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

1908

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

A. Instruments, Accessories, etc.*

(1) Stands.

Watson and Sons' Metallurgical Microscope, "The Horizontal."† This instrument (fig. 7) is designed for bench work and for photographic purposes. It possesses great conveniences for fine work, and is extremely stable. It is attached to a bench or some firm base by means of screws. The body is of extra large diameter, and has a sliding draw-

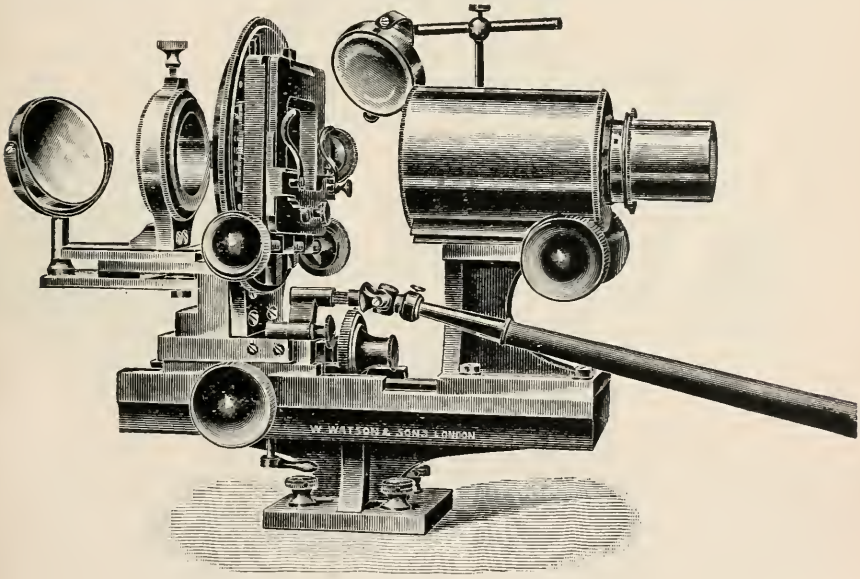


FIG. 7.

tube. It is fitted with rackwork and pinion for focusing. The stage has mechanical movements and rotates concentrically. The vertical and horizontal movements are divided and read by verniers to $\frac{1}{10}$ mm.; the stage is focused by means of coarse- and fine-adjustments. A compound substage with screws to centre and rackwork to focus, and also double mirror, are included for transparent objects. A Hook's joint handle with connecting device is provided for operating the fine-adjustment of

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

† Watson and Sons' Supplement to Catalogue No. 2, p. 8.

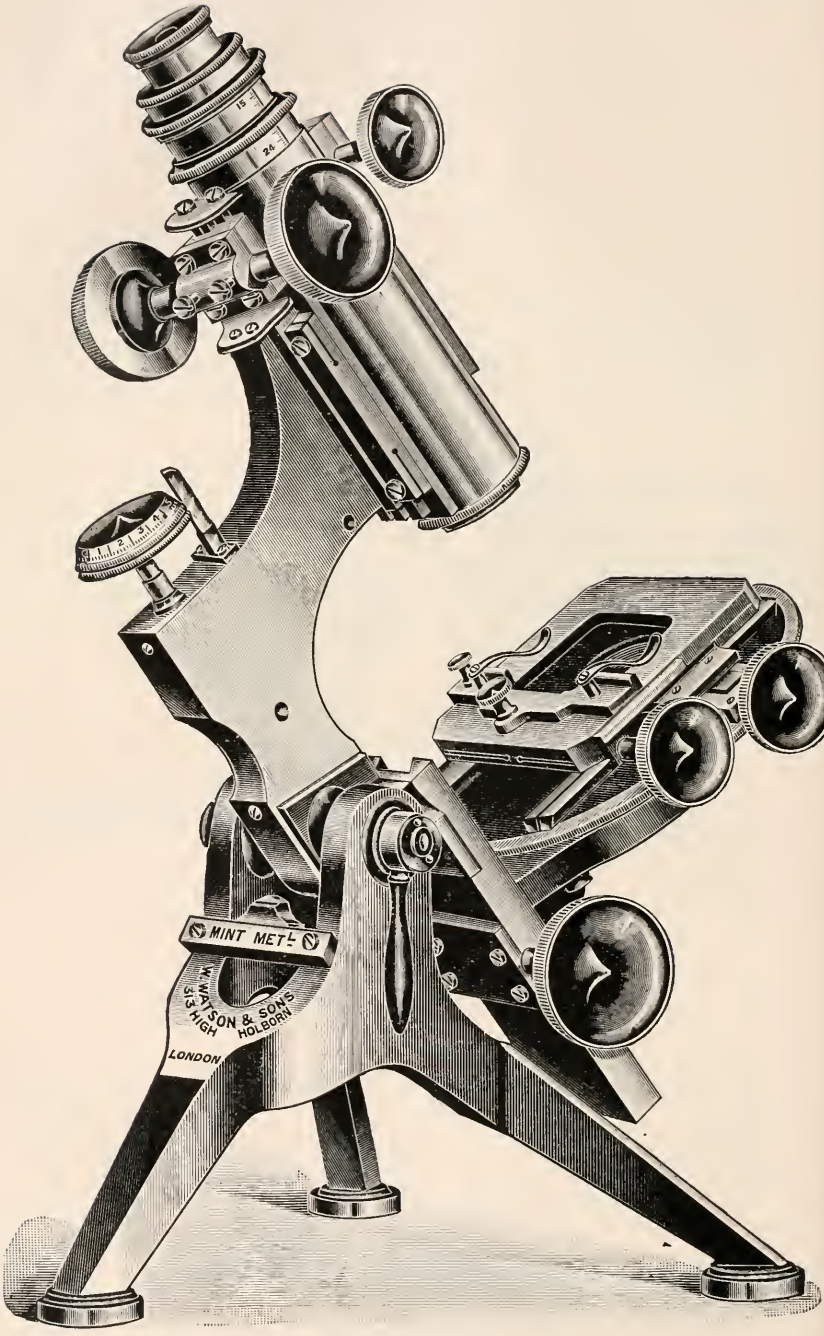


Fig. 8.

the stage when a photomicrographic camera is in use, and a bullseye condenser is included for illuminating opaque objects.

Watson and Sons' "Mint" Metallurgical Microscope.* — This instrument (fig. 8) is substantially the same as the "Works" model, previously described in the Journal,† but is not so large nor so massively constructed. The body is of large size, and fitted with rackwork and sliding draw-tubes. The stage is of the raising and lowering type, and has mechanical movements, and partial rotation. The instrument is made with either the horseshoe or tripod form of foot.

Watson and Sons' Laboratory Dissecting Microscope.‡ — The frame of this instrument (fig. 9) is constructed of mahogany; the sides slope at a convenient angle; the glass stage, 4½ in. square, is removable. The arm, which carries lenses, has a spiral rack-and-pinion adjustment. The mirror is on gimbals.

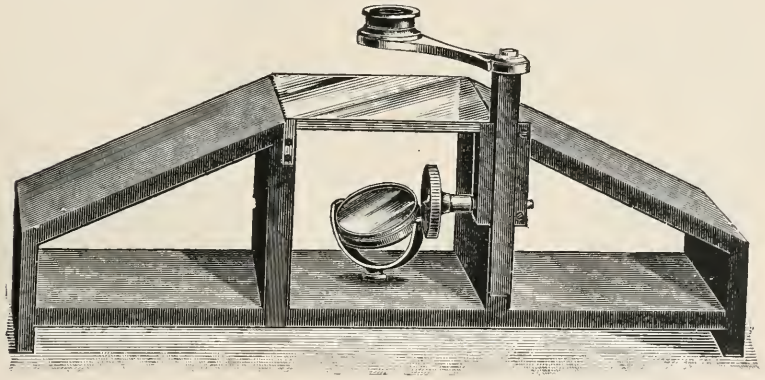


Fig. 9.

Binocular Instruments.§—M. von Rohr's book with the above title treats the subject from three points of view—theoretically, historically, systematically. Part I. (theoretical) discusses the theory of vision (pages 1–19). Part II. (historical) devotes the following 174 pages to the various types of binocular instruments, and describes in detail their fluctuations in utility during each of the last five decades of the nineteenth century, the period 1890–1900 being one of marked recovery. Part III. is a very interesting and useful chronological bibliography under numerous heads and sub-heads.

(2) Eye-pieces and Objectives.

Photographic Objective containing a Uranium-glass Lens.‖—In connection with the increasing use of colour filters, it has occurred to

* Watson and Sons' Supplement to Catalogue No. 2, pp. 6–7.
† See this Journal, 1904, p. 105.
‡ Watson and Sons' Catalogue, 19th edition, 1907–8, p. 71.
§ Die binokularen Instrumente. Berlin: Julius Springer (1907) 223 pp. 90 figs.
‖ Bull. Soc. Franç. Photog., xxiii. (1907) p. 212. See also Zeit. Instrumentenk., xxvii. (1907) p. 233.

M. Houdaille that it might be of advantage to make the objective itself act as a filter. After consultation with the firm of Parra-Mantois, a uranium-glass, 10 mm. thick, absorbing 10 p.c. of the visible rays, and 50 p.c. of those incident on the photographic plate, was selected. From this glass a compound objective was cut from a design calculated by the author. The results were compared with those obtained by a colourless objective. With equal exposures the negatives obtained by the uranium-glass were clearer and could be longer developed. The tones corresponding to the yellow rays were deepened, and those corresponding to the blue weakened, while the plates were uniformly bright to the very circumference.

(3) Illuminating and other Apparatus.

Watson and Sons' Vertical Illuminator.* — This apparatus is made in two forms : (1) with a prism ; (2) with a disk of very thin glass. In the prism form (fig. 10) light concentrated by a bullseye is passed through a small aperture in the side of the illuminator. It is then reflected through the objective to the specimen, the objective acting

Fig. 10.

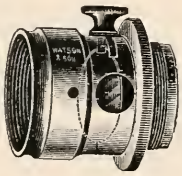


Fig. 11.

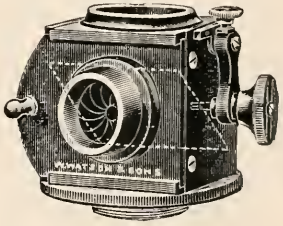


Fig. 12.

as its own condenser. In the glass disk pattern (fig. 11) the light is conducted in the same way as in the prism form, but the reflection is effected by means of a very thin disk of glass set at an angle of 45° to the optic axis.

Another variety of the disk pattern is seen in fig. 12. It is of square form with an iris diaphragm mounted on a plate sliding in a groove, allowing the light to fall obliquely or directly upon the reflecting glass as desired. This vertical illuminator can only be employed with Microscopes having a body of large diameter. If necessary, the iris diaphragm may be mounted on an excentric, so that vertical adjustment also may be obtained.

Watson and Sons' "Grip" Stage-spring.†—Four advantages are claimed for this pattern (figs. 13, 14) : (1) free rotation of the spring ; (2) firmly fixed butt ; (3) removal of spring and butt with perfect ease ; (4) non-liability of objectives to catch the spring, which lies quite flat

* Watson and Sons' Supplement to Catalogue No. 2, p. 17, 3 figs.
† Watson and Sons' Catalogue, 19th edition, 1907-8, p. 12.

except at top. As the illustrations show, the fitting socket which is inserted in the stage is sprung, and though the middle passes a conical-shaped pin, to which at the top a little screw-head is attached. By

Fig. 13.

Fig. 14.

screwing on this head the fitting socket is expanded, and hence the butt is held firmly. To release the apparatus the screwing action is reversed.

Electric Mercury Vapour Lamp for Microscopic Illumination. J. E. Barnard gives the following description of the mercury vapour lamp (fig. 15) exhibited by him on April 17th, 1907. The type of lamp used for the experiments here described, is that made by the Bastian Mercury Lamp Co. Owing to its convenient size and shape, and small current consumption, it has been found most suitable for microscopical purposes. Owing to the fact that, when mercury vapour is in a condition of incandescence, the light emitted by it consists spectroscopically of bright lines, which are evenly distributed over the visual spectrum, it has therefore been found to have considerable possibilities for microscopic work.

Fig. 15.

The Bastian lamp is of the arc lamp type, the light being produced between two bodies of mercury instead of between two carbons. Being inclosed within a sealed glass tube there is no loss of the mercury whatever, and the lamp once set up in operation continues to work without adjustment or renewal of any kind, until the "life" of the "burner" portion of the lamp is exhausted. This "life" in the nature of things must have some limit, though it is difficult to say at present what that limit is. Probably 3000 hours may be regarded as a fair average, though burners have been tested continuously for over 7000 hours without any sensible diminution in their efficiency, and it is quite possible that improved methods of manufacture may render a life of 6000 hours the rule rather than the exception.

The lamp as now in use commercially, is, in fact, an arc lamp, that is to say, it is in working much the same as a carbon arc. The difference, however, is that in the mercury lamp the arc itself is very long, and constitutes the source of light. In the carbon arc this is not the

case, the carbon poles themselves, either one or both, being the source of light.

It is, with this lamp, quite easy to obtain monochromatic light, as it is obviously only necessary to screen off the bright lines in the spectrum which are not required, and the one which remains will then constitute a source of light which is not merely monochromatic, but is of one wave-length. The brightest lines in its spectrum lie in the region of the orange-yellow, green, and blue-violet, and it is these three that are of use. There are a number of faint lines, but for the purpose now described they are not of any importance, and are not sufficiently bright to interfere in practice with the result. The necessary colour-screens can be made by staining gelatin films with a suitable dye, or a more exact and convenient method is to use glass cells in which is placed a solution of the dye employed. By means of a direct-vision spectroscope it is easy to observe the exact concentration of the solution that is required, and no undue absorption of light therefore occurs.

The following combinations of dyes in aqueous solution have been found satisfactory:—Eosin and filter yellow K (Fuerst Bros.) will filter out all but the orange-yellow line. The eosin should be sufficiently concentrated to exclude the green line, the filter yellow K, being used only to subdue the violet and ultra-violet. This screen is perhaps the one of most value for either visual or photographic work, as the position of the line in the spectrum is that of the greatest visual luminosity. In photomicrography its application will be sufficiently obvious. Naphthol-green and filter yellow K will give a light that is visually a brilliant green, but spectroscopically transmits some yellow as well. The green, however, predominates so largely that for visual work it is very useful where a considerable quantity of light is required.

Tartrazine will transmit the yellow and green lines, but in this case the yellow predominates, the green being somewhat subdued. To obtain the green line only, a solution of acid-green must be used together with filter yellow K, and this gives a source of green light for microscopic work, either visual or photographic, which it is difficult to imagine can be improved upon. The violet line is more easy to isolate, as it can be filtered off with a screen of methyl-violet or gentian-violet. It lies rather far in the spectrum towards the ultra-violet, so that visually it is not of great use, but its possibilities in photography are obvious.

The illustration herewith shows the form of lamp made by the Bastian Co., and suitable for microscopic work. It has an automatic tilting device, so that immediately the current is switched on the arc is struck and the lamp lights. The process is therefore similar to the starting of a carbon arc, in which the two poles have to touch one another before any current passes or light is produced.

When the mercury bridges over the gap between the poles and is allowed to flow back again, some mercury is vaporised in the tube and the light is at once emitted.

The length of the glass tube is dependent on the voltage of the supply, and the polarity of the current must be arranged so that the mercury commences to vaporise at the negative pole, the residual mercury being driven back into the bulb at the positive pole.

For microscopic work it possesses the additional advantage that there is practically no radiant heat.

Watson and Sons' New Mechanical Condenser Mount.*—In this mount (fig. 16) a tube of the universal substage size is fixed below the

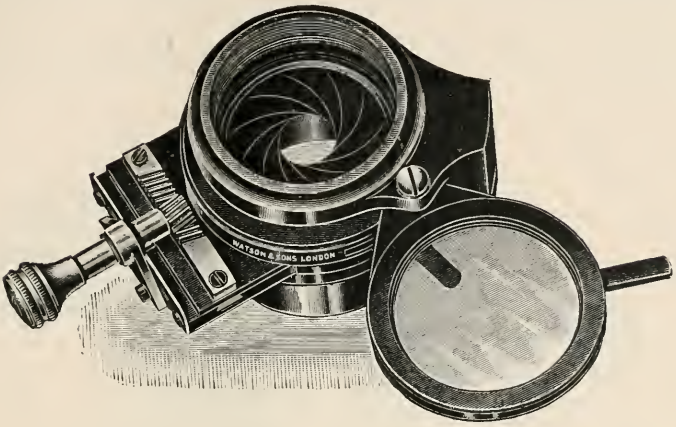


Fig. 16.

iris-diaphragm, which can be carried by rackwork out of the optical axis for obtaining effects when testing objectives for oblique illumination. The apparatus includes also a rotating ring to carry dark-ground and oblique light stops.

Watson and Sons' Aplanatic Low-power Condenser.† — This condenser (fig. 17) is suitable for low and medium powers, up to a numerical aperture of 0·65. It has a power of $\frac{2}{3}$ in., and a numerical

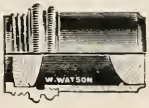


Fig. 17.

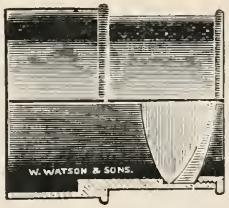


Fig. 18.

aperture of 0·5, of which 0·48 is aplanatic. The diameter of the back lens is 0·6 in.

Watson and Sons' Macro-illuminator.‡—This is a single achromatic combination of 1·25 in. clear aperture and 2 in. focus (fig. 18). It is suitable for illuminating large objects under low powers. The lens is mounted to fit into the substage close to the object, so as to focus the image of the source of light on the objective.

* Watson and Sons' Catalogue, 19th edition, 1907–8, p. 98.
† Loc. cit. ‡ Loc. cit.

Bechstein's Photometer, with Proportional Graduation and Decimally-divided Scale.* — This instrument, which is made by Schmidt and Haensch of Berlin, is an improved form of certain others manufactured by the same firm, and is shown in figs. 19 and 20. The following advantages are claimed for it :—(1) Easy portability and small weight ; (2) absence of unit-marks ; (3) convenient legibility in the

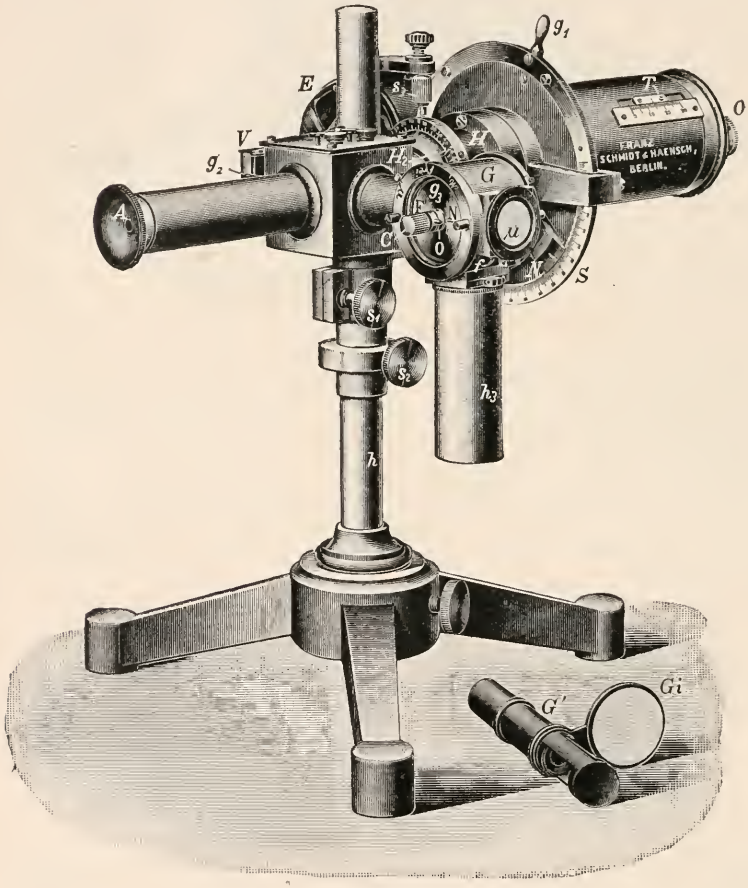


Fig. 19.

graduations ; (4) simple calculation with extreme accuracy of measurement ; (5) long range of measurement both downwards and upwards ; (6) special protection of the parts important for the constant of the given medium ; (7) universal application ; (8) moderate price.

It will be seen from the figures that the instrument consists essentially

* Zeit. f. Instrumentenk., xxvii. (1907) pp. 178–83 (6 figs.).

(1) of a comparison light-source O, whose intensity can be weakened by a double sector S; (2) of a Lummer-Brodhun comparison cube

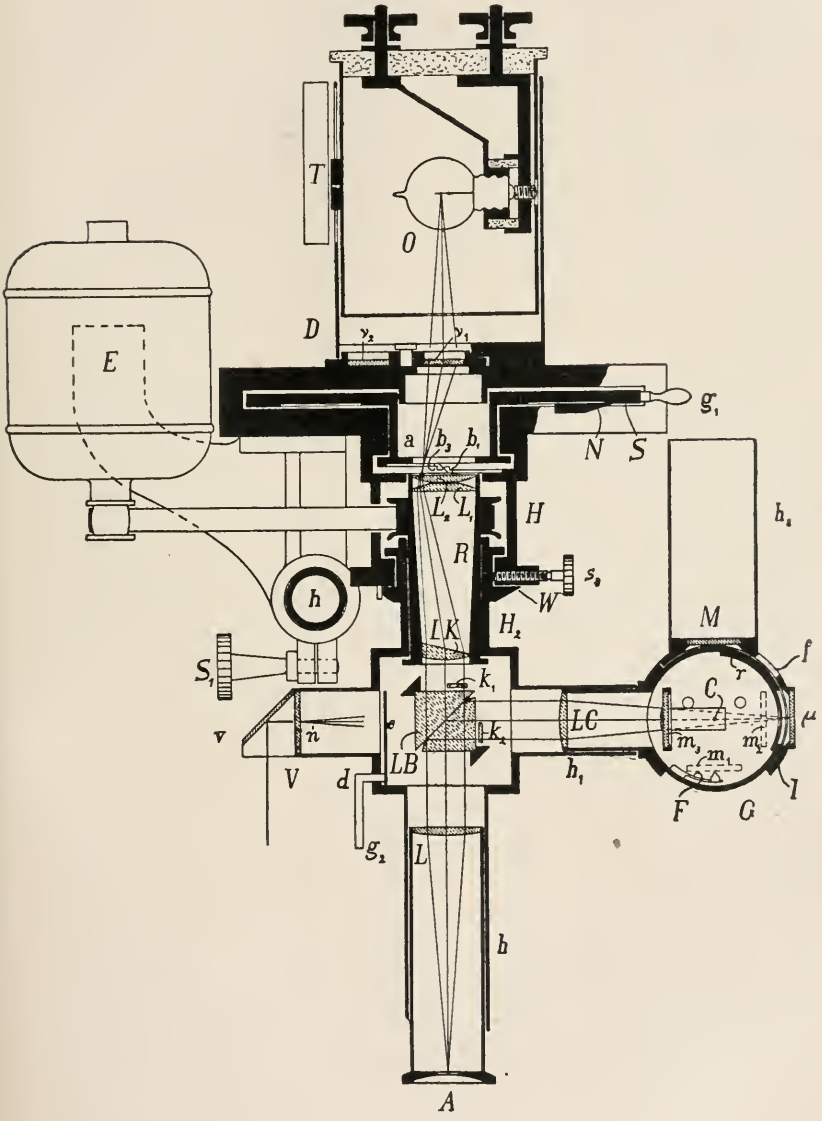


FIG. 20.

P, adjustable both for equality as well as for equality and contrast; (3) of a tube h_3 (fig. 20) for the reception of the light to be measured

and of the apparatus G′ (fig. 19) necessary for the decinal enlargement of the measuring-scale; and finally (4) of an inspection contrivance V for the purpose of the proper adjustment of the light-source to be measured. The weakening of the light emitted from the electric comparison light-source O, and diffusely refracted through the three plates ν_1, ν_2, ν_3, set in the light-and-dust proof revolver D, is effected by the fixed sector and rotating light-beam. The sector-measuring apparatus consists of two equally large detached sectors operated by a handle g and symmetrically arranged about a diameter; they rotate over another pair similarly arranged but of different size. Between the sectors are slits forming the four arms of a cross. The opalescent glass plate ν_1 (fig. 20), regarded as self-luminous, is focused through the lens-combination L_1, L_2, sharply on to the wedge-shaped lens IK. The plane formed by the sectors coincides with the focal plane of IK; the eye-cap with the aperture A is in the focus of the lens L, adjustable in the tube h. Thus at A the sector-slits above referred to are sharply defined. For fuller explanation the course of the rays must now be considered in a reversed direction, i.e., originating from A. A sharp image of the eye-cap would now be formed at a (fig. 20), but, on account of the refraction of wedge-lens IK this image would be laterally displaced from the principal axis. If rotation be imparted to the lenses IK, L_2, L_1, which are all set in a tube rotatory about the principal axis, the image at a will describe a circular path in a direction opposite to that of rotation. In its subsequent course the light falls on the plate ν_1, whose illumination would be intermittent on account of the slits between the sectors; but this illumination could be made uniform to the eye if sufficient velocity of rotation were imparted, and the intensity of illumination would be proportional to the aperture-angle of the sectors. The lenses L_1, L_2, which take part in the rotation, are continuously penetrated at the same distance by the rays, and could not affect the proportionality. The sector-adjustment can be read off on the circle S by means of the index N. The graduation extends to 10, each main graduation being divided into tenths. A small electric motor rotates R.

The comparison-lamp O is electric incandescent, and is secured within its chamber by strong clamps. This lamp-chamber is adjustable by push action in the axis of the instrument, the movement being read off on the scale T, and the brightness can be regulated within the limits of the current-intensity. Some adjustment of light-intensity is also attained by passing the light through more than one plate ν (blue tinted if preferred) of the revolver D. To secure uniformity of diffusion through the revolver plates, the electric lamp, approximately a point, should be mounted in an Ulbricht globe; the opal glass plate is then opposite a uniformly illuminated gypsum screen, and transmission of the glow-threads is prevented. The position of the rotatory upper structure H_2 in the main body H is governed by the screw s_3 and the circular scale H. The glass strips k_1, k_2, are for attaining contrast, and can be applied to the Lummer-Brodhun cube LB by small levers externally controlled. The light to be measured falls on LB from μ or M through the tube h_1,μ being intended for measurement of illumination and M for measurement of intensity. The lens LC not only produces image-formation from μ or M at the aperture A of the

eye-cap under simultaneous use of the cube LB and the lens L, but serves also to adjust the tube h_1 with regard to the light to be measured.

When all the upper structure is in adjustment, LC produces on a ground-glass disk n provided with a mark an approximately sharp, image of the light-source to be measured. A mirror is set at v so that the experimenter can conveniently observe the proper orientation of the instrument. The screen c rotates on d by means of the external handle g_2. It is moved aside when the adjustment of LC is in process but, on release, automatically resumes its first position and effectually prevents the interference of any light from the observer's position with that diffused through the revolver plates. The equation of observation is $B = cS$, where B = the illumination strength in metre-candles, c = the intensity, and S = the sector-opening as given on the graduated scale at S. Then, if light of unit metre-candle is passed through μ, and if equality or equal contrast is obtained when S = 10, it follows that $c = 0{\cdot}1$. If, the instrument remaining in the same adjustment, illumination of 10 metre-candles is presented at μ, S would equal 100, a number beyond the sector-range (graduated from 1 to 10). A plate rotatory about C is now brought into the position m_2, where it transmits only $0{\cdot}1$ of the light; thus c now equals $1{\cdot}0$; in the position m_3 it would transmit $0{\cdot}01$ of the light, and c would now equal 10. These positions are all known by marks external to the chamber G, and thus by product of the values of c and S the candle-power of an illuminant is known. Further weakening of the light-source can be effected by rotation of the tube r, which is fitted with windows of such a size that they transmit 10^{-1}, 10^{-2}, etc., of μ. For the measurement of smaller illuminations a mirror of gypsum is placed obliquely before μ. The diffuse reflecting power of gypsum is greater than the transmissibility of the opal glass plates, and therefore the brightness of the source is increased. Diminution of the comparison-light must be effected, if necessary, by any of the means provided, and the calculation made as before.

Bell, L.—**Physiological Basis of Illumination.**

[The author discusses many familiar difficulties of vision, e.g. the well known trouble found at twilight in trying to work by a mixture of natural and artificial lights.]

Proc. Amer. Acad. Arts and Sci., xlviii. (1907)pp. 77-96 (6 figs.)

Reprinted as a separate pamphlet.

(4) Photomicrography.

Turneretscher's Apparatus for Photomicrography.*—The full title of G. M. Turneretscher's treatise is given below. The apparatus is the outcome of many years' experience, and is adapted to the photography of objects in their natural size, as well as to enlarged or diminished reproductions. In all cases the apparatus lends itself to the easy determination of the proportion between object and image. The camera is

* Apparate zur Herstellung von wissenchaftlichen photographischen Aufnahmen und von Mikrophotographien bei schwachen Vergrösserungen unter bequemer Einhaltung eines genauen, Grossenverhältnisses zwischen Objekt und Bild. Museumskunde, iii. (Berlin, 1907) pp. 158-70 (4 figs.). Also as a separate pamphlet.

always set in the vertical position, and fig. 21, which omits the bellows, shows its adaptation to the more delicate requirements. F is an iron horseshoe-shaped foot carrying a vertical board B which acts as the pillar of a Microscope. On the lower half of this board two projecting bearers T support a mirror S, 15 by 17 cm., rotatory about a horizontal axis, and removable, if required, by single hand-use. To the upper half of this vertical board is attached an arrangement V which allows the object-table to rise or fall about 6 cm. by the action of a micrometer screw M. By means of a lengthening rod, applied at a ball-joint K over the rack of the micrometer screw, the micrometer screw itself can be actuated at a greater distance away—a necessity often felt

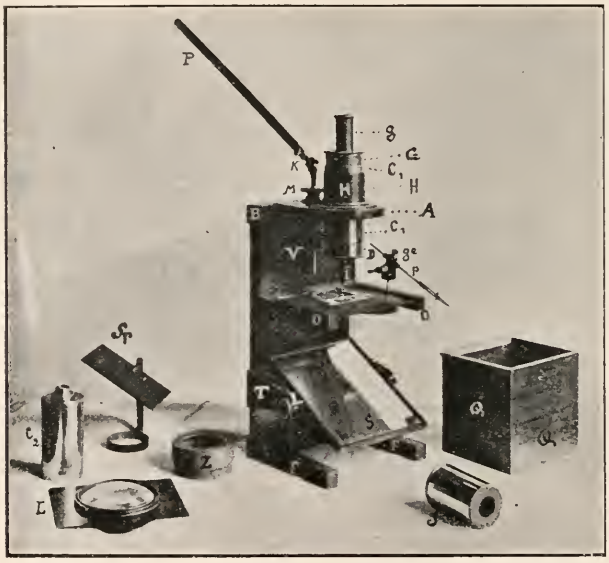


Fig. 21.

with increased bellows extension. Thus the fine-adjustment is attained by movement of the object-stage, which has the advantage that for a selected objective and a selected bellows length the magnification is a known quantity. The arrangement of the upper part of the apparatus closely resembles that of a Microscope. A sleeve H fitted to the horizontal slab A carries a tube C_1, 57 mm. wide and 105 mm. long, within which, on its under side, a second tube D, cloth covered, is inserted, its lower end being threaded for the reception of an ordinary micro-objective, or projection-objective, E. For diminutions or for photography in natural size, other tubes C_2 of similar width and thread can be inserted. At the upper end of the tube C, a short tube G can be used for carrying the narrower tube *g* of an ocular. This arrangement, of course, reproduces a Microscope, but is useful for determining the

most convenient position of the object. When it is required to produce photographs by the objective alone, a special tube J is provided, 75 cm. long, open at its upper end, but carrying at its lower end a diaphragm of 25 mm. diameter. The tube is controlled by push-movement, and can be manipulated until a perfect image is obtained. The object-stage is 12·5 by 15 cm., and has three grooves at its narrow sides for various exchangeable accessories. A blackened metal plate R, with object-clamps, inserted into the uppermost groove, forms the object-stage proper. The second groove is for an opal disk to secure uniformity of illumination. The third groove is for obtaining a dark background, the mirror S being removed and the wooden box Q (blackened inside) put in its place. In the case of larger objects, dark-ground illumination is secured by removal of the box and by placing the object on black cardboard. For transparent objects on a bright ground, the mirror itself serves as an object-stage, and is placed in the uppermost groove. For opaque objects on a bright ground, a strong illumination is directed from above on to the object, whilst the mirror (now an opal glass plate) is illuminated from a weaker source. This method has the advantage of almost eliminating the shadow.

(5) Microscopical Optics and Manipulation.

Measurement of Resolution in Microscopy.*—C. Fabre discusses the theory of microscopical resolution, and emphasises the results of his experiments with Grayson's test-plates. He has found plate No. 6, designed for use with objectives of large aperture, especially satisfactory. On this plate the lines of the first group are at intervals of 10,000 to the inch; those of the next group contain double that number; and in the last group there are 120,000 to the inch. A prolonged use convinced the author that this plate is the best means of measuring the resolving power and the defining power of an objective. The length and the regularity of the lines give also a very clear notion of the curvature of the field of the objective under examination. The author also points out that knowledge of the resolving power of a lens may prevent false decisions as to the existence, or otherwise, of micro-organisms in an object.

New Method of Measuring Directly the Double-refraction in Strained Glass.†—L. N. G. Filon describes his method for the above. A horizontal beam of parallel homogeneous light is made to impinge normally on a vertical face of a rectangular horizontally-placed glass slab, subject to vertical flexure. If C_1 = stress-optical coefficient for the ray polarised in the plane of the cross-section, and for light of the given wave-length; M = bending moment; I = moment of inertia of the cross-section about the "neutral axis"; and T = thickness of the slab, then the points at which the disturbance is in the same phase can be shown to lie upon a straight line inclined at θ_1 to the vertical, where $\theta_1 = \frac{C_1 M T}{I}$. Such a slab under flexure will deflect the wave-front like

* Mem. Acad. Sci. Toulouse, vi. (1906) pp. 142–9.

† Proc. Roy. Soc., Series A, lxxix. (1907) pp. 440–2 (1 fig.).

a prism, and will do the same, but to a different extent, to the wave polarised in the perpendicular direction. If the beam of light be analysed by means of a grating, the spectrum lines all appear doubled, the two components being oppositely polarised. The shift, so produced, can be measured, and θ_1 therefore obtained; hence, C_1 is known. Similarly C_2 can be found. Thus the absolute changes in the two indices of refraction can be calculated, and this not only for one kind of light, but for as many kinds at once as there are lines visible in the spectrum under observation.

Atlas of Absorption Spectra.—This is a very excellent collection, by H. S. Uhler and R. W. Wood, of photographs of absorption spectra. For their production a mirror and a concave grating were employed, the light from the source passing through a wedge-shaped layer of the solution under investigation, after reflection from the mirror. This layer is placed horizontally over the slit, which is also horizontal, the path of the rays being vertical. Through a tilting arrangement adapted to the containing cell its angle is variable. Its edge is at right angles and in the same plane as the direction of the slit.

Three exposures of different but relatively uniform duration were usually given to each plate. As source of light a Nernst lamp was used for wave-lengths between $0{\cdot}65\,\mu$ and $0{\cdot}326\,\mu$, and for wave-lengths between $0{\cdot}326\,\mu$ and $0{\cdot}2\,\mu$, and as an index a specially arranged spark discharge between electrodes of an alloy of cadmium and zinc on the one hand, and of brass on the other was used, the spark spectrum photograph being superposed on that from the Nernst burner.

The authors recommend water as a solvent of the substances investigated as being free from absorption in the ultra-violet. But a recent determination of the refractive indices of water has shown that for the extreme wave-length $0{\cdot}185\,\mu$ this is not the case.*

As Professor Wood points out in the introduction, several workers have made a series of photographs of absorption spectra previously, but with them, the end in view was not a book of reference. Work of this kind was undertaken under the auspices of the Royal Microscopical Society in 1893, the outcome of which were the F and G line screens described subsequently in this Journal,† and also a screen for use in orthochromatic photography.‡ On that occasion the sun alone was used as light source, the fine absorption lines of the solar spectrum in no way interfering with the observation of the comparatively broad absorption bands of the substances under investigation, and showing their position at a glance. In this way most of the anilines now described, besides others, and the principal salts of copper and chromium were then photographed. But the present authors, by employing light from the artificial sources described, have extended the range to the ultra-violet, and finally have published their work, together with a descriptive table of the substances investigated, and of the results obtained. This table gives the commercial as well as the chemical name of each, and also that of

* Proc. Roy. Soc., 1906.
† See this Journal, 1894, pp. 164–7, and 1895, pp. 145–7.
‡ Journ. Roy. Photo. Soc., 1895.

the maker. The whole forms a very complete and accurate book of reference.

Die neue Spektralmethode der Lippmannschen Farbenphotographie. *Centralbl. Zeit. f. Opt. u. Mech.*, xxviii. (1907) pp. 219–21 (2 figs.).

Die Photographie in natürlichen Farben. *Tom. cit.*, pp. 254–5.

(6) Miscellaneous.

Quekett Microscopical Club.—The 443rd Meeting of the Club was held on November 15, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., etc., in the chair. Mr. James Murray communicated a valuable paper, which was read by Mr. D. J. Scourfield, F.Z.S., F.R.M.S., on "*Philodina macrostyla* Ehr., and its Allies." Mr. F. P. Smith made some remarks on "British Spiders taken in 1907," and dealt with some twenty species, of which one, *Tarentula nemoralis*, taken at Bexhill High Woods on June 21, is for the first time recorded as British.

At the 444th Ordinary Meeting held on December 20, the President in the chair, Mr. J. I. Pigg, F.R.M.S., exhibited lantern photomicrographs illustrating the development of the prothallus from the spore of the maidenhair fern. A paper communicated by Mr. E. M. Nelson, F.R.M.S., on "Some Hairs upon the Proboscis of the Blow-fly," was read by the Hon. Sec. Four kinds of hairs were described. Mr. E. F. Law exhibited a number of lantern slides in colour obtained by the Lumière autochrome process. They were photomicrographs, mostly × 1000, of the oxidisation colours obtained by heat-tinting the polished surfaces of phosphor-bronze, gunmetal, and various commercial cast-irons.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Method by which Sponges may be Artificially Reared.†—H. V. Wilson gives the following method. Into a tub about 60 × 30 cm., and covered with glass, a half-dozen sponges, freed from live oysters and crabs, are put. They are raised from the bottom on bricks. The tub is emptied, filled, and flushed for some minutes, thrice daily. Direct rays of the sun should be avoided. In the course of some weeks the sponges regenerate, giving rise to small masses of undifferentiated tissue. When in this condition, if these masses be attached to wire gauze and suspended in a live-box floating at the surface of the open water of a harbour, the masses will in a few days grow and re-develop spores and oscula, flagellated chambers, and skeletal arrangement of the normal sponge.

Cultivation of Gonococci.‡—Nakao Abe uses a meat extract, which he prepares as follows: 500 grm. of chopped-up beef are immersed in 1000 c.cm. of tap-water, and placed in a refrigerator for 18–24 hours.

* 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, preserving fluids, etc.; (6) Miscellaneous.

† Science, xxv. (1907) pp. 912–15.

‡ Centralbl. Bakt. Orig., 1te Abt., xliv. (1907) pp. 705–9.

The fluid is then passed through a paper filter, and afterwards through a Chamberland filter. The reddish germ-free filtrate is preserved in test-tubes or flasks, and if prevented from drying, the stock will keep for weeks. For cultivation purposes it is mixed with solid or liquid peptonised media. Thus, with 2 p.c. nutrient agar, the procedure is as follows: test-tubes containing some 5 c.cm. of 2 p.c. nutrient agar are liquefied and cooled down to 40–50° C., and then 1–2 c.cm. of the meat extract are added; in about a minute the medium is ready for use.

