. γ-iron nickel chromium steels have a higher elastic limit than γ-iron nickel steels.

Etching Velocity of Metallographic Reagents.§—A number of etching reagents investigated by Kourbatoff,‖ chiefly alcoholic solutions

* Electrochem. and Met. Ind., iv. (1906) p. 253.
† Rév. Metallurgie, iii. (1906) pp. 331–42.
‡ Tom. cit., pp. 462–84 (17 photomicrographs).
§ Tom. cit., pp. 426–7.
‖ See this Journal, 1905, p. 392.

of organic nitro compounds, were found to act slowly and to give fine preparations. A relationship was observed between the speed of etching and the degree of molecular dissociation of the liquid. P. Lejeune, following up this point, indicates the effect of viscosity and dielectric constant. By etching exactly similar pieces of steel under identical conditions, using different reagents, the etching velocity of the solutions may be compared; 4 p.c. solutions of picric acid in acetonitrile, propionitrile, methyl-alcohol, and ethyl-alcohol were compared; the order given is that of their activity, the last being the slowest in etching. This is the order given for the electric conductivity of solutions of sodium chloride in these liquids. It is necessary when comparing the etching velocity of such solutions that the solvents should be anhydrous, traces of moisture increasing the ionisation. A method of photographically recording the progress of etching is suggested.

Iron-Nickel-Manganese-Carbon Alloys.* — H. C. H. Carpenter, R. A. Hadfield, and P. Longmuir give as the seventh report to the Alloys Research Committee, the results of an exhaustive investigation of the properties of ten alloys containing 0·79 to 1·03 p.c. manganese, 0·4 to 0·52 p.c. carbon, nickel varying from 0 to 19·9 p.c. The results of numerous mechanical tests and physical measurements are fully set out in tables and as curves. The range of solidification and the critical ranges on heating and cooling were determined. The lowering of the critical range on cooling is fairly uniform up to 4 p.c. nickel. Further increase of nickel causes a change of character in the cooling curves, the critical ranges being spread over a wide interval of temperature. The authors' metallographic results agree on the whole with Guillet's.† A 5 p.c. solution of picric acid in alcohol, used at the outset as an etching reagent, was replaced by 1 p.c. nitric acid in alcohol, giving the same results more quickly. The alloys were examined as forged, and after being thermally and mechanically treated in various ways; they are classified as follows:—

Cast alloys ..	0 to 5 or 6 p.c. nickel ..	Pearlitic
	5 or 6 to about 16 p.c. nickel ..	Martensitic
	Over 16 p.c. nickel	Polyhedral
Forged alloys ..	0 to 4 p.c. nickel	Pearlitic
	5 to 20 p.c. nickel	Martensitic

No evidence for the existence of a carbide of nickel was found. The effect of mechanical work on the alloy with 19·9 p.c. nickel was to change its microstructure and cause it to become magnetic. A dark etching constituent was produced. The alloy previous to deformation gave a white polyhedral structure on etching. The polyhedral structure is restored wholly or in part by heating at 900° C. J. O. Arnold criticised the authors' method of taking critical range curves.

Peirce, B. O.—**On the Permeability and the Retentiveness of a Mass of Fine Iron Particles.** *Proc. Am. Acad. Arts and Sci.*, xlii. (1906) pp. 87–91 (2 figs.).

Osmond, F.—**French Contributions to the Progress of Scientific Metallurgy.** [Recent metallographical research in France is briefly reviewed in this paper.] *Rev. Metallurgie*, iii. (1906) pp. 365–81.

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* Proc. Inst. Mech. Eng., 1905, pp. 857–959 (87 figs.); discussion, pp. 959–1041.
† Bull. Soc. de l'Enc., 1903.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Old Portable Microscope by Dollond.—Major F. R. W. Sampson has kindly presented to the Society this instrument (fig. 76). The Society has not hitherto possessed one of this form, and it is therefore a very desirable acquisition, more especially as it bears the maker's name.

It seems to be an adaptation of Cuff's New Constructed Double Microscope, the body, stage, and some other details and the accessories, being similar to those of Cuff's instrument, but the pillar, instead of being fixed, is hinged to a bracket secured to the inside of the bottom of the case. The Microscope always remains in the case, which serves as a base for it. When packed the instrument lies horizontally in its box, but it can be set at any position from the horizontal to the vertical. One end of the box is hinged so as to let down and allow the mirror to project beyond when the body is elevated. To economise space in packing, the body is removed from the socket of the arm, and the stage is racked down low enough to allow of the lower part of the body being passed through the stage. The latter is then racked up until the eye-piece enters the socket of the arm from below: the body is thus securely held in place.

The pillar is square, and, as already mentioned, hinged at its lower end. The stage is attached to a sliding bracket, and is focused by rack-and-pinion. There are two springs under the stage for holding a small tube for observing objects in water. The tube is held in a diagonal position to prevent the water running out, and it also permits any air to escape and not remain to obstruct the vision as it would do if the tube were corked and used in a horizontal position. The mirror is concave, and can be moved up and down on the pillar. The body slides into a socket at the end of a short arm that is secured to the top of the pillar. The part of the body standing above the arm forms the eye-piece, the eye-lens of which is compound, consisting of two lenses, the upper one being plano-convex and the other bi-convex. The field-lens is also bi-convex. There is a micrometer scale ruled in squares, forty to the inch, screwed into the eye-piece just below the diaphragm.

Originally there were six powers—simple lenses—but No. 1, the highest power, is missing. The remaining apparatus consists of the usual spring-holder for "sliders," a cone for cutting off extraneous light from the mirror, a lieberkuhn and fitting that slides on the lower part of the body, bull's-eye and arm, stage forceps, etc. There are also two

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

lenses of low magnification which may have belonged to a sub-stage condenser, but there is now no fitting for them.

This Microscope resembles one that had belonged to Sir David Brewster, and was exhibited at the Meeting of the Society on November 17, 1897, by Mr. C. Lees Curties. An illustrated description by Mr. Nelson appeared in the Journal for February, 1898. From the particulars

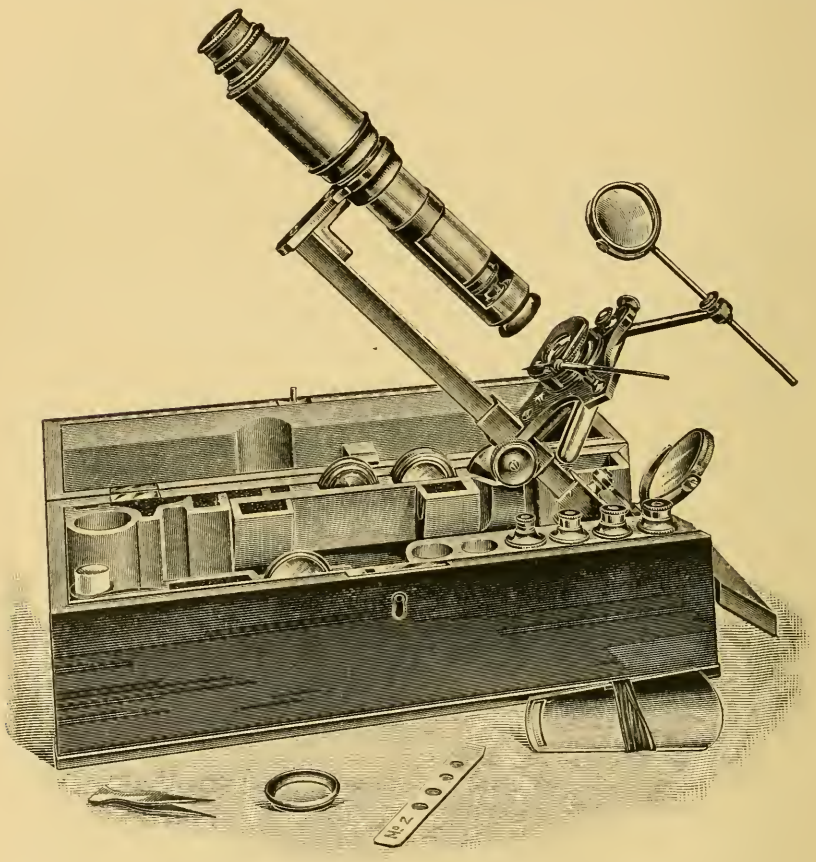


Fig. 76.

there given Sir David Brewster's instrument appears to have been larger. Its general appearance was very similar to the one now exhibited, but the stage is rectangular and has clips upon it for holding slides in position.

The case measures outside $11\frac{1}{2}$ in. by $5\frac{1}{4}$ in. by $5\frac{1}{8}$ in. deep. The total length of the body over all, from eye-cap to nose-piece, is $6\frac{3}{4}$ in.,

and from nose-piece to field-lens 4 in. The concave mirror is $1\frac{5}{8}$ in. diameter and $3\frac{1}{2}$ in. focus; there is no plane mirror. The pillar is $9\frac{1}{4}$ in. in length, from top to centre of rule-joint, and is $\frac{1}{2}\frac{1}{8}$ in. square in section. The limb, or arm, is fixed: the centre projecting $1\frac{9}{16}$ beyond the pillar.

Granger's Pocket Microscope. — The Society is indebted to a Member of the Quekett Microscopical Club, who desires to remain anonymous, for this interesting little pocket Microscope (fig. 77). The donor writes that it was given to the person from whom he obtained it some thirty years ago, or more, by one of the Grangers, who were a family of lawyers. On the underside is engraved the following:— "B. Granger, Tettenhall, 1790."

This little object seems to have been a forerunner of the modern pocket magnifier. It is a sort of *multum in parvo*, for, besides an arrangement for viewing an object impaled on the point of a needle, it contains two other magnifiers, one of which is packed away within the mount of the other. The inner magnifier has an arrangement for

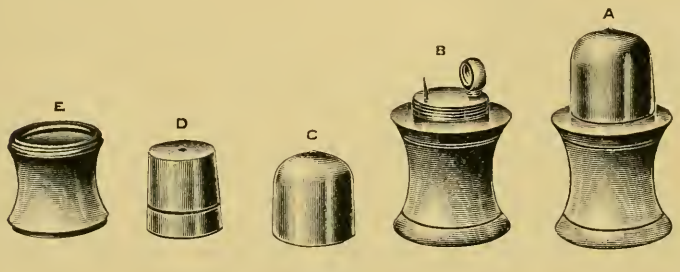


Fig. 77.

containing a minute living or other object between two glasses, one of which is concave. The lenses are all of very low power.

In this connection it may be mentioned that among the apparatus belonging to the Pritchard Microscope exhibited at the June Meeting by Mr. Holder, was an object that no one could then understand. It is evidently part of a similar box of magnifiers. The lens and needle for viewing opaque objects, and the bottom cover, are missing, and the inner magnifier is different, for, instead of the arrangement for containing a live or other object, it is fitted with a second lens, thus increasing its magnifying power.

These two specimens have been shown to Mr. Nelson, who says he has seen several similar to them, but they were made of ivory.

In the figure, A represents the brass box closed. B represents the dome C removed, and shows the arrangement for viewing an object fixed on the point of the needle. E is a magnifier formed of the central part or body of the box, the top and bottom covers being removed. It has a lens of low power mounted at the upper end. The magnifier D, which has a lens at its upper end and a live-box at its lower end, goes inside E when the box is closed.

The following are some of the dimensions of this toy :—Total height of A $1\frac{7}{8}$ in. ; diameter of base $1\frac{1}{16}$ in., diameter at centre $\frac{25}{32}$ in. ; height of dome C $\frac{13}{16}$ in. ; height of E between screwed parts $\frac{3}{4}$ in. ; height of D $\frac{11}{16}$ in. ; diameter at top $\frac{5}{8}$ in., at bottom $\frac{23}{32}$ in.

Watson's Junior Metallurgical Microscope.*—This instrument (fig. 78) is on the lines of an ordinary Student's Microscope, but the stage is a solid one designed especially for holding metal specimens, and can be raised and lowered in the optic axis, and permits of a separation between the nose-piece of the Microscope and the surface of the stage of 5 in.