Simple Method of Sterilising Blood for Cultural Purposes.*—E. P. Bernstein and A. A. Epstein place 400 c.cm. of fresh ox-blood in a sterile Erlenmayer's flask of 500 c.cm. capacity, in which have been previously placed 30 c.cm. of 1 p.c. ammonium oxalate solution and $\frac{1}{2}$ c.cm. of 40 p.c. formalin. After shaking, and then allowing to stand for $\frac{1}{2}$ hour, an equal quantity of sterile physiological salt solution is added to the blood. After 24 hours the blood may be used for cultural purposes. One part of the diluted blood is added to 15 parts agar or broth, so that the tubes contain about 1 : 36000 formalin.

Cultivation and Preparation of Myxomycetes.†—E. Pinoy cultivated *Dictyostelium mucoroides* on a medium composed of 20 grm. agar, 50 grm. linseed, and 1 litre of water. This was heated to 117° C., and after having been distributed into glass vessels was sterilised at 115° C. for $\frac{1}{4}$ hour. As the medium could not be filtered, the impurities were got rid of by keeping the medium at 37° C. until the extraneous matters had sedimented. When the agar had set, the clear portion was cut off and was used. On this medium spores were sown, and cultures associated with bacteria were obtained. The presence of one or more kinds of bacteria seems to be indispensable for the nutrition of the fungi, and all, with the exception of *B. pyocyaneus*, were Gram-negative.

For examining the cultures the condensation water was used, and preparations made as hanging drops, or in Van Tieghem's cells. For examination in vivo, neutral red was found to be the best stain, as it colours not only the partially digested bacteria, but also has the property of indicating the reaction of fluids, turning yellow if they be alkaline, and red or blue purple if acid. Hence it indicates the acid or alkaline reaction of the liquid in the vacuoles. Neutral red does not affect the living organisms, but if in excess the myxamœbæ are killed, and therefore stain. For fixed preparations Laveran's method was adopted. A film is made in the usual way, and when dry is fixed with alcohol for ten minutes. It is then stained with the following mixture: 4 c.cm. of 1 per thousand aqueous eosin, 6 c.cm. distilled water, 1 c.cm. Borrel's blue. The stain is allowed to act for 15–20 minutes, and then the film is differentiated with a 5 p.c. tannin solution. The results obtained by the foregoing method were controlled by two other procedures, viz. staining with Heidenhain's iron-hæmatoxylin after fixation in sublimate, and by Borrel's method. This consists in fixing with the following fluid: water 300 grm., acetic acid 20 grm., osmic acid 20 grm., platinum chloride 2 grm., chromic acid 3 grm., then staining with

* Journ. Infect. Diseases, iii. (1906) pp. 772.
† Ann. Inst. Pasteur, xxi. (1907) pp. 622–56 (4 pls.).

magenta red and differentiating with picro-indigo-carmine, followed by alcohol and oil of cloves.

Culture of Anaerobes.*—A. le Dantec describes a method for cultivating anaerobes. It depends on the slow diffusion of gases through liquids in capillary tubes. The upper end of a pipette is drawn out into a capillary neck; broth, previously boiled, cooled and inoculated with an anaerobic organism, is drawn in as far as the upper cylinder above the constricted neck, and the lower end of the pipette is then closed in a flame. Satisfactory anaerobic growth occurs in the medium contained in the body of the pipette.

Collecting and Preserving Fresh-water Rhizopods.†—E. Penard, in describing his methods, states that the collecting of these creatures is as simple as possible. In ponds, streams, and marshes he closes the mouth of a small test-tube with the thumb and plunges the whole arm in the water, so as to bring the test-tube level with the organic felt which usually covers the bottom, then on raising the thumb the water rushes in, carrying with it the surface mud, which is always richest in organisms of all kinds. For collecting in deep lakes, a very simple dredging apparatus is used, which brings up strips of brown organic felt which covers the bottom mud, and which alone contains the Rhizopods. Details as to finding and isolating the creatures so collected will be found in the paper, as well as the various methods of preparing them as microscopic objects. It need here only be mentioned that the author fixes the Rhizopods with absolute alcohol, stains them with borax-carmin, and mounts them in balsam, the whole process being performed on the mounting slip.

Intestinal Broth for the Isolation of Essential and Potential Intestinal Anaerobes.‡—M. Cohendy prepares this medium as follows: 1. The stomach, tongue, liver, intestine, and pancreas of the dog, sheep, pig, or fowl are washed and defatted. 2. Then the stomach and tongue, pounded up together, are mixed with 7 c.cm. HCl, and 500 c.cm. water, and incubated at 40° C. for 18 to 20 hours. 3. To 500 grm. of intestine, liver, and pancreas, pounded up together, are added 1100 c.cm. of water and macerated for 18 to 20 hours at 24° C. 4. The two fluids are mixed together, and, after boiling for 2 minutes, strained through a fine sieve. 5. After alkalinising, the fluid is cooled down to 50° C. and the white of one egg to every 250 c.cm. is added. 6. Boil for 2 minutes, filter, cool to 50° C.; add the white of an egg to every 500 c.cm., sterilise at 120° C. for 20 minutes. 7. Add 0·9 grm. anhydrous glucose to every 100 c.cm., filter through Chardin paper. 8. Distribute into sterilised tubes or flasks; sterilise for 20 minutes at 115° C.

To make solid media with agar, add between (6) and (7), i.e. before the glucose, and with the white of egg 8·5 grm. agar, but sterilise for 45 minutes at 120° C. Then proceed as before.

The foregoing embraces the general principles, but for certain details

* C.R. Soc. Biol. Paris, lxiii. (1907) p. 135.
† Journ. Quekett Micr. Club, x. (1907) pp. 107–16.
‡ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 649–51.

the original should be consulted. The author has, from an experience of six years, found that essential as well as potential anaerobes form colonies in these media within 24 hours at 38°.

Porous Culture Vessels.*—A. Rosam calls attention to the value of a utensil, used for keeping butter cool in hot weather, for cultivating micro-organisms which require moisture and darkness. In shape it is somewhat like a dish-cover, and is made of porous earthenware. It is constructed to hold water between its inner and outer surfaces, and is filled or emptied from the top. As shown in the illustration (fig. 22) it is placed on a dish and is of sufficient size to accommodate several Petri's capsules.

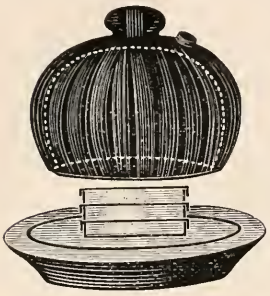


Fig. 22.

Collecting Fossil Flora.†—C. Reid and Eleanor M. Reid obtained specimens from the brickearth of Tegelen-sur-Meuse by following three or four seams to a place where each was overlaid by barren clay. Samples from the seam were then cut out and placed at once in clean boxes for removal. Afterwards the clay was taken out and allowed to dry thoroughly. When dry, about half a pound of clay was placed in a sieve and water poured over it. All the floating particles were collected with a camel's-hair brush and placed aside. The washing was continued until the vegetable material was free from mud. The muddy filtrate was next passed through four sieves with increasingly finer meshes, the residues from each being separately collected and placed in jars with clean water. The residues were then examined in water with suitable lenses, and everything determinable picked out. The selected seeds were then stored in suitable bottles.

Enrichment Method for Detecting Bacillus typhosus.‡—E. Klein has devised an enrichment method for detecting *Bacillus typhosus* in polluted material. He used beef broth mixed with bile salt and malachite-green adjusted in the following manner: To 400 c.cm. of faintly alkaline beef broth were added 5 c.cm. of 5 p.c. aqueous solution of sodium taurocholate and then malachite-green (No. 120 Höchst) in the proportion of 1 : 1500. The medium was decanted into tubes (10 c.cm. each), and then sterilised. Tubes examined 24 hours after inoculation with the suspected fluid showed that *B. typhosus* had grown freely, i.e. had become enriched, while the progress of *B. coli* had been inhibited. Subcultures were made on Drigalski plates.

The use of malachite-green for inhibiting the growth of *B. coli* was discovered by Loeffler.§

Simplified Method for Detecting the Presence of Bacillus typhosus.‖—H. Dunschmann recommends a medium of the following

* Centralbl. Bakt., 2te Abt., xx. (1907) p. 154 (1 fig.).
† Verh. k. Akad. Wetensch. Amsterdam, xiii. (1907) pp. 1–26 (3 pls.).
‡ Lancet, 1907, ii., pp. 1519–21. § See this Journal, 1906, p. 612.
‖ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 483–5.

composition for isolating *B. typhosus* from stools, etc.: 3 p.c. agar, 1 p.c. gelatin, 3 p.c. peptone, 3 p.c. lactose, 0·7–1 p.c. taurocholate. The taurocholate is prepared from ox-bile by precipitating with alum, and then treating the filtrate with perchloride of iron. The resulting fluid is filtered until quite clear. This filtrate, which is strongly acid, is neutralised with sodium carbonate, and after addition of some animal charcoal, is evaporated on a water-bath. The residue is treated with alcohol and filtered, the treatment being repeated twice, and then the dry residue dissolved in water to make a 10 p.c. solution, after which it is sterilised at 110° C.

Simple Thermostat.*—A. Sineff describes an effective incubator which any person can make. It is made of cardboard or a thin wood used for box-making. It has a lid through which a thermometer is inserted (fig. 23), and at its lower part, just above the bottom, a couple of slits for the insertion of an iron plate. Convenient sizes are 20 × 20 × 20 cm. or 30 × 20 × 20 cm., the iron plate being 18 × 50 cm.

As shown in the illustration, the iron plate is heated by means of a paraffin lamp or other source of heat, after the manner of the early hot-stage. The apparatus is said to be capable of working within 0·5°.

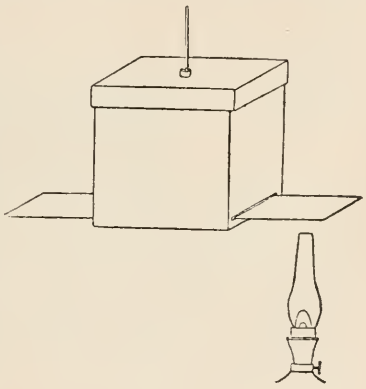


Fig. 23.

Sterilised Bacterial Media for Cultivation of Anaerobes.†—G. Proca finds that used and sterilised cultures of certain bacteria form excellent media for cultivating anaerobes in the presence of air. The tubes should be sterilised at 65–70° C., and inoculated directly they have cooled sufficiently. In broth the growth is scanty, but more abundant cultures are obtainable by pouring the inoculated medium over agar or serum slopes. Instead of cultures, thick suspensions of bacteria may be used, and agar tubes be liquefied, and, after inoculation, be rapidly cooled down. Good growth takes place in the depth of the medium provided the surface be covered with a broth culture sterilised at from 65–70° C. The cultures used were those of *B. coli*, *B. typhosus*, and *Vibrio cholerœ*, and the anaerobes cultivated were *B. tetani*, *B. botulinus*, a club-shaped bacillus isolated from earth, and a bacillus obtained from a case of gangrene.

Observing Living Developing Nerve-fibres.‡—The method employed by R. G. Harrison was to isolate pieces of embryonic tissue known to give rise to nerve-fibres, such as the whole or fragments of the medullary tube or ectoderm from the branchial region, and to observe their further development. The pieces were taken from frog

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) pp. 191–2 (1 fig.).
† C.R. Soc. Biol. Paris, lxiii. (1907) pp. 620–1.
‡ Amer. Journ. Anat., vii. (1907) pp. 116–18.

embryos about 3 mm. long, at which stage, i.e., shortly after the closure of the medullary folds, there is no visible differentiation of the nerve elements. After carefully dissecting it out, the piece of tissue is removed by a fine pipette to a cover-slip upon which is a drop of lymph freshly drawn from one of the lymph-sacs of an adult frog. The lymph clots very quickly, holding the tissue in a fixed position. The cover-slip is then inverted over a hollow slide, and the rim sealed with paraffin. When reasonable aseptic precautions are taken, tissues will live under these conditions for a week, and in some cases specimens have been kept alive for nearly four weeks. Such specimens may be examined from day to day under high powers.

Cultivation of Treponema pallidum.*—C. Levaditi and J. McIntosh have obtained cultivations of Spirochætes by means of the following method. They inserted collodion bags charged with infected material into the peritoneal sac of monkeys. The material used was obtained from syphilised monkeys. From the cultures thus made were obtained organisms morphologically identical with *Treponema pallidum*, but without pathogenic power.

(2) Preparing Objects.

New Method of Fixation.†—Wl. Rudnew places pieces of freshly killed animals in the ordinary ether-alcohol solution of celloidin, and after 3 or 4 weeks removes to thick celloidin solution. The pieces are then stuck on wood-blocks and hardened in 70 p.c. alcohol, and sectioned in the usual way. Unlike most inventors, the author does not claim that this method is perfect: indeed he admits that it has defects which he hopes to remedy, but in the title of the paper points out that it is specially adapted for the study of the nervous system.

Fixation and Preparation of Nematohelminthes.‡ — E. André finds that boiling water gives the best results. When small the animals should be placed in a capsule and boiling water poured over them; this should not be allowed to act longer than the fraction of a second, and then the animals must be plunged into cold water. Large worms should be placed in a glass tube of a diameter a little larger than that of the animal. The tube is plunged into boiling water, and after one or two seconds transferred to cold water. If these large worms are to be sectioned they must be cut up into lengths of several centimetres before immersing in the appropriate fluid. For staining *in toto* an alcohol fluid is recommended, for the reason that while hot water is a fixative it is in no sense a preservative.

Small thread-worms, to be mounted whole as microscopical specimens, should be transferred after fixation to the following medium: distilled water 80, glycerin 10, formol 10, placed in a watch-glass or capsule. The vessel should be uncovered but protected from dust. When the fluid has evaporated to the extent of several cubic centimetres the animals may be mounted in glycerin or glycerin-jelly. This method of

* Ann. Inst. Pasteur., xxi. (1907) pp. 784–97 (2 pls.)
† Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 243-53.
‡ Tom. cit., pp. 278–9.

fixation by means of boiling water and preservation in formol-glycerin is also applicable to small Arthropoda.

Apparatus for Rapidly Cooling Paraffin.*—C. U. A. Kappers describes an apparatus (fig. 24) for rapidly cooling paraffin blocks. It consists of a metal box A, which has an opening B for connecting with the water supply. The table C has two steps, the object being to accommodate blocks of different sizes. A piece of one side D is cut out so that the level of the water in the tank is just below the upper surface of the blocks. When the upper surface of the paraffin has

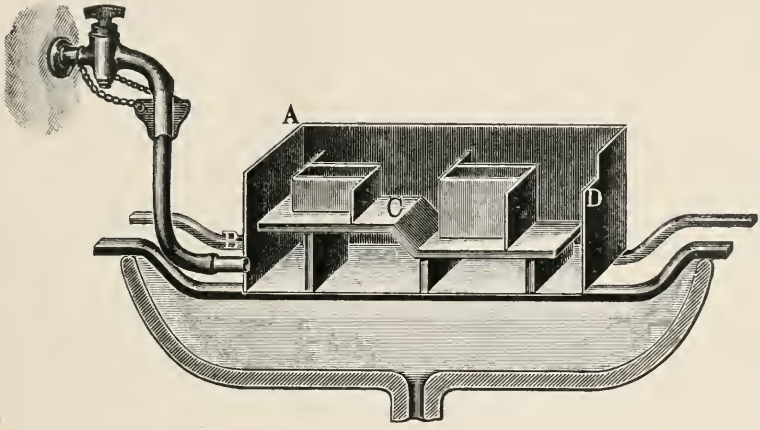


Fig. 24.

become sufficiently hard to bear the water, the aperture D is closed by means of a glass plate. The apparatus is supported upon a basin by means of four arms.

Studying the Development of Ophiothrix fragilis.†—E. W. MacBride made observations on and also drawings of living larvæ. Those used for sections were fixed in 1 p.c. osmic acid, followed by Müller's fluid. The sections were made by the celloidin-paraffin method and the procedure similar to that already described by the author in the case of *Echinus esculentus*. It was found that the celloidin became badly cracked if the sections were left drying on the top of the thermostat for longer than 40 minutes. When it was necessary to supplement the information obtained from views of the living larvæ by whole mounts of preserved ones, these were cleared from osmic acid by immersion in water or weak alcohol. The vessel containing them was then placed (open) inside a larger one, on the bottom of which was a layer of chlorate of potash crystals, over which strong hydrochloric acid was

* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 254–7 (1 fig.).
† Quart. Journ. Micr. Sci., li. (1907) pp. 557–606 (6 pls. and 4 figs. in text).

poured. The larger vessel was closed. The euchlorine gas evolved soon oxidised the black deposit of metallic osmium on the tissues.

In the orientation of sections the postero-lateral arms of the larvæ were of the greatest assistance, for they persist until the metamorphosis is quite complete, so that they mark a constant plane amidst the varying position of the other organs. This plane is called the frontal plane, and most of the sections were cut parallel to it. Sections parallel to the median sagittal plane of the larva were also employed, as were transverse sections when they became necessary in order to elucidate special points.

Studying the Adenoid Tissue of the Spleen, etc.*—C. Ciaccio adopted Levaditi's *Spirochæta* method for studying the fine structure of the adenoid tissue of the spleen, lymphatic glands, and intestine. He fixed in 10–15 p.c. formalin for 24 hours, and, after a short washing in distilled water, immersed the tissue in 90° C. alcohol for 24 hours. After removal of the alcohol in distilled water, the pieces were passed into 1·5 p.c. silver nitrate for 3 to 4 days at 38 °C. On removal they were again washed in distilled water, and then placed in the reducing solution, which consisted of 2 p.c. pyrogallic acid plus 15 p.c. formalin. After reduction, the pieces were passed successively through water, alcohols, and xylol to paraffin. The sections were examined unstained and stained: the best staining solution was Pianese's fluid (acid-fuchsin, Martin's yellow, and malachite-green).

Examining the Trophospongia of Striated Muscle.†—E. Holmgren examined the striated muscle of Insecta, Crustacea, Amphibia, fish, reptiles, birds, and mammals. At first the author's trichloracetic-resorcin-fuchsin method was employed, but was afterwards supplanted by Golgi's silver-chromium method. The solution consisted of 4 parts of 4 p.c. bichromate of potash and 1 part 1 p.c. osmic acid, the material being immersed therein for 6 to 8 days at 30–31° C. This was followed by 0·75 p.c. silver nitrate solution for 24 to 48 hours at the same temperature. The material was then placed in alcohol, frequently changed, for 24 hours, then xylol, xylol-paraffin, and pure paraffin. Carnoy's and Flemming's fluids were also used, the sections being stained with Heidenhain's iron-hæmtoxylin, acid-fuchsin, and picro-carbol-fuchsin.

Fixation of Insect Larvæ.‡—W. D. van Leeuwen has devised a mixture which he has found very useful for fixing insects, especially during metamorphosis. It consists of 1 p.c. picric acid in absolute alcohol 6, chloroform 1, formalin 1, acetic acid ½ part, or less. The mixture should be freshly prepared. The insects, pupæ, larvæ, imagos are left in the fluid for 24 hours or so, and then transferred to 90 p.c. alcohol for 3 days, and afterwards preserved or further treated in any desired manner. Good sections can be obtained by the benzol-paraffin method.

* Anat. Anzeig., xxxi. (1907) pp. 594–601 (7 figs.).
† Arch. Mikr. Anat., lxxi (1907) pp. 165–247 (8 pls.).
‡ Zool. Anzeig., xxxii. (1907) pp. 316–20.

Studying the Interstitial Cells of the Ovary.*—P. Aimé worked with the ovaries of several species of mammals. These were at different stages of development, ranging from the early fœtal state to the adult condition. The material was fixed in Bouin's fluid (formol-picro-acetic acid), Flemming's strong fluid, Tellyesnicky's bichromate-acetic acid mixture, sublimate, sublimate and platinum chloride, and also by Altmann's special method. After a few days' immersion the material was washed. The best results were obtained from pieces which were washed in running water for 12 to 48 hours.

The paraffin sections were stained with iron-hæmatoxylin and eosin or light-green, Delafield's hæmatoxylin, or with iron-hæmatoxylin plus picric acid-fuchsin, or eosin and light-green. Sections from pieces fixed with Flemming were stained with the triple safranin, gentian-violet and orange mixture, or with safranin and light-green. Altmann's method was adopted for showing the granules of the interstitial cells.

Schouten, S. L.—**Methode zur Anfertigung der gläsernen Isoliernadeln, gehörend zu dem Isolierapparat für Mikroorganismen.**

[A description of the apparatus and method of making the glass needles for the author's isolating apparatus. A full description of the method has previously appeared in this Journal, (1905, pp. 758–60).]

Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 258–68 (15 figs.).

(3) Cutting, including Imbedding and Microtomes.

Studying the Structure of Mammalian Ear.†—W. Kolmer gives at considerable length the results of his experiences for examining the auditory apparatus of certain domestic mammals. The difficulties to be overcome are the prevention of distortion of the soft parts and the effective removal of the lime salts from the bone. Injection of the fixative, after washing out the blood, through the carotid, is tedious but gives good results. The best method of decalcification seems to be to imbed the fixed material in celloidin, and then immerse in some decalcifying medium, nitric acid for choice. Most of the well-known fixatives were tried (Flemming, Hermann, sublimate, sublimate and picric acid. formol-bichromate-acetic). Small objects were imbedded in paraffin, large ones in celloidin.

The sections were stained with some hæmatoxylin solution, and contrast-stained with Congo-red or acid-rubin, or by Bielschowski's and Cajal's methods.

Use of Sulphuric Ether in Imbedding.‡—F. Federici describes methods for using sulphuric ether for imbedding in paraffin, and also in celloidin and paraffin. He found that while sulphuric ether at ordinary temperature was a poor solvent of paraffin, its solvent power increased proportionately to the temperature. Recalling Heidenhain's method of paraffin imbedding by the aid of carbon bisulphide,§ he removed pieces of tissue from absolute alcohol to ether, and after a few hours trans-

* Arch. Zool. Expér., vii. (1907) pp. 95–143 (3 pls.).
† Arch. Mikr. Anat. u. Entwickl., lxx. (1907) pp. 697–706 (3 pls.).
‡ Anat. Anzeig., xxxi. (1907) pp. 601–3.
§ See this Journal, 1902, p. 111.

ferred them to a mixture of ether and paraffin (ether 5 c.cm., paraffin m.p. 50° C. = 4 grm.) for 3 or 4 hours, and then for a similar period to a second solution (ether 5 c.cm., paraffin m.p. 50° C. = 4 grm.), The ether and paraffin solution is easily made by placing fragments of paraffin together with the ether in a well stoppered bottle and incubating at from 30–40° C. ; care must be taken not to bring the bottle near an open flame. After the second impregnation in the ether-paraffin mixture, the pieces may be transferred to pure paraffin m.p. 50° C.

As ether readily dissolves celloidin, the author saw his way to perfect a method for a mixed imbedding. In this method the pieces are removed from absolute alcohol to ether for 12 to 24 hours, and then to a 3–4 p.c. solution of celloidin in ether. This is followed by the ether-paraffin solutions, and finally by pure paraffin. From blocks made by this latter method sections may be obtained which are not only very thin, but form ribands quite easily. Such sections may be stuck on the slide by the water, albumen or Schällibaum's methods. While sectioning, the block does not require moistening with alcohol, though when the cutting is finished, it is advisable to cover the surface with paraffin.

(4) Staining and Injecting.

Picric-acid Carmin.*—R. Thoma finds that picric-acid-carmin is of great use for double staining, for staining nuclei and for decalcified osseous tissue. 1 grm. of picric acid is dissolved in 100 c.cm. warm distilled water, and filtered. To the hot filtrate is added 0·5 grm. red carmin. The mixture is warmed until the powder is dissolved, is constantly stirred and brought to the boil once. It is allowed to cool slowly, and after about 24 hours is filtered.

Picric-acid-carmin stains sections in about 20 minutes. The sections are washed in tap-water and differentiated with 1 p.c. picric acid solution. After several washings in water the sections may be examined in glycerin or dehydrated and mounted in balsam.

New Method of Staining Micro-organisms.†—F. Loeffler describes the following methods for staining micro-organisms, especially spirochætæ, gonococci and diphtheria bacilli. The film is fixed with ethyl-alcohol, and then treated with 3 drops of 0·5 p.c. solution of sodium arsenate and 1 drop of 0·5 p.c. solution of malachite-green-zinc-chloride (Höchst). This is warmed for one minute and then the preparation is carefully washed. 5–10 drops of Giemsa stain are mixed with 5 c.cm. of ½ p.c. glycerin, and brought to the boil. The film is then treated for 4–5 minutes with the hot solution, and afterwards washed with a stream of water.

Another procedure given consists in mixing 4 parts borax (2·5 p.c.), methylen-blue (1 p.c.), with 1 part polychrome methylen-blue, and then adding an equal quantity of 0·05 p.c. brom-eosin B extra or extra A. G. (Höchst). The preparations are treated with the warmed solution for one minute, and then immersed in a solution consisting of saturated

* Zeitschr. wiss. Mikrosk., xxiv. (1907) p. 139.

† Deutsche Med. Wochenschr., 1907, No. 5. See also Centralbl. Bakt., 1te Abt. Ref., xl. (1907) pp. 307–8.

aqueous solution of tropæolin OO 5 parts, acetic acid 0·5, water 100. They are then washed with water. In order to decolorise the preparations more slowly, the tropæolin solution may be diluted 5–10 times with water.

Giemsa-staining of Spirochæta pallida.*—J. Schereschewsky exposes the prepared slide, the film being still moist, to osmic acid vapour for a few seconds, and after drying in the air fixes in the flame and then treats it with Giemsa's stain in the following way: 13 drops of Giemsa solution are diluted with 10 c.cm. of 0·5 p.c. glycerin and heated to boiling, and if no precipitate occurs the film is treated therewith. After 2 or 3 minutes the solution is poured off, and if the preparation be not sufficiently stained, the operation is repeated. After a short wash the preparation is mopped up with blotting-paper, dried, and examined in the usual way.

Staining Sudanophil Leucocytes.†—D. Bultino and G. Quarelli used the following solutions for staining the fat globules in leucocytes: 0·2 p.c. solution of Sudan iii in absolute alcohol, and a 0·1 p.c. solution of brilliant Kresyl-blue in the same medium. The authors found that the percentage of sudanophils is much increased in all suppurating affections and in pneumonia.

Borrel's Blue.‡—E. Pinoy states that Borrel's blue is conveniently made by mixing 100 grm. distilled water, 1 grm. silver oxide, and 1 grm. medicinal methylen-blue. The mixture should be kept in a yellow glass bottle. After three weeks, during which period the flask should be shaken from time to time, it is filtered. The maturation may be hastened by keeping the fluid at 37° C. Its staining property depends much on the quality of the methylen-blue.

New Method of Preparing the Romanowsky Stain.§—N. MacL. Harris gives the following procedure. Make up a saturated solution of Grübler's aqueous yellow eosin in methyl-alcohol and preserve; then mix 2 grm. medicinal methylen-blue and 9 grm. sodium bicarbonate, and triturate in mortar. Remove to beaker of 250 c.cm. capacity and mix in 25–30 c.cm. distilled water; steam sterilise for an hour and a quarter. Grind up the black residue, mix with 200–250 c.cm. water and add 10 c.cm. of 4 p.c. sodium hydrate. Extract with chloroform and then evaporate off the chloroform in a water-bath. The resulting mass is made up largely of methylen-violet, variable amounts of methylen-azure, and other substances. Dissolve the mass in methyl-alcohol: this makes the stock solution of crude methylen-violet and azure.

To make the staining fluid, take of the stock solution 60 c.cm., of methyl-alcohol 33 c.cm., of the stock eosin solution 1–1·5 c.cm. Bottle and add from 0·05–0·15 grm. methylen-blue.

The staining of blood-films is carried out by Wright's method, the film being covered with the solution, which is allowed to act for one

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) pp. 91–4 (1 pl.).

† Rev. Clin. Med. Florence, 1907, pp. 321 and 337. See also Brit. Med. Journ., 1907, ii., epit. 108. ‡ Ann. Inst. Pasteur, xxi. (1907) pp. 633–4.

§ Johns Hopkins Hosp., Bull. xviii. (1907) p. 281.

minute. A similar amount of water is added and allowed to stand for five minutes. Wash for 1–2 minutes in running water.

If dysenteric stools are to be stained, the dye should be allowed to act for 2 minutes, while for *Treponema pallidum* 10 minutes may be necessary.

Gram's Staining Method.*—F. Loeffler has tested a number of methyl-violets and gentian-violets in their relation to Gram's method. The best results were obtained with methyl-violet 6 B and B N in 10 p.c. solution freshly dissolved in 1–2·5 p.c. aqueous carbolic. Sections taken from alcohol were placed in the stain solution for 2 to 10 minutes, washed in water, transferred to Gram's iodine solution for 2 minutes, then into 5 p.c. aqueous nitric acid or sulphuric acid for 1 minute (or for 10 seconds into 3 p.c. alcoholic hydrochloric acid), and finally into absolute alcohol until completely decolorised; cleared in xylol, and mounted in balsam.

Studying the Nerve-endings in the Urinary Bladder of Mammals. Sergius Michailow† treated the material by the supravital method. Pieces of quite fresh bladder were immersed in the Ringer-Locke fluid, to which methylen-blue had been added, and when sufficiently stained the tissues were fixed with 7–10 p.c. molybdanate of ammonium. The pieces were then washed with water, dehydrated, and mounted in balsam. Occasionally the material was stained with Grenacher's alum-carmin.

Staining-tank with Movable Grooves.‡—Casimir Cépède describes a staining-tank with movable grooves. These slots or grooves are like the tanks made of glass or porcelain, and are of such dimensions that the pieces can be easily removed. This device enables the various parts of the tank to be easily cleaned.

Simple Method of Staining Blood-films.§—F. Weidenreich places in a watch-glass or capsule some 5 c.cm. of 1 p.c. osmic acid solution, and adds 10 drops of acetic acid. Perfectly clear slides are laid over the glass pan and exposed to the action of the paper for 2 minutes; the capsules should be covered during the exposure with a bell-jar. The blood obtained in the usual way is then made into a film on the side of the slide which has been exposed to the paper. The slide is at once returned to the bell-jar for about 1 minute. When the film is quite dry the slide is passed thrice through the flame and then is flooded for about a minute with a very dilute solution of potassium permanganate (pale red hue). The film is then washed with water and mopped up with filter paper, after which it is ready for staining, for which purpose the following are suitable: Ehrlich's tri-acid mixture, Giemsa, gentian-violet, eosin-methylen-blue, hæmatein.

* Centralbl. Bakt., 1te Abt. Ref., xi. (1907) p. 78.

† Arch. Mikr. Anat., lxxi. (1907) pp. 254–83 (2 pls.).

‡ C R. Soc. Biol. Paris, lxiii. (1907) pp. 485–7 (2 figs.).

§ Folia hämatologica, iii. (1906) 7 pp. See also Zeitschr. Wiss. Mikrosk., xxiv. (1907) pp. 301–2.

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

Preserving Fossil Seeds and Leaves.*—C. Reid and Eleanor M. Reid treated the fossil seeds they had collected † in the following way. A few seeds were removed from the store-bottles and washed in water to remove the formalin or salicylic acid used for their temporary preservation. Then a thin film of wax (paraffin filtr., 45° C. Grübler) was melted on a glass plate or Microscope slide. The seeds or leaves were placed, still wet, on the film, and the plate immediately heated to a temperature just sufficient to melt the wax. By this procedure the seed is impregnated with wax and rendered so tough that it could be easily handled. The superfluous wax was then removed with blotting-paper, or by brushing the surface with benzine. In the case of leaves it was found best to place them between two glass plates charged with films of wax; they then become quite flat, and were easily photographed. When the wax is hard one plate is warmed and slid off, and the exposed surface of the leaf cleaned with benzine. The second glass was then warmed until the leaf could be slid to a clean part of the plate, and no excess of wax remained. The toughened leaf could then be lifted off and mounted on a card like an herbarium specimen.

(6) Miscellaneous.

Dust-excluding Histological Reagent Bottle.‡—The bottle (fig. 25) devised by W. H. Harvey differs from the ordinary type in the structure of the neck, which ends abruptly without any lip. The pipette has a glass cover or dome, through which it passes, sufficiently large to receive the neck of the bottle. The cover must be at least 1 mm. longer than the neck, to prevent fracture at the union of pipette and cover. As a further precaution, a thin rubber or felt washer may be placed upon the shoulder of the bottle.

Fig. 25.

Nathorst's Use of Collodion Imprints in the Study of Fossil Plants.—By the term "collodion imprint" is meant, says F. A. Bather,§ the impression of any surface on a thin film of collodion. An impression is obtained by letting a drop or two of collodion, dissolved in ether, fall on the surface to be copied. The ether evaporates rapidly, so that the film is hard in 2 or 3 minutes. When dry it is removed to a slide, and preserved dry under a cover-slip held in position by gummed strips of paper or by Canada balsam. When the imprint is very sharp, the film may be preserved in glycerin-jelly without its distinctness being much impaired. It is advisable to throw away the first made, as it usually retains some dust from the surface of the object, the following films being free from this.

* Verh. k. Akad. Wetensch. Amsterdam, xiii. (1907) pp. 1–26 (3 pls.).
† See this Journal, *ante*, p. 108.
‡ Zeitschr. wiss. Mikrosk., xxiv. (1907) p. 280 (1 fig.).
§ Geol. Mag., iv. (1907) pp. 437–40 (1 fig.).

The film placed on the slide is examined under the Microscope by transmitted light ; quite high powers may be used, and photomicrographs taken. The illumination should be oblique, the mirror being shifted until the best effect is obtained. Though such collodion films have long been used in the measurement of microscopic objects, and by botanists for copying the cuticular surface of living plants, Nathorst was the first to employ the method in the study of fossils.

Rawitz' Microscopical Technique.*—This manual, by B. Rawitz, aims at giving as complete an account as possible of the present condition of microscopical technique, in a handy form, and suitable for reference in the laboratory. The work is divided into two parts, the first dealing with the various methods of research, and the second with the application of these methods to the different organs and tissues. The volume is but little adorned with illustrations, there being but eighteen altogether, and all of them old friends.

Metallography, etc.

Melting Point Diagrams of the Binary Systems Galena-Magnetic Pyrites and Galena-Silver sulphide.†—K. Friedrich has employed for this work lead sulphide with 87·1 p.c. Pb, magnetic pyrites with 62·35 p.c. Fe, and silver sulphide with 99·6 p.c. Ag_2S. Both equilibrium diagrams are simple, consisting of two branches meeting at the eutectic point, and the horizontal eutectic line. A lower horizontal at 175° C. in the galena-silver sulphide diagram indicates a transformation point in Ag_2S. The melting points are, lead sulphide 1114° C., magnetic pyrites 1187° C., eutectic (70 p.c. PbS) 863° C., silver sulphide 835° C., eutectic (77 p.c. Ag_2S, 23 p.c. PbS) 630° C. Photomicrographs are given.

Melting Point Diagrams of the Binary Systems, Silver sulphide-Copper sulphide and Lead sulphide-Copper sulphide.‡—K. Friedrich gives the equilibrium diagrams. Ag_2S and Cu_2S appear to form an unbroken series of mixed crystals. A minimum occurs at 70 p.c. Ag_2S (677° C.), there is no eutectic. 1121° C. is the melting point of copper sulphide. The lead sulphide-copper sulphide diagram has two branches meeting at the eutectic point 51 p.c. Cu_2S, 540° C. No ternary compounds exist. A dilute solution of iodine in potassium iodide was used for etching the sections.

Influence of Stress on the Corrosion of Iron.§—Walker and C. Hill measured the potential given by pure Swedish iron, stressed in tension in a testing machine, against a normal calomel electrode, in ferrous sulphate solution. Below the elastic limit the potential change is exceedingly small. Somewhere above the elastic limit the potential rises suddenly. Out of a considerable number of specimens broken in

* Leipzig: W. Engelmann (1907) 438 pp.
† Metallurgie, iv. (1907) pp. 479-85 (21 figs.).
‡ Tom. cit., pp. 671–3 (7 figs.).
§ Mechanical Engineer, xx. (1907) p. 155.

tension, the potential of six reached a constant value shortly after fracture. The difference between the initial and final potentials varied from 0·0019 to 0·0077 volt. The conclusion is drawn that even beyond the elastic limit the corrosion of iron is not greatly affected by stress.

Hard and Soft States in Ductile Metals.*—G. T. Beilby, in continuation of his previous work on this subject, has sought to define more accurately the temperature range over which crystallisation takes place in metals hardened by cold work. Hard drawn wires of gold, silver and copper were heated to various temperatures. Observations were made of the microstructure, the mechanical stability (by determining the load which would give a permanent extension of 1 p.c.), the E.M.F. given by a thermocouple consisting of a hard wire and a wire previously heated to the given temperature. The change in elasticity was determined by taking the pitch of the note given by reed vibrators of different metals annealed at various temperatures. The following are among the author's conclusions. The most severe mechanical working of a metal always produces a mixed structure of the hard and soft phases. It has not yet been found possible to produce a homogeneous specimen of metal entirely in the hard state. The temperature ranges over which (1) re-crystallisation, (2) loss of mechanical stability, (3) development of thermal E.M.F. between wires in the hard and soft states, (4) complete restoration of elasticity in hardened metal occur, coincide with each other closely. The maximum amount of change in gold, silver and copper occurs between 200° and 300° C. The change is essentially the development of the crystalline from the non-crystalline condition.

Densities and Specific Heats of Some Alloys of Iron.†—From measurements made on a large number of alloys, quenched in water from a bright red heat, W. Brown has determined the effect upon the specific volume and specific heat of iron, of additions of carbon, manganese, nickel, tungsten, silicon, chromium, copper, cobalt and aluminium. The results are expressed as change per 1 p.c. of added element. By applying these results to the calculation of dissipation of energy per cycle in armature cores, the superiority for this purpose of silicon steel to pure iron or other alloys is demonstrated.

Alloys of Iron with Molybdenum.‡—Lantsch and G. Tammann have sought to determine the equilibrium diagram. The metals melted in magnesia tubes were heated to 1800°–1850° C., and the protected thermocouple inserted when the temperature had fallen to 1600° C. Alloys with more than 70 p.c. molybdenum could not be made homogeneous in this way, the molybdenum not dissolving completely. Abnormalities apparent in the curve, which theoretically cannot occur in a two-component system, have led the authors to put forward the hypothesis that owing to the slow formation of a compound the system must be considered as one of three components—iron, molybdenum and the

* Proc. Roy. Soc., Series A, lxxix. (1907) pp. 463–80 (12 figs.). See also Nature, lxxvi. (1907) pp. 572–4 (2 figs.).

† Trans. Roy. Dublin Soc., ix. (1907) pp. 59–84 (6 figs.).

‡ Zeitschr. Anorg. Chem., lv. (1907) pp. 386–401 (18 figs.).

compound x. The equilibrium diagram is accordingly shown in the three dimensional system. If iron and molybdenum could be mixed at 1800° C. so quickly that the compound x had not time to form, two series of mixed crystals only would be formed. The compound x and iron do not form mixed crystals. Alloys prepared by the aluminothermic process, and thus heated to a much higher temperature, contain distinctly more of the compound x. The structure of alloys prepared in either way is not altered by heating to 1200° C. and quenching, showing that the differences are not due to reactions occurring in the solid state. It appears that the amount of the compound present slowly increases as the temperature rises. A similar case is that of aluminium and antimony.

Copper-bismuth Alloys.—K. Jeriomin* gives the equilibrium diagram, differing considerably from Gautier's. No compound is formed. If mixed crystals exist, their concentration is very low—less than 0·5 p.c. copper in bismuth, or bismuth in copper. The eutectic contains not more than 0·5 p.c. copper.

A. Portevin † has also determined the equilibrium diagram, and states that neither compounds nor solid solutions are formed. The eutectic contains very little copper. Crystals of copper are found in the alloy with 0·3 p.c. copper.

Zinc-cadmium Alloys.‡—G. Hindrichs gives the equilibrium diagram, showing no compounds or solid solutions. The eutectic composition and temperature are 82·6 p.c. cadmium and 270° C. The thermal results were confirmed by microscopic examination.

Antimony-lead Alloys.§—W. Gontermann has re-determined the equilibrium diagram, because of some discrepancies and omissions in previous determinations. No compounds or mixed crystals are formed. A peculiarity was noted in the cooling curves of the alloys from which antimony first crystallises. The eutectic point is apparently double, two halts occurring at temperatures about 5° C. apart. After showing that this cannot be due to the formation of a compound or to changes occurring in the solid state, the author suggests the explanation that the double halt is due to the difference in solubility of large and small crystals of antimony.

Special Cast Irons.‖—By adding nickel in increasing amounts to (1) white iron, (2) grey iron, L. Guillet prepared a series of nickel cast irons. Microscopic examination showed that nickel favours the formation of graphite. Similar tests were made with manganese. The author arrives at the general conclusion that those elements which enter into solution in iron (nickel, aluminium, silicon) promote the formation of graphite, while the elements which form a double carbide with cementite (manganese, chromium) tend to prevent graphite formation.

* Zeitschr. Anorg. Chem., lv. (1907) pp. 412–14 (1 fig.).
† Rev. de Métallurgie, iv. (1907) pp. 1077–80 (4 figs.).
‡ Zeitschr. Anorg. Chem, lv. (1907) pp. 415–18 (1 fig.).
§ Tom. cit., pp. 419–25 (2 figs.).
‖ Comptes Rendus, cxlv. (1907) pp. 552–3.

Thermo-electricity of Nickel.*—H. Pécheux has measured the E.M.F. developed by thermocouples prepared from copper and three specimens of commercial nickel, varying somewhat in chemical composition. The notable effect of impurities in the nickel, and of annealing, on the E.M.F. developed is shown.

Blowholes in Steel Ingots.†—E. von Maltitz discusses the formation and prevention of blowholes. Though the gas found in them consists almost wholly of hydrogen and nitrogen, the gas evolved during solidification contains a large proportion of carbon monoxide, and it appears that the formation of blowholes is largely due to the evolution of carbon monoxide. The solvent power of molten steel for ferrous oxide (the source of the carbon monoxide) increases as the temperature rises, and at the same time the affinity of iron for oxygen increases more rapidly than that of carbon for oxygen. Thus carbon monoxide is given off when highly heated molten steel (containing both ferrous oxide and carbon in solution) is cooled, as by stirring with a steel rod. The liberation of carbon monoxide probably induces the simultaneous liberation of hydrogen and nitrogen.

Melting Points of the Iron Group Elements.‡—G. K. Burgess has obtained the following values by a new radiation method :—Iron 1505° C., cobalt 1464° C., manganese 1207° C., chromium 1489° C., nickel 1435° C. Minute quantities of the metal were placed on an electrically heated platinum strip within a brass tube through which hydrogen was passed. The particles were microscopically observed through a mica window, and the temperature of the platinum strip was taken by a Holborn-Kurlbaum optical pyrometer at the instant when the metal was seen to melt.

Melting Points of Palladium and Platinum.§—C. W. Waidner and G. K. Burgess have selected the values, palladium 1546° C. and platinum 1753° C., from the results given by radiation and other methods.

Electrolytic Corrosion of Brasses.‖—A. T. Lincoln, D. Klein, and P. E. Howe have subjected to electrolytic corrosion in normal solutions of some sodium and ammonium salts a series of copper-zinc alloys representing most of the different solid solutions, annealed at 400° C. for several weeks. For the alloys of 50 p.c. or more copper the corrosion product (precipitate resulting from corrosion) has practically the same composition as the alloy. For alloys of low copper content the corrosion product is nearly pure zinc. While the amount of corrosion in sodium chloride decreases with increase in copper content of the brass, in other solutions the reverse was found to be the case.

* Comptes Rendus, cxlv. (1907) pp. 591-3.
† Bull. Amer. Inst. Mining Eng., xvii. (1907) pp. 691-726.
‡ Bull. Bureau of Standards, iii. (1907) pp. 345-55 (1 fig.).
§ Tom. cit., pp. 163-208.
‖ Journ. Phys. Chem., xi. (1907) pp. 501-36 (12 figs.).

Alloys of Iron with Chromium.*—W. Treitschke and G. Tammann have investigated the equilibrium diagram. Owing to the high viscosity of molten chromium at 1600° C., it was found necessary to heat the alloys to 1700° C. in magnesia tubes in order to secure complete mixing of the fluid metals. With more than 10 p.c. chromium the cooling curves no longer indicated the transformation points of iron. The peculiarities of the freezing point curve are explained in the same way as for the iron-molybdenum alloys, by the existence of a compound x with a relatively slow rate of formation. The system thus becomes a ternary system. The diagram, and the microstructure of the alloys, are discussed in detail.

Alloys of Potassium with other Metals.†—D. P. Smith has determined the equilibrium diagrams of the binary alloys of potassium with aluminium, magnesium, zinc, cadmium, bismuth, tin, and lead, and gives a table summarising his results. Potassium is not miscible in the liquid state with aluminium and magnesium, and only partially miscible with zinc, cadmium, and lead. Compounds were found in each series except the potassium-aluminium and potassium-magnesium systems. Owing to the rapidity with which the alloys oxidised, microscopic examination was difficult. Some sections were cut and examined under paraffin oil.

Metallography of Cast Iron.‡—E. Heyn and O. Bauer have sought to determine the range of temperature in which graphite is formed, in two series of alloys, the first containing about 4 p.c. silicon, 3 p.c. carbon, the second about 1·5 p.c. silicon, 3·2 p.c. carbon. The samples were slowly cooled from a temperature well above the melting point, and quenched at different temperatures. One sample of each series was slowly cooled to atmospheric temperature, the cooling curve being taken. Graphite was estimated in each sample, and sections were microscopically examined; total carbon and silicon were also determined. The results indicate that iron alloys containing 1·2–4·25 p.c. silicon and 2·7–3·12 p.c. total carbon solidify as white iron, and that nearly the whole of the graphite is formed in the temperature interval of 40° C. below the end of solidification. E Heyn discusses the literature of the subject. P. Goerens § and E. Heyn ‖ deal with the formation of kish.

Crystallisation and Structure of Steel.¶ — A. Bajkow has made analyses and microscopic examination of octahedral crystals found in blow-holes in steel castings. In three specimens the carbon was 0·54–0·98 p.c., manganese 0·78–1·06 p.c. All the crystals contained inclusions of slag in crystalline form.

Osmondite.**—H. M. Howe gives an account of the experimental results from which Heyn and Bauer deduced the existence of this new

* Zeitschr. Anorg. Chem., lv. (1907) pp. 402–11 (9 figs.).
† Op. cit., lvi. (1907) pp. 109–42 (9 figs.).
‡ Stahl und Eisen, xxvii. (1907) pp. 1565–71, 1621–5 (33 figs.).
§ Tom. cit., pp. 1776–7. ‖ Tom. cit., p. 1778.
¶ Journ. Soc. Chem. Ind., xxvi. (1907) p. 1139. Abstract from Journ. Russ. Phys.-Chem. Ges., xxxix. (1907) pp. 399–410.
** Electrochem. and Met. Ind., v. (1907) pp. 347–50 (2 figs.).

iron-carbon phase. When hardened steel is tempered, the change in physical properties precedes the change in carbon condition. Thus, when a 0·95 p.c. carbon steel quenched in water from 900° C. was reheated to 400° C., 70 p.c. of the loss of hardness had taken place, and only 13 p.c. of the change from hardening carbon to cementite had occurred. Osmondite, the chief constituent when the change has proceeded thus far, is defined as a solid solution of iron carbide in α-iron. Doubt is thrown on the suggestion that the hardness of osmondite, which is still distinctly harder than pearlite, is due to "inequiaxing" (distortion of the crystalline grains).

Apparatus for Polishing Metal Sections.*—K. W. Zimmerschied describes a machine designed for the use of a number of students. The ten horizontal polishing wheels are driven from two shafts running below the bench. The spindle of each polishing wheel carries at its lower end a friction disk, which can be raised out of contact with the driving wheel on the shaft, thus stopping the polishing wheel. Speed is regulated by sliding the driving wheel along the shaft. Each polishing wheel is provided with a water-guard, and is continuously supplied with distilled water from a glass nozzle. The metal section, after surfacing on a fine carborundum wheel, is polished in turn with (1) very fine carborundum powder on a canvas-covered disk; (2) alumina on broadcloth; (3) if still finer polishing is required, rouge on broadcloth.

Annealing of Sterling Silver.†—W. H. Walker found that the dark "fire-surface" produced on silver containing 7·5. p.c .copper, by annealing, was due to the oxidation of the copper. By annealing in a non-oxidising atmosphere this surface darkening may be prevented. Sterling silver which has been partially oxidised and afterwards annealed in a reducing atmosphere, shows blisters on the surface, apparently caused by the formation of water vapour within the metal.

Tellurium-tin Alloys.‡—H. Fay has determined the freezing-point curve, and studied the microstructure. One compound, SnTe, melting at 769° C., occurs, and forms a eutectic with tellurium, containing 85 p.c. of that metal, melting point 399° C., and a eutectic with tin of very low concentration in tin.

Longitudinal Impact of Metal Rods.§—J. E. Sears has determined the velocity of propagation of elastic waves in rods of steel, copper, and aluminium, by a dynamical method. Two equal rods of the metal were suspended horizontally by cords, with their ends (made slightly convex) just touching and their axes in the same straight line. One rod was withdrawn a given distance and allowed to swing against the other. The duration of longitudinal impact was measured by allowing an electrical circuit to be completed by the contact, and measuring the total quantity of electricity passing during contact. The results are in very close agreement with the velocities calculated from the formula $v = \sqrt{\frac{Eg}{\rho}}$, subjected to a small correction to give the true adiabatic

* Journ. Amer. Chem. Soc., xxix. (1907) pp. 855–8 (3 figs.).
† Tom. cit., pp. 1198–1201 (3 figs.). ‡ Tom. cit., pp. 1265–8 (1 fig.).
§ Proc. Camb. Phil. Soc., xiv. (1907) pp. 257–86 (9 figs.).

values. Young's modulus, therefore, has the same value whether the loading is slow or sudden.

Annealing of Copper.*—T. Turner and D. M. Levy have determined the dilatation of copper, both hard-drawn and annealed, between 0° C. and 600° C. The curves obtained for the two varieties are almost identical, and are nearly straight lines; the change taking place when hard worked copper is annealed is not accompanied by any alteration of length. Similar determinations were made on wrought iron, steel containing 0·94 p.c. carbon, and several copper alloys. An extensometer designed by the author was used for measuring the increase of length.

Magnetisation of Iron and Nickel.†—P. Weiss found the intensity of magnetisation to saturation of pure Swedish iron to be 1731, and that of nickel 497, at the ordinary temperature, the error not exceeding 0·5 p.c. Two different methods were employed.

Equilibrium of the Nickel-bismuth System.‡—A. Portevin states the results obtained by the application of the method of thermal analysis to cooling curves, but does not give the equilibrium diagram. Microscopic examination indicated that equilibrium was reached only for alloys near either end of the series; complexes of three or four phases were obtained in alloys further removed from the pure metals.

Annealing-carbon in Cast Iron.§—G. Charpy divided a quantity of molten cast iron into two portions. One was cooled slowly, giving its carbon as graphite, the other rapidly cooled and subsequently annealed, causing the separation of the carbon as annealing- or temper-carbon. The author then demonstrated the identity of these two forms of carbon: (1) by the chemical reactions of the carbon separated on dissolving the iron in nitric acid; (2) by the similarity in progress of decarburisation of the two samples on heating in a current of hydrogen.

Solubility of Graphite in Iron.‖—G. Charpy prepared a grey cast iron with total carbon 3·75 p.c., graphite 3·34 p.c., and with only traces of impurities, by melting cemented Swedish iron with wood charcoal, and slowly cooling. Small pieces were heated to different temperatures for several hours and quenched. The combined carbon increased steadily from 0·31 p.c. in the sample heated at 750° C. to 2·47 p.c. at 1,150° C. The results of these determinations and of other experiments described by the author lead him to consider that the solubility of graphite in iron decreases regularly with temperature. A probable value for the solubility at 1000° C. is 1 p.c.

Occluded Gases in Steel.¶—G. Belloc summarises the results of his extensive investigations, to be fully described later. A steel containing 0·12 p.c. carbon was used; the work included determination of (1) the composition of the gas evolved on heating, and variation of composition with temperature; (2) rate of evolution of gas at different

* Proc. Roy. Soc., Series A, lxxx. (1907) pp. 1–12 (4 figs.).
† Comptes Rendus, cxlv. (1907) pp. 1155–7.
‡ Tom. cit., pp. 1168–70.
§ Tom. cit., pp. 1173–4.
‖ Tom. cit., pp. 1277–9.
¶ Tom. cit., pp. 1280–3.

temperatures ; (3) influence of position from which the sample is taken, on the amount of gas evolved.

Extraction of Gases contained in Metals.* — O. Boudouard has shown, by successive heatings of samples of iron at 1100° C. *in vacuo*, that gas is still evolved at the third heating. A much larger quantity of gas (amounting to 0·22 p.c. by weight) was evolved from filings than from the same metal in the form of wire or sheet, and a greater proportion of the total gas evolved was given off at the first heating in the case of filings. Volatilisation of the iron commenced at 900° C., and was marked at 1100° C.

Vibrations accompanying Shock.†—C. de Fréminville has made an extended study of the fractures of glass, sandstone, steel, and other materials. It is to be regretted that his deductions as to the character of the vibrations accompanying shock are so vaguely expressed as to be of little practical value. A comprehensive classification of fractures is given.

Alloys of Cobalt and Copper.‡—The equilibrium diagram of this series, determined by N. Konstantinow, indicates that no compounds are formed, and that there are two series of solid solutions with concentration limits, 6·5 p.c. cobalt and 15 p.c. copper. From 30 to 70 p.c. cobalt the melt splits up into two liquid layers on cooling. Confirmation of the diagram was obtained by micro-examination ; the separation into two layers was not evident in the sections, probably on account of the small difference in specific gravity of the two liquids. The etching reagents were hydrochloric acid for the copper-rich alloys, and ferric chloride for the alloys of low copper content.

Sorbitic Rails.§—By experiments carried out on 1·5 m. lengths of steel rail, F. Limbourg has shown that the hardness, tensile strength, and stiffness (indicated by deflection in a drop test) of rails may be considerably raised by treatments of the kind suggested by Stead and Richards. The treatment consisted in quenching the rails hot from the rolls, in water, and reheating to temperatures ranging from 450–650° C. ; or in immersing in water till no longer red, and cooling in air, the internal heat of the rail effecting a partial annealing.

Iron-carbon System.‖—A. Portevin considers that the multitudinous investigations of this system have led to the final establishment of the theory of equilibrium. He gives a clear account of the diagram expressing the labile equilibrium between iron and cementite and the stable equilibrium between iron and graphite. The numerous references in the course of the paper constitute a useful bibliography.

* Comptes Rendus, cxlv (1907) pp. 1283–4.
† Rev. de Métallurgie, iv. (1907) pp. 833–84 (38 figs.).
‡ Tom. cit., pp. 983–8 (8 figs.). § Tom. cit., pp. 989–92.
‖ Tom. cit., pp. 993–1005 (3 figs.).

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL, 1908.

TRANSACTIONS OF THE SOCIETY.

V.—*Francis Watkins' Microscope.*

By Edward M. Nelson.

(*Read November* 20, 1907.)

Mr. J. Scott Underwood has kindly sent for inspection an old Microscope signed "Fra. Watkins, Charing Cross, London." One point of interest in this instrument is its sumptuous construction; the limb, body, foot, and all the fittings, down to the handle of its box, are of solid silver.

Silver Microscopes are not unknown, I have myself seen three besides this one. Watkins appears to have been an Anglo-Frenchman; he published a book in French entitled "L'Exercice du Microscope," 12mo, London. A copy of this work is in the Society's library, and the date of the hall mark upon the Microscope is the same as that of the publication of the book, viz. 1754–5.

A reference to fig. 26 shows the general construction of this Microscope. It has a folding tripod foot, from which rises a vertical pillar;* to the top of this pillar an inclinable limb is attached by a compass joint; this limb carries the body, the stage, and the mirror. To discover how much is original in this Microscope it is necessary to examine some of those which pre-date it. In the "New Universal Double" Microscope, by George Adams, in 1746 † (fig. 27), we find a folding tripod foot with a vertical pillar: the body is attached to this pillar and the mirror to the foot. For focusing the "Universal Double" Microscope the coarse-adjust-

* The folding tripod foot with vertical pillar was first used by Edmund Culpeper (at y^e^ Crossed Swords in Moore fields), as a stand for Wilson's "screw barrel" Microscope, *circa* 1730.

† Micrographia Illustrata. Adams, 1746. Plate iii. It is stated that the Microscope is made either of brass or of silver.

ment is effected, as in John Marshall's Microscope, by sliding the body up or down the pillar to a line numbered with the same number as that of the power used, and for a fine-adjustment the stage is actuated by a screw at the foot of the pillar. Adams' Microscope had a rotating wheel of six powers. * This wheel was

Fig. 26.

very large; it had six spokes; the powers were set at the end of the spokes, the upright pillar being the axis upon which this wheel rotated.

Now, if we return to Watkins' Microscope, some improvements of first importance will be found, the principal one of which is the introduction of an inclinable limb to carry the body, stage, and

*The first rotating nosepiece was designed by Le père Chérubin d'Orléans, capucin, (François Laserré), 1681.

mirror. This is, so far as I know, the earliest example wherein this design is to be seen; and it should be borne in mind that this design is the basis upon which the modern Microscope is built. This plan was afterwards adopted by Adams in his "Variable" Microscope,* 1771 (fig. 28), which he tells us was designed by a nobleman, who did not wish his name to be published. I was of opinion, until I had seen the Watkins Microscope, that the "Variable" of the anonymous nobleman was the prototype of the modern Microscope, but it is clear that the "Variable" is nearly a quarter of a century later than this signed and dated example of Watkins' Microscope. The coarse-adjustment focusing arrange-

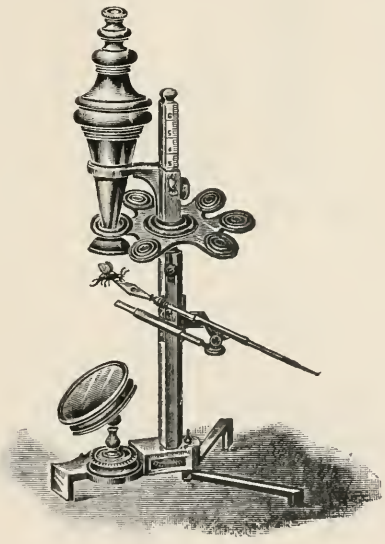


Fig. 27.

ment of Watkins' Microscope differed from those of its day, inasmuch as the stage, which slides up and down the limb, is placed to a number similar to that of the power used (in fact, there are two sets of numbers, marked S and D: S indicating the set of numbers to be used with the simple, and D those with the "double," or compound, Microscope), whereas in earlier instruments it was the body, and not the stage, that was moved in this way. Watkins' Microscope has a neat form of spring-clamp to fix the stage in a definite position. The fine-adjustment, which in Watkins' Microscope is worked by a screw at the end of the limb, moves

* Micrographia Illustrata, ed. 4, plate ii.

the body, but in Adams' "Universal Double" Microscope the screw, at the bottom of the pillar, moves the stage.

Watkins in this design has therefore reversed the motions of Adams' earlier Microscopes by changing a stage fine into a coarse-adjustment, and a body coarse into a fine-adjustment.

The principal fault in Watkins' design is that the instrument is too much like a split-cane fishing rod. It is all on springs; it cannot be touched without its shaking like an aspen. The folding tripod is a spring; the compass joint on the limb is in a totally wrong position, viz. at the end where it manifestly is devoid of any

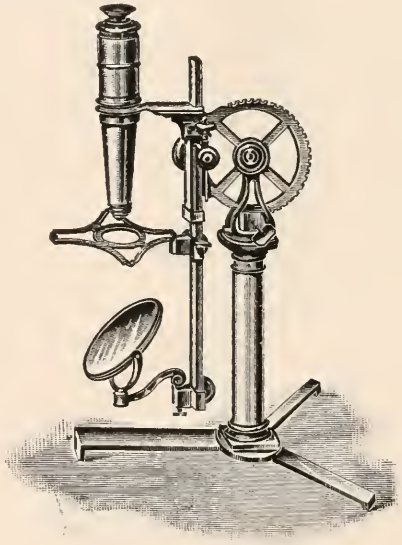


Fig. 28.

balance; the difficulty, therefore, of bringing this Microscope, on account of its instability, to a correct focus can be imagined. The arm which holds the body, and which is at right angles to the limb, is a thin plate of silver, far too weak for its work. It is important thus to trace the faults of this old Microscope, for by doing so we are enabled to find out what influence the design had in Microscope construction; for if we examine the Microscope that next followed it, viz. Adams' "Variable" (fig. 28), we shall see what points in Watkins' design were retained, and what rejected as faulty. We find, then, that the folding tripod, vertical pillar, and the inclinable limb are retained, but the limb

has now a much stouter form of joint,* and the point of its attachment is in the best position for stability. The plate by which the body is attached to the limb has a strengthening bracket below it. One cannot help thinking that the noble designer of the "Variable" Microscope must have been acquainted not only with this design of Watkins', but also with its faults, which he specially corrects while following the Watkins' design in the main.

Returning again to Watkins' Microscope, we find the wheel of powers much improved. The seven † powers are mounted between two disks of silver 1·15 in. in diameter. This form of the wheel of powers lasted until the early part of the nineteenth century, for it was afterwards adopted by Adams, Benjamin Martin,‡ and still retained in the "Most Improved Compound" Microscope of Jones in 1798.

If a digression is allowed, it may be explained that the nobleman's "Variable" was optically of a very advanced type. The Huyghenian eye-piece had, in addition to the field-lens, a double eye-lens; there was, besides, another lens lower down the tube, to act as a back lens for the various powers—this was probably copied from Benjamin Martin.§ The "Variable" had a very important novelty, for the powers were not placed in a wheel, but were mounted in separate "buttons," so that they could be combined, which was of course a great advance, for by this means the spherical aberration was reduced, and so a larger aperture could be used. The nobleman's "Variable" was therefore the first Microscope to possess an objective which was a "combination." If any one takes the trouble to examine a good specimen of an old non-achromatic Microscope, they will find that the image, field, etc., are not at all bad, so far as they go: the one drawback is lack of aperture. The spherical and chromatic aberrations were so great that the apertures of the object-glasses had to be reduced to a pin's point. The fault, therefore, with all of them is too much empty magnification.

The best form ever attained in pre-achromatic days was either Wollaston's doublets (1829) or Coddington's Microscope (1830). These instruments will show the watered-silk appearance upon a strongly marked *Podura* scale just breaking up into small exclamation marks.

* Joints of this form were in common use for Gregorian and other telescopes at that time.

† Lindsay's Microscope, patented 1743, had seven powers mounted in two strips, four in one, and three in the other.

‡ At the sign of Hadley's Quadrant and Visual Glasses, near Crown Court, Fleet Street.

§ I have made exhaustive experiments with Martin's back lens, and find that it is an advantage because it increases the N.A., and still more the Optical Index, as it lowers the power. The focal length of the lens is $5\frac{3}{4}$ in. See this Journal, 1898, p. 474, fig. 81.

The measured foci of Watkins' seven powers* are as follows :—

No. 7 ..	0·95 in.	No. 3 ..	0·28 in.
„ 6 ..	0·55 „	„ 2 ..	0·11 „
„ 5 ..	0·78 „	„ 1 ..	0·086 „
„ 4 ..	0·46 „		

The powers with the compound body attached would, therefore, range from about 30 to 430 diameters. Nos. 5 and 6 obviously have been transposed. There are three lieberkühns, diameters— 1·3 in., focus 0·6 in. ; 1·1 in., focus 0·4 in. ; 0·8 in., focus 0·3 in.

This is an improvement upon Lindsay's plan of a single conical speculum, which had to do duty for all the powers. Dr. Lieberkühn's compass Microscope, made by Cuff (1743) had a separate spherical mirror adjusted to each of its four powers, thus pre-dating Watkins'. The body of Watkins' Microscope is 6 in. long, $1\frac{1}{2}$ in. diameter at its widest part, and elegantly tapered. Adams' "New Universal" (fig. 27) is probably the earliest Microscope to possess a body with this kind of taper. This taper survived a long time, for it is found in Coddington's Microscope of 1830,† and in 1843 a remnant of it is left by Hugh Powell at the bottom of the tube ;‡ Beck and Ross never tapered the body, but the Lister-Tulley, made by Smith in 1826, was tapered at the bottom ; so tapered bodies lasted about 100 years.

The eye-piece is Huyghenian, and a very good one ; the eye-lens is a plano-convex of 1 in. focus, and the field-lens an equi-convex of 2 in. focus, the distance between them being $1\frac{3}{4}$ in. Calculation shows that to obtain the best results the eye-lens ought to have a focal length of 0·865 in., and the distance between the lenses ought to have been 1·785 in., so the old eye-piece is not so far wrong after all.

The fine-adjustment screw, which is placed at the bottom of the limb, has 30 threads to the inch. This position for the fine-adjustment screw is derived from Adams' "New Universal Double" (fig. 27) ; the difference between them should be noted, Adams' at the bottom of the pillar, Watkins' at the bottom of the limb. There is an old Microscope in the Society's cabinet with the

* Culpeper and Scarlet's Microscope had five powers ; Wilson's screw barrel six powers, foci 0·5, 0·3, 0·16, 0·08, 0·05, 0·02. Lieberkühn's compass Microscope, made by Cuff (1743) had four powers, foci 1·0, 0·6, 0·3, 0·08. A Benjamin Martin (*circa* 1760) has six powers ; their measured foci are as follows : 1·25, 0·96, 0·46, 0·37, 0·31, 0·13. The highest power was always numbered 1. It is curious to note that the screw-thread of the "pipe" in Benjamin Martin's Microscope is almost identical with that of the Society's standard thread—it readily screws on the nose-piece of any modern Microscope !

† Coddington's Optics, pt. ii., pl. 13, fig. 190. See this Journal, 1898, p. 474, fig. 82. This is Gould's Pocket Microscope (1828), made by Cary, 181 Strand. It is very similar to Coddington's, the foci and lens distances are the same, but the lenses, for cheapness (it may be presumed), are all equi-convex.

‡ See this Journal, 1900, p. 289, fig. 79.

same construction.* Varley's † (1831) and Pritchard's ‡ (1838) Microscopes, made by Hugh Powell, were the last of this form.

The arm is only attached to the limb by three small knitting needles—these can be seen in fig. 26, the centre one, upon which the fine-adjustment screw-thread is cut, is the thickest, viz. 12 B.W.G., the other two, which are 17 B.W.G., act as guides.

The mirror, $1\frac{1}{4}$ in. in diameter, is both plane and concave; this is a very early, if not the earliest known example of a plane and concave mirror.

The limb is a dovetailed prism; this is probably the earliest instance of its use in Microscope construction.

The stage is 1·4 in. wide and 2 in. deep, the distance of the optic axis from the limb being $1\frac{1}{2}$ in. The stage is unlike those of other makers: on its upper side it has a spring-clip for "sliders," and on the lower one to hold a tube. Attention has already been called to the well designed spring-clip to hold the stage at any place on the limb.

The pillar is $4\frac{1}{2}$ in. long, and it, like the stage, is of artistic form. A single Microscope in form just like this one was presented to the Society by Colonel Tupman in 1905; it was thought to have been made by Lindsay,§ but now it is clear that it is by Watkins.

This Microscope is packed in a very handsome box ($6\frac{3}{4}$ by $5\frac{3}{4}$ by 2 in.) made of oak, covered with shagreen, the hinges and clips being of silver. This ends the description of the Microscope itself, but in the same cabinet there is packed, besides the shagreen box, a solar projection apparatus, also made of silver. The projection Microscope was invented by Dr. Lieberkühn, and in 1740 exhibited by him in London. The Microscope passed through the axis of a ball, which fitted in a socket in a window shutter; the Microscope was pointed directly to the sun, the projection being effected by means of a single lens, i.e. the simple Microscope. Le père Chérubin d'Orléans had, in 1671, placed a telescope in the axis of a similar ball-and-socket in a window shutter for the purpose of projecting the solar disk; this may have suggested the idea of the solar projecting Microscope to Dr. Lieberkühn.

John Cuff,‖ in 1743, greatly improved the solar projection Microscope by fitting a mirror to it, and by arranging matters so that the position of this mirror could be adjusted from the inside of the room, so that it was capable of rotation by cat-gut passing round a pulley, and its inclination could be varied by means of a rod. It was, in brief, a simple form of heliostat, which could be worked by hand.

* See this Journal, 1903, p. 587, fig. 143.
† Op. cit., 1900, p. 283, figs. 70–73.
‡ Microscopic Illustrations, Goring and Pritchard, figs. 12, 17, 21.
§ At ye Dial near Catherine Street in ye Strand.
‖ Against Serjeant's Inn Gate in Fleet Street.

There are several of these solar projection Microscopes, by various makers, in the Society's cabinet. Fig. 29 illustrates Watkins' projection apparatus, which is very similar to that of Cuff's ; the cat-gut and pulley are replaced by a rack-and-pinion. The instrument is shown fixed to the pillar and tripod ; it has been so placed for the purpose of being photographed for illustration, but in actual use the square silver plate would be fixed to a window shutter, the mirror being outside the window. The pillar and tripod-foot would be removed from the limb, the screw-pin having a butterfly-nut for this purpose ; the limb is held by a clamp on the tube, which screws into the square plate. This tube has three

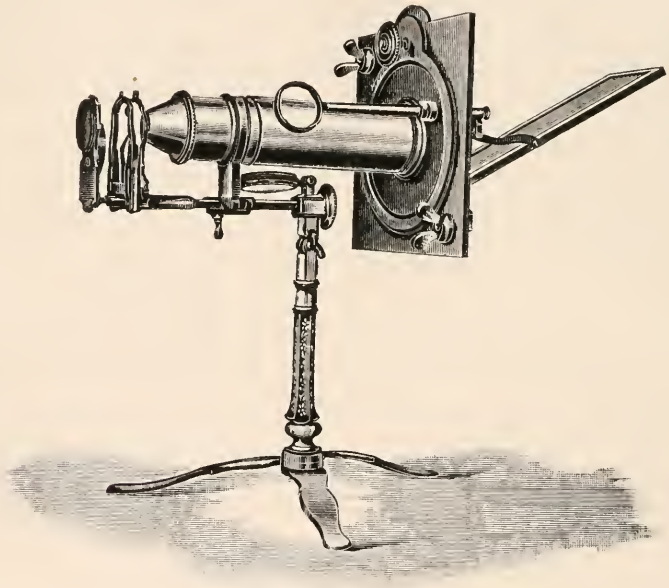


Fig. 29.

draws—they are not fully extended in the figure ; at the square plate end of the tube there is an equi-convex lens, 11 in. in focus, to condense the sunlight upon the object. The two butterfly-nuts, on the front of the square plate, are for the purpose of attaching it to the window shutter, and the milled head actuates rack-work for rotating the mirror. It seems a wonder that, in the absence of any heat absorber, the specimen upon the stage was not burnt up by the condenser : it is probable that the sun's image had to be placed considerably out of focus.

To sum up the important points in this beautiful Microscope of Watkins, we find that they are three in number ; the first, and

most important, is the hinged limb which supports the Microscope, the object, and illuminating apparatus; the second, almost as important, is the prism bar and V-grooves; the third is the plane and concave mirror. To this list may be added one of quite secondary importance, viz. it is an early example of the improved form of the wheel of powers. Permit me to express my thanks to Mr. Underwood for so kindly sending his Microscope for examination.*

Appendix.

As regards the performance of old non-achromatic Microscopes, it may be pointed out that empty magnification had its use in pre-achromatic days, for it was by this means that aperture in a dioptric Microscope was obtained. The method of making these objectives was probably to open out the diaphragm until the image just begun to show signs of becoming foggy; it will be found under these circumstances that a $\frac{1}{2}$ in. will have a N.A. of about 0·1, and a $\frac{1}{10}$ one of about 0·2.

Benjamin Martin's No. 6 measures 0·0425 N.A. and 5·3 O.I.
„ „ „ 1 „ 0 198 „ 2·5 „

It was mentioned above that when Martin's back lens was inserted, the apertures would be slightly increased; used thus, the No. 1 will just resolve 15,000 lines, Grayson. When a compound body is placed over a lens, the focus is lengthened and the aperture reduced; it was very probably on this account that many of the old observers, without knowing the reason, preferred a "single" to a "double" Microscope.

* This Microscope was sold by J. C. Stevens, of King Street, Covent Garden, Feb. 18, 1908, for 52 guineas. The price obtained was due less to the scientific or intrinsic value of the instrument than to the hallmark, date 1754.—[Ed.]

IX.—*Gregory and Wright's Microscope.*

By Edward M. Nelson.

(*Read December* 18, 1907.)

An old and rare book has just turned up which bears upon the evolution of the Microscope at an important period of its history, viz. when it was just beginning to crystallise into its present form. If you will refer to this Journal for 1899, p. 325, a description will be found of an interesting Microscope presented by Dr. Dallinger. This Microscope, not signed, was thought to be of Benjamin Martin's workmanship; now, however, it is possible to read its history more accurately.

The book from which this new information is derived, published in 1786 by Messrs. Gregory and Wright, opticians, No. 148 Leadenhall Street, describes a "New Universal Microscope, which has all the uses of the Single, Compound, Opaque, and Aquatic Microscopes." The plate in the book from which fig. 32 is copied shows that this Microscope is almost identical with that in the Society's cabinet. It has the same folding tripod-foot with the compass joint at the bottom of the limb, it has the same shaped body with a coned end, and the movement of the body, backwards and forwards and also in arc, is the same, even to details of ornament. There is the same holder for either the substage condenser or for the lieberkühn, and the same Benjamin Martin pivoted super-stage. The difference between the instruments is that Gregory's is a stage, and the other a body focuser. It is evident that in Gregory's Microscope we see a Benjamin Martin's latest type of instrument—in brief, a small edition, without accessories, of the magnificent instrument he made for George III., which is in the Society's cabinet. The limb, which is pivoted by a compass joint to the top of the tripod foot, is an equilateral prism;* the rack is cut into the base of this prism at the back, and the pinion, which protrudes at right angles from the base of this triangle, moves up and down with the stage. If we now examine the limb of the Microscope presented by Dr. Dallinger, we shall find that it is a tube of circular section, with an inner tube actuated by rack-and-pinion, and a third, a push-tube, inside this one to hold the body. The push-tube is the coarse-adjustment, and the rack-and-pinion the fine-adjustment. It is evident, therefore, that Dr. Dallinger's is a later and improved form of

* See this Journal, 1903, p. 589, fig. 144.

Gregory's. Now we know from the book that the date of Gregory's is 1786, and therefore we can say with certainty that Dr. Dallinger's was not made by Benjamin Martin, as he died in 1782. It is more than probable that Gregory and Wright became Benjamin Martin's successors, and were the makers of the Microscope presented by Dr. Dallinger. It is interesting to notice the name of Gregory's Microscope "Single, Compound, Opaque, and Aquatic." In early days Microscopes were termed "single" and "double," because they consisted of one or two

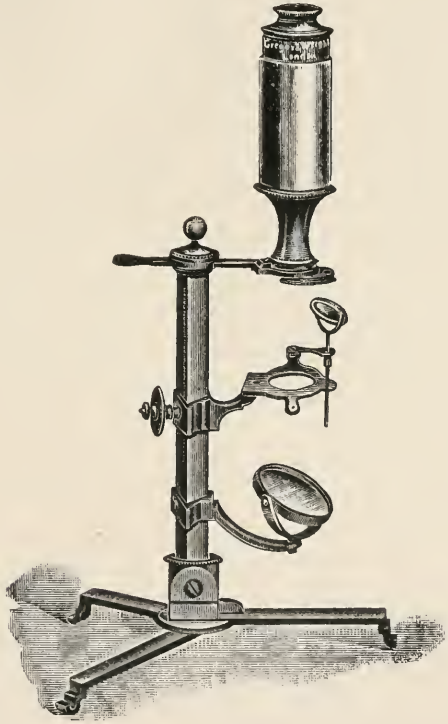


Fig. 32.

lenses, but after the "body lens" (field glass) was added by Monconys, in 1660, the word "double" became inappropriate, and it appears that "compound" was substituted for it by Dr. Smith in 1738 (Compleat System of Optics); in this he was followed by Benjamin Martin (Optical Essays), 1770. "Double" was last used by Wood (Master of St. John's College, Cambridge), in his Optics, 1818, but "single" lasted for nearly a century longer, until it was displaced by Wollaston's invention of the doublet in 1829, and so, in 1830, we find the word "simple" in Coddington

(Optics, Part II.).* "Single" is found for the last time in Potter's Optics, Part I., 1847.

"Opaque" is meant to convey the information that lieberkühns (invented 1738), are supplied for the illumination of opaque objects. The term "Aquatic" requires a longer explanation. In 1755 Cuff made Ellis's Aquatic Microscope, or what would now be called a dissecting stand. The lens-holder was so mounted that the lens could be moved backwards and forwards, as well as in arc, over an object upon the stage. This movement of the lens over the object, instead of the object under the lens, was at that time thought a great deal of because it was said that aquatic animals were disturbed by the movement of the stage. These movements were still in use in 1852, for they are seen in a dissecting stand by And^{w}. Ross.† All Microscopes having these movements were said to be "aquatic."

Martin's super-stage, found in numerous models of that time, consists of a plate of brass with three holes in it, the centre one $1\frac{1}{4}$ in., and those on either side ·7 in. in diameter. There was a pivot on the lower side which fitted into a hole in the stage, permitting the plate to be moved in arc. A watch-glass for holding living animals in water was placed in the large central aperture, and a piece of plain glass in one of the side holes for holding objects suitable for examination by transmitted light; in the other hole was fitted a piece of ivory, black upon one side and white upon the other, for holding objects which were to be illuminated by a lieberkühn; a white object would be placed upon the black side of the disk, and a black object upon the white side. So Martin's super-stage was an ingenious and useful adjunct to Microscopes of that date.

The total height of this Microscope was 14 in., the body being 6 in. when the draw-tube was closed. These are the same dimensions of Benjamin Martin's "No. 1," which is illustrated on page 474, fig. 81, of this Journal, 1898.

From Watkins' and Gregory's Microscopes was evolved, in 1798, Jones's‡ "Most Improved," which is, in essential particulars, the form of the modern Microscope. Jones's "Most Improved" has a foot with an upright pillar, to the top of which is hinged, by a compass joint, a limb which carries the magnifying portion, the object and the illuminating apparatus, and this is the form of every Microscope at present in use, for if we examine the most aberrant form, viz. Powell's No. 1, we find a gipsy tripod foot, which is merely a foot and pillar in one piece; the bent claw obviously falls under the same category.

* Barlow, Ency. Metrop., art. Optics. "Simple is found in the index, but the word in the text is "single." (Accompanying plate is dated 1822.)

† Quekett on the Microscope, 2nd ed., p. 59, fig. 37; copied in this Journal, 1900, p. 428, fig. 109. ‡ W. and S. Jones, 135 next Furnival's Inn, Holborn.

It has been said that the modern Microscope was evolved from Straus Durckheim's drum Microscope, made by Oberhaeuser in 1835, but between that and the hinged limb Microscope of the present day there is nothing in common, and no continuity.