The interest which is being shown in the study of Metallurgy has caused students to inquire for an instrument of simple form and less costly design than the large models which have hitherto been available.

Zeiss' Measuring Microscopes.†—1. *Microscopes for Metal Testing.* Models A, B, C of these instruments are intended for the measurement of short lengths of metals (to 20 mm.), with an accuracy of 0·01 mm. Their upper structure is essentially alike, and consists mainly of an ordinary Microscope with rack-and-pinion, the Microscope being movable on a horizontal slide by means of a screw of exactly 1 mm. thread. The spindle is rotated about its long axis by a micrometer drum whose circumference is graduated to a hundred parts. Each part corresponds, therefore, to a longitudinal movement of the Microscope equal to 0·01 mm. The magnification of the Microscope can be adapted to the object by alteration of objective and ocular. Models A and B have been constructed to the design and requirements of Dr. Schwinning.

Model A (plate XX. fig. 1). The object is placed on a simple ebonite stage-plate. The horseshoe foot rests on its base with four points only, two of the points being the rounded ends of the screws S_1 and S_2. If the piece of work, on which the measurement is to be made, be large enough and approximately plane, the Microscope can itself be placed thereon and sharply adjusted with rack-and-pinion on to the object at a distance corresponding to that of the stage-plate T. The whole of the upper structure of the Microscope is fastened to the lower part merely by means of a stout horizontal plug fitting into a strong cut collar H clamped by a screw K. It is thus possible to remove the upper part and adapt it to a laboratory stand for more convenient examination of any large object (plate XX. fig. 2). A magnification of 15–20 diameters is found to be sufficient.

Model B. This is especially intended for measurement in two mutually perpendicular directions. This convenience might be of important application in certain cases (e.g. in testing surfaces not perfectly plane), and is attained by equipping the lower part with a rotatory object-stage bearing on its circumference two grooves at 90° apart into which a spring engages. After measurements in one direction, the stage is rotated through 90°, and then a second series of measurements can be made. The upper part of the Microscope remains the same as in

* Watson and Sons' Special Catalogue, 1906.
† Carl Zeiss' Special Catalogue, Jena, October 1906.

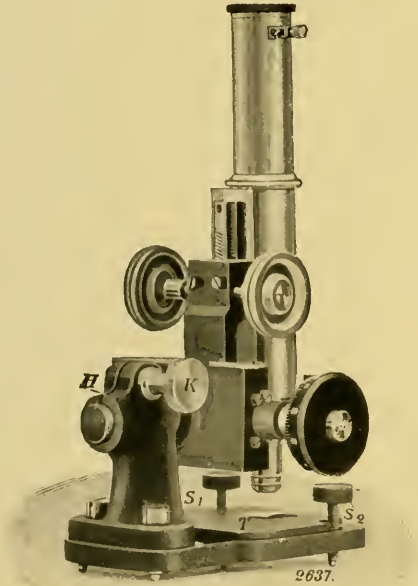


FIG. 1.

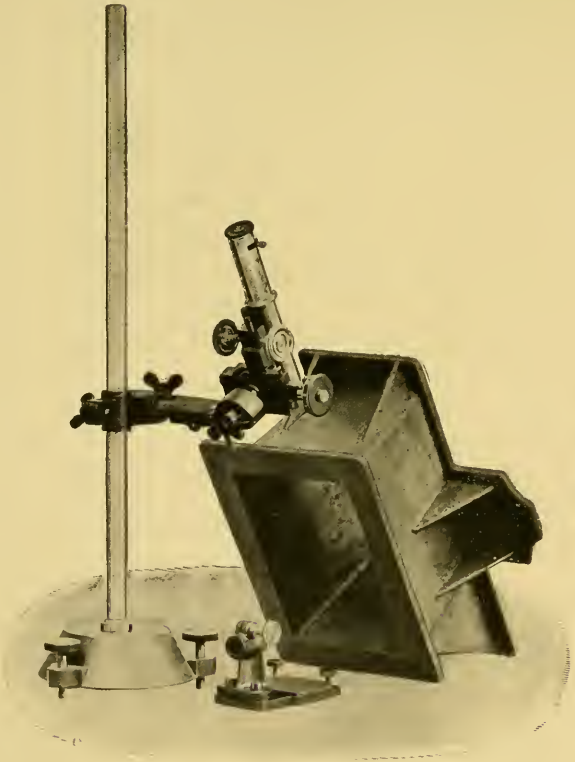


FIG. 2.

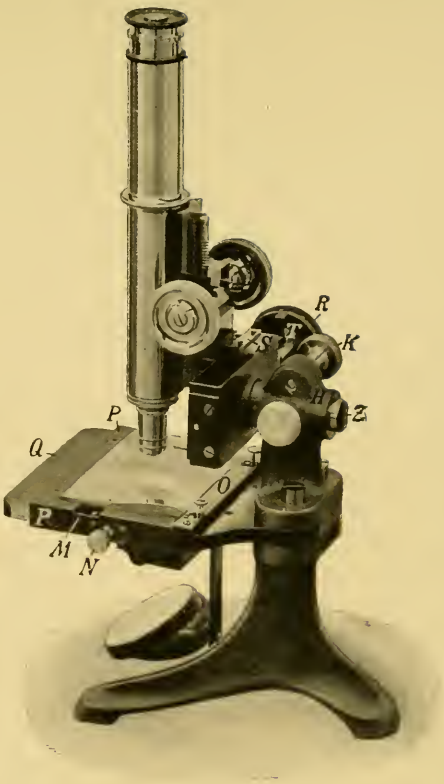


FIG. 3.

[To face p. 114.

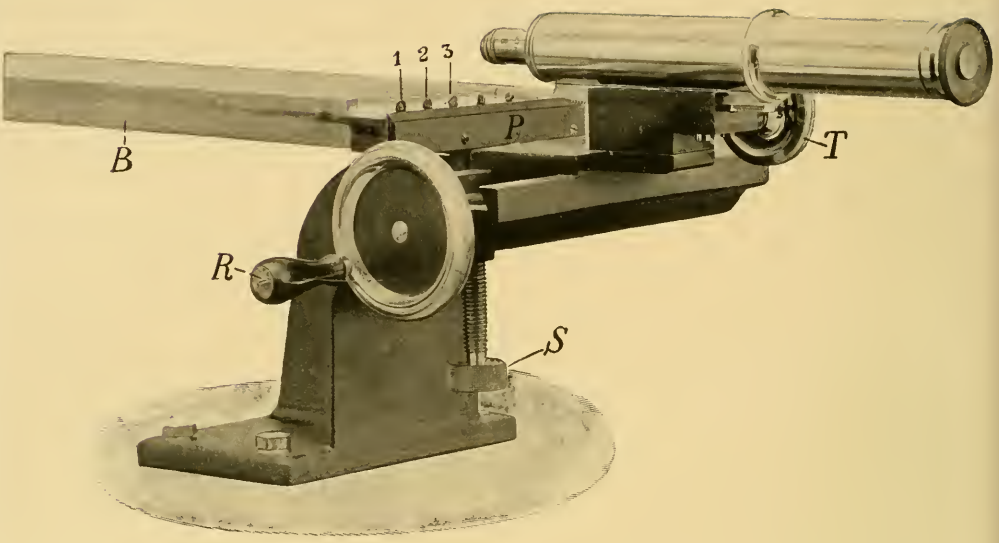


Fig. 4.

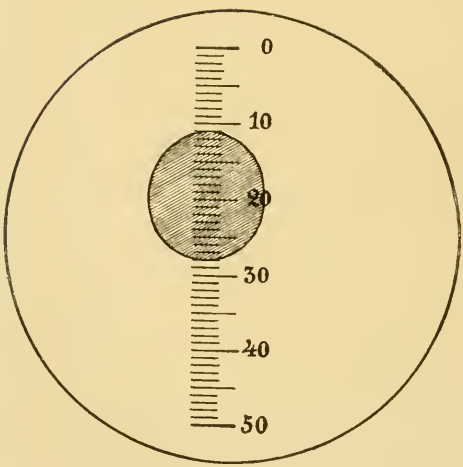


Fig. 5.

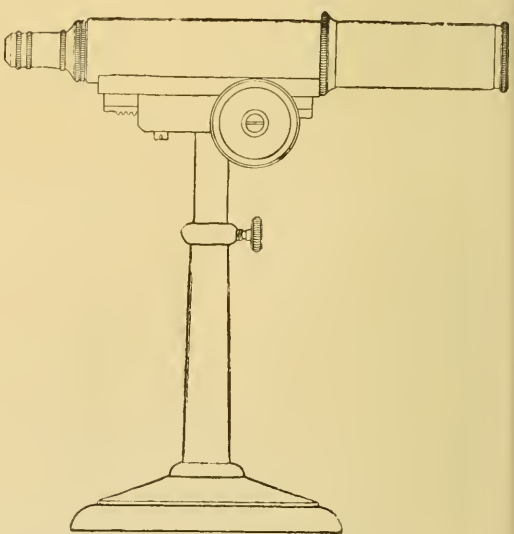


Fig. 6.

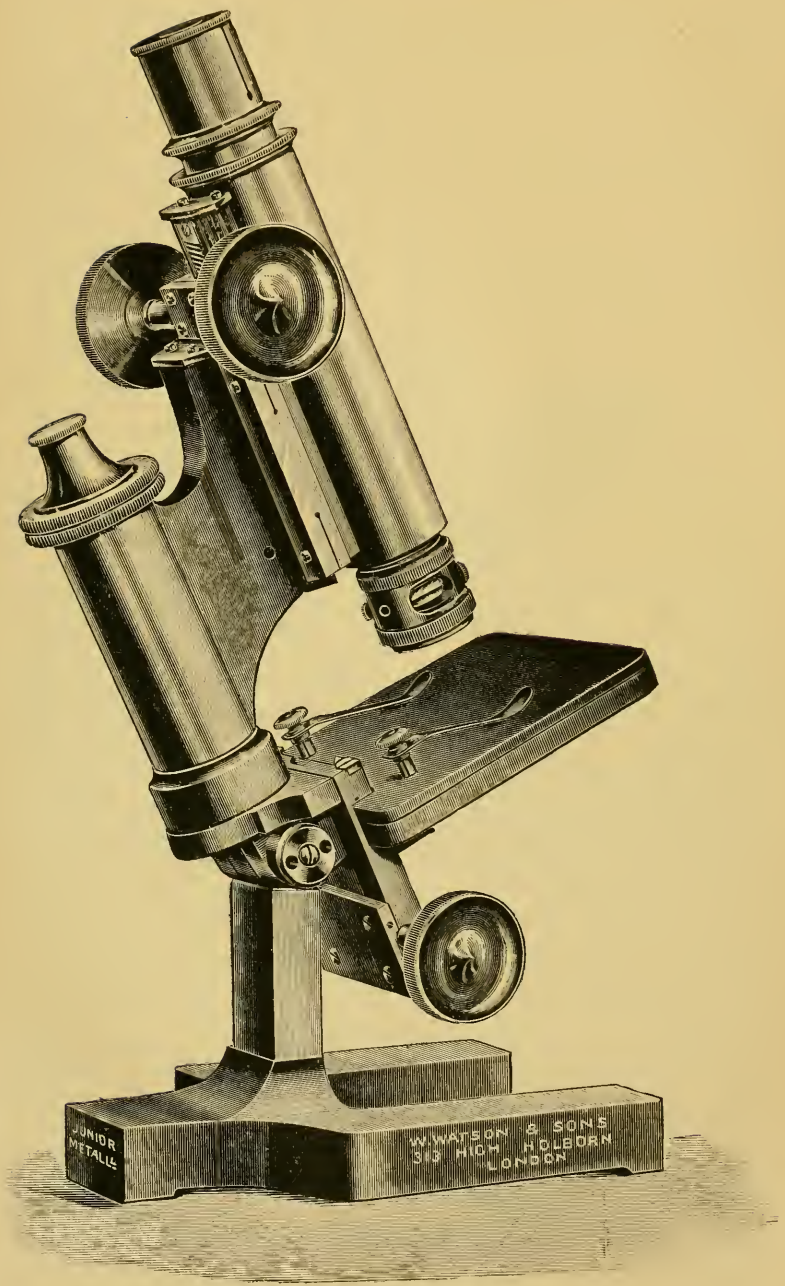


Fig. 78.

model A. The instrument can be applied to a large object, either directly or by help of a laboratory stand, exactly as A.

2. *Measuring Microscope for Negatives.*—This (plate XX. fig. 3) is, in the first instance, intended for the measurement of photographs of physical observations, e.g. spectra. It has the same ranges of movement and accuracy as models A and B. It may also be used for exploring plates of 6 by 9 cm., and for many other purposes. It differs from the previous instruments in possessing a stable understage with illuminating mirror, and a strong stage with central aperture of about 3 cm. diameter. But it resembles them in being provided with the collar H, and similar overstage. It has the same facilities for adaptation to a laboratory stand. The square strong stage is so worked on its right and left side planes that these can serve as guides to a metal frame sliding on the stage top. On this frame the plate to be measured is secured with two springs; the plate is then pushed on to the millimetre divisions serving as a bed. The frame can thus be pushed perpendicularly to the direction of the slide-guides and clamped by the screw N. Comparison of equal intervals of spectra is attained by this movement of the frame. Besides these millimetre graduations, there is also a second series, perpendicular to the first and readable through a window pierced in the frame. The two series serve as co-ordinates for localising any spot on the plate.

3. *Capillary Measuring Microscopes.*—These are made in two models (D, E), and have been suggested by the firm of F. A. Kühnlenz. They are intended for direct reading of the internal diameters of capillary tubes of any length, and therefore facilitate the rapid sorting of large quantities of such tubes according to their bore. The Microscope is adjustable with rack-and-pinion T, and has a magnification of about 100 diameters. The ocular contains a scale (plate XXI. fig. 5) reading the object to the hundredth part of a millimetre. Plate XXI. fig. 4 shows model D, about half full size. The capillary tubes, which may be $1\frac{1}{2}$ metres long, are placed on the board B, and the operator commences to read the lowest layer. As the Microscope is more easily moved than the heavy tubes, the instrument is placed on a slide which traverses the row by means of the hand-wheel R. In this way every tube of the lowermost layer can be successively brought into the field of view of the Microscope. Plate XXI. fig. 5 shows the appearance presented in the ocular. It is found convenient to take first the higher reading (28 in this case) and then the lower, as the figures are then conveniently placed for subtraction. It would, of course, be possible to place one edge of the circumference on the zero and take the diameter by direct reading; but experience shows this to be a slower way. By means of the screw S, the board is lowered till the next layer of tubes comes into view. These are tested in similar fashion. The instrument may also be used for calibrating thermometer tubes. In that case the spindle carries a micrometer screw, and the hand-wheel has a micrometer drum divided into 100 parts.

Model E, seen in plate XXI. fig. 6, consists of a Microscope with rack-and-pinion. It has the same optical equipment as model D, but is mounted on a pillar of adjustable height. It may be used for the tubes,

as above, but by application of suitable objectives and oculars, may also be used as a reading Microscope for general laboratory use.

FABRE, CH.—**Les nouveaux microscopes.**
[Gives some account of recent progress in the manufacture of instruments.]
Mémoirs de l'Acad. des Sci. de Toulouse, v. (1905) pp. 289–96.

PLATE, L.—**Demonstration eines Schau-Mikroskopes für öffentliche Museen.**
Compt. Rend. des Séances du Congrès internat. de Zool. Berne, 1904. Basle, 1905, pp. 529–30 (1 fig.).

(3) Illuminating and other Apparatus.

Watson's Ball-bearing Sliding Bar.—The illustration (fig. 79) shows the method by which this sliding bar is adapted to the stages in Watson and Sons' Microscopes. A grooved edge is provided in the stage, and

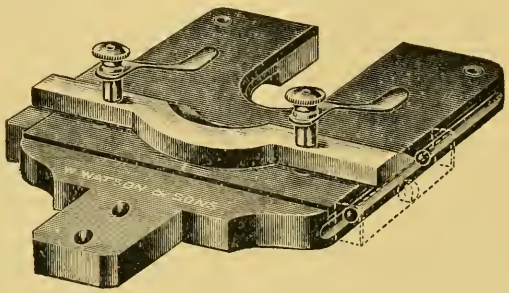


FIG. 79.

two steel balls fit into the grooves and are maintained in position by a light spring pressing on the back. A very soft movement is obtained by this means.

Simple Photometer.*—Stolze suggests the use of two right-angled prisms, *c d e* and *c f g*, fig. 80, fastened to a thin sheet of opal glass.

Assuming the light sources to be at *a* and *b*, the prisms have only to be shifted to the right or left till the illumination is even, and the

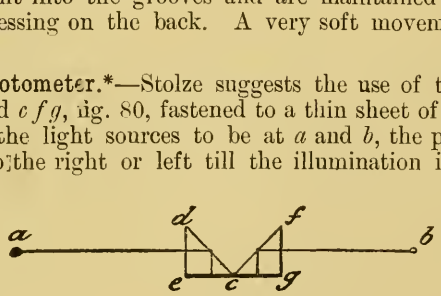


FIG. 80.

distances *a c* and *b c* measured; then the intensities of the lights will be as $(a\,c)^2 : (b\,c)^2$. This arrangement can obviously also be used to compare the actinic power of the two lights, and would be useful in measuring the power of the various illuminants for the Microscope.

Tswett's Luminoscope.†—M. Tswett, in discussing the interest universally excited by ultramicroscopes, draws attention to his lumino-

* Brit. Journ. Photography. See also English Mechanic, lxxxiv. (1906) p. 299 (1 fig.).

† Tswett, Zur Ultramikroscopie, Ber. Deutsch. Bot. Gesell., xxiv. (1906) p. 234. See also Zeitschr. wiss. Mikrosk., xxiii. (1906) p. 199.

scope, invented and described as far back as 1901.* In this instrument a strong beam of light is axially directed through a test-tube filled with the fluid to be examined, the tube being in a dark box. The light-trajectory is observed perpendicularly through a lateral ocular-tube. If the fluid is capable of fluorescence, or in a stricter sense not optically empty, the appearance presented is that of a luminous (fluorescent or opalescent) beam. A polarising prism applied in the ocular opening distinguishes between fluorescence or opalescence, for the latter, being polarised, is extinguished by rotation of the prism. Tswett's luminoscope does not render possible the direct observation of ultramicroscopic particles, but it establishes in a general way the presence of such particles. In physiological-chemical investigations (e. g., of chlorophyll pigments), where the observer has to be specially careful with regard to purity or accuracy of the solutions, or where he has to deal with mere traces of fluorescent materials, he will find the luminoscope an indispensable instrument.

(4) Photomicrography.

Principles on which Direct Photography of Colours Depends; Direct Colour-Photography Depending on Prismatic Dispersion.† M. G. Lippmann points out that two conditions are necessary in order that a photographic proof may reproduce the colours of the model.

1. The sensitive plate should clearly distinguish the differences existing between the various radiations combined in an incident ray: in other words, the system employed should analyse the incident ray.

2. In order that this incident ray, after impact, should be reconstituted with its colour, the system employed should be reversible, so as to effect the synthesis of elementary colours. Now, prismatic dispersion as used in a spectrocope is such a system. A photographic spectroscope is composed essentially of a slit *f*, a prism, a lens, and a sensitive plate. It evidently effects the analysis of the light incident on the slit; thus it remains to show that the apparatus is by itself reversible and that it does reconstitute after impact, the coloured light which has impinged on the slit. Let us suppose that the sensitive plate has been developed, a positive obtained, and the plate replaced by the positive. If the slit has been illuminated by (e.g.) red rays, these rays will have produced in the spectrum an image *r* of the slit. This image is transparent on the positive proof and constitutes a kind of slit which, when the plate has been replaced, is the conjugate image of *f*. Inversely *f* is the conjugate image of *r*. It follows that, if *f* be illuminated with white light, the transparent region *r* will receive only the rays which have formed it, and will only transmit those. If the light is inverted and *r* is illuminated by white light, only those rays will be transmitted which have left their trace on *r*. This reasoning applies to light of any refrangibility whatever. When the positive proof is replaced by its negative the slit is illuminated by a light exactly complementary to that radiation which had acted on it, and thus

* Vorrichtung zur Beobachtung von Fluoreszenz- und Opaleszenzerscheinungen, Zeit. Physik. Chemie, xxxvi. p. 450; Constitution physicochimique du Grain de Chlorophylle, Trav. de la Soc. des Naturalistes de Kazan, xxxv. p. 58.

† Comptes Rendus, cxliii. (1906) pp. 270–2.

r in the spectrum is opaque. Thus, this particular radiation will not be able to reach the slit, for the only radiations of this kind which would have been able to fall upon the slit would have had to pass through r. In order to apply these principles to the reproduction of colours the author has installed the following apparatus. The single slit of a spectroscope is replaced by a series of slits very close together, viz. the fine transparent lines of a web, five threads to the millimetre, as used in industrial photography. This web is fixed in the opening of a photographic enlarger, i.e. of a box fitted at the mouth with a slit carrying a sensitive plate, a convergent lens being fixed inside. A small-angled prism is arranged before this lens with its edge parallel to the lines of the web. The image is projected on the web: the sensitive plate is then developed and replaced. When the apparatus is illuminated with white light the image is seen with its colours. Each line of the web acts as the slit of a spectroscope. At the distance of distinct vision the lines of the web are no longer seen and the image appears continuous. The experiment was at first made with the spectrum of electric light, which was reproduced complete with its colours, a positive being used. With a negative the colours were replaced by their complementaries. A coloured window, red and green, projected on this web was similarly successfully reproduced. It is necessary that the prism should have an angle so small that each spectrum should have a length less than an interline, otherwise the spectra will overlap. It is also necessary that the photometric plate should be re-inserted in exactly the same position. Very sensitive orthochromatic plates may be used. It must be admitted that the necessity of having to replace the proof in the same apparatus which has produced it is not very convenient. When seen in the hand the proof has the ordinary black-and-white appearance. Seen with a lens it appears lined, and each line is divided into small zones which are the parts of an elementary spectrum. The author suggests the following as a possible improvement of the process. Insert a sensitive plate in an ordinary dark camera, without a prism, but with a web of, say, five threads to the millimetre. Superpose on the web a network of 500 threads to the millimetre. Every luminous point projected on the plate is received as a spectrum and so photographed.

On applying the web with its network upon the developed proof the colours of the original ought to be seen, the only condition being that the eye should occupy the position of the objective. The system is, in fact, reversible in virtue of the reasoning above given.

LIPPMANN, M. G.—**Remarques générales sur la photographie interférentielle des couleurs.** *Comptes Rendus*, cxliii. (1906) pp. 273-4.

(5) Microscopical Optics and Manipulation.

BRASS, A.—**Ueber die Doppelbrechung.** *Centralbl. Zeit. f. Opt. u. Mech.*, xxvii. (1906) pp. 192-4 (1 pl.).

HARTL, H.—**Ein Modell zur Erlänteruug der Zerlegung eines linear polarisierten Lichtstrahles bei der Doppelbrechung.** *Zeitschr. f. Unterricht*, xix. (1906) p. 175.

KOERBER, F.—**Ein Freihandversuch zur Ermittlung des Brechungsexponeten des Glases.** *Tom. cit.*, p. 167.

(6) Miscellaneous.