Before closing, allow me to correct a mis-statement in a former paper (see this Journal, 1901, p. 729), where in a description of a Powell Microscope of 1840, presented to the Society by Messrs. Watson, I stated, upon the authority of Hannover,* that Fraunhofer was the designer of the screw-stage micrometer. A similar statement is made in the 9th ed. Ency. Brit., art. Fraunhofer. The screw-stage micrometer and webbed eye-piece are described by Benjamin Martin in his Optical Essays (1770),† page 48, and were fitted to his large instrument in our cabinet. Fraunhofer was not born until five years after Martin's death.

A correction is also needed in a paper on the rackwork coarse-adjustment (see this Journal, 1899, p. 262, Synopsis), where I stated that the Microscope "Body-focuser," one inch of rack in slot in tube (telescope form); example in Society's cabinet," was made by Benjamin Martin, *circa* 1776; for this, read made by Gregory and Wright, *circa* 1795.

* English Translation, 1853, p. 67, pl. 1, fig. 12.

† Martin's Optical Essays are not dated, but we learn from Adams on the Microscope, 1798, p. 21, that they were published in 1770.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Beck's "London" Microscope, Regent Model.†—This instrument is shown in fig. 33, and is designed for the most exacting research. The stage is square, 4 in. by 4 in., surfaced with ebonite, and provided with a mechanical stage, with racks and pinions, giving traversing motions of 2 in. in the horizontal direction and 1 in. in the vertical direction, each motion being provided with graduations by which the positions of objects can be registered and refound. The mechanical stage is removable, leaving the stage free for large dishes, and four spring-clip holes are provided. An iris diaphragm is set in the thickness of the stage, and is actuated by means of a lever extending to the stage edge. This diaphragm has a slightly curved form, so that when closed to a small aperture it is within one or two hundredths of an inch of the stage level. By this construction the iris may be closed even when an Abbe condenser in the substage is at its highest position, and when the light from the condenser is in focus upon the object. There is, therefore, no risk of damage being done to the stage iris diaphragm when focusing the condenser, as it does not come in contact with it at any position. The substage is focused by means of a spiral rack-and-pinion adjustment, and is carried on a massive bracket which swings to one side on a strong centre. The condenser (fig. 34) can, therefore, be instantly swung out of the optic axis to one side by means of the same milled head which actuates the focusing adjustment. As soon as the condenser has been racked down to its lowest limit, it swings clear of the stage. The substage is provided with centring screws. The limb of the instrument is made with a large aperture forming a handle, through which the entire hand can be passed for lifting and manipulating the instrument; no strain is put on any working parts of the Microscope when it is lifted in this manner. The fine adjustment is of a more sensitive pattern than that of the "London" model, being about four times as delicate, each division on the drum representing $\frac{1}{100000}$ in. This fitting is placed almost directly behind the Microscope body, so that the weight does not overhang the fitting to any great extent, and thus a fine adjustment can be made which, in spite of its extreme delicacy, is equally sensitive to the

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

† R. and J. Beck, London, Special Catalogue, 1908.

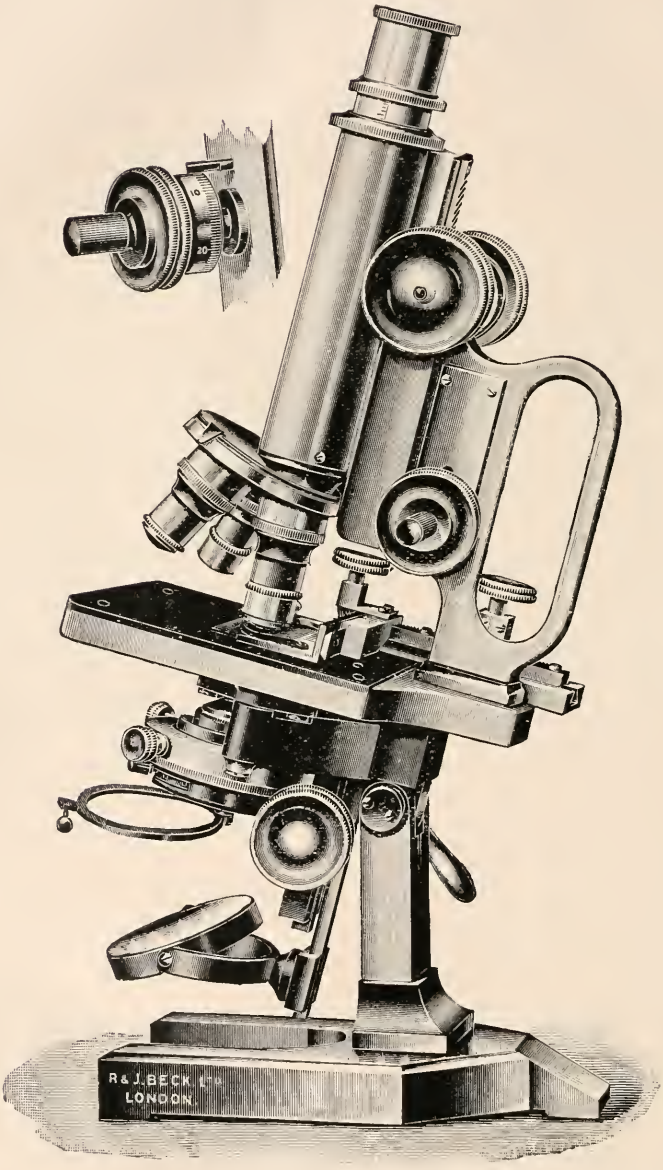


Fig. 33.

smaller motion. The milled head is made with a large and a small diameter, so that for moderate powers the small milled head can be rapidly revolved, thus giving a quick motion ; the larger milling enables full advantage to be taken of the delicate adjustment with high powers.

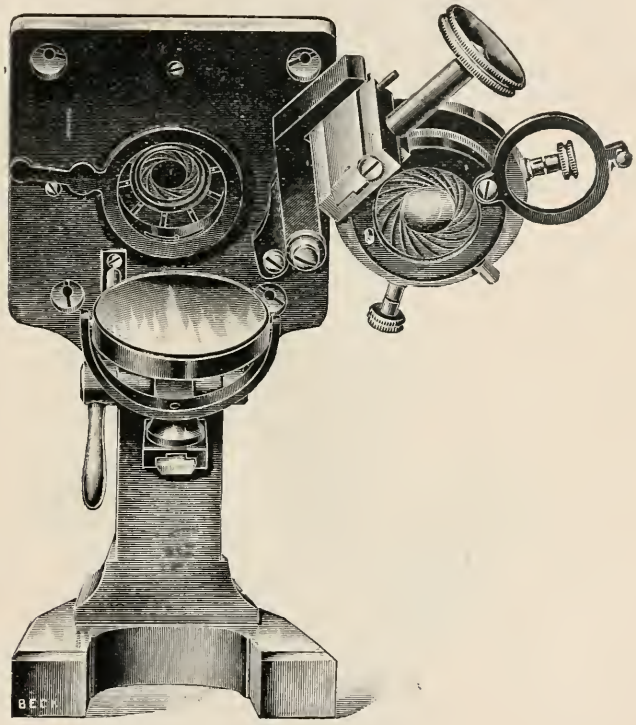


Fig. 34.

Société Genevoise : Mineralogical and Petrographical Microscopes, with Permanent Centring and with Objective Rotation.—A section of this instrument, numbered 2426 in the maker's catalogue, is shown in fig. 35. The system has the advantage of remaining always centred. The stage carries a column on which slides the objective-holder, and to this latter the objective is applied by means of a spring clamp, which facilitates rapid change of objective. The Microscope tube is mounted on a strong column and moves independently of the objective. There is an opening in the tube above the objective for inserting optical lamellæ or for a revolver of plates of mica and quartz.

Fig. 36 shows model No. 2429 of the same firm. The purpose of the instrument is the same as with the last, and similar advantages are

* Catalogue of the Société Genevoise pour la construction d'instruments de physique et de mécanique, 1907.

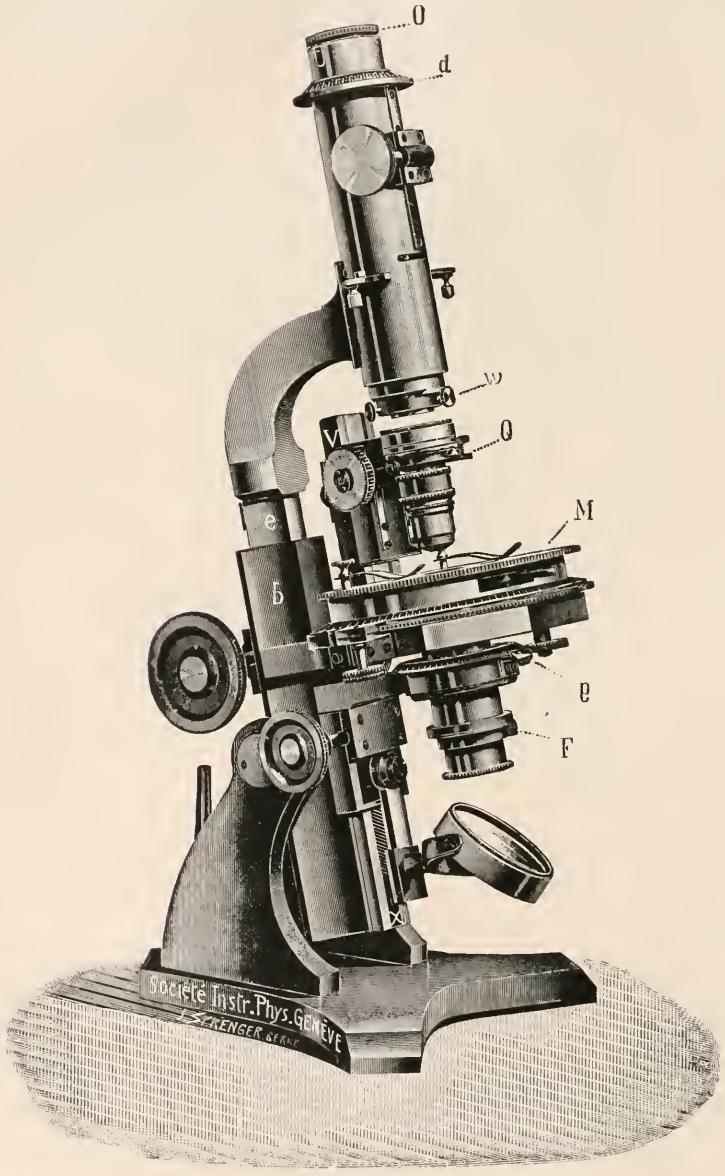


FIG. 35.

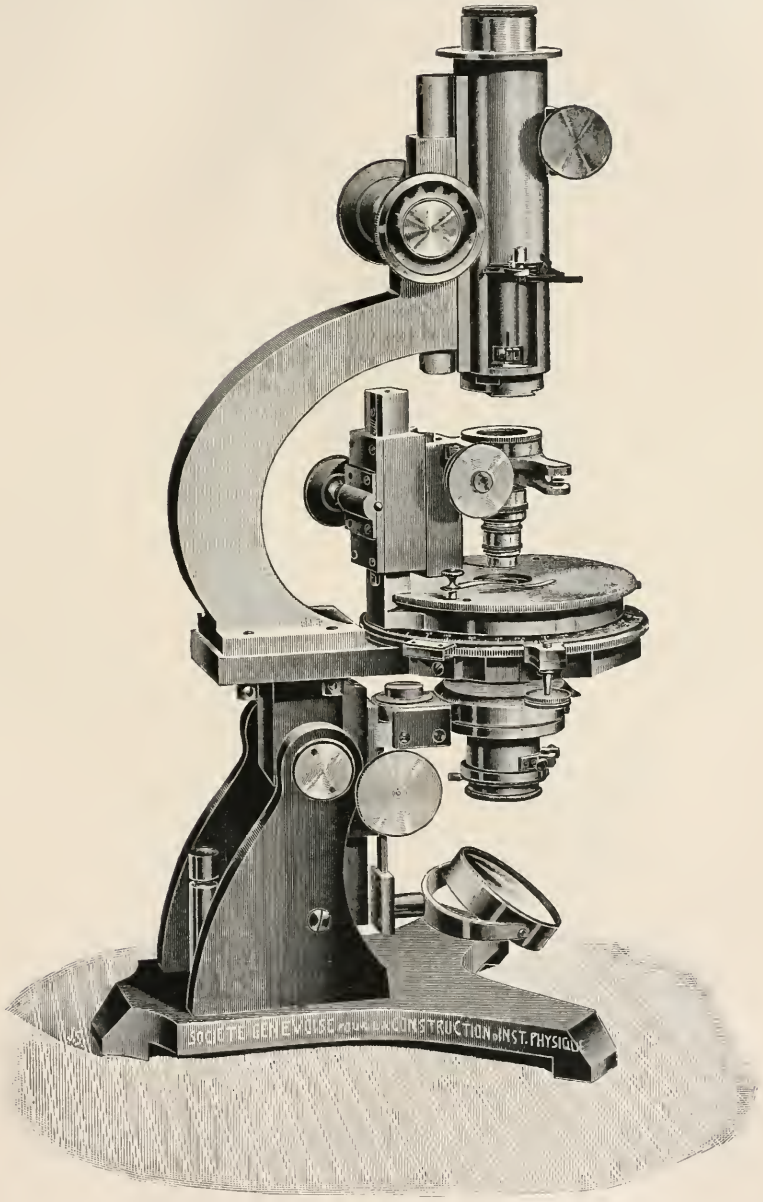


Fig. 36.

claimed. The difference is in the limb which supports the tube; the limb being solidly attached to the base and carrying the rackwork at its

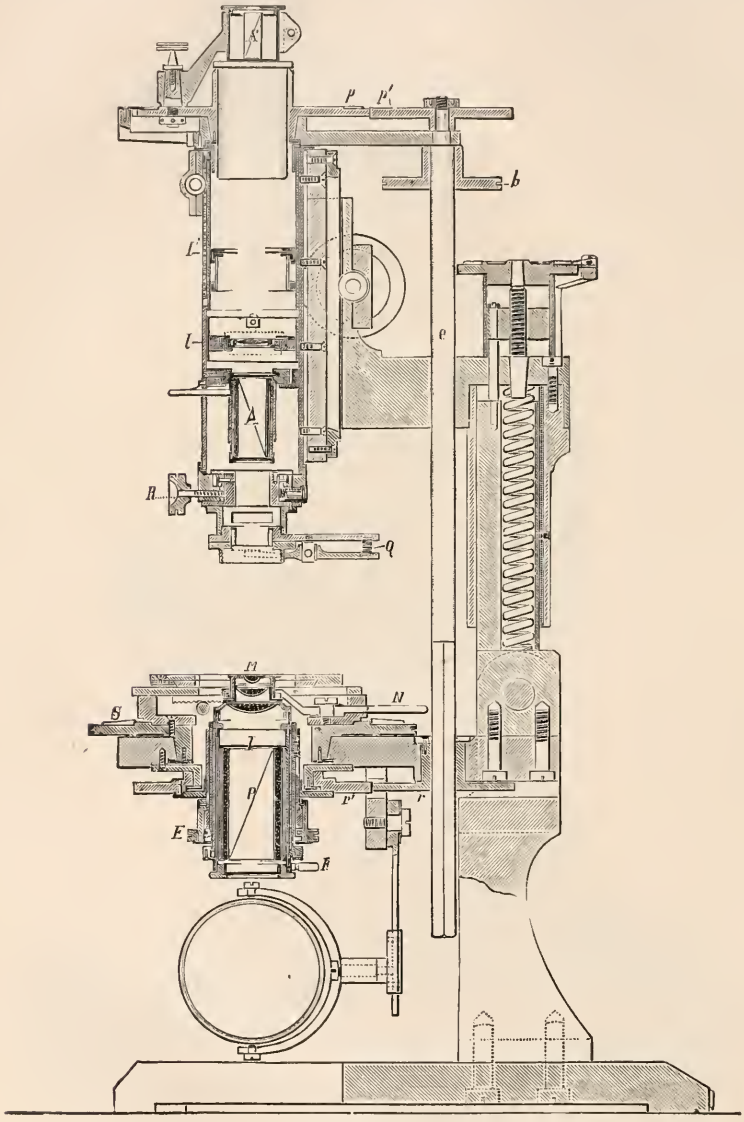


FIG. 37.

upper end. The tube movement is independent of that of the objective.

Fig. 37 shows model No. 2431 in section. Here the nicols rotate while the stage is fixed, and this arrangement gives a means of suppress-

ing all decentring of the microscopic stage in relation to the optical axis of the Microscope. The rotation of the nicol is obtained by means of a pillar, parallel to the Microscope, and bearing two pinions engaging in two small stages supporting the polarisers and analysers. The polariser is fitted with a quick-movement screw for raising or lowering. The object-stage can be rotated, as desired, independently of the nicol ; it carries a pivoting condenser.*

Mechanical Stages.† — Fig. 38 represents a mechanical stage designed for use with the above mineralogical and petrographical

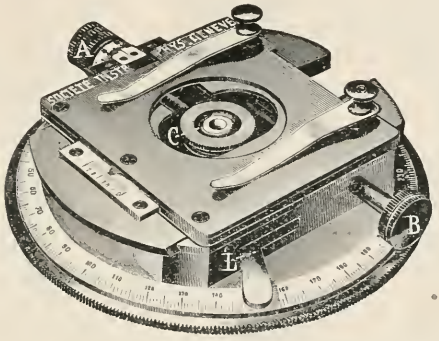


Fig 38.

Microscopes. The apparatus is constructed with crossed carriers for centring ; it has a coarse-adjustment by rackwork, and a fine-adjustment by a micrometer screw with divided head.

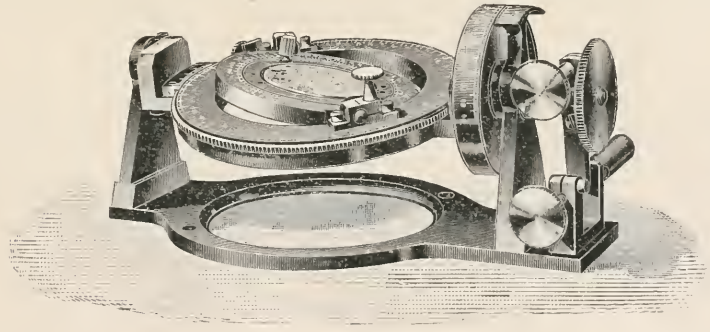


Fig. 39.

Fig. 39 shows Fédorow's stage.‡ It is made in two forms : a small model, with two movements of rotation ; and a large model, with four

* There is a great resemblance to Swift's patent, which has, however, perhaps run out.—Ed.

† Catalogue of the Société genevoise pour la construction d'instruments de physique et de mécanique, 1907, No. 2421 (fig. 2121a).

‡ Op. cit., Catalogue No. 2492.

such movements. The illustration refers to the latter model, and is considered by the makers to be self-explanatory.

Micrometer Microscope.*—This instrument, mounted on a stand (fig. 40), has a movable thread at the focus of the ocular for sub-

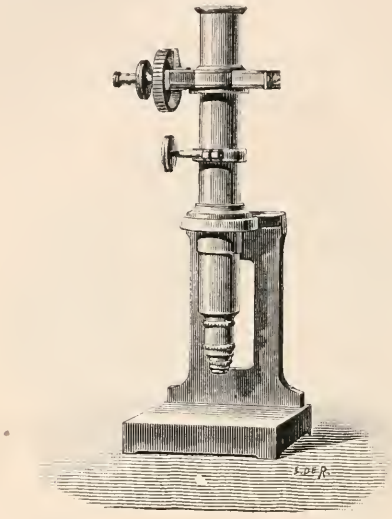


FIG. 40.

dividing the spaces on a graduated bar. The ocular field is about 9 mm. Magnification from 30 to 40.

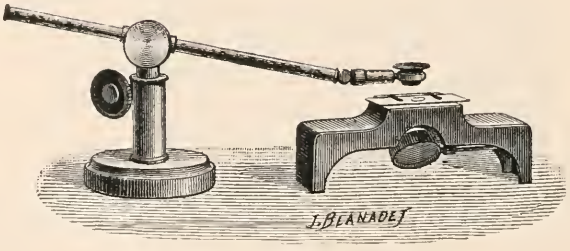


FIG. 41.

Dissecting Microscope.†—This instrument (fig. 41) has the arm and dissecting stage, and is independent of the Microscope stand. The objective, which has a rack-and-pinion adjustment, is composed of three doubles.

* List Phys. and Mech. Instr. Soc. genevoise, 1907, p. 37 (1 fig.).
† Tom. cit., pp. 97–8.

Frauenhofer's Screw Micrometer.*—This instrument is fitted to a telescope or Microscope of low power, and is mounted on a brass column. It is provided with turning movements so that it can be used vertically

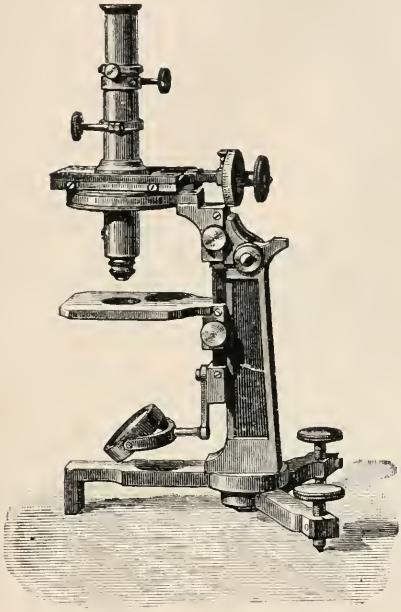


FIG. 42.

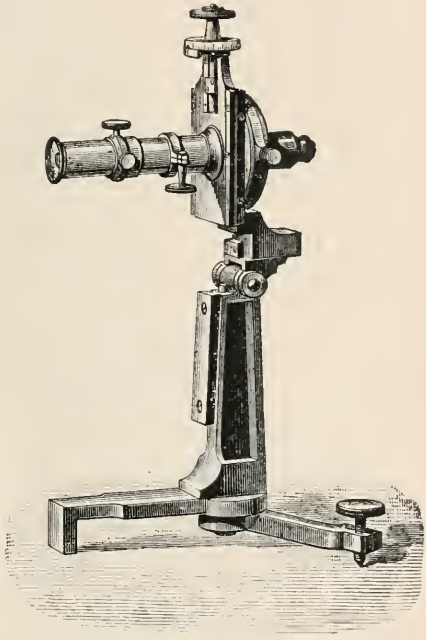


FIG. 43.

(fig. 42) and horizontally (fig. 43), and measurements taken in all directions. The micrometer can change places with the shelf, so that the instrument may serve as Microscope with micrometric shelf. The tripod folds up.

(2) Eye-pieces and Objectives.

Société Genevoise: Eye-pieces for Mineralogical and Petrographical Microscopes.†—Fig. 44, numbered 2442 in the maker's catalogue, represents an auxiliary nicol, with divided circle for use above the ocular. Figs. 45, 46, numbered 2485 by the makers, show Babinet's

* List Phys. and Mech. Instr. Soc. genevoise, 1907, pp. 36–7 (2 figs.).

† Catalogue (1907) of the Soc. genevoise pour la construction d'instruments de physique et de mécanique, p. 12.

compensator in general view and in section. No description is furnished with the illustration.

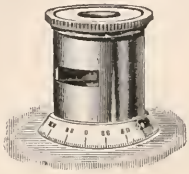


FIG. 44.

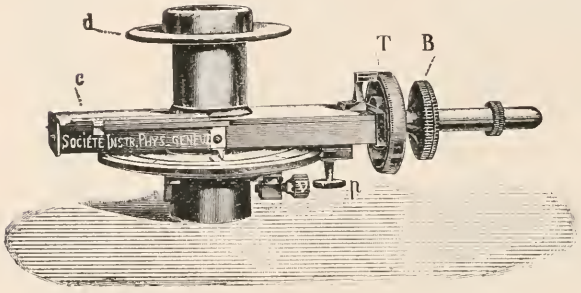


FIG. 45.

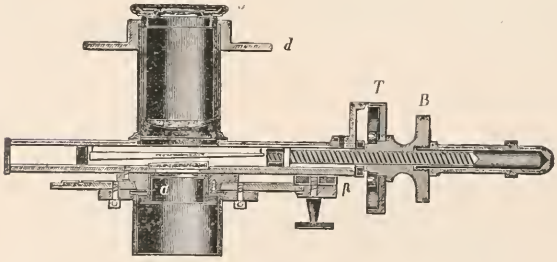


FIG. 46.

(3) Illuminating and other Apparatus.

Pearce's Total Reflexion Refractometer.*—This instrument (fig. 47), numbered 2190 in the catalogue of the Genevan firm, has been made after the designs of F. Pearce. The general view recalls that of Abbe's refractometer, but Pearce's optical arrangements are suitable for measurements upon large as well as upon small fragments. In case of large fragments, an objective O′ and an ocular A′ replace the objective

* Soc. genevoise pour la construction d'instruments de physique et de mécanique, Special circular, 1907.

O and the ocular shown in the figure. The magnification of this combination is from 3–4 diameters, and the separating power is sufficient to insure under good conditions evaluation to the fourth decimal. This

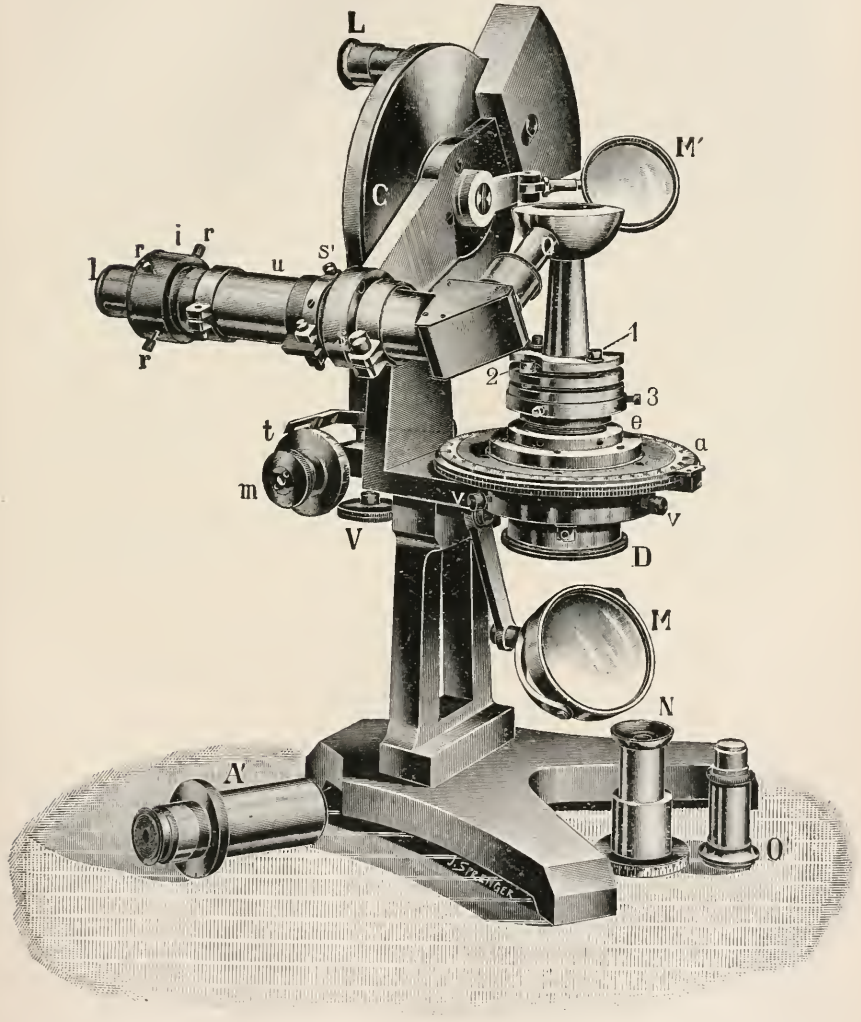


Fig. 47.

objective O′ is formed of an achromatic lens combined with a plano-concave lens of the same glass as the hemisphere. This latter lens, whose concave surface has a radius of curvature equal to that of

the hemisphere, is intended to nullify the influence which the spherical surface of the hemisphere exerts on the paths of the rays. The objective O′ can also be provided with a correction lens, when using the combination for the vision of very distant objects by reflexion on the plane surface of the hemisphere; this property is useful for the adjustment of the hemisphere. For small fragments the combination used consists of an objective O, composed of an achromatic lens of about 40 mm. focal length, with a correction lens and a special ocular. This ocular fits with gentle friction into the tube *u* of the instrument, and bears at its anterior end a network in the focus of the objective; the anterior lens (divergent) giving, in combination with the objective, an enlarged image (4–5 diameters) of the object placed on the hemisphere. This image is formed in the plane of an iris diaphragm *i*, which, for more convenience, can be laterally displaced by the aid of the screws *r*. The image is viewed by the loup *l*. When the loup *l* is replaced by another of a focus giving vision of the net, this optical combination, which is a real Microscope, is converted into a telescope directed on infinity, and by it the phenomenon of total reflexion can be observed. A nicol prism N fitted with a graduated circle can be easily adapted to either of the two combinations without deranging the observations. Perfect centring of the objective is obtained by the action of three screws not shown in the figure, and that of the hemisphere by the three screws 1, 2, 3. The makers supply full instructions for the use of the instrument.

Beck's New Illuminator for High-power Dark-ground Illumination.* This apparatus permits of dark-ground illumination, with object-glasses

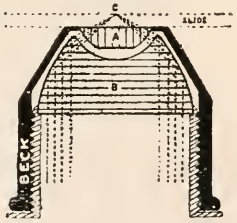


FIG. 48.

as high as a $\frac{1}{12}$ in. oil-immersion. The principle is that of a reflecting paraboloid, specially designed to obviate the difficulty arising from the immersion fluid running down the side of the paraboloid and the consequent impossibility of adjusting the focus. The new illuminator is made of two parts, which may be more or less separated, and this enables the light to be focused, according to the thickness of the slip on which the object is mounted, and the oil is kept away from the reflecting surface. The lower portion consists of a reflecting paraboloid B (fig. 48), reflecting parallel light to a focus at C, with a concave upper surface. The upper portion of the apparatus is in the form of a lens A, with focus at C, the upper surface of which is placed in immersion contact with the under surface of the slip; the curved side is concentric

* R. and J. Beck, London, Special Catalogue, 1908.

with the focus C, and truncated to such an extent as to stop all light of less obliquity than 1·0 N.A. from reaching the object. Therefore when dry lenses, or oil-immersion lenses, with no greater angle than 1·0 N.A. are used, no direct light enters the Microscope, but the objects are illuminated by an annular ring of very oblique light, and are seen due to the light which they reflect. By moving the paraboloid B up or down by means of the lower milled ring which rotates the sleeve in which it is held, the lens A being retained in contact with the slide, the light is accurately focused and the maximum brilliancy obtained. Various forms of bacteria, viewed by this method, show different structure, and it would appear to be a hopeful method of obtaining an increased power of examining living micro-organisms. A powerful light is essential. An incandescent gas lamp, with a bullseye

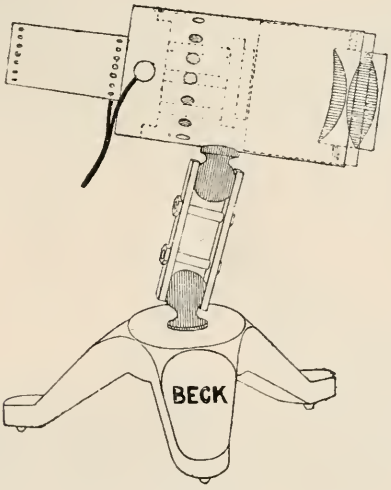


Fig. 49.

to project a parallel beam upon the mirror of the Microscope, gives good results. The Nernst electric lamp forms an excellent light for this purpose. But whatever light is used it should be parallelised by means of a bullseye or aplanatic condenser. Fig. 49 shows the Nernst lamp on stand complete with an aplanatic Herschel condenser.

New Microscope Lamp.*—C. Troester has devised a lamp by which light is transmitted from its source to the Microscope through a straight, internally-polished tube (fig. 50). The source of light is an incandescent burner, with a metal chimney having an opening in front. The tube is so fitted that it can revolve in a vertical plane, and about a point in the centre of the incandescent body. The Microscope mirror is placed close to the end of the tube and arranged to catch the central beams. A convex lens is inserted at the lamp end, and a blue glass disk at the Microscope end. The light obtained is said to be more powerful than

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) pp. 574–5 (1 fig.).

the best daylight. The apparatus, which takes up little space and is easily arranged, is made by E. Leitz.

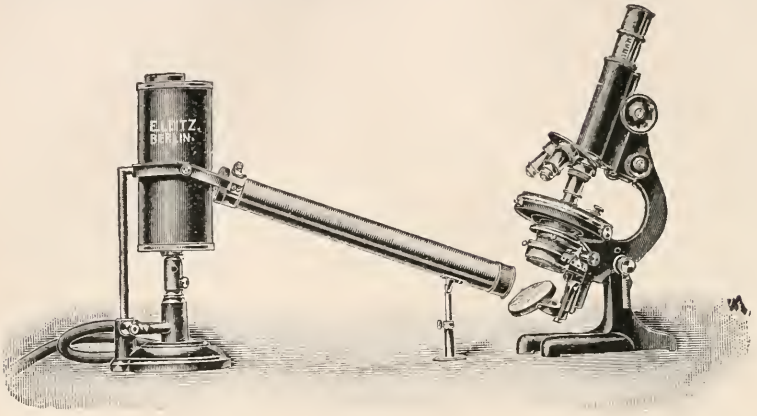


FIG. 50.

Foucault's Heliostat.*—In this instrument (fig. 51), which can be adapted to different latitudes, the mirror has a diameter of 30 cm.

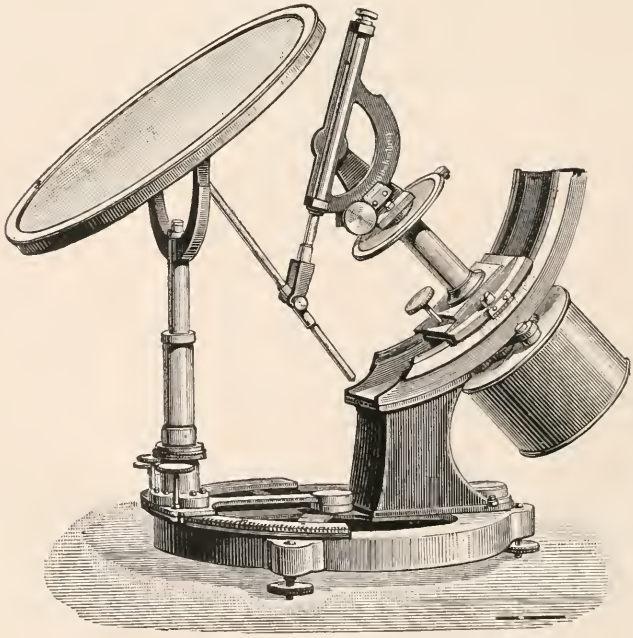
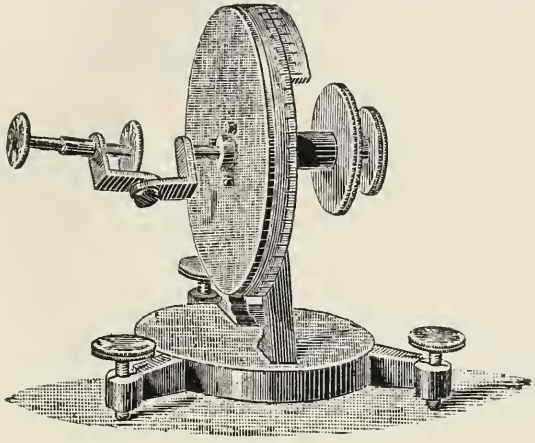


FIG. 51.

* Catalogue (1907) of the Soc. genevoise pour la construction d'instruments de physique et de mécanique, pp. 87–8.

Wollaston's Goniometer.*—This instrument (fig. 52), the circle of which is 140 millimetres in diameter, is provided with regulating screw apparatus for centring crystals, and vernier reading to 30 seconds.



F.G. 52.

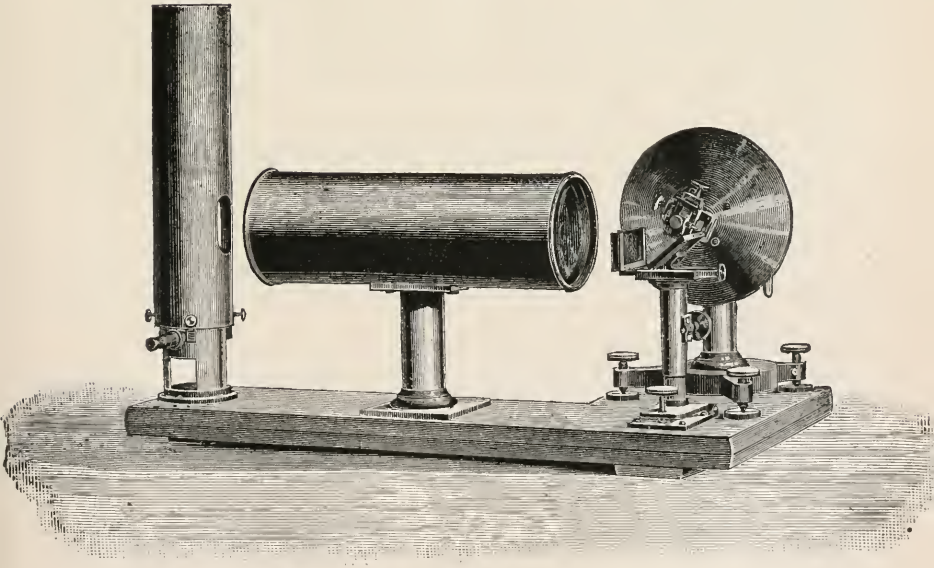


FIG. 53.

The same instrument, as improved by Mallard (fig. 53), has, in addition, a collimator with slit of various forms and an adjustable support for the black mirror.

* List Phys. and Mech. Instr. Soc. Genevoise (1907) pp. 48–9.

Reglet for Direct Reading in Microscopic Measurements.*—To facilitate quick measurement with camera-lucida drawings, F. Guéguen has contrived a simple apparatus such as every microscopist would be able to make to suit his instrument. The Microscope having been first slanted at a suitable inclination to the vertical, a rectangle is cut out of a piece of celluloid, the longest side of this rectangle being equal to the vertical distance separating the base of the micrometric screw from the table on which the Microscope is placed. This transparent rectangle, being placed upright on its narrow side in a plane parallel to the plane of symmetry of the Microscope, is cut obliquely across the corner by a line parallel to the axis of the instrument. The reglet thus formed gives a means of always insuring the same slope of tube. When the instrument has been thus inclined and provided with a micrometer objective and a camera lucida at a variable angle, the micrometric scale seen under the various magnifications employed, is drawn successively on the table. For strong optical combinations a tenth, or perhaps a fifth of a millimetre would be drawn: for weak enlargements the entire scale would be drawn. Each of these traces having been afterwards geometrically sub-divided into fractions, whose smallest division would equal 1 μ, it will only remain to counter-draw side by side on the sheet of celluloid the various graduated scales (this can be done by the aid of a graver or scalpel), and record their values. The appropriate part of the celluloid sheet, when used for measurement, would be superposed on the drawing obtained by the camera-lucida.

Grimsehl's Liliput-projection Lantern.†—This instrument is made by A. Krüss, of Hamburg, to the design of Professor Grimsehl. Its optical peculiarity is a short-focus illuminating lens. The light-source is an electric arc lamp requiring a current of 1·5 ampères. The whole arrangement is extremely compact, and being mounted on a pillar-stand can be raised or depressed at pleasure.