Principles of Microscopy: being a Handbook to the Microscope.* This book fills a gap in the literature of the subject, inasmuch as it is written for the information and guidance of microscopists, to whom the theory of the instrument with which they work is a matter of practical, as distinguished from speculative interest. Although the undulatory theory and the mathematical analysis of light pervade the work, they are never suffered to become either the subject-matter of discussion or its medium. The author absolutely eschews the "inarticulate" method of expression by means of mathematical signs, with the result that the book is a literary work from end to end. Notwithstanding the abstruse nature of many of the problems attacked, it is readable by everybody, mathematician or not, to whom the Microscope is practically familiar.

The work is divided into two parts. The first part deals with the "object picture," a term used to denote the object under that aspect which furnishes a picture to the eye. Object pictures are classified under four heads—as "outline pictures, colour pictures, outline and colour pictures, and pictures in relief." The advantages and disadvantages which attach to these various kinds of images—considered as means of revealing the form and structure of objects—and their liability to originate false impressions, form the subject matter of the first chapter. The next three chapters of the first part are devoted to the examination of the practical consequence deducible from the principles developed in the first chapter, and in these the theory and practice of illumination, mounting, and staining are successively discussed, while the fifth chapter sums up the whole result, and points the moral of what has preceded. These five chapters together thus form a treatise upon the preparation and exhibition of transparent objects in the Microscope, with special reference to such objects as occur in the course of medical practice and research.

The second part is much the larger part of the book, and is devoted to the image formed by the Microscope. This part of the work, therefore, covers more familiar ground than the first, since all the text-books which treat of the theory of the Microscope deal with this subject. The mode of treatment is, however, in this part equally original, and an impression which the author is very successful in leaving on the mind of his reader is that there is nothing occult about the theory of the Microscopic image. The optical laws involved, even where high magnification is concerned, are all illustrated by experiments which can be made with low-power lenses and large scale objects. The notion that microscopic vision is something *sui generis* finds here no quarter.

Ten chapters are devoted to this division of the work. The first of these—the sixth chapter of the book—is devoted to the discussion of images formed by simple apertures, from which the general laws of image-formation are very ingeniously deduced, and the main ideas, such as magnification, illumination, definition, and resolution—with which the reader is concerned to become familiar—are easily intro-

* By Sir A. E. Wright, M.D. F.R.S. London: Archibald Constable and Co., Ltd., 1906, xxii. and 250 pp., 18 pls. and 97 figs. in text.

duced and clearly illustrated. Following this is a chapter upon image-formation by means of lenses, or, as our author says with greater exactitude, by means of "lens-armed" apertures. The essential importance of the aperture in the formation of an image is never allowed to escape the reader's attention, and leads in the end to a notable elucidation of some of what are commonly supposed to be the more abstruse problems in the theory of the Microscope. But it is true—and a truth of which the reader of this book grows very conscious as he proceeds—that abstruseness is a matter depending almost wholly upon the point of view and mode of approach. Many things which seem remote and abstract when treated merely as aberrations become very concrete and very intelligible when presented as fundamental facts. The question whether a particular phenomenon shall take rank as the rule or the exception is usually a question simply of the point of view. Sir A. E. Wright chooses to build up his theory of the Microscope about an aperture as its essential element. The various lenses and combinations of lenses which enter into the composition of the instrument are merely so many appliances for supplying the deficiencies of the "vacant aperture." They improve the definition of the image which the simple aperture yields, and increase the resolving power of the beam which it transmits, but the theory of the instrument and of its image is nowhere involved with the theory of lenses; and the reader—working out by easy steps the properties of the simplest imaginable images—finds that he is successfully grappling with some of the tougher problems of image formation almost before he is aware that he is fairly launched upon the subject. Thus the seventh chapter, which for the first time introduces the lens and its function to the reader's notice, puts him in possession, and almost without effort, of matters so "abstruse" as Huyghen's law of wave-front propagation, and La Grange's numerical relation between magnifying power and the diameter of the Ramsden disk.

Succeeding chapters treat of the defects which occur in the image through aberration caused by the lens, and diffraction produced by the aperture—in connection with which latter subject a singularly complete series of experiments serves to illustrate the effect which the form and dimensions of the antipoint have upon the appearance of the image. In this connection the "Abbe theory" comes up for discussion, and an exposition of the optical system of the eye, and of the psychological factors involved in the use of the Microscope, completes what may be called the abstract theory of image-formation with the aid of lenses. What is really a subdivision of this second part commences with the eleventh chapter, in which the simple Microscope is discussed. Following upon this by a regular development comes a chapter dealing with image-formation in the compound Microscope, and another in which the anatomy of the compound instrument is discussed in detail. We thus come to the fourteenth chapter, which deals with the much-neglected subject of dark-field illumination, and following this is a chapter in which the corners of the subject are swept up by the discussion of various adjustments necessary for securing a critical image. The sixteenth (and last) chapter is

devoted to the question of the limit of resolving power, and the problems especially associated with high magnification.

Very remarkable is the way in which the whole subject is illustrated by experiments, and experiments conducted by means, for the most part, of apparatus of extraordinary simplicity. The writer's resource in this direction may be illustrated by his discussion of subjective colours, which is based, in fact, upon a coloured plate facing page 20. Excellently coloured diagrams accompany the text and make the meaning clear to the eye, and by an ingenious use of the tissue paper employed to protect the plate from contact with the printed page opposite to it, the effect of letting a top light in to the stage of the Microscope is most strikingly and successfully imitated. The work is spoken of in the preface as a task which has occupied the author for many yea s, and it may be admitted that the unusual amount of original work of which the reader finds traces on almost every page, seems to warrant this statement being taken *au pied de la lettre.*

The book is admirably printed and illustrated, so that its publishers may fairly claim to have placed the work before their readers in the best possible form.

Note on Sir A. E. Wright's Resolving Limit.*—Mr. Nelson writes: "The wave-length selected by Sir A. E. Wright in his examples for ultimate resolution is 0·6 μ; this lies on the red side of the sodium or D line, whereas the one commonly used is that of maximum visual intensity, which is situated on the blue side of the D line, about one-third of the distance between D and E.

"It is therefore not possible to compare his results with those in the table at the end of this Journal, or with those in my table on p. 529 of

Numerical Aperture. ($n \sin u = a$)	Sir A. E. Wright's Resolving Limits with the usual values of λ. $c = 1{\cdot}2$ $\kappa = \frac{1}{\lambda}$ Limit $= \frac{2\,\text{N.A.}\,\kappa}{c}$						Illuminating Power $\left(\frac{\text{N.A.}}{c}\right)^2$	Penetrating Power $\frac{c}{\text{N.A.}}$
	White Light. $\lambda = 0{\cdot}5607\ \mu$. Number of lines		Blue Light. $\lambda = 0{\cdot}4861\ \mu$. Number of lines		Photography. $\lambda = 0{\cdot}4000\ \mu$. Number of lines			
	in $\frac{1}{100}$ in.	in $\frac{1}{10}$ mm.	in $\frac{1}{100}$ in.	in $\frac{1}{10}$ mm.	in $\frac{1}{100}$ in.	in $\frac{1}{10}$ mm.		
·2	151	59·4	174	68·6	212	83·3	·028	6·0
·3	226	89·2	261	102·8	317	125·0	·063	4·0
·5	377	148·6	435	171·4	529	208·3	·17	2·4
·7	528	208·1	609	240·0	741	291·7	·34	1·7
1·1	830	327·0	958	377·1	1164	458·3	·84	1·1
1·3	981	386·4	1132	445·7	1375	541·7	1·2	0·92

this Journal (1906), before bringing them to terms of the same denomination. It will be noticed that the value of c adopted in the 'Principles of Microscopy' is 1·2.

"The values for objectives with N.A.'s other than those in this table may be found by inspection, by halving or doubling the values there

* Principles of Microscopy, 1906, by Sir A. E. Wright, p. 231.

given. Example: Required, the number of lines in the $\frac{1}{100}$ of an inch that can be resolved by an objective of 0·65 N.A., with white light.

"Take the half of 0·3 and the half of the corresponding number of lines, and we find that an objective of 0·15 will resolve 113 lines; this added to those opposite to 0·5 gives the answer—490 lines in the $\frac{1}{100}$ of an inch that can be resolved by an objective of 0·65 N.A. with white light.

"This method of inspection is much quicker than that of multiplying a constant out by the N.A., but this rule does not apply to the columns "Illuminating and Penetrating Powers": those figures must be worked out independently.

"If the values given in the table at the end of the Journal be multiplied by 0·833 they will be reduced to Sir A. E. Wright's limit, and if they are multiplied by 0·769 they will be reduced to those given in my table on p. 529 (1906). To reduce my table to Sir A. E. Wright's, multiply by 1·083.

Application of the Method of Rotary Disks to Microscopical Technique.*—H. Lebrun has given much attention to the best means for attaining rapid and systematic examination of microscopic objects. With this purpose in view he has constructed several contrivances.

1. *The Microstereoscope.*—This is intended for the examination by museum visitors of small creatures visible, but whose characters are only revealed by a microscopic view. The author arranges a kind of endless chain, on the principle of what are called American stereoscopes, working obliquely upwards. Each link of the chain carries a slide provided with an object, and this object at a certain part of the chain motion falls into a position suitable for observation by a fixed Microscope. Fifty slides are mounted in this way, and can be varied by the museum curator as he thinks fit. The whole arrangement is inclosed in a wooden case provided with a suitable window for admission of light. The body of the Microscope and certain adjustment screws are the only parts visible outside the case. The author uses a binocular, and the magnification employed does not exceed 70 diameters.

2. *A Microscope Table.*—This arrangement is suitable for the use of objects requiring high powers. A specially designed table carries the Microscope, and a disk bearing the slides rotates in a constant plane so as to bring the objects successively under the instrument. The table is mounted on four feet, of which the two rear ones are higher than the front, so as to slope the Microscope at an angle of 45° to the horizon. The four feet carry a metallic rectangular frame containing a kind of mechanical stage, to which the Microscope limb is attached without the usual foot. Verniers are attached to the two plates of this stage for the precise measurement of abscissæ and ordinates. The rotary disks are secured to a small vertical pin in such a way as to insure constancy of plane, smoothness of rotation, and facility of replacement. The disks may be of metal, wood, or cardboard, and may be solid or perforated. When a disk has been once equipped with a series of slides it may be removed and kept intact for future demonstrations.

3. *Microtome.*—In ordinary serial section-cutting it is not unusual to

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 145–73 (36 figs.); also published as an extract.

obtain ribbons more or less incurved owing to want of perfect rectiliniarity in the preparation of the paraffin block. The author has sought to regularise the inrolling so as to form ribbons of sections whose curvature should vary with the circumference of the disk where they are to be deposited, with the dimensions of the block to be sectionised. To obtain this result it is only necessary to give to the paraffin block a shape whose two faces correspond to two rays of the disk determined by the dimensions of the object. This cutting is facilitated by the use of a specially designed articulated and adjustable knife. A Minot-Zimmermann microtome with vertical carrier is adapted so that the sections fall, as cut, on a rotating glass disk and range themselves spirally, ready, save for clearing and covering, for immediate examination.

4. *Rotatory Stage.*—The disk just referred to, is of a size suitable for the Microscope stage, and is transferred to it. The disk is perforated at its centre, and this perforation enables it to be placed on a sort of vertical pin in the centre of the stage and secured by a nut. A rack-work movement is connected with the pin so that the disk may be rotated or moved as a whole in two mutually perpendicular directions.

Mounting Stereoscopic Views.*—Stereoscopic slides cannot give a true stereoscopic effect unless they are observed under the same conditions of convergence as those which prevailed when the exposures were made, and the true effect cannot be secured unless the views are mounted with the proper degree of separation, and observed from the proper distance. If the two negatives are on one plate, as is usual in most cases, and are produced with lenses a known distance apart, it is quite easy to ascertain the proper mounting separation for the positives.

The complete rule for a lenticular stereoscope is as follows :—Add the separation between the two lenses (centre to centre) to the distance separating the eyes of the observer, and then deduct the distance between any two corresponding points on the two negatives. The result is the proper separation of the same two points in the positive prints. If the points selected are distant points, their separation on the negatives will be equal to the lens separation, and the two distances will therefore cancel each other. It is then only necessary to mount the positives so that two corresponding distant points are separated by a distance equal to that between the eyes. If there are no distant points in the view, the complete rule must be applied, and if all the objects are very near, it is especially important that the rule should be strictly observed. If a prismatic stereoscope is to be used, the width of one prism should be added to the positive separation as found by the rule. This addition is exactly correct if the prisms are half-lenses properly centred in front of the eyes ; and though these conditions are seldom fulfilled, the correction is generally true enough for all practical purposes. With very near objects and widely separated lenses the proper separation for the positives is sometimes so small that the prints have to be trimmed down to absurdly small dimensions. Further, the negative images come very near the ends of the plate. To avoid these effects the separation of the lenses must be reduced, and the adjustment is

* British Journal of Photography. See also English Mechanic, lxxxiv. (1906) p. 208.

best made by trial on the focusing screen, for if each of the two negative images is fairly well centred in its own half of the plate, a convenient mounting separation will generally be secured.

Quekett Microscopical Club.—The 433rd Ordinary Meeting of the Club was held on October 19, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair.

Mr. C. F. Rousselet, F.R.M.S., gave a corrected description, and exhibited a specimen from the Matoppo Hills, Rhodesia, of the rare Rotifer *Tetramastix opoliensis*.

Mr. Jas. Burton read a paper "On the Reproduction of Mosses and Ferns."

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Doulton's White Porcelain Filter.†—W. Bullock and J. A. Crau have tested the filter recently introduced by Doulton and Co., of Lambeth, using as control the Chamberland F. Filtration experiments

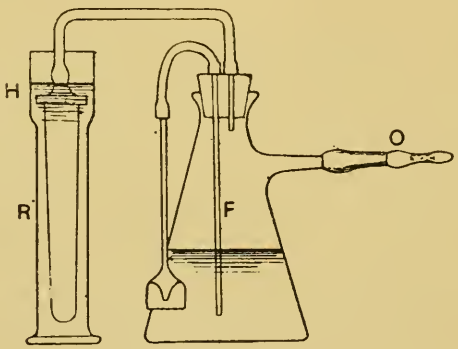


Fig. 81.

at low pressure showed practically no difference between the two filters. Tested by means of the vacuum pump, it was found to be eminently suited for obtaining sterile filtrates in the laboratory. Under high pressures (taps and mains) the results were quite as satisfactory as those obtained by other filters, but the candle was occasionally liable to break at the base, a defect remediable by making the candle a little thicker. The illustration (fig. 81) shows the apparatus fitted up for laboratory work.

Medium for Cultivating Delicate Microbes.‡—G. Bordet and O. Gengou have cultivated successfully the bacilli of whooping-cough

* 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, etc.; (6) Miscellaneous.

† Journ. Hygiene, vi. (1906) pp. 409–20 (4 figs.).

‡ Ann. Inst. Pasteur, xx. (1906) p. 734.

and influenza, gonococcus and meningococcus, on a medium the mode of preparation and composition of which is as follows. To 200 c.cm. of 4 p.c. glycerin-water are added 100 grm. of sliced potato; by boiling this mixture in an autoclave a glycerin-extract of potato is obtained. To 50 c.cm. of this extract are added 150 c.cm. of 0·6 p.c. salt solution and 5 grm. of agar (gélose). After melting it in the autoclave, the potato-agar is distributed into test-tubes, about 2–3 c.cm. in each, and then sterilised.

Rabbit's blood (though human is preferable) obtained aseptically is defibrinated, and to each tube, the agar being previously melted, is added an equal quantity of blood. The tubes are well shaken, and then cooled on the slant.

As this medium does not contain pepton, it does not favour the growth of putrefactive bacteria.

Fish Tubercle grown at 37° C.*—A. Aujeszky cultivated the fish tubercle bacillus on potato dipped in 3 p.c. aqueous solution of glycerin, and incubated at 28°–30° C.; after six weeks, and at successive intervals of six weeks, sub-cultures were made and incubated at gradually higher temperatures, so that the fifth generation grew well at 37° C.; the cultures were now no longer white and moist, but yellow-grey to brick-red, and resembling mammalian tubercle. The eighth generation was fatal to a guinea-pig after 63 days; control experiments with fish tubercle grown at room temperature were without effect.

Bacterioscopic Analysis of Excremental Pollution.†—E. Klein insists that *B. coli communis* is the typical microbe of sewage and excremental matter. MacConkey's medium makes no selection between typical and atypical *B. coli*, nor does it exclude other microbes capable of producing acid and fermenting glucose. The principal differential character of *B. coli communis* is its power to ferment lactose. The author inoculated, with high dilutions of sewage, human fæcal matter, fluid from shell-fish, from polluted layings, and also from clean layings, in parallel series, tubes of ordinary MacConkey medium, and MacConkey medium made with lactose instead of glucose. The results showed that whenever the lactose MacConkey tubes showed redness and gas after 24–48 hours at 37° C., subsequent sub-cultures proved the presence of typical *B. coli communis*; whereas in a number of cases, after redness and gas in ordinary MacConkey tubes, subsequent sub-cultures failed to show the typical *B. coli communis*; when the lactose MacConkey tubes remain unchanged or become bleached and without gas, it is certain that *B. coli communis* is not present, although in the glucose MacConkey tubes, redness and gas have been produced.

Taurocholate broth (5 c.cm. of 5 p.c. solution of sodium taurocholate to 400 c.cm. of broth) that shows turbidity and gas-formation after 24–48 hours incubation at 37° C., is a certain indication of the presence of typical *B. coli communis*. The author found also that this medium allows the growth of fæcal streptococci, but inhibits the growth of *Streptococcus pyogenes* and the streptococcus of saliva.

* Centralbl. Bakt., 1te Abt. Orig., xlii. (1906) p. 397.
† British Med. Journ., 1906, ii. p. 1090.

Value of Malachite-green Medium for Differentiating B. typhosus and B. coli.*—G. Kiralyfi has made a number of observaions of cultivating bacteria on media containing malachite-green, and from these he concludes that the addition of this material does undoubtedly hinder and stop the growth of many micro-organisms, such as streptococci, staphylococci, *B. anthracis*, *Vibrio choleræ*, etc., but for the purpose of differentiating *B. typhosus* and *B. coli*, it is irregular and quite unreliable.

Cultivation of Microbes in Media of Definite Chemical Composition.†—J. Galimard, L. Lacomme, and A. Morel obtain acid amides from the hydrolysis of various albumens, and these are then added either separately or mixed together, in proportion of 1 to 2 p.c. to bouillon composed of sodium chloride 0·5 grm., sulphate of magnesium 0·05 grm., glycerophosphate of calcium 0·2–0·3 grm., bicarbonate of potash to produce a slight alkalinity, glycerin 1·5 grm., and water 100 grm. The whole is sterilised at 120° C. for 45 minutes. The different media thus obtained from the various albumens are then inoculated with *B. pyocyaneus*, *B. prodigiosus*, *B. coli* R 2, and pneumobacillus of Friedlander, etc.

Cultivation of Bacillus typhosus from the Blood by means of Bile Culture Medium.‡—H. Conradi places a mixture of one part of blood from a typhoid patient and two parts of sterilised ox-bile in an incubator for 16 hours, after which varying amounts of the mixture are transferred to litmus-lactose-agar. An addition of 10 p.c. of pepton to the bile encourages the growth of *B. typhosus*, and better results are obtained by an addition of 10 p.c. of glycerin which hinders the development of saprophytes. The principle of this medium depends on the fact that whereas 0·3 c.cm. of normal guinea-pig serum in dilution of 1 in 80 will kill 20,000 typhoid bacilli within two hours, after the addition of 1–0·1 c.cm. of bile to the same normal guinea-pig serum, the bactericidal serum action is no longer observed. The author claims that this method may be readily used by general practitioners and clinicians, and he describes its practical application. It is further claimed that after 30 hours it is possible to establish with certainty a typhoid diagnosis.

(2) Preparing Objects.

Studying the Tympanal Apparatus of Orthoptera.§—J. Schwabe begins his description with the remark that he has had no trouble with the chitin, and has made perfect series of sections. He begins by removing quickly all superfluous parts, and then getting the material into paraffin as rapidly as possible. The prolonged use of alcohol must be avoided, as it obscures the histological details and also makes the chitin so brittle that it cracks like glass when cut. Each section should be picked up with a brush. The use of eau-de-Javelle, eau-de-Labarraque, or hot potash is deprecated. The difficulty of fastening sections of

* Centralbl. Bakt., 1te Abt. Orig. xlii. (1906) p. 371.
† Comptes Rendus, cxliii. (1906) p. 349.
‡ Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1906) p. 55.
§ Zoologica, xx. (1906) pp. 3-5.

Orthoptera to the slide is easily overcome by sticking them down with 0·25–0·5 p.c. solution of photoxylin in equal parts of alcohol and ether; this does not interfere in any way with the further manipulation.

The fixatives mostly used were Flemming's and Hermann's fluids, but excellent results were obtained from formalin-chrom-acetic acid and formalin-alcohol-acetic acid; in the formalin mixtures the material was immersed for 6–8 hours.

The sections, which were from 3–20 μ thick, were stained with Heidenhain's iron-hæmatoxylin or with Ehrlich's alcohol-hæmatoxylin.

Studying the Histology of the Lungs of Domesticated Animals.* J. Müller fixed the lungs with absolute alcohol, or with 4 p.c. formalin, by passing these fluids into the trachea. For alcohol 48 hours sufficed, while formalin required 4 days or longer. Cubical blocks with sides from 0·5–1·2 c.m. were cut out of the fixed tissue. The pieces fixed in formalin were dehydrated in upgraded alcohols. The material was then cleared in xylol or cedar-oil, and afterwards imbedded in paraffin, the latter process taking several days in order to get rid of all the air. Sections from 4–30 μ were made, and were stained with hæmatoxylin, hæmalum, borax-carmin, and lithium-carmin. The contrast-stains were eosin, fuchsin, or Hansen's picric-acid-fuchsin. The elastic fibres were picked out by Weigert's method. For the mucous glands, thionin, mucicarmin, muchæmatin, and methylen-blue were used.

For corrosion preparations Wickersheim's alloy (lead 32, zinc 16, bismuth 60, cadmium 12, mercury 10 parts) was employed. The liquefied metal was injected through the trachea, or a large bronchus, after the lung had been thoroughly warmed by immersion in water at 65°. The maceration was effected by means of 10 p.c. caustic potash.

For demonstrating the respiratory epithelia, the pulmonary tissue was filled with 0·2 p.c. silver nitrate, and afterwards hardened in upgraded alcohols, the material being kept in the dark the while. After the paraffin sections had been mounted in balsam or in glycerin, they were exposed to sunlight.

For demonstrating the pores in the alveolar walls, living animals were killed by confining them in an atmosphere of carbonic acid. This made the lungs perfectly atelectatic. They were then injected through the trachea with an aqueous solution of Berlin-blue and gelatin under very slight pressure.

Studying the Pollen-tube in Houstonia cœrulea.†—C. A. Matthewson fixed both old and young flowers in Flemming's fluid, chrom-acetic acid, and alcohol-acetic solution. The Flemming triple stain was used for the first two fixatives.

The tissue fixed in alcohol-acetic solution was stained with iron-alum-hæmatoxylin and Bismarck-brown. The latter method gave the best results. The sections were all 10 μ thick.

Studying the Cytology of the Entomophthoraceæ.‡—L. W. Riddle fixed most of the material in 0·75 p.c. chrom-acetic acid, which gave

* Archiv Mikrosk. Anat. u. Entwickl., lxix. (1906) pp. 1–61 (1 pl.).
† Bull. Torrey Bot. Club, xxxiii. (1906) pp. 487–93.
‡ Proc. Amer. Acad. Arts and Sci., xlii. (1906) pp. 177–97 (3 pls.).

satisfactory results except for the more mature stages of the resting spores, when it became necessary to use hot sublimate-acetic.