A Micro-object Locater.‡—S. E. Dowdy writes: "When showing a mixed slide of objects under a low power to friends or to a class, the necessity often crops up for locating a particular specimen which has been picked out by the observer. There is an eye-piece on the market, fitted with an index-needle, specially devised to overcome this difficulty; but it is expensive, and is very little, if any, more effective than the contrivance which any working microscopist can make for himself. All that is wanted is a circular piece of glass capable of fitting between the eye-piece lenses, resting on the diaphragm usually to be found in the eye-piece tube. This glass must be ruled off into small squares. If one possesses a glazier's diamond, the glass can be cut and ruled at home; but any optician could get it done for a small sum. If, however, it is preferred to make it at home, and no diamond or glass-cutter is available, here is an alternative method of manufacture. Get a circular glass, such as is used in phonograph reproducers, just the right

* C.R. Soc. Biol. de Paris, lxiii. (1907) pp. 117–18.
† Central. Ztg. f. Opt. u. Mech., xxviii. (1907) pp. 307–8 (2 figs.).
‡ English Mechanic, lxxxvi. (1908) pp. 564–5.

size. Now dip it in a solution of gelatin, draining off the superfluous liquid, and allowing it to dry. The squares can then be scratched on the film side with a pin. In whichever way the glass is prepared, it must have the squares numbered consecutively in small figures. When this glass is inserted in the eye-piece, each square covers a small portion of the field, and the squares being numbered, the location of any particular object can easily be signified to any number of observers."

(4) Photomicrography.

Scheffer's Microscopical Researches on Plate-grains.—W. Scheffer has devoted much attention to the above subject, and his results are herewith summarised under the titles of his respective articles.

*Microscopical Researches on the Effect of the Persulphate and Ferricyanide Reducers, as also on the Re-developing of Bleached Negatives with Alcoholic Developers.**—The author's object was to investigate the reason for the difference in action of Lumière's ammonium persulphate reducer (soft result) and Farmer's ferricyanide of potash reducer (harsh result). Suitable preparations were made, and the gelatin films sectionised by the microtome, and examined microscopically. It was found that the effect of the ferricyanide was limited to the upper part of the surface, all grains then being dissolved, while in the lower part they were not touched. The persulphate, on the other hand, penetrated the whole film, and thus reduced all grains in an equal proportion. The author quotes Werkner's redevelopment formula, which is especially suited for changing harsh negatives into soft ones without loss of image in the transparent part.

Note on the Reversal of Solarised Negatives with Farmer's Reducer.† If a bromide negative is exposed under a photometer in such a way that the more transparent area of the field appears already as a positive by solarisation, and the negative obtained by this is reduced afterwards with Farmer's reducer, then a part of the reversed (by solarisation) regions is changed again into a negative. This is best to be seen in those places where the solarisation has not gone too far. Microscopic examination showed that in the solarised parts the grains were equal in size and evenly distributed over the whole thickness of the film. In the less exposed parts the size and quantity of grains in the upper parts were both greater. Under certain circumstances, reduction with ferricyanide of potassium would invert the relative portions of transparency of these two parts, e.g. if the reducer had penetrated down to the half of the two films equally. In one case the greater quantity of the grains would have dissolved, and only a very slight opacity remain; in the other, comparatively more of the grain would remain unattacked, and consequently the parts, formerly more opaque, would be relatively more transparent after reduction.

Microscopical Researches on the Size and Distribution of the Plate-grains.‡—The author illustrates his researches by a series of nineteen

* British Journ. Photog., liii. (1906) pp. 964-5 (9 figs.).
† Tom. cit., p. 1027 (2 figs.).
‡ Op. cit., liv. (1907) pp. 116-20 (19 figs.).

photographs, showing various stages and results in the development of a plate. The first stage of development always seemed to originate in the protrusion of small rod-like processes, usually knob-terminated, from the grains. These processes, or filaments, seemed to be more numerous on the smaller grains than on the large ones. The impression suggested to the observer was that the results were in the nature of an explosion, which took place during the exposure, small bodies being apparently shot away from the grains and making their way through the gelatin either in straight or in irregularly curved lines. Both the terminal knobs and the filaments acted as germs, at which development commences. Sometimes the filament is hardly visible even with the highest power oil-immersions. Thus the germs at which the formation of the developed grain commences are situated outside the original grains, and also the further stages of development are outside the original grains. The developed grains are always clumsily-aggregated masses.

It would seem that in an exposed film the grains may be divided into three classes :—(1) Original grains, i.e. grains which have germs round themselves, which germs are the points where development commences. These original grains are not dissolved by development. (2) Dissolving grains—grains which show no germs, and which are dissolved either partly or entirely by chemical development. (3) Developed black grains.

*Microscopic Researches on the Plate-grain.** — In this article the author examines the relations of "dissolving" and "original" grains under different conditions of development and exposure. He infers that the solubility of the dissolving grains in chemical developers is governed by the exposure, and that the solubility increases at the commencement corresponding with the exposure up to a maximum, after which it decreases with the increasing exposure. He also found that the solubility of the dissolving grains, as well as the size of the developed grains, corresponded with the concentration of the developing solution. The size of the developed grains also depended on the number of grains in unit volume of the gelatin.

Mees, C. E. K.—**Screen-plate Colour Photography.**
[The author describes some twelve processes, and discusses the scientific principles which underlie them.]
Journ. Soc. Arts, lvi. (1908) No. 2878, pp. 195–204 (6 figs.).

(5) Microscopical Optics and Manipulation.

Correction of the Astigmatism of Doubly Refracting Prisms.†— C. Tissot and F. Pellin refer to the deformation of image produced in various degrees by all doubly refracting prisms. In the case of a nicol, it is only the *extraordinary* rays which contribute to the image, i.e. rays which do not, *in general*, remain in the plain of incidence. The result is a dyssymmetry which can be proved by an easily shown astigmatism. Thus, if a homocentric beam, limited by a narrow circular diaphragm, be

* British Journ. Photog., liv. (1907) pp. 271–3 (7 figs.).
† Comptes Rendus, cxlv. (1907) pp. 866–7 (3 figs.).

received on a nicol provided with a convergent lens, two real perfectly distinct foci will appear capable of reception on a screen. The astigmatism is still more clearly seen with a polarising Microscope. The authors show, however, that an image as sharp as when there is no interposition of a nicol can be always obtained by superposing on the ocular a cylindrical lens of suitable power, orientated so that the axial section coincides with the plane of symmetry of the prism.

Cantor Lectures: Theory of the Microscope.*—A series of Cantor Lectures in December and January last were given by C. Beck on the theory of the Microscope. The author did not treat the subject on the usual lines, but devoted his attention mainly to the instrument as at present in actual use, with especial reference to practical considerations. Although he fully recognises indebtedness to others, e.g. E. M. Nelson and J. W. Gordon, his lectures contain much novelty and originality, and will be found to include many points which have recently occupied the attention of microscopists. The first two lectures discuss lenses, and the author gives it as his opinion that the limits of constructive excellence have been practically attained. The third lecture deals with diffraction, and the fourth with practical applications of theory.

(6) Miscellaneous.

Compass Reading to $\frac{1}{500}$ or $\frac{1}{1000}$ Millimetre.†—This instrument (fig. 54) measures objects 3 millimetres thick. The amplification is obtained by a lever and a Microscope having at its focus a glass micrometer.

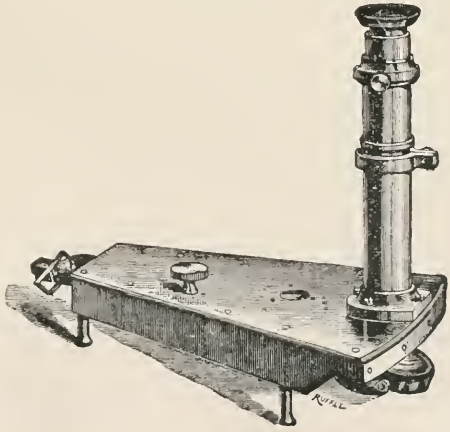


Fig. 54.

Caliper with Micrometer Screw.‡—This instrument (fig. 55) is mounted on a cast-iron foot, has a ratchet head, and exerts a uniform

* Journ. Soc. Arts, lvi. Nos. 2875–8; and as a reprint.
† List Phys. and Mech. Instr. Soc. Genevoise, 1907, p. 44.
‡ Tom. cit., p. 41.

pressure on the object measured. The larger size measures to approximately $\frac{1}{200}$ of a millimetre.

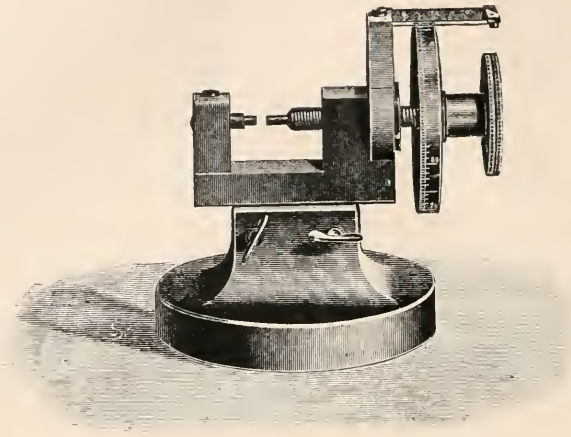


Fig. 55.

Quekett Microscopical Club. — The 445th Ordinary Meeting of the Club was held on January 17, the President, Dr. E. J. Spitta, F.R.A.S. F.R.M.S., in the Chair. Owing to the unfortunate absence through illness of the authors, neither of the two papers announced were read. Messrs. Baker exhibited with the lantern a number of slides, mostly of pond life. Mr. E. Large, using the projection polariscope, exhibited some very interesting and beautiful sections of selenite crystals, also some photomicrographs of twinned crystals.

At the 446th Ordinary Meeting, which was also the 42nd Annual General Meeting, Professor E. A. Minchin, M.A. (Oxon.), was elected President. The usual reports, which were very satisfactory, were presented by the Committee, Treasurer, Librarian, and Curator. Dr. E. J. Spitta, F.R.A.S. F.R.M.S., the retiring President, delivered the Annual Presidential Address, taking for his subject "The Photography of Very Translucent Diatoms at High Magnifications." Reference was made to the difficulty of obtaining contrast between the object and the background, and this being due to the nearness of the index of refraction of the mounting medium to that of the silex of the diatom (1·43) (Canada balsam is 1·52), it was advised that, if possible, diatoms to be photographed under high powers should be mounted in realgar, the "index of visibility" of which is 121, that of Canada balsam being only 9. The "fog" seen round dot markings was stated to be caused by the fact that no lens, or combination of lenses, can represent the image of a point as another point, but such must be shown as a disk of more or less sensible diameter. This "fog" is got rid of in the following manner :—A negative is made on a fast plate, and is developed preferably with hydrokinone to obtain maximum contrast. A positive

is made from the negative, by contact, on a second fast plate. From this positive a second negative is made, and subsequently from this a second positive, both by contact, on slow "process" or "lantern" plates. Lantern slides showed the great improvement and practical absence from the "fog" thus obtained.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Multiplication in vitro of Treponema Pallidum.†—C. Lebailly finds that liver and spleen infected with *Treponema pallidum* are excellent cultivation media for these organisms. Pieces of liver and spleen were cut out, with the usual precautions, from the body of a fœtus and incubated for 45 days. Examination at the end of 15 days showed a great increase in the number of Treponemata; at the end of 45 days there was no apparent increase in the number, and many were much degenerated.

Cultivation of Anaerobic Bacteria.‡—J. Kursteiner finds that two chief methods have been employed for the cultivation of anaerobic organisms: (1) in which oxygen is apparently not excluded, as with media containing reduced substances, or portions of organic tissue, or as in mixed cultures with aerobes; (2) in which oxygen is excluded, either by covering the lower or upper layers of the medium with glass, mica, or paraffin, by boiling the medium, by vacuating, by substituting another gas for the oxygen, by absorption of the oxygen, or by a combination of these principles.

The author describes the most practical methods of R. Burri and of J. H. Wright. 1. Burri employs a glass tube the size of an ordinary test-tube, closed at either end by wool plugs and sterilised for two hours at 160° to 180° C.; a number of rubber corks kept under sterilised water; a sterile Petri dish, a scalpel, and a sheet of clean white filter-paper; 2 p.c. glucose-agar is prepared and sterilised, and when cooled to 42° C. is inoculated and poured into one of the glass tubes, which is then plugged with wool and a rubber cork, stood in cold water to solidify the medium, and incubated at 30° C. or 37° C., and finally on the top of the solid medium a few c.cm. of fresh sterilised agar are poured and quickly solidified. After the colonies have appeared the rubber cork is removed, and the cylinder of agar is allowed to slide out of the tube on to the filter-paper, where it is dried; sections of the medium 1–2 mm. in thickness are then made with the sterilised knife, and transferred directly to a Petri dish, placed on a dark ground; by carefully made cuts a colony is then removed from one of the sections

* 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.

† Comptes Rendus, cxlvi. (1908) pp. 312–14.

‡ Centralbl. Bakt., 2te Abt. xix. (1907) pp. 1–26, 97–115, 202–20, 385–88 (6 figs.).

and examined microscopically and subcultured to determine whether the organism is obligate anaerobe or not (fig. 56).

2. By the method of J. H. Wright, an ordinary test-tube containing 8–10 c.cm. of some fluid medium is inoculated, and a sterile plug of wool is pushed down in such a way as to touch the medium; on to this

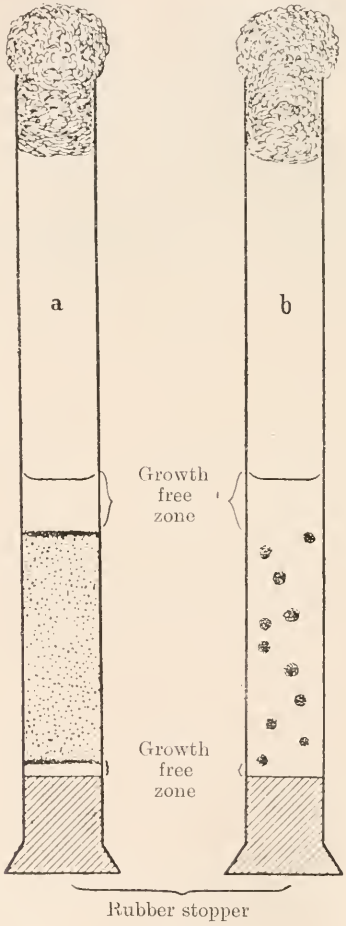


Fig. 56.

plug sodium pyrogallate solution is dropped, and the tube is at once closed with a rubber cork. A refinement of this method was devised by Burri, who flamed the wool plug before it was pushed into the tube, and after it had been pushed down a second wool plug was introduced, and this was soaked with the pyrogallate solution, the tube being then

closed with a rubber cork, thus avoiding much risk of contaminating the medium (fig. 57).

This modified method is also applied to plate cultivations ; a small

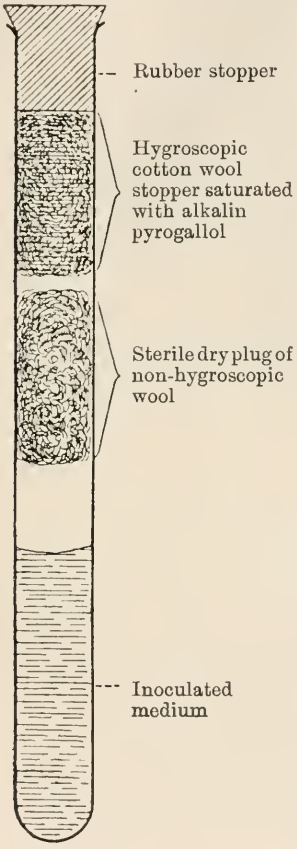


FIG. 57.

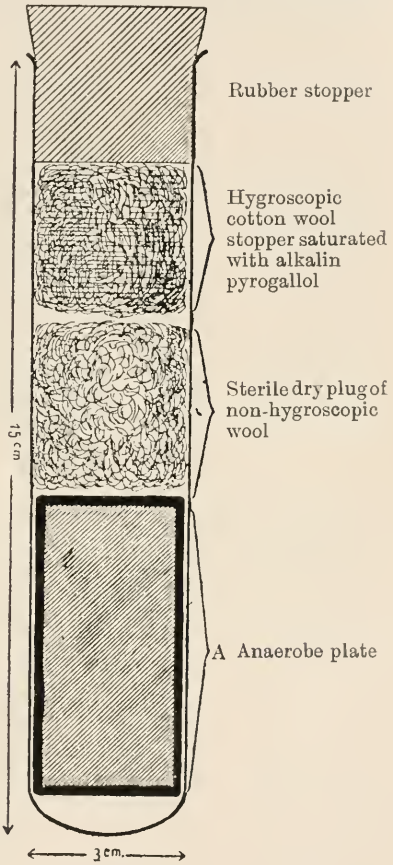


FIG. 58.

glass dish 80 by 30 by 7 mm. being used to hold the medium, and which, after inoculation, is passed into the tube, which is plugged and corked as before (fig. 58).

The author also describes a method for cultivations under conditions completely free from oxygen. The apparatus is shown in fig. 59 ; it consists of a long tube holding sterile broth, and communicating at the middle with a short tube, in which is the inoculating material, and both tubes are corked, like the modified Wright's tube (fig. 57) ; after standing at 37° C. for five days, the long tube is inoculated, and after 18 hours the broth is clouded. The absence of oxygen is demonstrated by control tubes, the long arm containing a clear solution of pyrogallic acid, the

shorter tube a solution of caustic potash, the tube being corked as before ; after 10 days at 37° C. the contents of the tubes are mixed, and no sign of brown coloration occurs.

Light bacteria may be used as oxygen indicators. The author refers to the absolute anaerobic cultivation of Stüler, and to the extreme diffi-

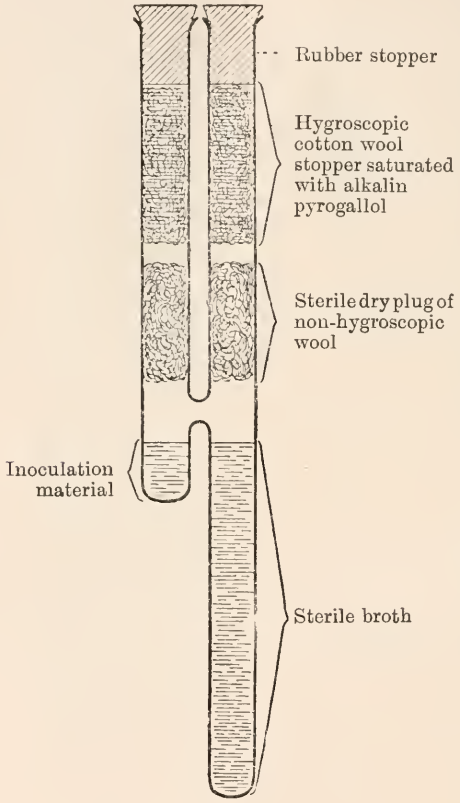


Fig. 59.

culty of attaining it, on account of the air adhering to the surface of the glass culture tube and contained also in the medium ; these traces of oxygen may be readily removed by employing an obligate aerobic micro-organism, but the amount of oxygen may be too minute to enable the light bacteria to emit light. By means of *B. mesentericus* the author was able to free his medium from oxygen as quickly as with a light bacterium.

The author next considers the method of effecting a number of sub-cultures in continuous oxygen-free condition. The apparatus (fig. 60) is a development of the double culture tube (fig. 59), and consists of 4 to 16 tubes, joined at the middle, the level of communication between succeeding tubes being higher than between those immediately

preceding ; the series of tubes contains fluid medium ; the right amount of liquid necessary to allow succeeding tubes to be filled from the preceding by tilting the whole apparatus, is previously tested and the levels marked. The tubes are sterilised and inoculated with *B. mesentericus*.

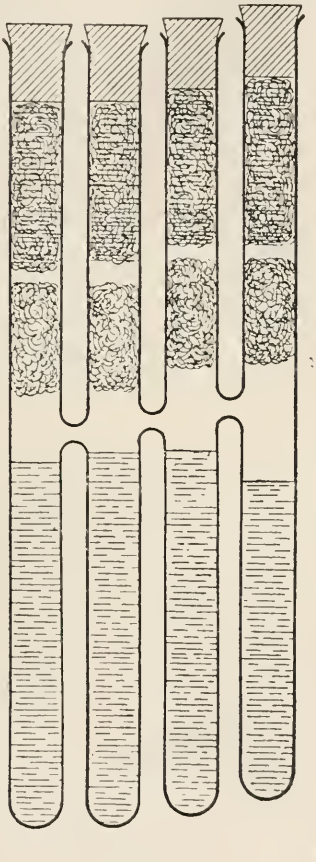


FIG. 60.

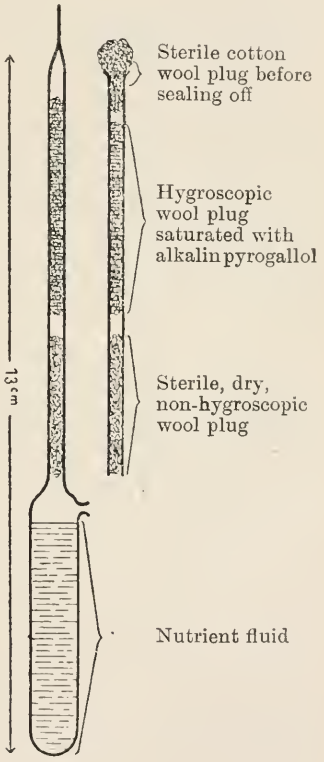


FIG. 61.

and after 10 hours the broths are clouded ; the first tube is then inoculated with a loopful of *B. putrificus* broth, and all the tubes are closed anaerobically as before ; subcultures were made from tube to tube every two days, and after the appearance of growth in the last tube this was opened, and on microscopical examination was found to be typical *B. putrificus*, with no evidence of involution forms. Similar results were obtained, in a long series, by using light bacteria in place of *B. mesentericus*, and subculturing other anaerobic organisms.

The author further modified the tubes by drawing out the upper portions into narrow necks, which, after receiving the two plugs of wool as before, were sealed in the flame instead of being corked (fig. 61).

Referring to the use of paraffin in excluding oxygen, the author demonstrated by several experiments, employing light bacteria, that paraffin is useless, since it not only allows the passage of oxygen, but can store it up.

The author concludes from his observations, that both obligate and falcultative anaerobes can live for a number of generations, without any functional alteration, in complete exclusion from free oxygen. The similar behaviour of these two classes of organisms expresses the fact that potential anaerobes are just as good representatives of anaerobic life as the essential anaerobes, over which they have the advantage of being able to grow normally also in air.

Isolating the Nodule Organism of the Leguminosæ.*—F. C. Harrison and B. Barlow have examined upwards of thirty species of Papilionaceæ, and with two exceptions, found nodules developed on the roots. To isolate the nodule organism the authors employed a medium consisting of wood ashes, which contains phosphate, sulphide and chloride of potassium, sodium, calcium, magnesium and iron, but no nitrogen, to which was added some form of sugar. Fresh ashes were shaken up in water, boiled and filtered, and to various strengths of the aqueous filtrate 2 to 5 p.c. of maltose were added. Ash maltose agar was also used.

To isolate the *Pseudomonas radicicola*, the root of the plant is washed under a tap, and a nodule is removed with forceps and immersed in an aqueous solution of hydrochloric acid and mercuric chloride crystals for two to three minutes ; it is then placed on a filter-paper moistened with the same solution, and cut open by a specially made knife needle, previously flamed, and portions of bacteroidal tissue are removed into sterile water in a Petri dish. From the resulting emulsion cover-slips were prepared and stained, and ash agar plate cultivations were made and incubated at 20° C. No other organisms were detected in the nodules besides the *Pseudomonas radicicola*. On ash maltose agar, in two to three days it forms a raised, transparent, wet, shining, spreading growth, which draws out into a fine thread when touched with a needle. Cultures on this medium remain alive for over a year. The organisms are small rods, often swollen at one end, and rarely branched ; they are actively motile, and a single polar flagellum may be developed ; the cell-contents are not uniform, often concentrated in bands, and varying with the species of the legume, the condition of infection and growth, the age and size of the nodule, and the portion of the nodule examined. They stain well with ordinary dyes, but are decolorised by Gram's method. The authors give some reports showing the benefit obtained by the distribution of pure cultures of *Pseudomonas radicicola* in Canada.

Method for Isolating Anaerobes.†—F. Marino describes the following simple method for isolating anaerobic bacteria. 30–35 c.cm. of a mixture of ordinary agar and 3–5 p.c. glucose are distributed into large test-tubes. When required for use such a tube is melted, and on attaining a temperature of 42°, 1 c.cm. of rabbit or horse serum is passed in ; the

* Centralbl. Bakt., 2te Abt. xix. (1907) p. 264.

† Ann. Inst. Pasteur, xxi. (1907) pp. 1005–8 (2 figs.).

serum has been previously heated to 55° for 20 minutes. It is then inoculated with the material to be examined; from this first tube, a second is inoculated, from the second a third, and often a fourth from the third. After the inoculations, the contents are poured into the larger half of a Petri's capsule, and covered with the small part turned upside down; the pair is then covered with a still larger half (fig. 62).

Fig. 62.

After 3 or 4 days' incubation, one of the halves is removed and any colonies descried are fished out by means of a glass pipette.

When dealing with very slowly growing anaerobes, especially in intestinal contents, it is advisable to add 3 p.c. lactose as well as the foregoing constituents.

When the microbes are isolated it is quite easy to cultivate them in a liquid medium.

(2) Preparing Objects.

Fixation Methods and Elimination of Artefacts.*—G. Rubenthale has obtained satisfactory results towards the eliminating of artefacts produced by existing fixation methods, by endeavouring to minimise the shock produced on the living tissue by the reagent, and, besides insisting on the principles of isotony and isothermy, the author advocates diminishing the sensibility of the tissue by anæsthesia, and a slow application of the fixation reagent, commencing with weak solutions and gradually increasing them until the desired result is obtained. Isotony is attained by placing the specimen in the medium to which it naturally belongs—muscle into blood-serum, nerve into cerebrospinal fluid, embryonic tissue into amniotic fluid, etc. Anæsthesia is conferred by immersing the tissues in solutions of hydrochlorate of cocaine or chloral hydrate. These methods, however, increase the duration of the fixation process, and to somewhat obviate this effect the author reduces the size of the specimen. A detailed account is given of the technique employed.

Studying Spirochæta Balbiani and Spirochæta Anodontæ.†—H. B. Fantham examined these two Spirochætæ in their natural environment as far as possible. When a style was present, the freshly extracted structure was mounted in a drop of sea-water or fresh-water in the cases of *Ostrea* and *Anodonta* respectively, and placed in a moist chamber. The organisms were thus kept alive from 3 to 6 hours while the style was examined in sections in the laboratory at a temperature above that normal to the animals. The fluid contents of the style were pressed out and the still wet smear fixed with osmic acid vapour, or hanging drops of the parasites in their natural medium were made

* Zeitschr. wiss. Mikrosk., xxiv. (1907) p. 133.

† Quart. Journ. Micr. Sci., lii. (1908) pp. 1–73 (3 pls. and 11 figs. in text).

and thus examined. Methylen-blue in ½ p.c. solution effectively stained the parasites.

For examining the parasites in the fixed condition, osmic acid vapour was found to give the best results. The wet film obtained from the style was in the vapour of 2–4 p.c. osmic acid for 1–4 minutes. Dried films, after fixed in ethyl or methyl-alcohol, also gave good results. The most successful stains were gentian-violet (Ohlmacher's formula, which contains formalin), hæmatoxylin (Delafield's, Ehrlich's, and Heidenhain's formulæ), Giemsa, Leishman, alcoholic safranin, and Loeffler's methylen-blue. For revealing structural details in the membrane, gentian-violet and iron-hæmatoxylin were most useful. The various modifications of Romanowski were much less successful than the hæmatoxylin stains. Sections were made of the style of Anodin which had been fixed in Flemming's fluid: these were stained with hæmatoxylin solutions, Giemsa and methylen-blue.

Demonstrating the Histogenesis of Nerve-fibrils.*—D. J. Pesker opened the abdominal cavities of gravid white mice killed with chloroform, and removed the embryos separately or together with the membranes and the uterus.

The material was fixed in the following fluid: alcohol (96 p.c.) 96–97 c.cm.; ammonia (10 p.c.) 4–3 c.cm. In this fluid, changed after 24 hours, the embryos were left for 2 days. The larger embryos were cut in several pieces after 24 hours. On removal from the fixative, the pieces were washed in water and then transferred to 1½ p.c. silver-nitrate and kept for 3 or 4 days at 37° C. When withdrawn from the silver solution, the objects were mopped up with blotting-paper and placed in the following solution for 24 hours in diffuse daylight: pyrogallic acid, 2; formalin, 5; distilled water, 100. Paraffin sections were then prepared in the usual way, and these were treated for 5 to 15 minutes with 1 p.c. gold-chloride solution, from which they were directly transferred to 5 p.c. hyposulphite of sodium for 10 to 12 minutes. The sections were then submitted to prolonged washing in water, and afterwards mounted in the usual way.

(3) Cutting, including Imbedding and Microtomes.

Demonstrating the Microscopic Structure of Fossil and Recent Reptilian Bone.†—A. L. L. Seitz remarks that one of the greatest difficulties in obtaining microscopical preparations of fossil bones is their fragility, and tendency to crumble in manipulation. His method was to surround the pieces with a mixture of resin and wax (9–1), and then to remove slices with fine fret-saws, or with circular saws and emery. The slices thus obtained were stuck on stout slides with a mixture of resin, wax, and hard balsam (9–1–1), and then ground down with emery on rough glass, and afterwards, if necessary, polished with smooth glass. The flattened surface was then fixed with the resinous mixture to another slide, and the first one removed by careful heating and manipulation. The other surface of the slice is then ground down on an emery wheel with water until it is about 1 mm. thick, when it is

* Archiv Mikrosk. Anat. u. Entwickl., lxxi. (1908) pp. 333-49 (1 pl.).
† Nova Acta Leopold-Carol. Acad., lxxxvii. (1907) pp. 229–400 (14 pls.).

further thinned down by means of the first-mentioned method, and when of suitable thickness may be mounted straight away or first stained with a 1–3 p.c. eosin solution for the purpose of detecting traces of organic matter. Several pages full of precautions to be taken during the different stages are given, but for these details the original should be consulted.

(4) Staining and Injecting.

Staining the Tubercle Bacillus.*—M. Herman recommends the following method as being superior to the Ziehl-Nielsen procedure. He uses a 1 p.c. solution of ammonium carbonate in distilled water as a mordant, and a 3 p.c. solution of crystal-violet (methyl-violet 6 B) in 95 p.c. ethyl-alcohol. The solutions are mixed when required for use in the proportion of 3 of mordant to 1 of stain. The sections or smears are hot-stained in the usual way and then decolorised with 10 p.c. nitric acid and 95 p.c. alcohol. The author claims that by this method many more tubercle bacilli are to be demonstrated than by any other.

Syringe for the Injection of Lymph-vessels. †—P. Bartels gives the following description of a syringe (fig. 63) used by him for anatomical

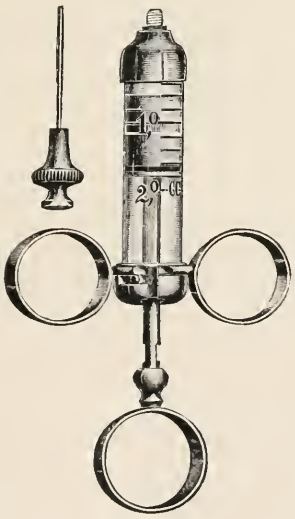


Fig. 63.

purposes, and especially for the injection of lymph-vessels: A. The syringe barrel (1) consisting of a graduated glass tube, having at one end (2) a metal nozzle, and at the other end (3) a metal ring, both being provided with a knob for a bayonet lock. B. A metal club consisting of a rod (4) and a piston (5) in the middle of which a ring is cut out for a washer. C. A metal junction piece (9) fitted to the

* Ann. Inst. Pasteur, xxii. (1908) pp. 92–6 (1 fig.).
† Anat. Anzeig., xxx. (1907) p. 613 (1 fig.).

bayonet lock of the nozzle (2), and holding a glass cannle (7) fixed by a strip of leather (8). D. A metal cover to fit into the metal ring (3) of the syringe, and to which are attached rings to take the index and middle fingers and thumb.

(6) Miscellaneous.

Forceps-scissors.—W. R. Traviss exhibited at the October 1907 Meeting * an instrument which is at once a pair of scissors and a folding

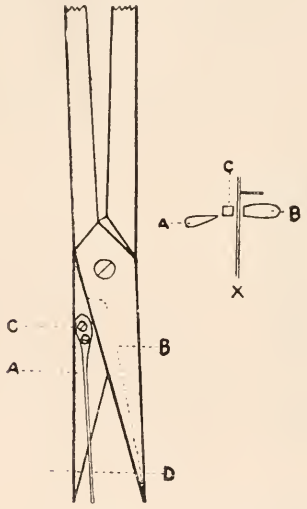


Fig. 64. Fig. 65

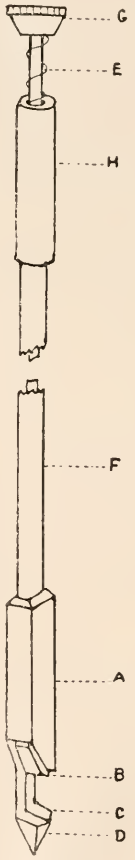


Fig. 66.

forceps. It is intended for cutting off particular pieces of weed, etc., and for retaining them until released. In fig. 64 are seen the general features of the instrument. The blade B is ground away so as to allow space for the wire spring C, which is fixed to the blade A. The extremity of C

* See this Journal, 1907, pp. 760–1.

projects beyond the cutting edge of A when the scissors are open, but when these are closed the spring is forced past the cutting edge. In fig. 65 is shown a section through D, with an object X which is to be cut. Inspection of this proves that when B and C meet, the object is first held and then cut.

Fig. 66 shows another weed-cutter, in the form of a guillotine, useful for cutting and holding specimens in deep jars, etc. A is a square brass tube, cut away at its lower end, as shown in the figure, with a slot in the remaining side, leaving a cutting edge C; beyond C is fitted a small block D. A square plunger B fits this tube, having its lower end bevelled to a square edge. This plunger is actuated by a rod sliding in the tube F, and is kept raised by a spiral spring E (in a spring box H) against the under side of the milled-head G. The instrument is plunged into the jar of water containing the weed or other like object, which is caught in the slot above mentioned. On pressing the milled head the plunger descends, cuts the object as it passes the edge of the slot, and holds it against the block D. On withdrawing the instrument and releasing the spring the plunger rises, and the fragment which has been cut is released.

Metallography, etc.

Iron-tungsten System.*—H. Harkort gives a lengthy account of the preparation of a large number of carbonless iron-tungsten alloys, the determination of their solidification temperatures and critical ranges, and their microstructure. A section of the paper deals with the theory and construction of granular carbon resistance furnaces, one type of which was used for the melting of the alloys. The Saladin double galvanometer was used for the heating and cooling curves. Many of the alloys obtained were inhomogeneous, and marked discrepancies exist between the tungsten added and that found by analysis. The freezing-point temperatures, though too irregular to admit of the construction of a reliable equilibrium diagram, point to the existence of a compound. Ar 2 and Ac 2 appear to be little affected by addition of tungsten, while Ar 3 and Ac 3 are raised.

Zinc and Nickel.† — V. Tafel has determined the equilibrium diagram in the range 0–50 p.c. nickel. At about 60 p.c. nickel the boiling-point and melting-point coincide. One compound, $NiZn_3$ occurs, melting at 876° C., distinctly brittle and giving a characteristic blue coloration with dilute nitric acid. One of the series of mixed crystals passes through a transformation point in the solid state. The microsections were etched either with dilute nitric acid, or first electrolytically, suspended as positive pole in water containing a little sulphuric acid, this process being followed by staining with iodine solution.

Structure of Metals.‡ — W. Campbell has accumulated much evidence in support of the universally accepted theory of the crystal-

* Metallurgie, iv. (1907) pp. 617–31, 639–47, 673–82 (44 figs.).
† Tom. cit., pp. 781–5 (14 figs.).
‡ Tom. cit., pp. 801–9, 825–34 (85 photomicrographs).

line structure of metals, and illustrates the paper with an instructive series of photomicrographs. A molten metal, on cooling to its freezing-point, starts to crystallise from centres which are more numerous as the speed of cooling is greater. Thus rapid freezing produces a small grain. In impure metals the greater purity of the first forming dendrites produces irregularity in composition in the solid metal; this may be rendered visible in etched sections. In pure metals the orientation within each grain may be revealed by deep etching, developing etching-pits and secondary crystals. The influence of mechanical distortion and of annealing was investigated. The author describes the crystalline structure of aluminium, antimony, bismuth, cadmium, copper, gold, lead, nickel, platinum, silver, tin, and zinc.

Theory of Malleableising.* — F. Wüst found that in cast iron containing 4 p.c. total carbon, 1 p.c. silicon, with very small amounts of other impurities, 3·4 p.c. temper carbon was formed by heating in vacuo for two hours at 950° C. Weighed quantities of the cast iron and of dried iron oxide, contained in separate porcelain boats, were heated in a previously evacuated tube in a Heraeus furnace. Samples of gas formed could be drawn off and analysed. The author gives the results obtained, from which he concludes that malleableising proceeds through the combination of oxygen with temper carbon (formed by annealing) giving CO_2, which then penetrates the iron and forms CO with more temper carbon. The CO then takes oxygen from the ore, which is reduced, and CO_2 is again formed. If the supply of oxygen from the ore fails, CO_2 ceases to be re-formed, and the iron may even be re-carburised by the decomposition of CO into CO_2 and C. Photomicrographs and diagrams illustrate the paper.

Melting Point Diagram of Nickel-sulphur Compounds.† — K. Bornemann gives the equilibrium diagram of the nickel-sulphur system from 0–31 p.c. sulphur. A homogeneous melt is obtained in this range. The only compound stable in the molten state is Ni_3S_2, melting-point 787° C. Others exist at lower temperatures. Ni_3S_2 and nickel form two series of mixed crystals; the eutectic of the two saturated solid solutions melts at 644° C. The thermal results were microscopically confirmed.

Steel and Meteoric Iron.‡ — F. Berwerth describes the structure of meteorites, with special reference to the Vienna collection, and points out that meteoric iron may be regarded as a variety of steel. Kamacite, taenite, and plessite are the three chief constituents, all containing nickel. A plate of Toluca meteoric iron was kept at 950° C. for seven hours and slowly cooled. The kamacite was then found to have changed into a finely-granular aggregate. The author proposes to distinguish meteoric irons, whose structure has been changed by heating within terrestrial space, as metabolites. Such meteorites have a finely-granular fracture, differing greatly from the usual coarsely crystalline

* Metallurgie, v. (1908) pp. 7–12 (16 figs.).
† Tom. cit., pp. 13–19 (20 figs.).
‡ Journ. Iron and Steel Inst., lxxv. (1907, 3) pp. 37–51 (5 figs.).

fracture. The surface furrows (piezoglyps) found on meteorites are ascribed to erosive action of gases on originally rough and irregular fractured surfaces in their passage through the atmosphere. J. E. Stead, and others, contributed to the discussion.

Case-hardening of Mild Steel.*—C. O. Bannister and W. J. Lambert have heated mild steel bars in a cementing material at 871° C. and at 982° C. for varying lengths of time. The structure and hardness were investigated both after slow cooling and after re-heating to 843° C. and quenching in water. At 871° C. the carbon content of the outer layer did not increase beyond 0·9 p.c., while at 982° C. the bars became supersaturated on the outside.

Case-hardening.†—G. S. Scott, in the course of experiments on the influence of time, temperature, and composition of cementing material, has found that the materials which give the most rapid case-hardening effect either contain nitrogen or have the power of utilising atmospheric nitrogen. Guillet's mixture (60 p.c. wood charcoal, 40 p.c. $BaCO_3$), is very effective. Samples of mild steel, cemented in a non-nitrogenous material (sugar carbon), were found to absorb less carbon than samples (1) cemented in the same way, but previously heated in an atmosphere of ammonia-gas at 550° C., or (2) cemented in the same material through which passed a stream of ammonia-gas. Heating in ammonia-gas was found to produce twinning; the author suggests that nitrogen induces the formation of γ-iron, and that this is the explanation of its effect in accelerating carburisation.

Hardened Steels.‡—P. Longmuir examined the microstructure of a large number of commercially hardened tools, carbon 0·5 to 2·0 p.c. The good tools were found to consist of hardenite, alone or with cementite or ferrite, and had a characteristic absence of definite structural pattern. The tools spoilt in hardening frequently showed marked patterns, and martensitic, austenitic, and troostitic appearances were noted. The effect of different heating and quenching temperatures on a 1·15 p.c. carbon steel was determined. Uniformity of structure in tool steel is only obtained by quenching in a certain range of temperature.

Hardening of Steel.§—L. Demozay states at some length the conclusions, many of which are of an obvious character, drawn from extensive series of experiments, in which the rates of heating and of cooling of steel, under widely varying conditions, were determined. The heating curves given are of value. The transformation point on heating varies between two temperatures, the maximum value being the transition temperature at the centre of a very small sample rapidly heated, the minimum that of the surface of a large sample slowly heated. For a given temperature of heating-bath the maximum rate of heating diminishes from outside to centre of the sample.

* Journ. Iron and Steel Inst., lxxv. (1907, 3) pp. 114–19 (22 photomicrographs).
† Tom. cit., pp. 120–36 (12 figs.).
‡ Tom. cit., pp. 137–43 (16 photomicrographs).
§ Tom. cit., pp. 144–78 (49 figs.).

Constitution and Treatment of Steel.*—A. Portevin applies the equilibrium diagram of the iron-carbon system to the constitution and thermal treatment of steels and cast irons. The constituents, microscopically distinguished in a polished section, may correspond (1) to the phases in stable or labile equilibrium at the ordinary temperature; (2) to the phases in equilibrium at a higher temperature, preserved unchanged by quenching; (3) to states of transition between the phases as in (2) and as in (1). The author briefly describes the mode of production of the known constituents, including osmondite, but purposely leaving out of account Benedicks' ferronite and Kourbatoff's troosto-sorbite because so little is known regarding them.

Binary Alloys of Copper.†—R. Sahmen has determined the equilibrium diagrams of the systems cobalt-copper, iron-copper, manganese-copper, and magnesium-copper. The component metals of each system are miscible in all proportions in the molten state. In the cobalt-copper and iron-copper systems, mixed crystals occur at both ends of the diagram. Temperatures of magnetic and thermal transformations were determined in these series. Manganese and copper form a continuous series of mixed crystals with a minimum freezing-point at 866° C. and about 65 p.c. copper. Magnesium and copper form two compounds, Cu_2Mg and $CuMg_2$, melting-points 797° C. and 570° C. Etching reagents used were ammoniacal solution of hydrogen peroxide, and dilute sulphuric acid, used electrolytically.

Binary Alloys of Nickel.‡—G. Voss gives the results of his determinations of equilibrium diagrams for the binary alloys of nickel with tin, lead, thallium, bismuth, chromium, magnesium, zinc, and cadmium. Tests were made of magnetic permeability, temperatures of magnetic transformation were determined, and the alloys were microscopically examined. Owing to the low boiling-points of zinc and cadmium, the diagrams for the systems containing these metals only cover the range, 0–27 p.c. nickel and 0–15 p.c. nickel, respectively. The compounds found were Ni_3Sn_2, Ni_3Sn, Ni_4Sn, $NiBi$, $NiBi_3$, Ni_2Mg, $NiMg_2$, $NiZn_3$, $NiCd_4$. With tin, lead, and thallium, nickel is not completely miscible in the liquid state.

Binary Alloys of Aluminium.§—A. G. C. Gwyer has determined the equilibrium diagrams for the alloys of aluminium with copper, iron, nickel, and cobalt, with which metals aluminium is completely miscible in the molten state. Aluminium does not mix in any proportion with lead or cadmium: no alloys are formed therefore, and the diagrams for these two binary systems are the simplest possible. The compounds are $CuAl_2$, $CuAl$, Cu_3Al, $FeAl_3$, $NiAl_3$, $NiAl_2$, $NiAl$, Co_3Al_{13}, Co_2Al_5, $CoAl$. Thermal results were confirmed by microscopical examination. The author considers that Carpenter and Edwards assumed the existence of Cu_4Al on insufficient evidence, and points out that they did not mention $CuAl$, though its existence was indicated by their thermal results. A

* Rev. de Métallurgie, v. (1908) pp. 24–33 (10 figs.).
† Zeitschr. Anorg. Chem., lvii. (1908) pp. 1–33 (27 figs.).
‡ Tom. cit., pp. 34–71 (42 figs.).
§ Tom. cit., pp. 113–53 (30 figs.).

comparison is made between the three metals of the iron group in their behaviour with aluminium.

Binary Alloys of Calcium.*—The electrolytic production of pure metallic calcium in large quantities has rendered the study of its alloys possible. L. Doński has investigated its alloys with zinc, cadmium, aluminium, thallium, lead, tin, bismuth, antimony, and copper, and gives incomplete equilibrium diagrams. Owing to the powerful affinity of calcium for oxygen, the great amount of heat evolved when calcium is dissolved in molten metals (causing an explosive reaction in some cases), and the destructive action of high calcium alloys on the Jena glass and porcelain tubes used, the alloys were prepared only with great difficulty. Some of the high calcium alloys were melted in vacuo. Most of those of low calcium content were prepared by dropping calcium in small amounts into the metal heated considerably above its melting-point. Calcium is remarkable for its readiness to form compounds. The following were found :— $CaZn_{10}$, $CaZn_4$, Ca_2Zn_3, CaZn (?), Ca_4Zn, $CaCd_3$, CaCd, Ca_3Cd_2 (?), $CaAl_3$, $CaTl_3$. CaTl (?), $CaPb_3$, $CaSn_3$. Compounds with antimony and bismuth probably exist. Microscopic examination confirmed the diagrams deduced from thermal analysis.

Impact-testing on Notched Test-pieces.†—Ehrensberger considers this to be a useful addition to testing methods, affording additional information on mechanical properties, and makes the following recommendations as the result of an investigation of the test. The machine to be a Charpy pendulum, one of three types giving respectively 250, 75, and 10 kilogram-metres striking energy. In the test-piece $160 \times 30 \times 30$ mm. a hole 4 mm. diam. is drilled in the centre of the length, parallel to one face and 15 mm. distant from it ; a cut is made from the hole to the opposite side. A rounded notch is thus produced. The width of test-pieces cut from plates and similar material may be less than 30 mm. The test-pieces are machined cold, and must not afterwards be heated. The results to be expressed as energy absorbed per square centimetre ("spezifische Schlagarbeit"). The test-piece to be completely broken. The numerous diagrams and tables of tests on different steels with variously shaped notches show the necessity for standardisation of methods.

Constitution of Manganese Cast Irons.‡—L. Guillet retracts his former statement that cast irons of high manganese content do not contain γ-iron. What appeared to be pearlite was, in fact, the eutectic mixed crystals-cementite. The addition of nickel or manganese to cast iron in sufficient quantity produces γ-iron. In the case of a grey iron the addition of manganese produces γ-iron before the graphite has disappeared. Increase in manganese is accompanied by an increase in amount of carbide.

* Zeitschr. Anorg. Chem., lvii. (1908) pp. 185–219 (8 figs.).

† Stahl und Eisen, xxvii. (1907) pp. 1797–1809, 1833–9 (19 figs.). (Report of committee appointed by the German Association for Testing Materials to investigate this method of testing.)

‡ Comptes Rendus, cxlvi. (1908) pp. 74–5.

Heat Treatment of Copper-zinc Alloys.*—G. D. Bengough and O. F. Hudson have investigated the effect upon microstructure and mechanical properties of Muntz metal of annealing at different temperatures. The brass contained 60·43 p.c. copper, 39·21 p.c. zinc, 0·33 p.c. lead, and was rolled hot to round bars, which were finally reduced slightly by cold rolling. In this state the metal had a considerably higher tensile strength and elongation than in the cast condition. Brass of this composition is normally constituted of α and β solid solutions. On heating, α dissolves progressively in β with rise of temperature; at 720° C. β is the sole constituent. By quenching at different temperatures, alloys containing the two phases in different proportions may be obtained. Test bars quenched after heating to a temperature high enough to produce a notable increase in the proportion of β give a slightly increased maximum tensile stress and a greatly diminished elongation. β appears to be brittle. Dilute ammonia solution was used for etching; α etched light, β dark. By varying the strength of the solution a completely reversed effect may be produced.

Piping and Segregation.†—H. M. Howe and B. Stoughton have studied these phenomena in ingots cast from wax containing green copper oleate (1·5 p.c.). The wax was coloured by the addition of a little red cerasine, which does not segregate. The predictions made by Howe concerning the influence of casting conditions upon piping and segregation were verified.‡

Measurement of Extension of Tensile Test-pieces.§—W. J. Lambert claims great accuracy, combined with simplicity, for a method of measuring small extensions, which consists in projecting a magnified image of the gap between knife edges attached to the ends of the test-piece, on the focusing screen of a photomicrographic apparatus. The extension is readily calculated from the increase in width of the image of the gap, given the magnification.

Recovery of Steel from Overstrain.‖—E. C. Hancock has shown that a carbon steel and a steel containing 3·5 p.c. nickel, when overstrained in either tension or compression, lose their elasticity for stresses, both of the same and of the opposite kind Recovery takes place through rest and more rapidly on warming.

Influence of Stress on the Electrical Conductivity of Metals.¶ W. E. Williams has determined the effect of hydrostatic pressure upon the resistance of wires of lead, aluminium, bismuth, and manganin. The resistance of lead and aluminium is diminished by pressure, that of bismuth and manganese increased, the change in each case being proportional to the pressure.

* Journ. Soc. Chem. Ind., xxvii. (1908) pp. 43–52 (30 figs.).
† Bull. Amer Inst. Mining Engineers, xvi. (1907) pp. 561–73 (17 figs.).
‡ See this Journal, 1907, p. 382.
§ Proc. Inst. Civil Eng., clxix. (1907) pp. 349–51 (2 figs.).
‖ Phil. Mag., xiii. (1907) pp. 688–93 (8 figs.).
¶ Tom. cit., pp. 635–43 (3 figs.).

BACH, C.—**Investigation of a Copper Tube split in use.**
Zeitschr. Ver. Deutsch. Ing., li. (1907) pp. 1667–9 (12 figs.).

CAMPBELL, W.—**Heat Treatment of Medium-Carbon Steels; Influence of Speed of Cooling on Physical Properties and Structure.**
Metallurgie, iv. (1907) pp. 772–8 (50 figs.).

DIEGEL, C.—**Age-cracks in Copper Alloys.**
Rev. de Métallurgie, iv. (1907) Extraits, p. 678.

GIOLOTTI, F.—**Practical Value of Metallography.**
Rassegna Mineraria (1907) pp. 277–82.

GUILLET, L.—**A New Chromium Tool Steel.**
[The properties and micro-structure of an accidentally made "steel," containing 2·18 p.c. carbon, 14·88 p.c. chromium, are described.]
Rev. de Métallurgie, iv. (1907) pp. 1025–6 (2 figs.).

„ „ **Industrial Application of Metal Microscopy.**
Le Genie Civil (1907) pp. 111–13.

HARBORD, F. W.—**Action of Toothless Circular Saws.**
[Microscopic observations of disk and cut metal lead to the explanation that the action proceeds through fusion of the metal cut.]
Engineer, cv. (1908) p. 187 (8 figs.).
See also *Nature*, lxxvii. (1908) p. 419.

JÄNECKE, E.—**The Ternary System, Lead-cadmium-mercury.**
Zeitschr. Phys. Chem., lx. (1907) pp. 399–412 (7 figs.).

JÜPTNER, H. VON—**Application of the Laws of Physical Chemistry in the Metallurgy of Iron.**
Journ. Iron. and Steel. Inst., lxxv. (1907) pp. 59–85 (7 figs.).

„ „ **Microstructure of Steel.**
Oesterr. Zeitschr. für Berg-und Hüttenwesen, (1907) pp. 161–4, 177–80.

KERDYK, F.—**Microstructure of a Broken Shaft.**
[The failure of a propeller shaft is ascribed to faulty heat treatment.] *Dingler's Polytech. Journ.* (1907) pp. 683–5.

„ „ **Metallographic Practice.** *Stahl und Eisen*, xxvii. (1907) pp. 1892.

MOISSAN, H.—**Vaporisation of Metals.**
Proc. Roy. Inst., xviii. (1907) part 2, pp. 377–91 (1 fig.).

MOLDENKE, R.—**Production of Malleable Castings.**
Foundry, xxxi. (1907) pp. 257–9.

MOSTOWITSCH, W.—**Lead-oxide and Silica.**
Metallurgie, iv. (1907) pp. 647–55 (2 figs.).

PUSCHIN, N.—**Potential and Constitution of Metallic Alloys.**
Zeitschr. Anorg. Chem., lvi. (1907). pp. 1–45 (17 figs.).
See also *Journ. Soc. Chem. Ind.*, xxvi. (1907) pp. 1141–2; xxvii. (1908) pp. 77 and 126. *Journ. Russ. Phys.-Chem. Ges.*, xxxix. (1907) pp. 353–99, 528–66.

RUER, R.—**Form of Melting-point Curves in Binary Systems.**
Zeitschr. Phys. Chem., lix. (1907) pp. 1–16 (7 figs.).

SAPOSHNIKOW, A., & J. KANIEWSKI—**Hardness and Microstructure of Lead-antimony Alloys.** *Journ. Soc. Chem. Ind.*, xxvii. (1908) pp. 126–7 (abstract).

SAPOSHNIKOW, A., & M. SACHAROW—**Hardness and Microstructure of Cadmium-zinc Alloys.** *Tom. cit.*, p. 127 (abstract).

SHEMTSCHUSHNY, S., & N. JEFREMOW—**Phosphorus Compounds of Manganese.** *Tom. cit.*, p. 77 (abstract).

SHEMTSCHUSHNY, S., G. URASOW, & A. RYKOWSKOW—**Alloys of Manganese with Copper and Nickel.** *Tom. cit.*, p. 77 (abstract).

[The four papers, references to which are given above, appeared in *Journ. Russ. Phys.-Chem. Ges.*, xxxix. (1907).

Sauveur, A.—**Graphic Representation of the Solidification of Eutectic Alloys.** *Electrochem. and Met. Ind.*, vi. (1908) p. 18 (1 fig.).

Sahmen, R., & A. v. Vegesack—**Application of Thermal Analysis to Three-component Systems.** *Zeitschr. Phys. Chem.*, lix. (1907) pp. 257–83 (12 figs.) pp. 697–702 (3 figs.); lx. (1907) pp. 507–9 (1 fig.).

Sieverts, A.—**Occlusion and Diffusion of Gases through Metals.** *Zeitschr. Phys. Chem.*, lx. (1907) pp. 129–201 (8 figs.).

Stribeck, R.—**Spherical Test-pieces of Hardened Steel.** *Zeitschr. Ver. Deutsch. Ing.*, li. (1907) pp. 1444–51, 1500–6, 1542–7 (23 figs.).

Shuddemagen, C. L. B.—**Demagnetising Factors for Cylindrical Iron Rods.** *Proc. Amer. Acad. Arts. and Sci.*, xliii. (1907) pp. 185–256 (25 figs.).

Stromeyer, C. E.—**Further Experiments on the Ageing of Mild Steel.** [The author considers that the existence of an ageing effect is confirmed by the results of the further mechanical tests given. See this Journal, 1907, p. 640.] *Journ. Iron and Steel Inst.*, lxxv. (1907) pp. 86–113 (29 figs.).

Wawrziniek—**Elastic Properties of Steel.** *Metallurgie*, iv. (1907) pp. 810–15 (3 figs.).

,, ,, **Metal Microscopy.** *Stahl und Eisen*, xxvii. (1907) p. 1892.

Explosion of Thermal Storage Drum at Greenwich. [A report on the microstructure of the faulty plate is included.] *Engineering*, lxxxv. (1908) pp. 113–17 (17 figs.). See also *Engineer*, cv. (1908) pp. 57, 82–4, 91–2, 96–7.

Mitteilungen aus dem Königlichen Materialprüfungsamt, xxv. (1907) pp. 157–231. [Contains a section describing the year's work in metallography.]

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Old Microscope by Shuttleworth. — This Microscope (fig. 86), presented to the Society by Mr. Wynne E. Baxter, is signed Shuttleworth, London. It is known that after Benjamin Martin's death in 1782, his models were copied by other makers such as Gregory and

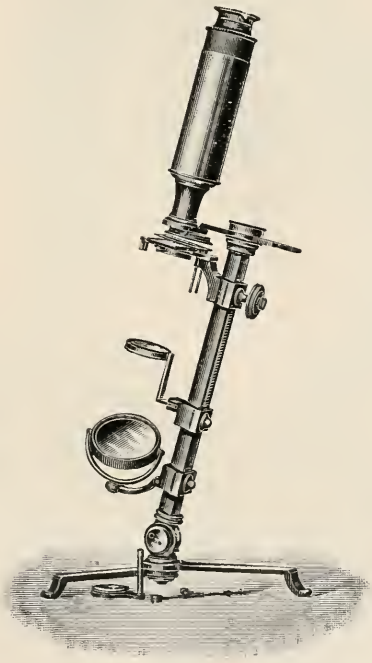
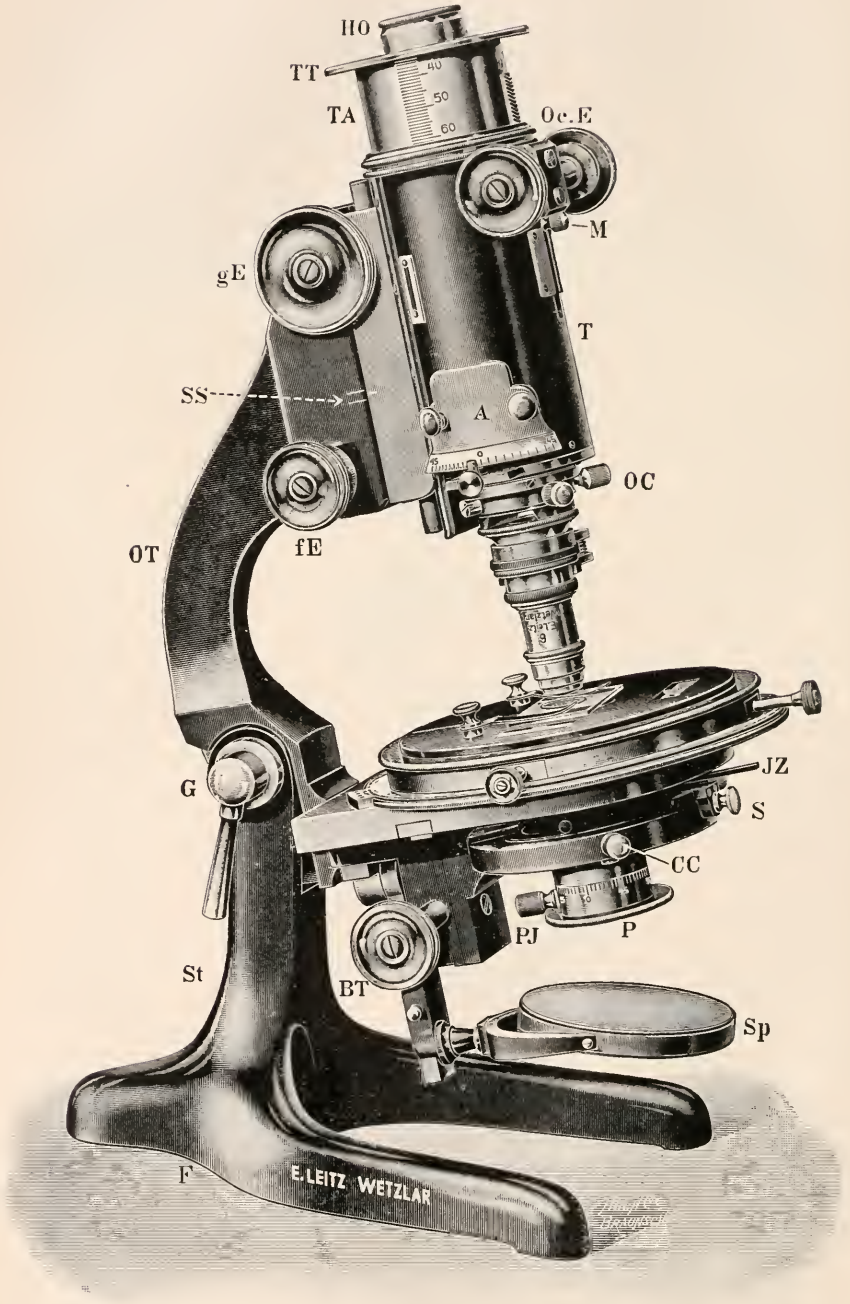


Fig. 86.

Wright, Shuttleworth, and others. It will be seen that the present instrument closely follows those of Benjamin Martin in shape and design.

The triangular limb is pivoted by a compass-joint to the top of the folding tripod-foot. The rack is cut into the back of the prismatic limb, and the pinion, which protrudes at right angles from the base,

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

Fig. 87.

moves up and down with the stage. Numbers 1–6 are engraved on one side of the limb to indicate the position of the stage with the six objectives. The body of the Microscope is fixed to an arm which can be moved backwards and forwards and also in arc over the object, and carries Martin's multiple disk of object-cases. Below the stage a condensing lens is fixed on a separate arm, and made movable out of the way by means of a joint when not wanted. The mirror is plane and concave, and both the arms carrying the mirror and the condensing lens are made to slide on the limb.

The date of the present instrument may be given as about 1786. It represents an important link between Benjamin Martin of 1782 and Jones' "Most Improved" model of 1797, and as such it is a valuable addition to our collection of old Microscopes.

Leitz' New Petrological Microscope, Type A.*—G. Lincio, of Varzo, fully describes this Microscope, of which Figs 87 and 88 give side views. It is made with a heavy foot F (fig. 87) surmounted by a forked piece S*t*, within which the upper body O T may be inclined about a hinge G. The latter is situated on a level with the stage, at such a height that when tilted back the Microscope may, without sacrifice of stability, be made to receive the light direct from an artificial source. The upper body is so designed as to provide an unusually large working space in the plane of the stage, and, incidentally, forms a convenient handle by which the Microscope may be grasped. This part carries the mechanism for the coarse-adjustment *g* E and the fine-adjustment *f* E. The former is effected by a rack-and-pinion provided with obliquely cut teeth so as to minimise play. The range of motion is such that a working distance of 9·5 cm. is obtainable with the shortest (low-power) objective (No. 1), and 7·5 cm. with the largest (high-power) objectives. The fine-adjustment is of the new form which has been already described in this Journal.† The stage-plate is provided with holes for the insertion of object-clips and angular-stops. The graduations and angular-stops serve as finders. The thickness of the stage-plate suffices, moreover, for the adaptation of fixing-clamps and clips for the usual forms of stage-fittings, rotation devices, etc. The position of large objects may, after centring the stage and setting the index back to the respective numbers of the $\frac{1}{2}$ mm. scales, be recorded with the aid of the graduations along two radial lines engraved at right angles to each other upon the stage-top. As a matter of fact an object marker, which screws to the tube like an ordinary objective, is obtainable for an insignificant sum, and is much to be preferred to any of these finders when quick work has to be done and when it is intended to subsequently photograph selected portions of specimens. The stage is fitted with a clamp and fine-adjustment, which will be found a useful adjunct in the measurement of angles of crystals, in determining the direction of extinction, etc. It consists of a tangential screw with milled head T S (fig. 88), which engages into a sector under the edge of the stage.

* Neues Jahrb. f. Mineralogie, Geologie, und Paläontologie, xxiii. (1906) pp. 163–86 (6 stereoscopic plates and 10 text figs.; also as an extract from above (E. Nägele, Stuttgart); and in an English trans. (E. Leitz, London), stereoscopic plates not included. † 1907, p. 479.

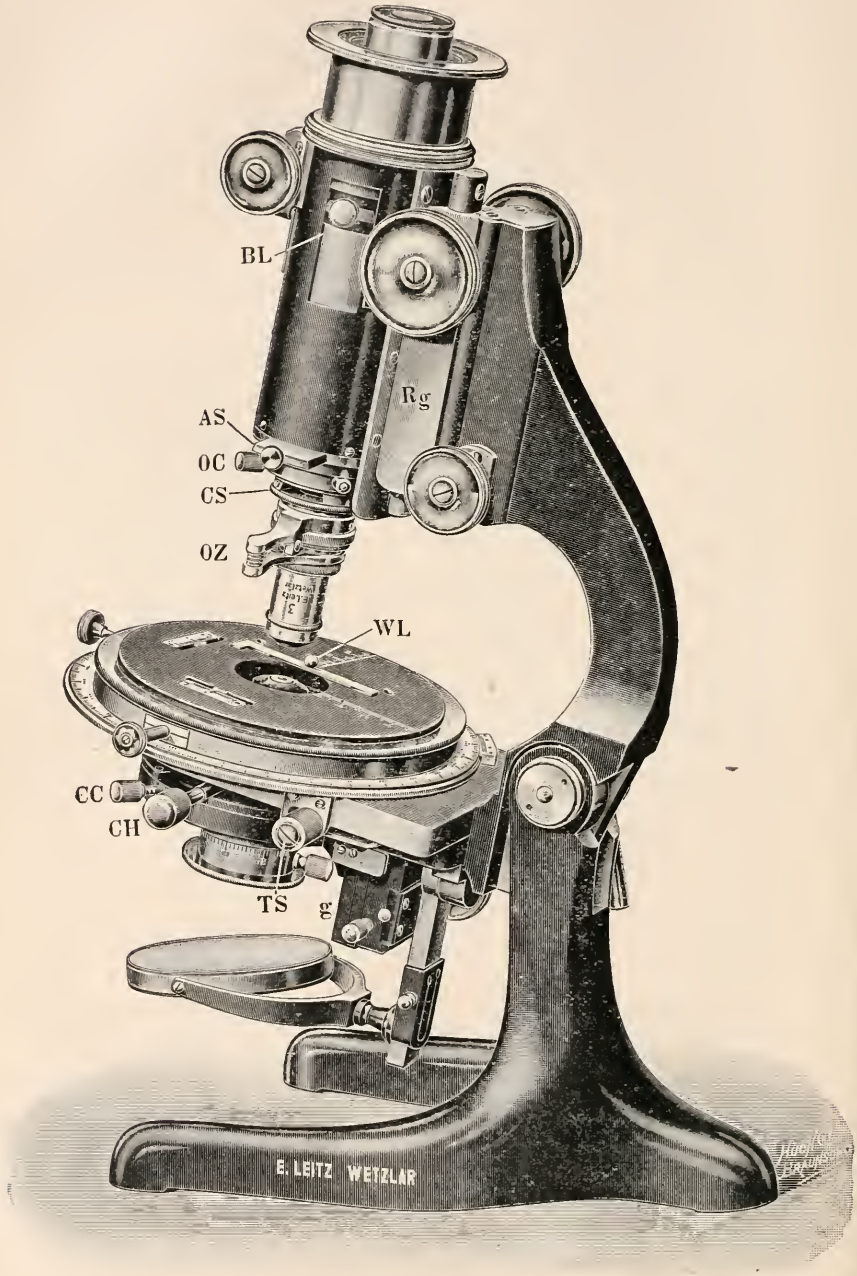

FIG. 88.

The illuminating apparatus consists of a mirror (plane and concave sides), polariser, iris diaphragm, and condenser, the last three (figs. 89, 90, 91), being mounted on a detachable angle-piece *g*, to which is likewise attached the rack *t g* (not shown in fig. 87). Those parts which are capable of being thrown out of action, viz. the hinged carrier of the upper condenser C B, the upper condenser O C with the slider S

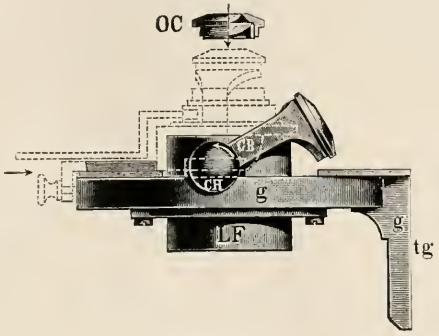

Fig. 89.

for the iris diaphragm J, and the lower condenser, are shown in both positions. The polariser, the lower and upper condenser lenses, are shown half in section and half as they appear when withdrawn from their respective mounts. The polariser is a large Glan-Thompson prism with a symmetrical field of polarisation of 30°; and the author fully describes the means provided for its adjustment. J is the iris

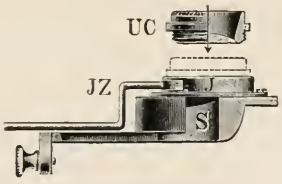

Fig. 90.

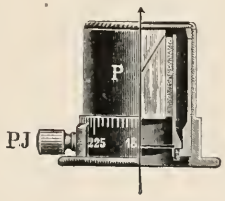

Fig. 91.

diaphragm, as followed by the lower condenser lens U C, which yield an approximately parallel beam of light. Both are carried by the slider S. The iris diaphragm is placed above the polariser so as to render it possible to limit at will the pencil of plane-polarised light. It is used in conjunction with the polariser, e.g. for determining after Becke's method the difference of refraction in minerals, twin laminæ, etc. The essentially novel feature of the illuminating apparatus is the upper condenser O C (fig. 89). This is so mounted that it may be tilted back

by a lever C H and bridge C B, and that it may be thrown in and out of action at any elevation of the illuminating apparatus. This hinged condenser may be supplied in two forms, one of the customary aperture of 120°, the other having an aperture corresponding to that of a wide-angle lens of N.A. 1·48. As the apertures of the objectives advance it will be found necessary to centre the hinged condenser after the interchange, if the available polarised field is to be fully used. This adjustment is effected by a horizontal ring recessed into the disk *g* and carrying the hinged condenser, whilst two screws, C C (figs. 87 and 88), and a copper spring serve to centre it accurately with respect to the axis of the Microscope. The movement of the hinged condenser is limited by a screw. In all, there are six methods of illumination attainable. 1. After removal of the entire illuminating apparatus the object may be illuminated either direct or with the aid of the mirror, according to the inclination of the body. 2. Illumination may be produced by means of the iris diaphragm and the rack-and-pinion only. 3. Illumination with the iris diaphragm, the lower condenser and the rack-and-pinion motion. 4. Illumination, after folding back the upper condenser, removing the slider S and substituting for the polariser a wide-angle Abbe condenser. In this case the rack motion serves for focusing this condenser, the angle of the illuminating pencil being adjustable either by a vertical movement of the condenser or by means of a wheel diaphragm, which may be attached to the lower end of the condenser mount. The wheel diaphragm forms part of a simple apparatus provided for the production of oblique illumination, such as is employed in determining refraction by Schroeder v. d. Kolk's method of envelopment. 5. Illumination by parallel polarised light in conjunction with the entire illuminating apparatus, excepting the hinged condenser; and (6) finally, illumination by convergent polarised light with the assistance of the hinged condenser.

The observation tube consisting of: the objective, objective clutch, compensation slit, objective centring device, and sliding analyser are placed at the lower end of the tube; whereas the Bertrand lens and the eye-piece are contained within the draw-tube. Full particulars of all these parts are given by the author.

To render the Microscope available as a focimeter, a vertical scale divided into $\frac{1}{2}$ mm. is attached to the left of the tube, so as to slide along a vernier on the intermediate fitting R *g* (fig. 88), above the milled-head of the coarse-adjustment, which renders it possible to read to $\frac{1}{200}$ mm.

The author adds and explains sectional drawings illustrating (1) the ray-path with parallel light in an ordinary Leitz Microscope; (2) the ray-path within the petrological Microscope of convergent polarised light.

Fig. 92 shows the revolving slide-diaphragm, which is affixed to the lower rim of the polariser or chromatic condenser by means of three converging or equidistant clips situated below the stationary disk L S. One of these clips may be displaced and fixed by a screw S. The diameter of the first hole corresponds to that of the polariser tube; from

2 downwards the holes serve as stops. The centre of hole 2 coincides with that of hole 1 when the spring-catch S*t* engages into the nick I. The centres of the holes are arranged heptagonally in a circle, and the object of introducing this diaphragm with its range of eight grades was to replace the iris-diaphragm, usually placed between the polariser and the mirror, and at the same time to render it available as a Wright's slider. The diameters of the apertures are engraved on the disk in terms of millimetres.

In the construction of the Microscope due allowance has been made for its practical applicability to photomicrography, and the stand may accordingly be employed with Leitz' New Universal Photomicrographic Apparatus. Besides photographs of the usual character, stereoscopic

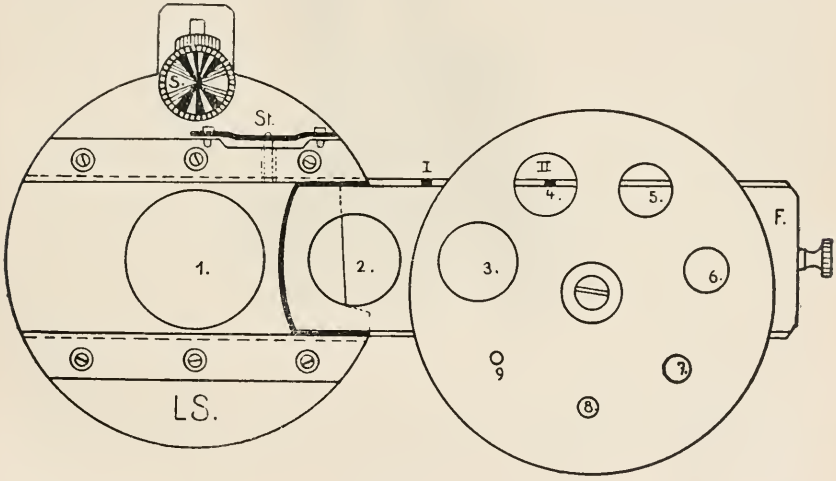

FIG. 92.

views of inanimate objects (e.g. crystals) may be obtained. For this purpose the object is successively displaced laterally 32 mm. to the left and to the right of the middle line and sharply focused, a photograph being taken in each position. A stereoscopic dark-slide has the advantage that both exposures may be made on one plate, without which it is difficult to obtain uniformly developed negatives or even prints.

Leitz' Museum Microscope.* — Leitz' Museum Microscope is a simple apparatus for showing persons unacquainted with the use of the microscope a series of specimens. In this instrument (fig. 93) the stage is replaced by a drum capable of rotation from left to right, and provided with supports for twelve preparations, which are retained in position by clips. Another detachable drum of sheet-metal serves to preserve the specimens from damage. Both drums are perforated by

* E. Leitz' Catalogue, No. 42 (1907) p. 63 (1 fig.).

twelve apertures for illumination and observation. In the interior of the drum is a mirror which is movable in all directions. A spring register

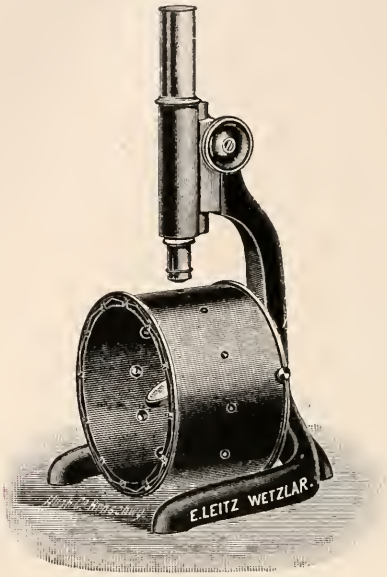

Fig. 93.

at the back of the drum insures the correct position of each specimen as it comes under observation. The Microscope is provided with a coarse rack-and-pinion adjustment.

Petri, R. T.—**A. van Leeuwenhoek's Mikroskop.** *Naturw. Wochenschr.*, xxii. p. 1–7.

(3) Illuminating and other Apparatus.

Polarising Prisms.*— B. Halle commences his treatment of this subject by an interesting historical outline of the calcite prism. He shows how the "epoch-making discovery of the Englishman Nicol" has suggested other forms due to later observers, e.g. to Foucault, Prazmowsky, Glan, Glan-Thompson, Hartnack-Prazmowsky, Ahrens, Grosse, Rochon, Senarmont, Wollaston, and Abbe. He describes and tabulates the characteristics of each, and shows that the necessary waste of material in their preparation increases rapidly in the more modern forms. This is a serious matter on account of the growing rarity of the raw material, the price of which has risen some twentyfold in the last thirty years. The author has partially met this difficulty, for by the help of a specially constructed saw † he has succeeded in reducing the

* Deutsch Mechaniker-Zeitung (Jan. 1908) pp. 6–8 and 16–19 (3 figs.).
† Op. cit., 1896, p. 143.

waste by one-half in the case of large prisms. This mechanical method, however, is not adapted for the smaller prisms. Now a study of his tables shows that the prisms, as used, differ considerably as regard their field of view (opening) and their polarisation-field. Whilst prisms with larger opening usually have a narrowly limited polarisation-field, those with smaller opening, in consequence of their large polarising angle, attain a proportionally large field. It is therefore necessary in selecting a prism to keep one's requirements carefully in view. For an analyser (eye-Nicol) a prism with large polarising angle, and consequently large opening, is desirable; whereas for a polariser a large beam with few converging rays would be usually recommended. The author describes and figures an apparatus by which the polarisation angle may be measured. The prism A to be investigated is securely mounted on a circular table B, whose centre is C. The analyser is placed on a segment D, which is concentric with C, and rotates round it. The plane of B extends slightly beyond the segment, and its circumference is graduated. The first prism is so placed that a narrow face is at C, and both prisms are so arranged that their extraordinary rays are in the same plane and at the zero of the scale. Illumination (lamp or daylight) reaches the remoter end of the polariser. The analyser and polariser are now interchanged and the segment rotated leftwise, until a point is reached at which no light passes through to the eye. This is the limit of the polarisation field on the one side, and, in the case of Nicols with inclined end-planes, is marked by a bluish tint. The segment is now brought back to the zero point, and the analyser rotated 90° about its long axis. The field of view is now quite black; but the segment is rotated rightwise until the blackness disappears, thus marking the other limit. The angle subtended at C by these limits is the value of the required angle of the polarisation field. If the limits are equally distant from the zero the polarisation field is symmetrical. The author gives the following values of the polarisation angle, the field being symmetrical unless otherwise stated :—

(The reference letters *a*–*l* relate to details of construction.)

(*h*) Glan-Thompson	34°	(*g*) Glan-Thompson, symmetric field	18°
(*e*) Hartnack-Prazmowsky	32	(*c*) Halle, unsymmetric field	19°
(*i*) Ahrens (linseed oil cement)	26	do. symmetric field	17
(*d*) Halle	25	(*f*) Glan	8
(*k*) Ahrens (balsam cement)	24	(*a*) Foucault	7
(*b*) Nicol	24	(*l*) Grosse	6
(*g*) Glan-Thompson, unsymmetric field	32		

The last three are thus only applicable for parallel light, the others being also useful for more or less convergent light. The forms *h*, *e*, *d*, *b* are especially suitable for analysers on account of their small cross-section and large polarisation angle; the others serve better as polarisers. The two Ahrens' prisms seem capable of great reduction in size. The different forms of the Glan-Thompson show that a large opening combined with reduced polarisation field is most economically attained by altering the angle of the prism; such a change is, however, possible only in prisms with balsam or linseed-oil cement.

Note on some Meteorological Uses of the Polariscope.*—L. Bell, as the result of certain observations made at Mount Moosilauke, New Hampshire, was led to think that the polariscope might have some use in meteorological prognostics. Atmospheric haze is well known to be due to suspended particles of one sort or another, and haze which produces polarisation as well as the ordinary sky polarisation, is due to particles small compared with the wave-length of light. The polariscope integrates the effects of such particles along the line of sight. The process of increasing nucleation, which results in cloud formation and frequently in subsequent rain, was found to be accompanied by a fall in polarisation, and its progress could be well followed by the polariscope.