Flemming's weaker solution was also tried, but though not superior to the chrom-acetic mixture, gave excellent preparations after an immersion of some weeks. Paraffin sections of the hosts infected with the fungus were stained with safranin-gentian-violet. Heidenhain's iron-hæmatoxylin was a failure.

Studying the Histogenesis of the Retina.*—A. W. Weysse and W. S. Burgess tried several fixatives with varying degrees of success. Kleinenberg's picro-sulphuric mixture proved satisfactory, but the best results were obtained from 70 p.c. alcohol 90 ; glacial acetic acid 3 ; formalin 7. In this the embryos remained for one week, and were then transferred to 70 p.c. alcohol.

The eyes were dissected out, cut in halves by a vertical section through the optical axis, and placed in 90 p.c. alcohol for 3 hours, followed by 95 p.c. alcohol for from 6–12 hours, according to size. They were then cleared in cedar-oil, and imbedded in paraffin. The sections were stained either with a 33 p.c. aqueous solution of Delafield's hæmatoxylin followed by eosin, or by iron-alum followed by eosin. In the latter case, the slide was first placed in a 4 p.c. aqueous solution of iron-alum for 10 minutes. It was then thoroughly washed in tap-water, dipped in a saturated aqueous solution of hæmatoxylin for 10 minutes, and then again washed in water. This left the sections black. The slide was then placed once more in the iron-alum solution, and carefully watched until the sections were of a light purple tint. They were then rinsed in water, and examined under the Microscope.

If overstained, they were bleached a little longer in the iron-alum ; if not stained enough, the hæmatoxylin was repeated. The slide was next placed in an alcoholic solution of eosin for about 15 seconds, and the excess of stain washed out in alcohol.

Studying the Gastrulation of the Horned Toad, Phrynosoma cornutum.†—C. L. Edwards and C. W. Hahn found that in order to obtain the earlier stages, it is necessary to take the eggs from the oviduct of the gravid female immediately after it has been chloroformed. The oblong eggs are cream-coloured, and when dry the shell becomes tough, but not brittle or stiff. To fix the embryos free from yolk and separated from the eggshell, a disk somewhat larger than the embryonic area was cut out. In removing this a considerable portion of the yolk immediately beneath was carried with it to sustain the embryo until it could be supported on all sides by physiological salt solution. By the use of a current from a pipette the yolk was removed and then the shell membrane and the vitelline membrane. Sometimes in very early stages it was found desirable to allow the shell-membrane to remain on the blastoderm for its support.

Usually a drawing of the unstained embryo was made under a magnification of 60 diameters in order to facilitate the interpretation of sections.

In general, Flemming's chrom-acetic-osmic acid followed by succes-

* Amer. Nat., xl. (1906) pp. 611–37 (17 figs.).
† Amer. Journ. Anat., v. (1906) pp. 331–51 (15 figs.).

sive alcohols was employed for fixing. A modification of Mayer's hæmalum was found to be superior to hæmatoxylin and other hæmatin stains, both for sections and specimens *in toto*. For the latter Mayer's hæmalum diluted with 20 parts of ammonia alum was used. The specimen was decolorised in 1–10 of 1 p.c. hydrochloric acid in 70 p.c. alcohol. Alcoholic cochineal gave good results *in toto*. Benzo-purpurin was advantageous in older stages. Orange G was used as a plasma stain on sections. The preparations were cleared in anilin or clove-oil, and afterwards in xylol.

Owing to the radially symmetrical appearance of the embryonic area in the earliest stages, they were difficult to orient. They were imbedded in celloidin, and then the celloidin was pared down until the embryos could be observed under a low power.

Triangular blocks were then cut with definite relation to the anterior and posterior ends of the blastoderm. They were then re-imbedded. The celloidin also acted advantageously in protecting the delicate embryos which had become brittle after several years in alcohol.

Demonstrating the Genitalia of Diptera.*—W. Wesché immersed newly killed insects in 15 p.c. caustic potash. When all but the membranes, the exoskeleton and the chitinous structures are dissolved, the preparations are thoroughly washed in water, and then placed in glacial acetic acid for 24 hours. They are again washed with water and then arranged on slides. Another slide is superimposed, and the two compressed by means of clips at both ends. If the arrangement is satisfactory the slides are tied at the ends with twine, the clips removed, and then immersed in methylated spirit for at least 24 hours. The preparation may, if desired, be now stained, for which purpose anilin-blue is recommended. It is now ready for transference to oil of turpentine : the slides are carefully removed, and then the object is removed with a section-lifter to turpentine, wherein it remains for at least 24 hours. After this it may be mounted in balsam, though some preparations are better for a further clearing in oil of cloves. Examination of the preparations should be made with a medium power ($\frac{1}{7}$) aided by a substage condenser.

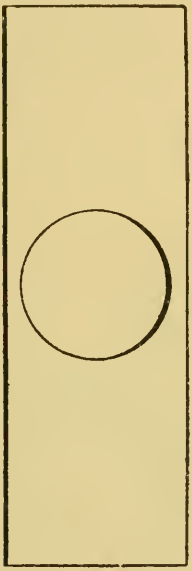
For dissecting under the Microscope, the end of the abdomen must be removed and placed in a drop of water in a live-box or compressorium (the cover being removed), and the organs teased apart by fine needles. The forcipes must be separated from their articulated bases, and the penis and appendages brought out free from the adhering muscles and duct. Impose a cover-glass and examine. Next take a $\frac{7}{8}$ in. cover-glass, place on it a small drop of spirit, and then, by means of a bristle or needle, the parts. Examine with lens, and, if the arrangement be successful, place some more spirit on the cover-glass and put it on a piece of white paper and both on the hot-plate, which must then be gradually heated. As the spirit evaporates it must be replaced with fresh ; a glass needle answers best for this purpose. When dehydrated, the preparation is treated with turpentine, and when cleared is mounted in balsam by superimposing another and thinner cover-glass. This $\frac{7}{8}$ in. glass when dry can be mounted

* Trans. Linnean Soc. (Zool.), ix. (1906) pp. 339-86 (136 figs.).

between three slips of cardboard, the upper and lower punched with a circular hole (fig. 82), and the middle cut to the shape of the larger cover-glass (fig. 83). They can be gummed together and placed in a press and permanently sealed by means of spirit varnish.

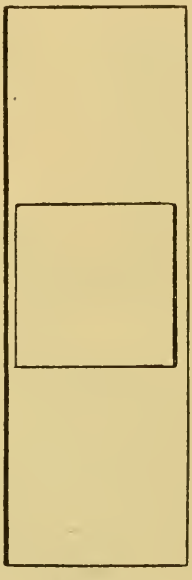
Dry and spirit-preserved insects must be soaked in water for a few hours before dissection.

Insects not larger than the common house-fly may be mounted



Lower and upper piece.

Fig. 82.



Middle piece.

Fig. 83.

whole without pressure. The initiatory stages are the same as the foregoing, but instead of being placed on a slip the insect is placed in a saucer on its back, and a little water poured in. After arranging in the desired position the water is replaced by spirit. When the insect is quite stiff, it is removed on a section-lifter to spirit in a closed flat-bottomed vessel. When thoroughly dehydrated it is removed to turpentine, and after 48 hours or so it is transferred to a slide and covered with balsam. Place round 3 or 4 glass beads or a glass ring which have been washed in alcohol and kept in turpentine. The cover-glass may now be put on and weighted down with a bit of lead. Run in more balsam and keep on doing so daily as the xylol evaporates.

This preparation is best suited for the binocular Microscope and low-power objectives; the position of the internal organs can be well seen in a successful preparation.

Method of Demonstrating Spirochæta pallida in the Blood.*—P. Ravaut and A. Ponselle take 30 c.cm. of distilled water in a test tube and add thereto 30 drops of the blood drop by drop. In about 3 hours a fibrinous clot entangling the white corpuscles and micro-organisms will have formed. The clot is withdrawn, washed several times to free it from any red corpuscles, rolled on filter-paper to remove superfluous water, then imbedded, sectioned, and stained by Levaditi's method.

In this way the writers found *Spirochætæ* in every section examined.

(3) Cutting, including Imbedding and Microtomes.

Cathcart-Darlaston Microtome.—This instrument, made by Watson and Sons, contains an addition to the ordinary well known Cathcart

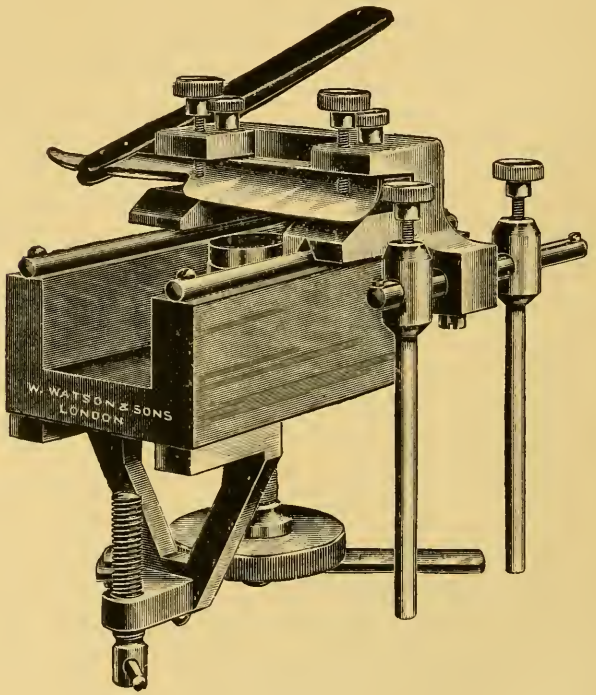


Fig. 84.

Microtome, consisting of an arrangement whereby the material to be cut is automatically raised (fig. 84). Two vertical forks, A A, are attached to the knife carriage, and as the latter is moved forward one of these forks catches an arm attached to the milled head below, thereby carrying a pawl the distance necessary to engage any desired number of teeth, according to the distance apart at which the two forks have been set.

* Gazette des Hôpitaux, 1906, p. 1023. See also Medical Review, ix. (1906) p. 517.

When the section has been cut, and the knife carriage is being drawn back, the arm on the milled head is carried backwards, thereby turning the milled head and raising the material for cutting. The automatic action can be thrown out of gear as desired, enabling the milled head to be rotated by the fingers as usual.

Darlaston Section Cutter.—This section cutter (fig. 85) is made of a solid brass rod $1\frac{1}{2}$ in. diameter, with a well $\frac{11}{16}$ in. diameter. It is claimed by the designer that sections can be cut with rapidity and accuracy, on account of the solid nature of the construction. It is made by Watson and Sons.

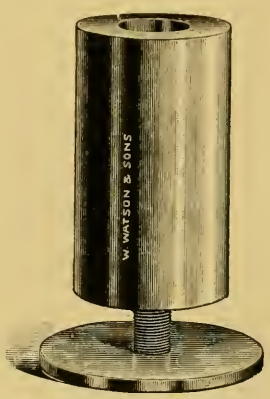


Fig. 85.

(4) Staining and Injecting.

Intra-vitam Staining of the Retro-cerebral Apparatus of Rotifers.*—P. M. de Beauchamp, in some further observations on the retro-cerebral apparatus of Rotifers, states that outside the sac, properly so-called, is a second formation having quite different anatomical characters. This subcerebral gland, which as a rule is only detectable in sections, becomes easily visible in the living animal by means of intra-vitam stainingwith neutral-red or with brilliant Kresyl blue.

New Method of Staining Plasma Cells.†—F. Federici prepares hot saturated aqueous solutions of safranin O, Grübler, and of "Lichtgrün." 60 c.cm. of the former are mixed with 20 c.cm. of the latter. The precipitate which forms is filtered off, the filtrate constituting solution A. The precipitate on the filter is washed several times with distilled water, and is then dissolved in 50 c.cm. of ordinary alcohol: this forms solution B. The final solution is made by mixing Mayer's hæmalum 40 c.cm., solution A 40 c.cm., and solution B 20 c.cm.

In the final solution the sections are placed for 1–3 hours. On removal they are washed for a few seconds in 1 p.c. iron-alum, then in distilled water, after which they are placed in absolute alcohol. Much safranin is herein removed, and when the sections have assumed a green tint the differentiation may be assumed to be complete. They are then passed through bergamot-oil, xylol, and finally mounted in balsam. By this method it is claimed that the nuclei are stained blue, the connective-tissue green, the cell protoplasm greenish-blue, the protoplasm of the plasma cells (Mastzellen) pink, and their basophile granules red.

Bielschowsky's Method of Staining Nervous Tissue.‡—R. Legendre has used this method with success, and finds that he obtains better results therefrom than from the procedure of Ramon y Cajal. Three modifications are given. The technique of the first consists (1) in

* Comptes Rendus, cxliii. (1906) p. 249.
† Anat. Anzeig., xxix. (1906) pp. 357–61. ‡ Tom. cit., pp. 361–7 (2 figs.).

fixing the pieces in 12 p.c. formalin for several days to months; (2) sections, 20 μ, made by the freezing method are immersed in 2 p.c. silver nitrate for 12–24 hours; (3) they are then passed through 3 p.c. ammonia for 10–20 seconds or until they assume a yellow tinge; (4) after which they are treated with 20 p.c. formalin for 10 minutes; (5) after passing again through 3 p.c. ammonia, they are dipped in 0·5 p.c. silver nitrate for $\frac{1}{2}$ minute and (6) then treated with 20 p.c. formalin to reduce the silver; (7) they are next passed through 3 p.c. ammonia and then washed in 20 p.c. formalin for several minutes; (8) the next step is to treat the sections with the following solution, which imparts to them a violet hue: gold chloride 1 p.c. 2–3 drops, acetic acid 2–3 drops, distilled water, 10 c.cm.; (9) they are subsequently passed through 5 p.c. hyposulphite of soda which dissolves the unreduced silver nitrate; (10) after washing in distilled water and then passing through up-graded alcohols, they are treated with carbol-xylol, and finally mounted in balsam.

In the second method which is intended for impregnation *en masse* and paraffin sections, pieces less than 1 cm. thick are fixed in 12 p.c. formol and then immersed in 2 p.c. silver nitrate for 24–48 hours. After a quick wash in distilled water the pieces are treated for $\frac{1}{2}$–1 hour with an ammoniacal silver solution prepared quite fresh in the following way: 20 c.cm. of 2 p.c. silver nitrate, and 2–3 drops of 40 p.c. soda are mixed; the black precipitate which forms is dissolved by adding ammonia, drop by drop. After washing in water the pieces are treated for 12–24 hours with 20 p.c. formalin, and then comes paraffin imbedding followed by the chloride of gold, and the subsequent stages detailed above.

The third method consists in fixing pieces less than 1 cm. thick in 10–15 p.c. formalin. Frozen sections 10 μ thick are made, and after being washed in distilled water are immersed for 24 hours in 2 p.c. silver nitrate. After a wash in distilled water the sections are treated for 15 minutes with an ammoniacal silver solution made as above but with 5 c.cm. 10 p.c. silver nitrate. Then follow 20 p.c. formalin, chloride of gold, hyposulphite of soda, etc., as before.

Method of Staining encapsuled Micro-organisms.*—A. Schädel stains the films for $\frac{3}{4}$–1 minute in ordinary carbol-fuchsin solution and then afterwards for 1 minute in the following solution: mercuric chloride, 0·1 grm.; water and alcohol, 25 c.cm. each. The micro-organisms are stained red, the capsules being colourless against the general pink ground. The stain is permanent. In staining sputa the preparations should be treated with the fuchsin solution for $1\frac{1}{2}$ minutes and for 2 minutes with the mercuric chloride.

Staining Neuroglia in Ichthyobdella.†—C. Pérez and E. Gendre recommend that the material should be fixed in Borrel's chrom-osmic-platinum mixture, and the sections obtained with magenta-red, and then differentiated with picro-indigo-carmin. Some, such as *Branchellion*,

* Lancet, 1906, ii. p. 190.

† Proc. Verb. Soc. Sci. Phys. et Nat. Bordeaux, 1904–5, pp. 50–2.

are stained by a 1 p.c. solution of magenta-red in half an hour, and then differentiated for a similar length of time. Sections of *Pontobdella* take an hour to stain, but are differentiated in from 10–15 minutes.

Demonstrating the Presence of Negri's Bodies in Hydrophobia.* Anna W. Williams and May M. Lowden demonstrated the presence of Negri's bodies in the following way. Smears were made from the cerebral cortex of the Rolandic region, the cornu ammonis, and the cerebellum. The smears were air-dried, and then fixed in methyl-alcohol. Some were stained by Giemsa's method (azur ii.-eosin, 3 ; azur ii., 0·8 ; glycerin and methyl-alcohol, 250 each ; the glycerin and alcohol are heated to 60° ; the pigments are then dissolved in the alcohol and the glycerin added slowly, stirring the while. After standing all night, the mixture is filtered, and the solution is then ready for use. One drop of the stain to every c.cm. of distilled water made alkaline by the previous addition of one drop of a 1 p.c. solution of potassium carbonate to 10 c.cm. of the water). The solution made in the foregoing manner is poured over the smear and allowed to act for ½–3 hours, or even much longer. The excess stain is removed with tap-water ; the smear is then dried with blotting-paper.

Other smears were treated by Mallory's eosin-methylen-blue method : The smears are fixed in Zenker's solution for ½ hour, and after rinsing in tap-water are placed successively in 95 p.c. alcohol + iodin, ¼ hour ; 95 p.c. alcohol, ½ hour ; absolute alcohol, ½ hour ; eosin solution, 20 minutes ; rinsed in tap-water ; methylen-blue solution, 15 minutes ; 95 p.c. alcohol, 1–5 minutes ; and then mopped up with filter-paper.

For sections the technique was as follows :—Fixation in Zenker's fluid for 3–4 hours ; tap-water, 5 minutes ; iodin-alcohol, 24–48 hours ; 95 p.c. alcohol, 24 hours ; absolute alcohol, 4–6 hours ; cedar-oil ; cedar-oil + paraffin 52°, 2 hours ; paraffin 52°, 2 hours. Sections 3–6 μ thick were dried in incubator at 36° for 24 hours, and stained by Mallory's eosin-methylen-blue method.

As depicted in the illustrations, the bodies stained by Mallory's method are red with one or more blue granules ; by the Giemsa method there is a thin peripheral zone of pink, inside this the body is bluish, the granules with which it is beset being red.

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

New Method of Mounting Fungi grown in cultures for the Herbarium.†—G. G. Hedgcock and P. Spaulding separate the fungi, and make pure cultures in Petri dishes upon a rather stiff agar made with some infusion suitable for the normal growth of the fungi. At the proper stage in their growth the plates are divided into square blocks of agar of a suitable size. Each of these blocks is placed right side up on stiff cardboard, and allowed to dry down. After the agar has become dry the mount is protected by pasting over the agar block a small square or circular piece of cardboard which has been perforated with a gun-wad cutter, the perforation being of a size necessary to include the mounted

* Journ. Infectious Diseases, iii. (1906) pp. 452–83 (4 pls.).
† Journ. Mycol., xii. (1906) p. 147.

block. These squares or circles of cardboard may be made of board of several thicknesses, varying from one to several millimetres, so that in selecting a protector the thickness may be adapted to the height of the filaments of the fungus. This method of mounting has proved very convenient for specimens of *Stilbum*, *Grophium*, *Ceratostomella*, and other fungi. It is advisable to poison the specimen after mounting by spraying it with a strychnin solution.

(6) Miscellaneous.

Immersion Oil Bottle.*—Watson and Sons claim that this form of oil bottle (fig. 86), which is constructed on the lines of the unspillable inkpot, possesses the advantage of its prototype, and is also very clean. The cover is made of boxwood, and from its middle a wooden rod for obtaining a drop of oil passes down to near the bottom of the tube.

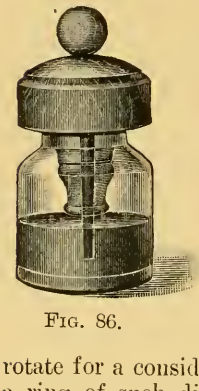


Fig. 86.

Watson's "Facile" Turntable with Ball-bearing.†— In this new turntable (fig. 87) the rotating table is below the level of the supporting block, which is higher than in ordinary models. The centre pin is of hardened steel, and the table at the centre where the pin comes in contact, is fitted with a hardened steel ball. As the pin and ball only engage at a small point, the action is so free that a slight push will make the table rotate for a considerable time. On the surface of the table is engraved a ring of such diameter that when a 3 in. by 1 in. slide is central on the table, the four corners exactly touch the circumference of the circle.

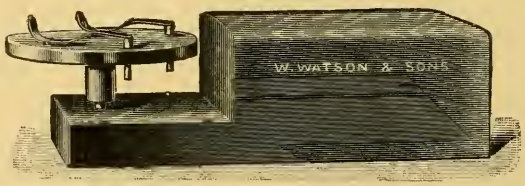


Fig. 87.

Microchemical Test for Zinc.‡—H. C. Bradley states that when a moderately concentrated solution of a zinc salt is treated with sodium nitro-prusside, there is thrown down a salmon-pink precipitate of zinc nitro-prusside, the characteristic feature of which is its definite and readily identified crystal form. All other nitro-prussides of the heavy metals which are insoluble in water are amorphous, slimy precipitates resembling the ferro-cyanides in general physical properties. Though the reaction is not new, its possibilities as a reliable test for zinc appear

* Watson and Sons' Catalogue, 1906, p. 104. † Special Catalogue, p. 10.
‡ American Journ. Sci., xxii. (1906) pp. 327–8.

to have been overlooked. It was found to be valuable in determining the presence of zinc in certain marine Gastropods, and by its means zinc was detected readily in the blood of these Molluscs in a few minutes, while the tests in ordinary use require many hours and much material. In the solutions of tissue ash used the copper was first removed by means of H_2S, and the filtrate concentrated to a small bulk. A drop of this solution was then placed on a Microscope slide and digested with a drop of freshly prepared nitro-prusside solution. On cooling, the rectangular plates and prisms of the zinc salt were deposited.

Gelatin Mass for Fixing and Mending Bone Preparations.*—C. Skoda has found that the following mixture makes an excellent fixative and reparative for uniting and repairing bones intended for museum and demonstration purposes. The adhesive consists of isinglass 2·0, white dextrin 1·0, zinc oxide 0·1.

It is not advisable to make more than is necessary, as the mass does not keep well. It may be thinned by dilution with water if necessary, e.g. it requires to be thin for fixing a weasel's tooth in the jaw and thick for a lion's.

Hardening of Organs with Formalin.†—V. L. Neumayer hardens brain and other organs by means of formalin, and obviates the disagreeable vapour with ammonia. The method is chiefly intended for brain, which is immersed for about three weeks in 10 p.c. formalin. The viscus is then placed for eight days in 12·5 p.c. ammonia, after which it is soaked in strong hydrochloric acid, diluted ten times, from eight to fourteen days; usually eight are sufficient.

Instead of hydrochloric, nitric acid diluted five times may be used.

It is advisable to test the acid solution from time to time, and renew it if the acidity be diminished or lost.

Metallography, etc.