Reichert's Novelties in Mirror Condensers.*—O. Heimstädt describes several new forms of mirror condensers which have been recently brought out by the firm of C. Reichert, of Vienna.

Mirror Condenser with variable disk-diaphragm.—This is shown in fig. 94, the principle being that of the well known iris diaphragm but

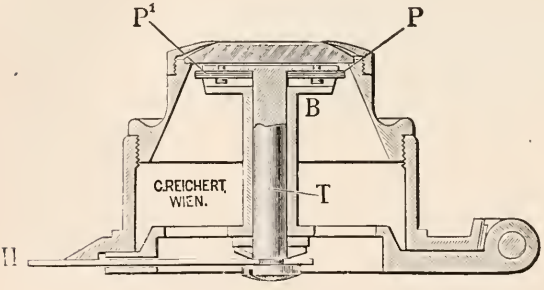

Fig. 94.

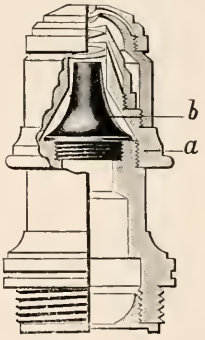

Fig. 95.

with reversed action. The small plates P of the disk B are projected over the rim of the top plate so soon as the lever H is rotated in the required direction about the axis T. The effect of the lever action is to extend outwards the little plates of the disk so that their rims approximately form a circle which can attain to the size of the opening of the mirror condenser. The above apparatus is listed by the maker as "Mirror Condenser C," and is optically the same as the mirror condenser A. With dry objectives the lever H is rotated rightwise, and with immersion systems leftwise. It is to be noted that this apparatus does not secure an absolutely dark field, because the aperture of the condenser cannot be greater than the aperture of the objective; some light other than that diffracted by the ultra-microscopic particles will therefore reach the eye. But this fact does not constitute a disadvantage, for it is found that the image is brighter and the higher powers of the immersion system have more effect.

* Proc. American Acad. of Arts and Sci., xliii. (1908) pp. 407–12 (1 fig.).
* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 233–42 (7 figs.).

Fig. 95 illustrates another method of securing a dark field with immersion objectives, the observation-objective being so stopped off that the rays passing by the rim of the disk-diaphragm are detained in the objective. This is effected by the insertion of an intermediate piece introduced between the tube-stop and the objective mount. This intermediate carries a tube-stop C of the required size, corresponding to the aperture of the objective. The stop is made removable so that it does not interfere with the ordinary use of the objective.

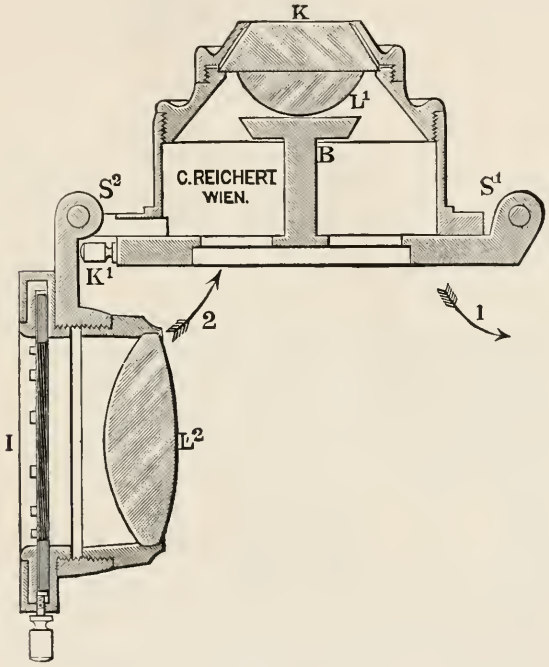

Fig. 96.

Exchange Condenser.—This is shown in fig. 96, and its construction is due to P. Schmidt. A double-action Abbe condenser of N.A. 1·10 is so combined with a conical condenser that, either the disk-diaphragm B, or the lens L_2, together with the iris I, can be inserted. In the first case the condenser functions as an ultra-microscopic illuminating apparatus (as shown in fig. 96); in the other case, as an ordinary condenser.

Plate-Condensers.—Figs. 97–101 illustrate an entirely new class of ultra-microscopical illuminators, and derive their name from the fact that they (especially the simpler forms) bear some resemblance to a glass plate. They have the advantage of being completely independent of the illuminating apparatus of the Microscope, and their application only requires the existence of the Microscope mirror and of a sufficiently large stage-aperture. They could therefore be used with the simplest

stand. Fig. 97 shows the most primitive form of such a condenser, the whole arrangement resembling an object-slide on whose lower surface a conical mirror K has been cemented by its smaller end. A metal plate B is cemented on to the large end of the frustum *k*, so as to keep the direct rays back from the preparation. This frustum lies, as shown, in the stage aperture, and as its lower diameter is 14·6 mm., the stage

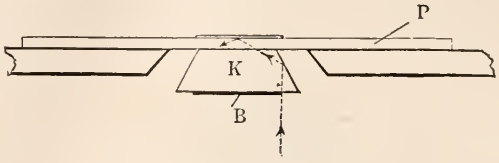

Fig. 97.

aperture must be at least 15 mm. in diameter. The axis of the conical mirror is indicated by a diamond scratch on the upper surface of the plate, and by the aid of a weak objective this mark is set in the midst of the field, and the point of the light-cone applied to it by manipulation of the Microscope mirror. The insertion of a strong illuminating lens between the light-source and the Microscope mirror is recommended, as

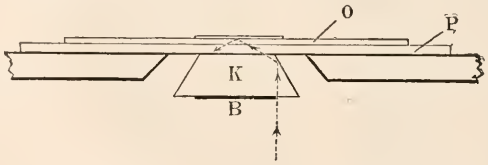

Fig. 98.

the illuminated plane of the preparation is thereby much increased. The preparation itself can be laid on the top of the plate without a slide, thereby avoiding the necessity of an immersion. It is obvious that such a method would, however, only be of advantage in a preliminary examination, and would not lend itself to permanent preparations. But the difficulty can be overcome if the permanent preparation (fig. 98)

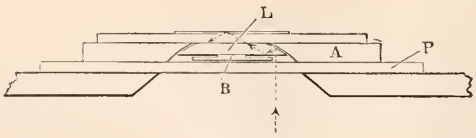

Fig. 99.

has been mounted on an extremely thin object-slide (about 1 mm. thick). Also the plate condenser must be secured by stage-clamps, and the preparation can then be shifted as desired. The application of a drop of immersion fluid is, of course, necessary.

Fig. 99 represents another very simple arrangement for ultramicroscopical purposes. The conical mirror is now replaced by a spherically

ground mirror-lens L, whose silvered surface is protected from injury by being cemented on to a glass block A, provided with a suitable recess. The stop B, T-shaped in cross-section, shuts out the direct rays, and those of N.A. less than 1·0; it is cemented centrally on the under surface of the mirror-lens. The glass plate P serves to protect the whole arrangement from external effects: its ends are made to project somewhat beyond A, so as to receive the stage-clamps. This instrument,

Fig. 100.

listed by the manufacturer as "mirror-condenser E," is centred and manipulated exactly as in figs. 97 and 98.

In figs. 100 and 101 we have a more developed form of type E, designed to satisfy the highest requirements. The lower glass plate is replaced by a metal plate Z, whose projecting ends serve for the stage-clamps. The obliquely ground plate A is pressed downwards by the fillets

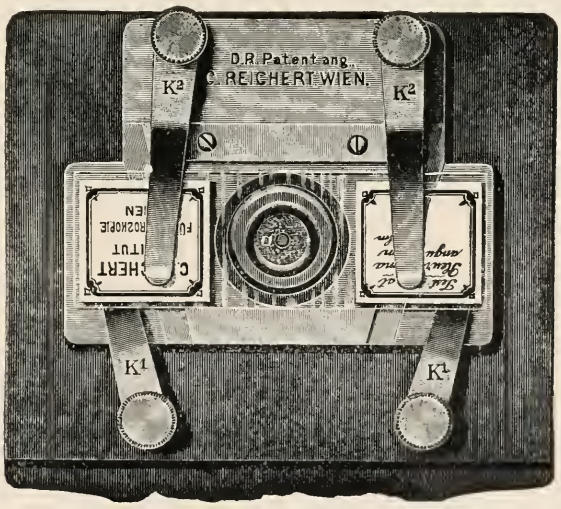

Fig. 101.

F. The plate D is perforated in the middle by an opening fitted in with a window, which can be easily screwed out. Plate A bears on its upper side two collars (fig. 101), which are intended to receive two smaller clamps, K_2, by which means the preparation can be fixed on the condenser. The advantage of this form, known as "mirror-condenser F," is that it can be taken to pieces for cleaning, and is better protected from injury by the metal mounting.

Ultramicroscopy and Dark-ground Illumination.* — The new catalogue of C. Zeiss not only gives a priced list of all the apparatus required for the above research, but also supplies a very full description of the methods of application, with a full bibliography. The subject is arranged into five parts: (1) General ultramicroscopic apparatus; (2) Ultramicroscopy for cells, fibres; (3) Ultramicroscopy for colloids; (4) Siedentopf's paraboloidal condenser; (5) Applying a stop to the immersion-condenser.

Kaiserling's Universal Projection Apparatus.† — This apparatus made by E. Leitz, of Wetzlar, has been already described in this Journal (1907, p. 627); but a new catalogue † explains in detail its application to various kinds of projection.

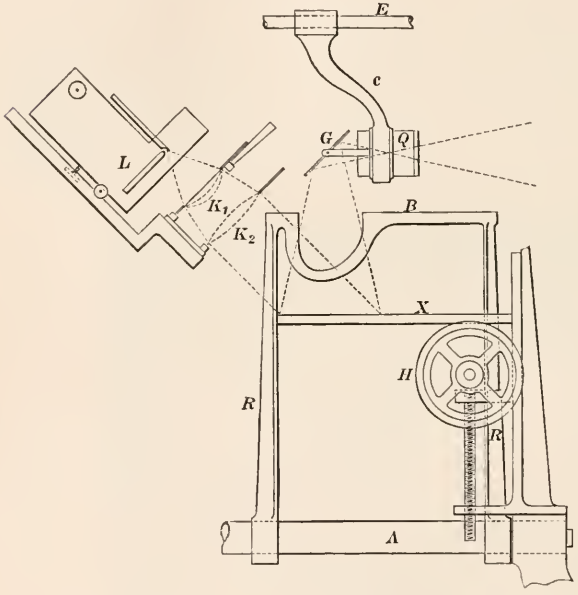

FIG. 102.

1. *Microscopic Projection.*—Before proceeding to direct projections with the Microscope it is necessary to turn aside lens Q of 400 mm. focus (fig. 102), which, together with the reversing mirror G, is hinged upon the upper steel tube E, after which the optical bench, together with its appurtenances, may be brought into the path of the light. The small optical bench B_1 (fig. 103), has three stands, which may be moved along the larger optical bench by a rack-and-pinion gear. The first stand, reckoned from lens K_3, is fitted with an iris-diaphragm, the second with

* Special Catalogue, C. Zeiss, Jena and London, etc. (English version), 1907. The various parts are numbered Mikr. 227–31.

† Universal Projection Apparatus. E. Leitz, London (Engish version), 1908.

a lens of 50 mm. diameter, and the third with a centring nosepiece for two objectives. One of the condensers is nothing more nor less than a microscope condenser of the usual type, whilst the other is a single lens. The judicious displacement of these stands furnishes the means of illuminating any of the microsummars of 24, 35, and 42 mm. focus, objectives Nos. 1–9 and oil-immersion lens $\frac{1}{12}$ in. Microsummars $f/4{\cdot}5$ are particularly adapted for low-power projection without an eye-piece.

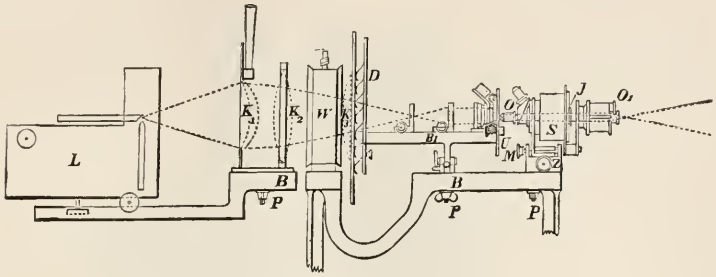

Fig. 103.

2. *Diascopic Projection.* — In this mode of projection the object-stage U (fig. 104) should be swung aside. Having displaced the objectives and eye-pieces, the lantern projection lens Q (e.g. aplanatic lens of 200 mm. focus) must be turned into the optic axis. The carrier itself remains in its original position, the objective of 200 mm. focus only requiring sharp focusing by means of the rack-and-pinion. The lantern slide-carrier (figs. 104 and 105) is arranged to take two slides at

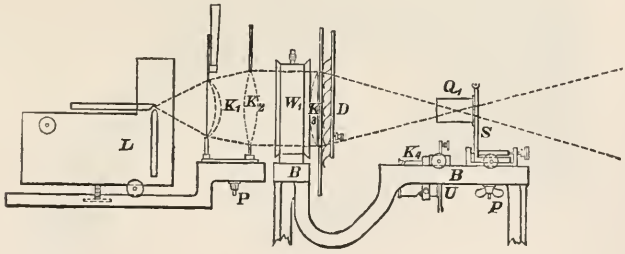

Fig. 104.

once, one above the other, the lower one being that which appears on the screen. The latter is removed in a downward direction, whilst the upper one glides into its place so as to be projected in turn. The succeeding lantern slide is introduced from above, and the process repeated as often as required. To facilitate the removal of the lower slide, the optical bench is provided with an arched gap, so as not to impede the motion of the hand, as may be seen from the figure. The holder of the lantern slides is adjustable in all directions, so as to render it available

for use with plates of various sizes, and the largest plate which it projects is 12 by 9 cm., casting an image 230 by 172 cm. (90 by 68 inches) on a screen at 4 metres distance with a lens of 200 mm. focus.

3. *Episcopic Projection* (*from above*).—For this purpose the optical bench with its fittings is swung aside, the stop-pin on the radial arm released, and the objective Q (figs. 102) of 400 mm. focused in the optic axis. The mirror G is then inclined at an angle of 45° to the axis

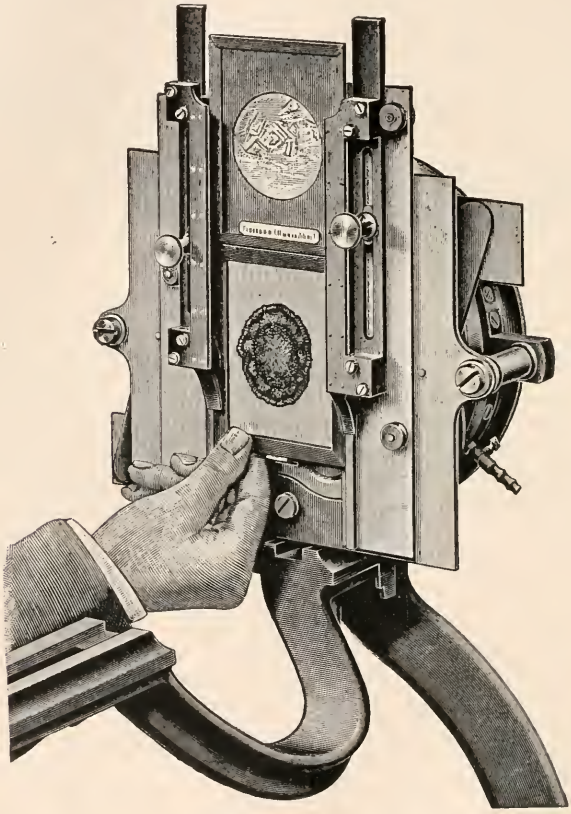

Fig. 105.

of the lens, this being greatly facilitated by the pressure of a spring catch. The lamp is tilted at 45° by the handle fitted at the back until the quadrant fixes its position. The mirror G, being silvered on its outer worked surface, should not be touched, and should not be cleaned otherwise than with a soft camel-hair brush ; after use the mirror should always be covered with its protecting cap. The illuminated area is of the form of an ellipse, measuring 28 by 20 cm. in the extreme case. By withdrawing the lamp from the lens the light may be concentrated

upon a smaller area. Fig. 102 shows diagrammatically the path of episcopically projected rays, and fig. 106 shows the optical bench as seen from the front when thrown out of action.

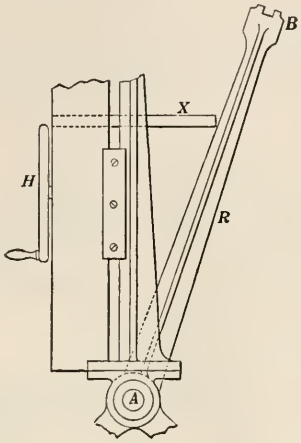

Fig. 106.

4. *Lateral Episcopic Projection.*—This mode of projection is principally resorted to in the case of those objects which must be maintained in a vertical position in a fluid medium, or which, owing to their size, cannot be accommodated upon the stage. If, for instance, it is required

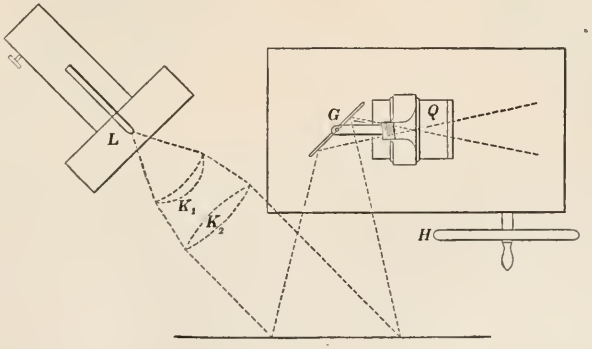

Fig. 107.

to project on the screen part of a living being, the subject is so placed at the side of the apparatus that the part in question may be illuminated by the lamp and completely reflected by the mirror. In this case the lamp is returned to its horizontal position and turned through 45° about

its vertical axis. The mirror G should be turned about the axis of the objective Q of 400 mm. focus. Fig. 107 represents this mode of projection, and shows the path of the rays.

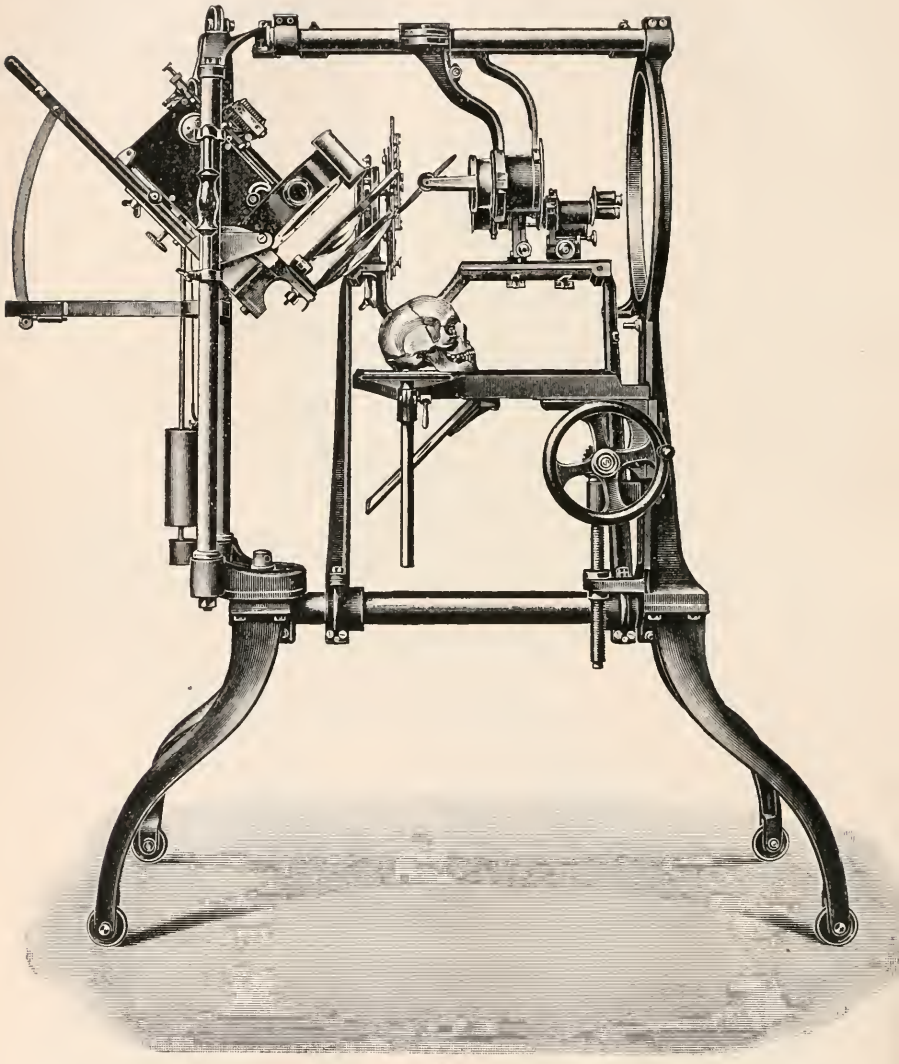

Fig. 108.

5. *Diascopic Projection* (*for horizontally-placed objects*).—Apart from its immediate purpose, that of projecting horizontal objects floating in liquid, the arrangement has the advantage that lantern slides or sections

up to 210 mm. in diameter may be projected by simply placing them on the condenser lens. The latter is let into the stage, and, when not required, is covered by a sliding shield. From fig. 109 it will be seen

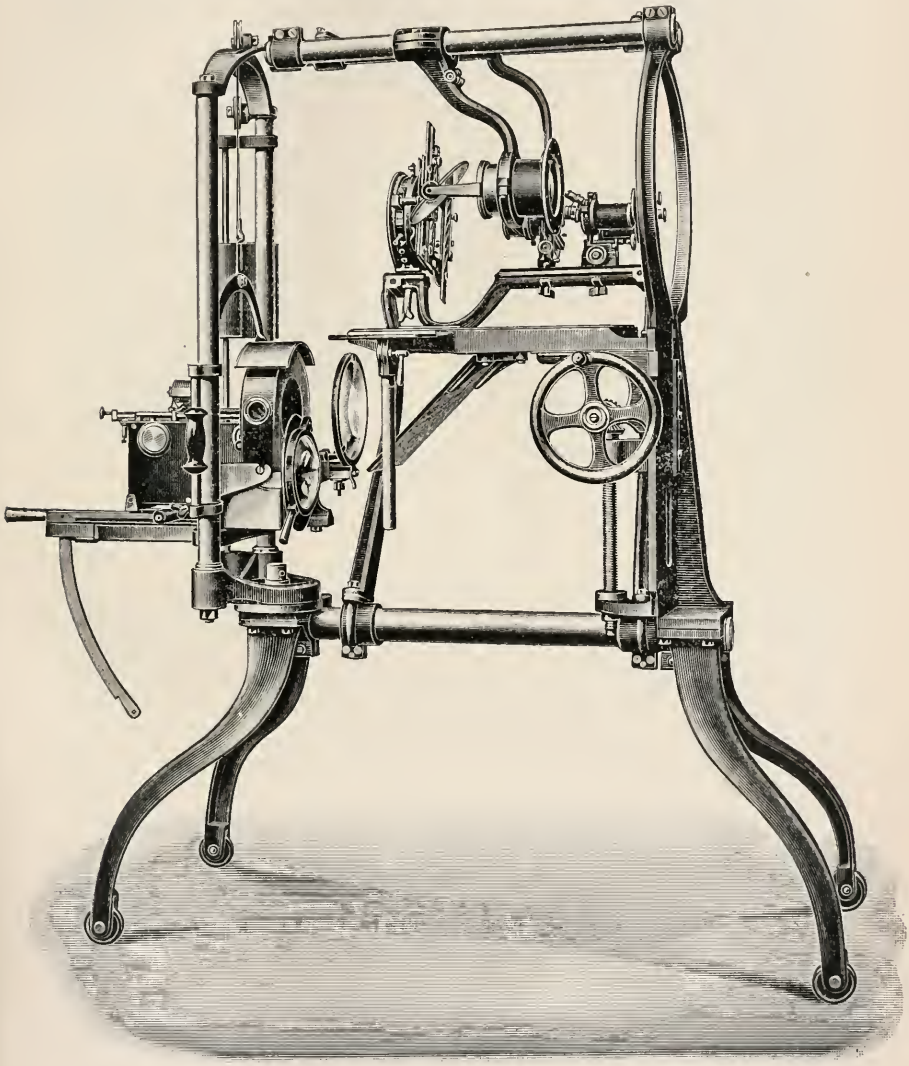

Fig. 109.

that the lamp is lowered for this mode of projection. To do so it is only necessary to loosen a clamping screw and to depress the handle provided at the side of the vertical steel tubes. The motion of the lamp

is facilitated by a counterpoise. After lowering the lamp lens K_1 should be thrown out of action, and the lamp placed at such a distance from lens K_2 that the pencil of rays emerging from the latter, after reflection at the inclined mirror placed below the stage, may entirely fill the lens let into the stage. The reversing mirror G sends the light through objective Q, whereby an image is formed on the screen.

LETTNER, G.—**Skioptikon Einführung in die projektionskunst.**
Leipzig (1907) 105 pp. (22 figs.).

(4) Photomicrography.

Reversible Photographic Proofs; Integral Photographs.*—Under the above titles G. Lippmann discusses the principles which must underlie the production on a single film of such an effect as would be equivalent to the actual view obtained of a landscape by an observer through a window, the film yielding the same varieties of effect as would be afforded by slight changes of position on the part of the observer. The author thinks that the practical difficulties to be overcome may not prove to be insurmountable. It is necessary to imagine a film as ordinarily used, formed of a transparent pellicule of celluloid or of collodion,

FIG. 110.

treated on one of its faces with an emulsion sensitive to light. Before spreading the emulsion on the pellicule, suppose that the latter has been pressed while hot in a kind of goffering machine, in such a manner as to produce on each of its faces a large number of small excrescences in the shape of spherical segments. Each of the excrescences with which the anterior face (this face will remain bare of emulsion) is intended to act as a convergent lens. Each of the excrescences of the posterior face is covered with a sensitive emulsion, and is intended to receive the image formed by one of the anterior lenses. Fig. 110 shows an enlarged section of a film thus constituted. In order that each image may be in focus, corresponding segments must have the same centre of curvature, and the ratio of a front ray to a back ray must be $n - 1$, where n is the index of refraction of the celluloid for rays photographically the most active. The system formed by any one whatever of the small front lenses, and by the portion of sensitive layer corresponding to it, forms a small camera like an eye, the lens being the cornea and the sensitive layer the retina. There is no crystalline, and none is required, for, in virtue of its small diameter, the tiny camera can remain sensibly in focus on every object, however slight its distance. If the term "cellule" be applied to each such elementary camera, it follows that the complete pellicule is a tissue of these cellules juxtaposed. If each cellule be a

* Comptes Rendus, cxlvi. (1908) pp. 446–51 (2 figs.).

simple eye, their combination recalls the compound eye of an insect. The first property of such a system is to give photographic images without its introduction into a camera. It suffices to present the system in full light before the objects to be represented. The use of a camera is unnecessary, because each cellule is itself a camera. The pellicule must, of course, be preserved in a light-tight box, and only exposed as required. The result is to give a series of small microscopic images fixed each on the retina of one of the cellules. Observed from the side of the sensitive layer, these images could not be distinguished with the naked eye, and they would give the impression of a uniform grey. On the other hand, suppose the eye placed on the anterior side, and the proof illuminated by transparency in diffused light, such as would be furnished by white paper applied to the pellicule ; the eye would then see, instead of the system of small images, *a single resultant image projected in space in actual size.* Moreover, this image will vary according to the position of the observer's eye. Such an image would be a negative, but the author suggests means for obtaining a positive.

With regard to the technical difficulties, the author points out that the necessary texture of surface must await the invention of a suitable moulding machine of high precision. But possibly collodion and celluloid could be abandoned in favour of other refrangible materials. Glass, for instance, would furnish the lens-spherules in unlimited quantities ; but there would still be the difficulty of sifting them out with precision and affixing them on a membrane of collodion, so as to obtain an exactly suitable thickness. If glass of index-refraction exactly equal to 2·0 could be obtained the difficulties would largely vanish, for a sphere of such a glass converges parallel rays on to its posterior surface. Such a sphere half-covered with a sensitive layer furnishes the simplest of cameras. Glass can be obtained with refractive index greater than 2·0, and also exceeding 1·9, but at present 2·0 is unattainable. The mixtures of silicates with molybdates and tungstates of lead, which might be expected to give the required result, seem always to crystallise out without formation of glass.

Perception of Relief and Depth in the Simple Image of Ordinary Photographic Proofs: Conditions and Theory of this Perception.* Lippmann's observations on integral photographs, noticed above, have suggested various considerations to A. Chauveau, which he has treated in a paper with the above title, and he adds that the scope of his article would be indicated by the addition of the following sub-title :—*The stereogenic property of retinal images, dissociated by cessation of the convergence of the two optical axes on the surface of a simple photographic proof. Exteriorisation of these two retinal images, with projection of their details on the respective planes which they occupy in the depth of the space photographed.* In the course of his treatment the author emphasizes the principle that binocular vision is not necessary to the appreciation of relief and of distances : it is capable only of improving this appreciation. Now photographic representation of a landscape is only an intermediate reception, a kind of relay between the eye and the landscape. The latter, in reality, is impressed in reduced

* Comptes Rendus, cxlvi. (1908) pp. 725-30.

form on the sensitive plate as it would have been on the retina of the eye had the eye been substituted for the photographic objective. The result is that vision instead of bearing directly on the landscape, is arrested on the proof representing it: it is an image, similarly reduced, of this first reduction which is impressed on the retinæ. Each of the latter acts separately and possesses the property of revealing in miniature the landscape photographed, as the real landscape when viewed directly is seen in its natural size. If a retinal image be reversed in direction it will reproduce the landscape in real size with its attributes of length, width, and depth; but if such an image exteriorise itself by means of a photographic proof, it will reproduce the landscape more or less reduced, as the three attributes will be in reality there, although the stereogenic property is for the time being suppressed. The author points out, as one of his illustrations, that single-eye observation of a perfectly illuminated ordinary photograph is seldom slow in detecting the details in the proof in their relief and depth. The dissociation of the two retinal images is then spontaneously accomplished; the two images, in fact, separately appear if one fugitively opens the second eye. Two-eye vision, really, brings the sensation of a plane image, and so long as single-eye observation is continued, the proof exhibits stereoscopic characteristics which persist if the primitive proof is replaced by a numerous series of others. If, instead of focusing one's optic axes directly on to a photographic proof, one makes them converge beyond it, the dissociation is again obtained and the landscape is seen double with all its reliefs and depths. If the focus is brought back on to the proof, the images fuse and the sense of relief disappears. The process which lends itself to the continuous and rapid repetition of these alternations must be the one to furnish the most complete information on the mechanism for the acquisition of the stereogenic property of retinal images furnished by moving photographs. Hence it may with confidence be declared that *this acquisition is the necessary consequence of the reversion and of the exteriorisation of these images, projected in a state of dissociation outside the eye.*

Additional Demonstration of the Mechanism of Monocular Stereoscopy.*—In this article A. Chauveau goes more fully into the theory of his subject, and describes several experiments. He concludes that the systematic use of dissociation prisms is to be recommended for the demonstration of the unity of the mechanism both of monocular stereoscopy and of binocular stereoscopy, both methods depending in the same manner on the phenomenon of reversion and of exteriorisation of retinal images. Even as regards the purely picturesque observation of stereoscopic photographs, this method is just as much to be recommended. With the two bare prisms in general use one obtains, in reality, besides the relief of the classic image of the ordinary stereoscope, that of the two components of this classic image. The simultaneous vision of these three images in a more or less marked relief, forms a picture so much the more interesting because the observer sees it in instantaneous self-constitution under his eyes, and because it explains

* Comptes Rendus, cxlvi. (1908) pp. 846–53 (1 fig.).

very clearly how the same apparatus, which creates the relief of retinal images by dissociating them, improves them by bringing these images into another combination.

François-Franck, Ch.-A.—**Note générale sur les prises de vues instantanées microphotographiques (plaque fixe à pellicule) avec l'arc voltaïque.** *C.R. Soc. Biol. Paris*, lxii. (1907) p. 657.

Neuhauss, R.—**Lehrbuch der Microphotographie.** Leipzig (S. Hirzel) 1907, xvi. and 273 pp. (3 pls., 63 figs.).

Pinoy, E.—**Nouvel appareil de microphotographie : possibilité d'obtenir même à de forts grossissements, une image donnant l'idée de la structure d'objet présentant une certaine épaisseur.** *C.R. Soc. Biol. Paris*, lxi. (1906) pp. 552-4 (1 fig.).

Siede, W.—**Über einen einfachen Mikrophotographischen Apparat.** *Zeitschr. f. angew. Mikrosk.*, xiii. (1907) p. 62.

Swingle, W. T., & L. T. Briggs—**Improvements in the Ultraviolet Microscope.** *Science*, n.s. xxvi. (1907) p. 180.

(5) Microscopical Optics and Manipulation.

Application of the Ultramicroscope (after Siedentopf) and of the Microspectral Photometer (after Engelmann) to the Textile and Dyeing Industries.—N. Gaidukov has investigated the above subject in regard to a great variety of materials, and states his conclusions as follows :—

1. By means of Siedentopf's ultramicroscope it is possible to test the qualities of woven threads, and to detect the sources of these qualities.

2. By means of Engelmann's spectral-photometer it is possible to examine the smallest particle of dye-stuff ; to arrive at a chromatic analysis (qualitative and quantitative) of individual threads ; to compare the colour peculiarities of the dye and of the threads dyed with it ; to observe the spectra of several adjacent threads ; and to compare with one another the intensities of the tint of several threads of the same material.

The author does not regard his results as exhaustive, but rather as suggestive of a very promising field for exploration.

Heimstädt, O.—**Spiegelkondensor für ultramikroskopische Beobachtungen.** *Zeitschr. f. Chemie u. Industrie d. Kolloïde*, i (1907) heft 9.

Clerici, E.—**Sulla determinazione dell'indice di refrazione al microscopio.** *Atti della R. Accad. dei Lincei*, xvi. (1907) p. 336.

Fauré-Frémiet, E.—**Sur l'étude ultramicroscopique de quelques protozoaires.** *C.R. Soc. Biol. Paris*, lxiv. (1908) pp. 582-4.

Gatin-Gruzewska, Z., A. Mayer, & G. Schaeffer—**Sur la structure ultramicroscopique des empois d'Amidon et de leurs constinants.** *Tom. cit.*, pp. 599-601.

Siede, W.—**Ein neuer Apparat zur Sichtbarmachung ultramikroskopischen Teilchen.** *Zeitschr. f. angew. Mikrosk.*, xiii. (1907) p. 79.

Schuster, A.—**Einführung in die Theoretische Optik Autorisierte, deutsche Ausgabe, übersetzt von H. Konan.** Leipzig und Berlin (B. G. Teubner) 1907, xiv. and 413 pp. (2 pls. and 185 figs.)

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* Zeit. f. Ang. Chemie und Zentralbl. f. Technische Chemie, xxi. (1908) p. 393 et seq. (1 pl. and 1 fig.).

(6) Miscellaneous.

Flagellum of the Tubercle Bacillus.*—A. A. C. E. Merlin confirms the observation of E. M. Nelson † that tubercle bacilli are possessed of flagella. He states that many flagellated specimens will be found in any ordinary well-stained sputum slide, and even a good $\frac{1}{4}$ or $\frac{1}{6}$ in. dry-objective, used critically with a large axial illuminating cone, should prove quite sufficient if an oil-immersion lens is not available.

Quekett Microscopical Club.—The 447th Ordinary Meeting was held on March 20, 1908, the President, Prof. E. A. Minchin, M.A., F.Z.S., in the chair. Mr. A. E. Hilton read a paper on "The Cause of reversing currents in Plasmodia of Mycetozoa." After describing the observed phenomena at some length, the author concluded that streaming of the interior plasm is controlled by the drier aggregations of plasm in contact with the atmosphere, and that these controlling centres affect the fluid plasm by an alternating force of pressure and suction. He suggests that the visible pulsations are indications of a respiratory function inherent in the whole mass of the plasmodium. Mr. C. D. Soar, F.R.M.S., read a paper on the genus *Hydrachna*. The term *Hydrachna* was first used by Müller in 1776. Of the 21 species now described, 4 were new, and 3 others first time of recording in Britain.

At the 448th Ordinary Meeting held on May 15, the President in the chair, Mr. C. Lees Curties, F.R.M.S., exhibited and described the simple form of apertometer devised by Mr. F. J. Cheshire, F.R.M.S., and an improved mercury-vapour lamp for use in microscopy. Mr. R. T. Lewis, F.R.M.S., exhibited some preparations of especially brilliantly coloured insects, and the President exhibited a preparation demonstrating the existence of an organic axial filament in the spicules of calcareous sponges. The spicule had been decalcified and the filament (and outer sheath) stained with picric (or nitric) acid and nigrosine. Mr. F. Martin-Duncan, F.R.P.S., delivered a lecture, illustrated with lantern photographs, dealing with points of interest in insect life and development.

Koch, L., & E. Gilg—**Pharmakognostisches Praktikum. Eine Anleitung zur mikroskop. Untersuchung von Drogen u. Drogenpulvern zum Gebrauche in prakt. Kursen der Hochschulen.**
Berlin: Gebr. Bornträger, 1907, viii. and 272 pp. (140 figs.).

B. Technique.*

(3) Cutting, including Imbedding and Microtomes.

Henneberg's Microtome Auxiliaries.*—The Leitz firm have made for the designer, Prof. Henneberg, an addition to their chain microtome. This addition the author finds of great service in cutting longer bands

* English Mechanic, lxxxvii. (1908) p. 112.

† See this Journal, 1905, pp. 412–13.

‡ 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.

§ Zeitschr. wiss. Mikr., xxiv. (1907) pp. 274–7 (2 figs.).

of serial sections as they are automatically carried along, unfolded, and delivered without hanging down from the back of the knife. A band-gear (fig. 111) is secured to the knife and consists of an endless band running on two rollers, which are set crosswise through the two ends of a tube. In order that the band may always be kept taut, the tube is

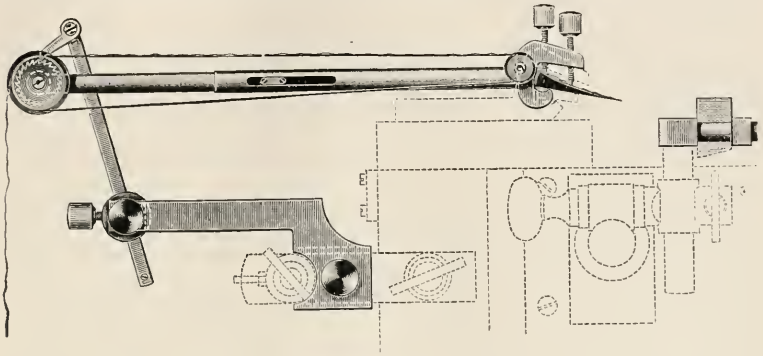

Fig. 111.

formed of two pieces fitting into one another and pressed outwards by a spiral spring lying in the interior of the tube, the tube being carried by a clamp fastened by two pressure screws on the knife-back. These

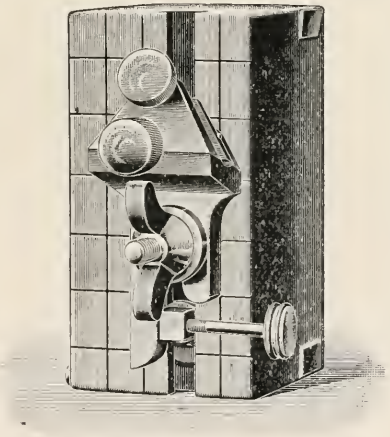

Fig. 112.

screws are set behind one another, not sidewise, so that it is possible to arrange the band horizontally or oblique. The roller is thus close behind the knife-back. In the axis of the other roller there is a toothed-wheel. An angle-piece carrying a clutch is fastened on to the arm which bears the chain-wheel. This clutch projects from the end of a staff which is adjustable in its length, and at its place of attachment is

rotatory about the angle-piece. The clutch when set engages downwards in the toothed-wheel of the rear roller. When the apparatus is in action the band in the case of every section travels just as much forwards as the movement in length of a section of the object under treatment. As soon as the serial sections have commenced formation their free ends are placed by a paint-brush on the band and then left: while the cutting is continued the sections unfold and arrange themselves ribbon-like on the band till they have reached the free end, where they are removed in their entirety. The movement of the knife-block insures the automatic action of the band-gear. The teeth of the wheel are so cut that the clutch slides downwards over them in the back stroke, and engages in them in the forward stroke.