Questions in the Chemistry of Iron.‡—H. von Jüptner deals with the physical chemistry of the alloys of iron, considering the iron-carbon system somewhat fully. The general theory of the solidification of solutions and alloys is outlined. Pure iron may exist in at least four modifications: above 1550° C. liquid, 1550°–900° γ, 900°–760° β, below 760° α. Liquid iron is capable of holding 4·3 p.c. carbon in solution at 1136°, more at higher temperatures: γ-iron dissolves 0·95 p.c. at 700° to 2 p.c. at 1136°; β-iron appears to dissolve about 0·15 p.c. at 760°; while carbon is nearly if not quite insoluble in α-iron. It is found that on dissolving pig-iron, steel, etc., in dilute nitric acid, the power of the combined carbon to colour the solution varies greatly in different cases. These facts, together with others, lead to the conclusion that there are four varieties of combined carbon: Fe_3C, Fe_2C, hardening carbon in annealed steel, and hardening carbon in hardened steel. The conditions of equilibrium between Fe and Fe_3C, Fe and Fe_2C, Fe and C,

* Anat. Anzeig., xxix. (1906) pp. 380-2. † Tom. cit., pp. 378–9.

‡ Ber. Deutsch. Chem. Ges., xxxix. (1906) pp. 2376–2402 (15 figs., 7 photomicrographs).

are considered, the order being that of increasing stability. The changes in the equilibrium curves necessitated by the supposition that α-iron and β-iron are capable of holding carbon in solution, are dealt with. The alloys of iron with silicon, phosphorus, carbon and phosphorus, and nickel, are briefly considered.

Copper Steels.*—P. Breuil gives the results of shock tests on notched bars, torsion tests, and hardness measurements of copper steels. In the low carbon steels the presence of copper appears to reduce the capacity of resisting shock. Elastic limit in torsion and work expended in rupture, are raised when the copper exceeds 2 p.c. Corrosion tests were made by determining the loss of weight resulting upon immersion in dilute sulphuric acid for one month. The loss was smaller with increase of copper up to 2 p.c. Stead's conclusions are confirmed by the author's microscopic examination of the steels. With more than 4 p.c. copper, red nodules of high copper content are isolated in the ingots. The structure of the steels capable of being utilised—i.e. containing less than 4 p.c. copper—is remarkably fine. These steels contain more granulo-sorbitic pearlite as the copper content is higher.

Brittleness and Blisters in Thin Steel Sheets.†—E. F. Law found, by microscopical examination, that brittle and blistered sheets were invariably of less pure steel than tough sheets. The steels from which the defective sheets had been rolled, showed marked segregation and contained oxide of iron. The oxide of iron, which always appears to be associated with blistered sheets, is reduced by nascent hydrogen in the pickling bath, with the formation of water vapour. During annealing the action is reversed, the water vapour being decomposed and hydrogen liberated. The internal pressure produced by these reactions is sufficient to cause the formation of blisters. Brittleness is frequently due to "ghost lines" rich in sulphur and phosphorus. The same plate may have a wide range of ductility.

The Relation between Type of Fracture and Micro-structure of Steel Test-pieces.‡—C. O. Bannister has selected typical fractures from a large number of broken tensile test-pieces and compared the mechanical tests, chemical analysis, and microscopic constitution. His main conclusions are: (1) cup fractures are obtained with homogeneous, minutely crystalline or granular steel, free from slag and manganese sulphide; (2) laminated fractures are due to slag lines (manganese silicate or sulphide) or "ghost lines"; (3) steels giving irregular fractures are generally inferior in quality, made up of irregular patches of pearlite and ferrite, nearly always accompanied by slag lines; (4) the size of the crystals in crystalline fractures has a distinct relationship to the micro-structure of the steel.

Progress of Metallography since 1901.§—F. Osmond and G. Cartaud give a comprehensive review of recent research in metallography. The first paper covers the period 1901–4, the second 1904–6.

* Comptes Rendus, cxliii. (1906) pp. 377–80. See also this Journal, 1906, p. 516.
† Journ. Iron and Steel Inst., lxix. (1906, 1) pp. 134–60 (7 figs.).
‡ Tom. cit., pp. 161–78 (25 figs.).
§ Internat. Assoc. for Testing Materials, Brussels Congress, 1906, 86 pp., 28 figs.

The authors point out that the micrographical study of alloys has become a branch of physical chemistry. The subject is dealt with under the following headings :

1. *Technique of Metallography.*—The progress made by Le Chatelier and others is indicated.

2. *Equilibrium Curves.*—The earlier paper includes an account of Heycock and Neville's well known work on the complex copper-tin system. The iron-carbon system is considered somewhat fully in both papers. In the second the valuable researches carried out in the laboratory of G. Tammann are summarised. The constituents of iron-carbon alloys are defined, and the conditions necessary to produce them stated.

3. *Modifications of One Isolated Phase or of a Complex of Phases within their Regions.*—Thermal and mechanical treatments. This section deals chiefly with researches on modes of deformation of metals.

It is here only possible to give a very imperfect account of these papers. As a guide to the literature of metallography of the last six years they should be of great value to the student. They derive additional importance from the fact that one of the authors is the foremost authority on the subject.

Quaternary Steels.*—L. Guillet gives in detail the results of extensive researches on alloys containing iron, carbon, and two other elements (nickel, manganese, chromium, vanadium, etc.) ; 250 alloys were examined, micrographically and mechanically, following the author's usual plan. The Guillery machine was employed for the shock tests. The steels are classified according to microstructure, and the mechanical qualities corresponding to each type of structure are indicated. The effect of heat treatment (quenching, etc.) on steels of each class is stated. Certain structures indicate the presence of certain elements, e.g. graphite usually demonstrates the presence of silicon in fairly high proportion. The structure may be simple, only one constituent being present, or complex, with two or more constituents. Martensite and γ-iron are the simple structures. Nickel, manganese, chromium, tungsten, and molybdenum tend to convert pearlitic steels into martensitic, while vanadium, silicon, and aluminium act in the opposite way. Martensitic steels, and steels containing graphite, are useless in practice ; γ-iron steels are difficult to machine. For general purposes pearlitic steels are the only useful class.

Deformation and Fracture in Iron and Steel.†—By straining a piece of ductile metal, one surface of which has previously been polished, slip bands are developed on the polished surface. Controversy as to the true nature of these slip bands has arisen. A method for studying their configuration has been introduced by W. Rosenhain, who here gives further details and numerous results obtained by its application. The method is also adapted for examining the surface of fractures. The specimen to be examined is imbedded in electro-copper. The composite mass is cut through approximately at right angles to the surface to be

* Journ. Iron and Steel Inst., lxx. (1906, 2) pp. 1–141 (145 figs.).

† Tom. cit., pp. 189–228 (25 figs.). See also this Journal, 1905, p. 391.

examined, and polished. In this section the boundary line between the specimen and the copper constitutes a sectional view of the original surface of the specimen. A thickness of $\frac{1}{8}$ in. of deposited copper is sufficient. The author's results support the view, with some reservations, that plastic deformation in metals takes place by slip and twinning alone. A modified form of Beilby's theory, that by mechanical disturbance of the molecular arrangement of a crystalline solid, a crystalline phase may be converted into an amorphous phase, is supported. The well known phenomenon of the transformation of γ-iron when strained was studied on a 20 p.c. nickel steel. The changed constituent was found to occur only upon surfaces of slip.

Hardness of the Constituents of Iron and Steel.*—H. C. Boynton has employed Jaggar's micro-sclerometer to measure this property. The instrument was originally introduced for measuring the hardness of minerals. It consists essentially of a diamond point of constant dimensions, which is rotated at a uniform speed and under a given load on the section to be examined. The number of rotations required to bore to a given depth is determined : this quantity is a measure of the hardness (resistance to abrasion). The instrument is adjusted to the Microscope, and has suitable mechanical devices for recording depth of hole, number of rotations, etc. The author uses a second Microscope, with its axis horizontal, for measuring directly the downward movement of a micrometer scale attached to the arm carrying the diamond point. Considerable differences were found in the hardness of the same constituent in different steels, and in the same steel differently treated. The following hardness numbers are selected from a table given by the author : ferrite 460–1643 ; pearlite 842–4711 ; sorbite 2400–24,650 ; troostite 40,564 ; martensite 17,896–120,330 ; austenite 47,590 ; cementite 125,480.

ADAMSON, E.—**Influence of Silicon, Phosphorus, Manganese, and Aluminium on Chill in Cast Iron.** *Journ. Iron and Steel Inst.*, lxix. (1906, 1) pp. 75–105 (5 figs.).

ARNOLD, J. O., & F. K. KNOWLES—**Preliminary Note on the Influence of Manganese on Iron.** *Tom. cit.*, pp. 106–24 (1 fig.).

ARRIVAUT, G.—**Constitution of Manganese-Silver Alloys.** *Proc. de la Soc. des Sci. Phys. et Nat. de Bordeaux*, 1904–5, pp. 9–14.

,, ,, **Preparation and Properties of Manganese-Antimony Alloys.** *Tom. cit.*, pp. 85–9.

,, ,, **Bismuth-Manganese Alloys.** *Tom. cit.*, pp. 89–93.

,, ,, **Manganese-Tin Alloys.** *Tom. cit.*, pp. 104–8

,, ,, **Manganese-Lead Alloys.** *Tom. cit.*, pp. 108–10.

,, ,, **Manganese-Platinum Alloys.** *Tom. cit.*, pp. 147–8.

,, ,, **Manganese-Copper Alloys.** *Tom. cit.*, pp. 148–51.

AST, W.—**International Researches in Macroscopic Examination (Etching Tests) of Iron.** *Internat. Assoc. for Testing Materials, Brussels Congress*, 1906, 42 pp., 27 figs.

* Journ. Iron and Steel Inst., lxx. (1906, 2) pp. 287–318 (8 figs.).

BRINELL, J. A., & DILLNER, G.—**The Brinell Hardness Test and its Practical Application.** *Internat. Assoc. for Testing Materials, Brussels Congress*, 1906, 27 pp., 7 figs.

BRUNTON, J. D.—**The Heat Treatment of Wire.**
Journ. Iron and Steel Inst., lxx. (1906, 2) pp. 142–56 (40 figs.).

HATFIELD, W. H.—**Influence of the Condition of the several Varieties of Carbon upon the Strength of Cast Iron as Cast and Heat-treated.**
Tom. cit., pp. 157–88 (26 figs.).

HEYN, E.—**Methods of Etching Malleable Iron for the Visual Investigation of Structure.** *Internat. Assoc. for Testing Materials, Brussels Congress*, 1906, 32 pp., 62 figs.

ROBERTS, E. G. L., & E. A. WRAIGHT—**The Preparation of Carbon-free Ferro-Manganese.**
[An account of the authors' researches on the constitution of ferro-manganese forms part of this paper.]
Journ. Iron and Steel Inst., lxx. (1906, 2) pp. 229–86 (12 figs.).

SAUVAGE, E.—**Impact Tests on Notched Bars.**
Internat. Assoc. for Testing Materials, Brussels Congress, 1906, 20 pp.

TURNER, T.—**Volume and Temperature Changes during the Cooling of Cast Iron.**
Journ. Iron and Steel Inst., lxix. (1906, 1) pp. 48–74 (9 figs.)

VIGOUROUX, E.—**Attempts to Prepare Iron-Bismuth Alloys.**
Proc. de la Soc. des Sci. Phys. et Nat. de Bordeaux, 1904–5, pp. 71–6.

,, ,, **Iron-Lead Alloys.** *Tom. cit.*, pp. 76–9.

,, ,, **Iron-Antimony Alloys.** *Tom. cit.*, pp. 79–85.

,, ,, **Iron-Tin Alloys.** *Tom. cit.*, pp. 99–104.

,, ,, **Iron-Copper Alloys.** *Tom. cit.*, pp. 119–22.

,, ,, **An Iron-Platinum Alloy.** *Tom. cit.*, pp. 136–9.

,, ,, **Iron-Aluminium Alloys.** *Tom. cit.*, pp. 139–43.

WIGHAM, F. H.—**The Effect of Copper in Steel.**
Journ. Iron and Steel Inst., lxix. (1906, 1) pp. 222–32.

The Microscopy of Metals. *English Mechanic*, lxxxiv. (1906) pp. 230–1.

The Metallurgical Department of the Sheffield University.
Nature, lxxiv. (1906) pp. 541–3 (1 fig.).