Some preliminary trials will be necessary to get the exact position of the clutch staff suitable for the section-length, so that the sections may form a perfect ribbon. In order to facilitate this operation the author has designed a special knife adjustment (fig. 112), consisting of a modified knife-clamp and a small block with position screw. A perforated circular disk around which the required movement is to take place is applied to and fixed upon the screw-holder. The shanks of the knife bear corresponding notches in which the disk engages. The small block with the position-screw is set in the groove of the knife-block, and a slight rotation of the position-screw gives the required inclination to the knife.

Method of Orientating Small Objects for Examination.*—W. F. Cooper and L. E. Robinson contribute a short note on a

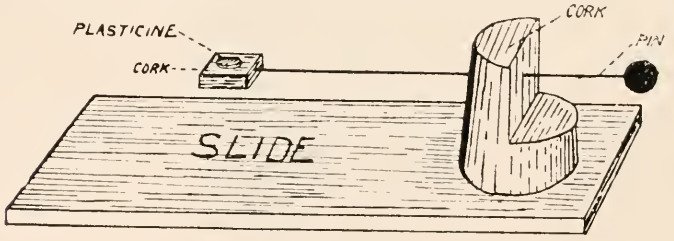

Fig. 113.

method they have found useful in their work on Ixodidea. The method is an improvement on those generally used for the examination of ticks. The authors give the following account of their procedure.

"In the examination of the appendages and small portions of Arthropods, considerable difficulty is often experienced in fixing them temporarily in a suitable position for observation. This can be overcome by the use of a preparation universally known as 'Plasticine.'

"A small bead of it is placed on a slide and slightly flattened: the object is then placed upon it, moved into a suitable position, and slightly pressed into the plasticine.

"We have devised a simple piece of apparatus by means of which the object may be rotated in one plane (fig. 113). A cork is cemented

* Original communication.

to one end of an ordinary micro-slide by sealing-wax; a glass-headed pin, about 2 in. long, is inserted through the upper end of the cork, in the direction of the long axis of the slide; on the point of this pin is placed a small rectangular piece of cork which carries the plasticine. By revolving the pin, the object can be rotated and observed through an angle of 180°."

(4) Staining and Injecting.

ARNOLD, J.—**Supravitale Färbung Mitochondrien ähnlicher Granula in den knorpelzellen nebst Bemerkungen über die Morphologie des Knorpelglykogens.** *Anat. Anzeig.*, xxxii. (1908) pp. 361–6.

BETHE, A.—**Ist die primäre Färbbarkeit der Nervenfasern durch die Amvesenheit einer besenderen substanz bedingt.** *Tom. cit.*, pp. 337–45 (1 pl.).

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

Preserving the Colour of Anatomical Specimens.*—G. Fornario finds that the following method is superior to that of Kaiserling for retaining the colour of museum specimens. The fresh specimens, which may or not be washed in physiological salt solution, are immersed in a 4 p.c. solution of commercial formalin for 48 hours, after which they are transferred to 90 p.c. alcohol for not more than 24 hours. The specimen is then placed in fresh 90 p.c. alcohol, and to this is added, drop by drop, a variable quantity of the following solution : saturated solution of picric acid 100 c.cm., glacial acetic acid 4 c.cm. The initial colour should reappear in the course of a few minutes.

The quantity of the picric acid solution varies according to the size of the piece; it does not exceed 10 c.cm. per litre. In this solution the pieces may remain indefinitely, but a few days suffice. They are then transferred to 90 p.c. alcohol, in which they are permanently preserved. For large pieces it is useful to add a very small quantity of hæmoglobin to the picric acid solution.

(6) Miscellaneous.

Improved Form of Celloidin Capsule.†—W. H. Harvey employs the following method for making celloidin capsules. The cover and body of a gelatin capsule are separated, and through the bottom of the latter a hole is made to admit a piece of glass tubing of 4–6 mm. external diameter. The capsule being closed again, the glass tube is warmed and passed through the hole until it touches the cover, to the inside of which it will adhere. The capsule and about 3 cm. of the glass tube are now dipped into a specimen tube of melted paraffin; on withdrawing, the tube is rotated to enable the paraffin to cool in an even layer. The capsule and tube are now dipped twice into a specimen tube containing a 3 p.c. solution of celloidin, and then three or four times into a 9 p.c. solution of celloidin. When the last layer has set, the structure is placed in a test-tube containing chloroform which hardens the celloidin and dissolves the paraffin, leaving the gelatin capsule free in a shell of celloidin. The whole is then placed in a bath of spirit for a few minutes, and then into a beaker of water. The glass tube may now be

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 543-4.
† Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 285.

readily withdrawn, and the gelatin capsule is removed by means of a wire hook, a transparent celloidin capsule being left. This is then sterilised and filled or inoculated, and then closed by passing a small plug of aseptic wool down the neck of the capsule, and capped with a drop of paraffin. The author claims that these capsules have strength, maximum of dialysing surface, no limit to capacity, and other obvious advantages.

Method for Photographing Superficial Bacterial Colonies.* — L. de Jager employs the following method for photographing certain transparent superficial bacterial colonies. On to the surface of the gelatin or agar-plate culture is pasted a piece of smooth, thin gummed paper; when this is removed again, after the manner of preparing a hektographic copy, the whole of the surface colony adheres to it; the paper is then dried and flamed like a coverslip, until it assumes a yellow colour: it is then covered with a concentrated solution of toluidin-blue, a piece of blotting-paper being placed under it to prevent the under surface from being stained; the colonies stain dark blue, and paper faint blue; after a few minutes the stain is removed by repeated washings in water; the paper is then soaked in oil, which renders it quite transparent, and it can then be used as a photographic negative. When printing, in order to protect the celloidin paper from the oil, it is well to interpose a layer of collodium between the two papers.

Red Blood Cells in Malaria.†—S. Sereni has subjected the blood of malarial patients to the centrifuge, and also to spontaneous sedimentation, and found that the red cells containing parasites preponderated only in the outermost zone of the centrifuged blood or in the lowest layers of the sedimented blood, and this was irrespective of the period or stage of the parasite, with the exception of the half-moon forms which were found in the zone between the globular sediment and the blood serum. The author concludes that the presence of a malarial parasite increases the specific gravity of the blood corpuscles, and that the crescent forms diminish their specific gravity. The author considers that to this increase of specific gravity, and consequent diminution of elasticity, and also to the increase of superficial viscosity, may be referred the fact that the parasite-holding red cells are fewer in the circulation, and in fresh blood are less readily distinguished than normal cells, and may also account for the accumulation of red cells containing developing or spore-forming parasites in the capillary network of various organs, and especially in the brain.

Moysey, L.—**Method of Splitting Ironstone Nodules by means of an Artificial Freezing Mixture.**

[Method of freeing fossils without damage; though not strictly microscopical, the method is indirectly useful if slices or sections of a fossil be required.] *Geological Mag.*, v. (1908) pp. 220–2.

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* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 92.

† Op. cit. 1te Abt. Ref., xl. (1908) p. 850.

Metallography, etc.

Importance of Centring in Microscopic Metallography.* — L. Guillet describes a stage fitting designed by Le Grix for the purpose of bringing the same field into view in successive examinations of a section. The edge of the section is grooved at one point. Two small angle-blocks are fixed at right angles to each other on a brass plate fitting on the stage. The section is placed so that one angle-block fits into the groove, while another point of the edge of the section is in contact with the other block. The author describes a number of examples of photographs of the same field after successive etchings, in sections of steel, cast iron, brass, etc.

Constituents of Quenched Steels.† — P. Breuil reports upon the research undertaken by him as the outcome of the formation of the International Committee for Investigating the Constituents of Steel.‡ This committee has apparently ceased to exist; no authoritative report seems to have been issued. The publication of Breuil's work has been long delayed through the opposition of H. le Chatelier and L. Guillet, who do not appear to have been satisfied with the methods adopted and the experimental programme followed. The author examined, microscopically and mechanically, six steels (carbon 0·38, 0·70, 0·85, 1·20, 1·40, 1·80 p.c.), and some cast-irons and cemented steels. Samples (three different sizes) of each were quenched from 650°, 750°, 850°, 1050°, and 1200° C., and were examined as quenched, and also after re-heating to 225°, 355°, and 455° C. The temperatures were taken by a thermocouple, in conjunction with a Callendar recorder arranged as a potentiometer. Considerable decarburisation occurred in heating, so that the true structures were only obtained in the central portions of the larger pieces. The author gives numerous details of methods of polishing, etching, and preparation of polishing powders. Powdered talc was employed for polishing, and Kourbatoff's reagents were used. The most remarkable conclusions reached by the author relate to the constitution of troostite, which is held to be finely divided graphitic carbon resulting from the decomposition of cementite before passing into solution in the iron. Cementite A is the cementite of pearlite, while cementite B is massive. Sorbite is a pearlite of fine emulsified granules of cementite. Martensite is a complete but unsaturated solution of cementite A in ferrite. Hardenite is a saturated martensite. Austenite is hardenite, in which is dissolved cementite B. Osmondite is an incipient solution of the granules of sorbite, which are surrounded by troostite. The changes which occur when an annealed steel is heated are as follows:—Towards 700° C. the sorbite or pearlite granulates and the granules enlarge, then begin to dissolve in the ferrite, apparently with some difficulty, for the larger grains, more slow to dissolve, give off carbon by dissociation. It is

* Rev. de Métallurgie, iv. (1907) pp. 1027–36 (33 figs.).

† Bull. Soc. Industrie Minérale, ser. 4, vi. (1907) pp. 553–683 (18 figs. and 333 photomicrographs). See also Metallurgie, v. (1908) pp. 59–60, 96–9, 105–14 (335 figs.).

‡ See this Journal, 1905, p. 534.

this carbon which the author terms troostite. The constituent containing this separated carbon is osmondite. All the carbide of pearlite or sorbite is dissolved at 850° C.; carbide B begins to dissolve at higher temperatures. The effect of reheating on quenched steels is destruction of unstable equilibrium, resulting in the formation of sorbite.

Thermomagnetic Analysis of Meteoric and Artificial Nickel-iron Alloys.*—S. W. J. Smith has determined the magnetic permeability of a sample cut from the Sacramento meteorite (7–8 p.c. nickel) and of an artificial nickel-iron alloy (5·8 p.c. nickel) at temperatures between 0° and 850° C., under varying conditions of heating and cooling. The meteorite consisted of kamacite, through which passed thin layers of taenite. Taenite is assumed to be a eutectic, with about 27 p.c. nickel, of (1) mixed crystals containing about 7 p.c. nickel (kamacite), and (2) mixed crystals of much higher nickel content, probably not less than 37 p.c. The temperature-concentration diagram, representing the magnetic changes in the nickel-iron system, is held to be the equilibrium diagram showing the crystallisation of these two series of mixed crystals from a homogeneous solid solution. From his results the author deduces a theory explanatory of the irreversibility of nickel-iron alloys. Irreversibility is held to be due to supersaturation. As the homogeneous solid solution is cooled, a point is reached at which it is saturated, and if nuclei of the mixed crystals which should separate were present, separation would commence. But the solution remains supersaturated (metastable) through a temperature interval. A lower point is then reached, at which the labile succeeds the metastable state. Crystallisation then necessarily begins.

Alloys of Gold and Tellurium.†—T. K. Rose has determined the equilibrium diagram. One compound, $AuTe_2$ or Au_2Te_4 (melting point 452° C.), and two eutectics, with 20 and 60 p.c. gold respectively, occur.

Platinum-thallium Alloy.‡—Thermal, microscopic, and chemical investigations of the alloys produced by dissolving platinum in molten thallium, lead L. Hackspill to assert the existence of the compound PtTl, the properties of which are described. It melts at 685° C., and is analogous to PtPb.

Austenite.§—Owing to the failure of numerous attempts to produce austenite in pure iron-carbon alloys, E. Maurer tried to obtain this constituent in three steels of the following composition :—

	1	2	3
Nickel	3·73 p.c.	..	..
Manganese	..	1·83 p.c.	2·20 p.c.
Carbon	1·21 „	1·18 „	1·94 „
Silicon	0·28 „	0·88 „	0·94 „

Martensite was obtained in Nos. 1 and 2 by heating at 1050° C. for 15 minutes, and quenching in ice water, while No. 3 yielded pure

* Phil. Trans. Roy. Soc., Series A, ceviii. (1908) pp. 21–109 (31 figs.).

† Journ. Soc. Chem. Ind., xxvii. (1908) p. 229. See also Bull. Inst. Min. and Metallurgy, 1908.

‡ Comptes Rendus, cxlvi. (1908) pp. 820–2.

§ Tom. cit., pp. 822–6.

austenite. This austenite showed distinct twinning. The steel in this state was not magnetic, was not very hard, but could be considerably hardened by mechanical distortion, by re-heating to 400° C., or by immersion in liquid air, all these treatments converting austenite into martensite.

H. le Chatelier points out the importance of Maurer's production of homogeneous austenite. While two well-known alloys of iron, containing respectively 13 p.c. manganese and 25 p.c. nickel are undoubtedly austenitic, it did not seem possible to produce austenite with certainty in steels containing small amounts of these metals.

Application of Colour Photography in Metallography.* — For developing the structure of metal sections, methods by which the constituents are differently coloured are in many respects superior to etching methods, which merely bring out the constituents in relief. P. Goerens regrets that heat-tinting is so little used, and describes the production on Lumière plates of photomicrographs in colour. The coloured photomicrographs of a heat-tinted iron-phosphorus alloy (1·5 p.c. phosphorus), given by the author as reproductions of Lumière photographs in colour, clearly show the variation in concentration of the solid solution. It is advantageous to have the section as richly coloured as possible ; a yellow screen is placed at the diaphragm of the photomicrographic apparatus. The theory of the process, and full directions for working it, are given.

BAYKOFF—**Crystallisation and Structure of Steel.**
Rev. de Métallurgie, v. (1908) pp. 177–81 (7 figs.)

BORNEMANN, K.—**Constitution of Nickel Ore.**
[A determination of the equilibrium diagrams of the systems $FeS-Ni_3S_2$ and $FeS-Ni_2S$.] *Metallurgie*, v. (1908) pp. 61–8 (22 figs.).

CROWTHER, J. A.—**Fatigue of Metals subjected to Radium Rays.**
Proc. Camb. Phil. Soc., xiv. (1908) pp. 340–50 (3 figs.).

GAHL, W.—**Graphite Separation in Iron-carbon Alloys.**
[A theoretical discussion of the results obtained by Heyn, Goerens, Benedicks, Osann, etc.]
Stahl und Eisen, xxviii. (1908) pp. 225–9 (5 figs.).

PORTEVIN, A.—**Alloys of Gold.**
[The second article of the series. See above, Portevin, "Alloys of Silver."]
Rev. de Métallurgie, v. (1908) pp. 182–204 (31 figs.).

REVILLON, L.—**Special Steels at the Automobile Salon.**
Tom. cit., pp. 53–68.

ROWLAND, W. S.—**Electrolytic Corrosion of Copper-aluminium Alloys.**
Journ. Phys. Chem., xii. (1908) pp. 180–206 (8 figs.).

STOUGHTON, B.—**Micro-constituents of Cast Iron.**
Foundry, xxxii. (1908) p. 41.

WATTS, O. P.—**Metals in the Order of their Boiling-points.**
Trans. Amer. Electrochem. Soc., xii. (1907) pp. 141–54.

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* Metallurgie, v. (1908) pp. 19–23 (5 figs.).

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

"Waterhouse" Museum Microscope.—This Microscope (fig. 121) is designed for the display of one dozen microscopic objects, in a museum or exhibition, where it is required to leave the instrument unattended and at the same time to prevent breakage or injury to Microscope or objects. The instrument here illustrated is an improved

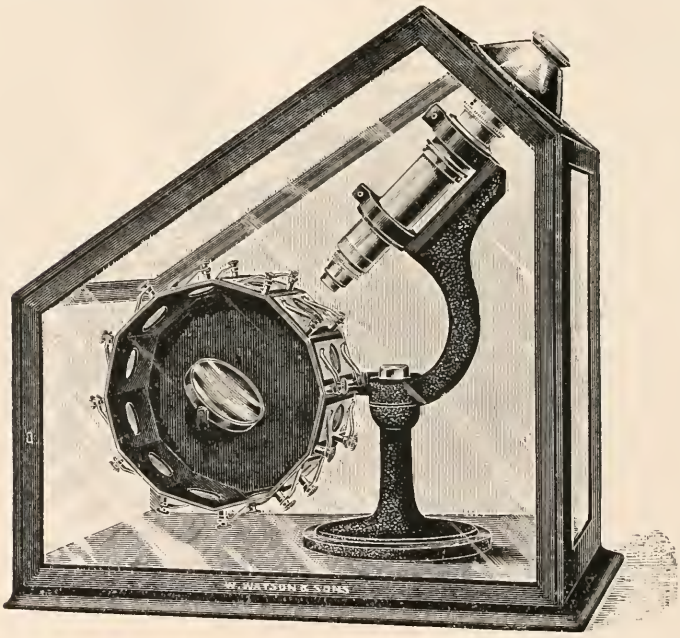

Fig. 121.

form of previous patterns. It consists of a dust-proof ebonised mahogany-framed glass case, in which the Microscope is fitted. The objects, twelve in number, mounted on the standard size of slips, 3 by 1 in., are placed upon a revolving brass drum of very solid construction. The surfaces on which the objects rest are machine-planed, thereby insuring proper focus being maintained when objects are changed. The drum is rotated by means of a milled head from outside the case, and fine focusing is effected by moving the projecting eye-piece

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

end in a spiral manner. A spring catch indicates when the object is exactly in line of vision. The body of the instrument is fixed at an angle of 45° approximately, this being found the most convenient position for ordinary observation. Illumination is obtained from an adjustable plano-concave mirror mounted in the interior of drum. All parts projecting outside the case are securely protected from injury, and the door is fitted with lever lock. The most suitable powers to use with the instrument are from 2–$\frac{1}{4}$ in. The instrument is made by Messrs. Watson and Sons.

Konkoly's Large Measuring Microscope.*—This apparatus (fig. 122) is made by Messrs. Otto Toepfer und Sohn, of Potsdam, and is listed

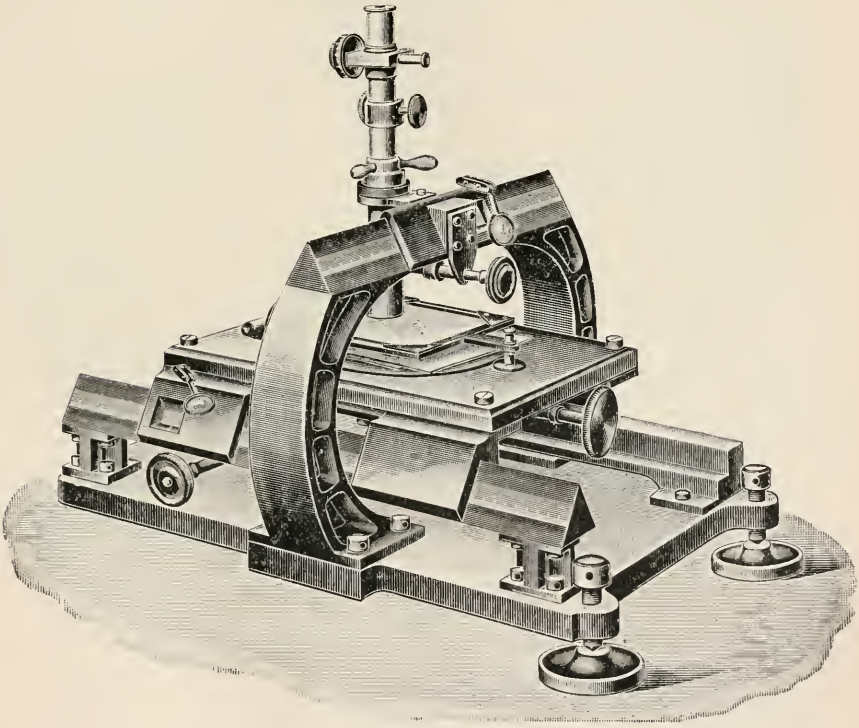

Fig. 122.

No. 8*b* in their catalogue. The instrument is specially intended for the measurement of sunspots, but is equally well adapted for other purposes. It is built up on a heavy cast-iron base plate, moving on three foot-screws. The upper surface of this base plate is planed, the lower strongly ribbed ; the centre part is perforated for the admission of light on to the plate to be measured. In the front of the base plate there is a prism

* Otto Toepfer und Sohn's Catalogue (Neue Astrophysikalische Apparate, 1908), Potsdam.

bar supported on two feet, and graduated into millimetres; at the back of the base plate there is a sill plate planed on top and parallel to the prism bar. The plate-stage (or object-stage) is carried on two bearers moving on the prism bars and supported by rollers, the bearers being actuated by rack-and-pinion. The base-plate also carries an arched support at right angles to the stage movement; the summit of this arch is another prism bar, and carries the Microscope on bearers actuated by rack-and-pinion. The Microscope movement is naturally at right angles to the stage movement. The upper prism-bar is graduated into millimetres, but both prisms can be more finely graduated if desired. A position circle on the stage is intended to receive photographic plates up to 16 by 16 cm., and is connected with a circular rackwork under this stage controlled from the right-hand end of the stage. A frame, clearly shown in the illustration, covers the object placed on the position-circle, and contains a grating divided into intervals of 2 by 2 mm. This frame moves on a hinge (seen to the left), and is kept tight, when shut up, by a screw. The Microscope magnifies ten times, and can be rotated in a long groove 90° about its optic axis; it can be clamped firmly on an adjustable peg, so that the micrometer screw of the Microscope is parallel to one or another of the lines of the grating-system. The Microscope measurement is, therefore, merely applied from line to line of the glass plate (at most 2–2 lines). The divisions on both prisms correspond to the glass net, and should be parallel with them; therefore, the divisions on the prisms should coincide with the net-lines, and this is easily regulated by the index. The index on the prism graduations, as well as on the position circle, is easily read by means of large loups of convenient size. This apparatus has been in use for four years at the Prussian Royal Astrophysical Observatory, and has given satisfactory results.

Vogel-Hale Measuring Microscope (Model C).*—This instrument is listed No. 8*c* in the maker's catalogue, and is shown in fig. 123. It is mainly intended for the measurement of solar spectra. The strong iron stand on which it is mounted can be inclined at any angle between 0° and 60° at the observer's pleasure. The iron frame forming the measuring stage slides between two steel runners, and is covered with a glass plate for the reception of the object, which is secured by pressure springs of adjustable length. The measuring screw is very carefully constructed, and has an available length of 150 mm.; one rotation of the thread gives an axial movement of 0·5 mm., and imparts a corresponding movement to the measuring stage by means of a steel nut beneath it. A counterweight is applied to the screw so as to avoid deadway. Two drums, with common index, are fitted near the screw-head, and give the readings: one of these drums records the rotations of the screw, and the other the rotations of the first drum. The first drum is divided into hundredths, and tenths of these can safely be estimated, so that a reading of 0·0005 mm. can be obtained; a scale divided into millimetres shows the movement of the stage in that unit. The illu-

* Otto Toepfer und Sohn's Catalogue (Neue Astrophisikalische Apparate, 1908), Potsdam.

mination of the object is attained by a rotatory long mirror placed underneath the stage. The Microscope is on a rail parallel to the measuring screw, and is adjustable by hand-movement, by which means the arrangement of long objects—e.g. spectra—is much facilitated. The Microscope is equipped with one ocular and three objectives, giving about 4–100 diameters; focusing is by rack-and-pinion. The ocular has strong threads, and can be rotated through 90°.

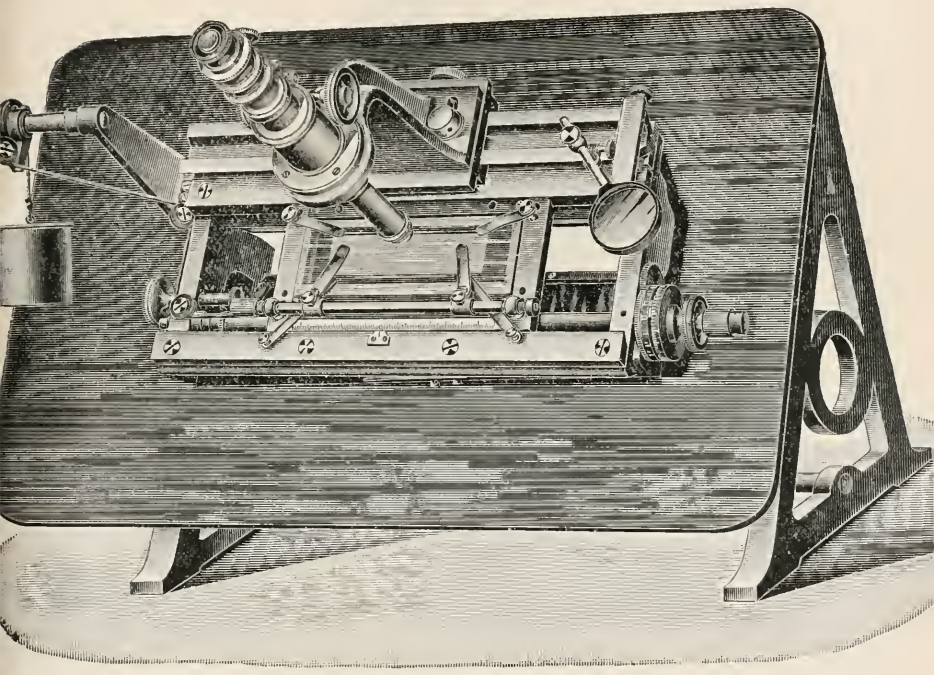

Fig. 123.

Vogel's Measuring Microscope (Model I.).*—This apparatus of Otto Toepfer und Sohn (No. 9 in their catalogue) serves for almost the same purpose as model C, but the Microscope is intended to be used in a constant position. For this purpose the Microscope is movable by hand on a slide, and is provided with a prism in order to be convenient for the observer. The illumination of the measuring screw, its gradation, and the optical equipment, are the same as in the similar parts of the measuring stage of model C. As will be plainly seen from the illustration (fig. 124), the apparatus may be accompanied with an etching installation which can be adjusted and clamped on the slide of the Microscope. This auxiliary gives a means of engraving fine divisions on

* Otto Toepfer und Sohn's Catalogue (Neue Astrophysikalische Apparate. 1908), Potsdam.

metal, glass, etc., and they can be arranged either obliquely or perpendicularly to the direction of the stage motion.

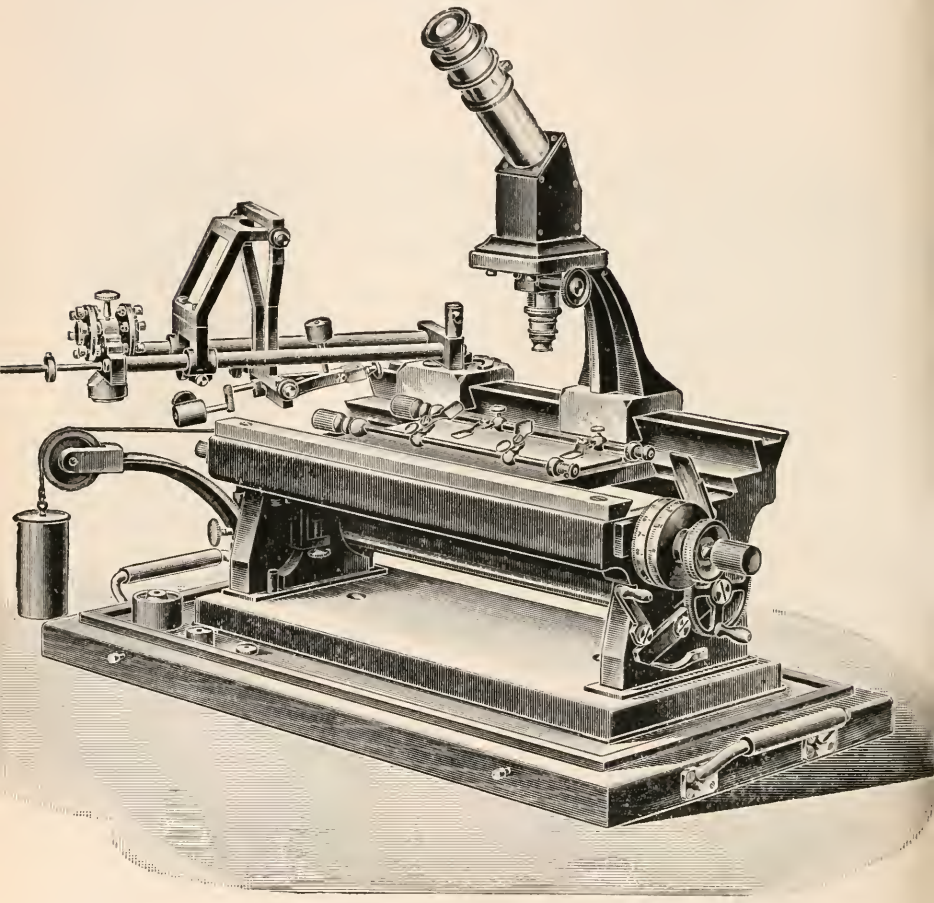

Fig. 124.

Vogel-Wanach Large Measuring Microscope (Model II.).*—This apparatus (fig. 125), 9*a* in the maker's catalogue, is specially constructed for the measurement of star spectra. It is mounted on a strong tripod with a hinged pillar, so that any desired inclination between 0° and 90° can be arranged. Microscope and measuring stage are arranged on a specially stiffened carrier, and an inclosed glass plate forms the object-bearer. A circular mirror with universal movement is set below the stage and illuminates the object. The measuring screw has an available

* Otto Toepfer und Sohn's Catalogue (Neue Astrophysikalische Apparate, 1908), Potsdam.

length of 50 mm. and a pitch of 0·5 mm. Certainty of screw action is attained by a counterweight, and the reading (0·0005 mm.) is given by a loup or two drums with common index, as in model C; there is also a scale for reading the millimetres. The Microscope is in a slide, and is

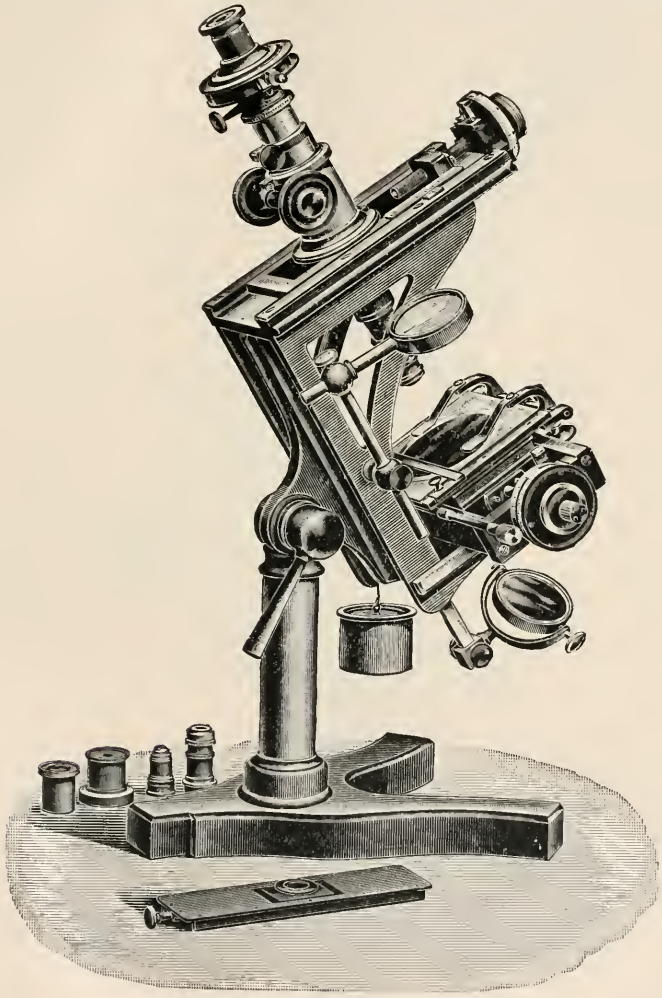

Fig. 125.

adjustable perpendicularly to the direction of measurement; it is operated by a screw of 50 mm. available length and 1 mm. pitch, which can therefore be used as a measuring screw. The corresponding drum is divided into hundredths, and by estimation of tenths readings can be taken to 0·001 mm. A laterally applied millimetre scale counts the whole rotations of the screw. The Microscope is equipped with a

Huyghen's ocular with variable thread distances; the field can be variously stopped off (as in model A). There are three objectives, giving about 10–100 diameters. Focusing is by rack-and-pinion, and the ocular is rotatory through 90°.

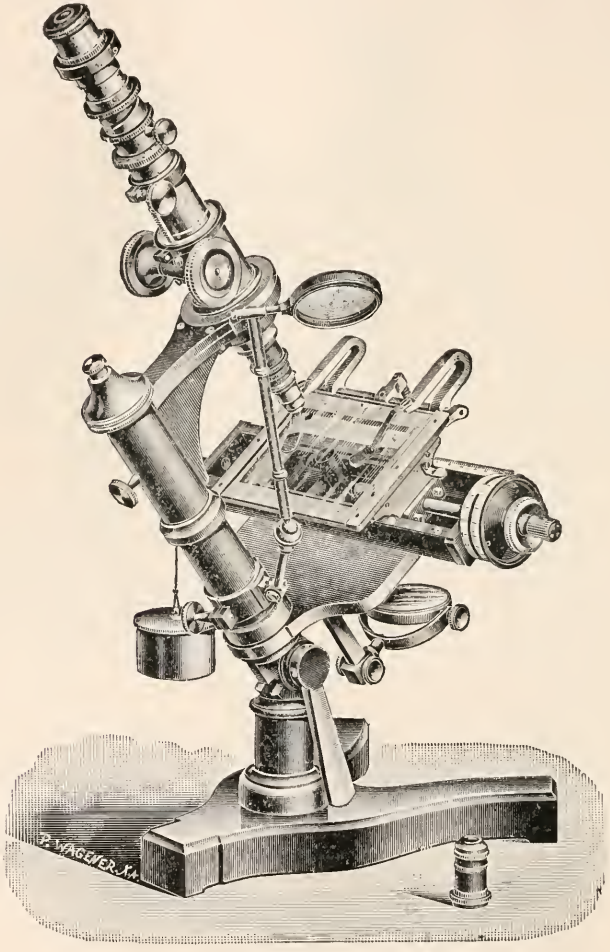

Fig. 126.

Vogel-Campbell's Large Measuring Microscope (Model III.).— This instrument (fig. 126), 9*b* in the maker's catalogue, resembles model II. in its horseshoe mount and hinged pillar, inclinable through 90°. But it differs essentially from the other types in its retention of

* Otto Toepfer und Sohn's Catalogue (Neue Astrophysikalische Apparate, 1908), Potsdam.

the ordinary Microscope form, so that in addition to the rack-and-pinion adjustment there is also a fine-adjustment by prism action and micrometer-screw; in consequence, stronger magnifications can be used. The great distance of the measuring stage from the pillar is notable, as well as the provision of stage spring-carriers, so that plates of 16 cm. by 16 cm. can be applied and their central parts measured. The details of the measuring stage, the illumination, the measuring screw, and the reading scales, are practically the same as for model II. The Microscope has one ocular and three objectives, giving about 10–100 diameters; stronger objectives can be used if desired. The ocular has strong threads, and is rotatory through 90°.

Vogel's Measuring Microscope (Model IV.).*—This instrument (fig. 127) is the oldest form of measuring instrument constructed by

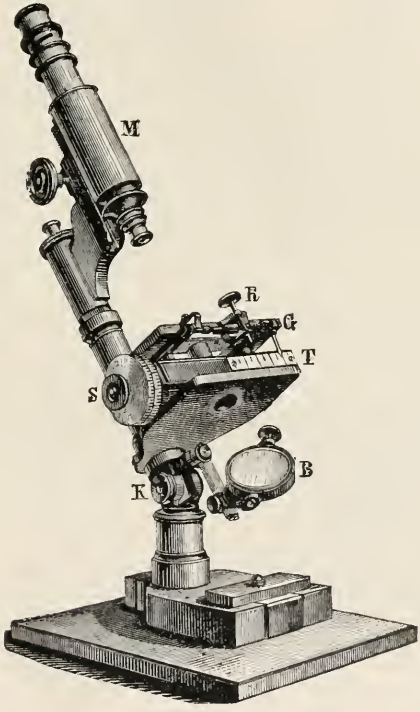

Fig. 127.

Messrs. Toepfer und Sohn (catalogue number, 9*c*). The principle is essentially that of a Microscope, with fine-adjustment and horse-shoe shape, hinged pillar for inclination, and a glass plate as object-carrier. The available part of the measuring screw extends to 30 mm, and the pitch is 0·5 mm. The scales read to 0·0005 mm. by means of two

* Otto Toepfer und Sohn's Catalogue (Neue Astrophisikalische Apparate, (1808), Potsdam.

drums with common index, and there is a separate scale for the millimetres. The Microscope has a simple ocular, with strong threads, and three objectives giving 10–100 diameters. The ocular is rotatory through 90°, and stronger objectives can be used if desired.

Toepfer's Universal Measuring Apparatus.*—The description given of this instrument (fig. 128) by A. Wolfer states that it is intended for the measuring of photographic star-plates of all kinds, as well as for other purposes requiring exact measurement, such as the examination of micrometer screws.

A desk-shaped protuberance *a* standing on an iron base-plate has its upper surface inclined to the observer at an angle of 45°, and carries the object-stage and the horizontally placed and horizontally working main measuring-screw. In front of the protuberance *a*, and partly extending over it, there is a very strong bearer *b b*, stiffened with ribs and bowed at its centre ; the lower part of the bearer is vertical, and its upper part is parallel to the object-stage, the Microscope being applied to it in a slide, and receiving, by means of a screw, a movement perpendicular to the movement of the object-stage. Thus the whole arrangement provides a very convenient attitude for the observer. There are means for levelling the instrument as a whole. The object-stage *c* is a glass plate fastened on to a square bronze frame, and works by means of four pins on a circular metal plate, whose circumference forms a position circle, and is graduated to half-degrees, and reads to minutes by means of two verniers diametrically placed. This position circle is rotatory in a strong cast-iron ring concentrically set beneath it, the verniers, as well as a tangent-screw, being attached to the ring. The measuring stage and all its parts are operated by the horizontal main screw, and may be moved in the direction of its axis. This screw is very strong, and is carefully designed for its double purpose of movement and measurement, the diameter of its thread being 16 mm., its thread-distance 0·5 mm., and the whole action range 100 mm. There are two drums (the right-hand one is shown in figure) near the screw-handle, and these give the whole rotations and hundredths, so that the accuracy of the direct reading extends to $\frac{1}{2000}$ mm. A scale *g*, divided into millimetres, and an index moving with the measuring stage, give the actual position at any moment in millimetres. In addition to the ordinary handles for the rotation of the screw, there is a disk *h* of 7 cm. diameter with finger openings ; this disk is outside the drum, and serves for quick rotation when rapid transport of the measuring stage over large distances is required. Means are provided whereby the weight of the stage is taken off the screw and thrown on to ball bearings working in grooves in the desk-shaped frame. The glass plate is 16 by 16 cm. ; smaller plates may be fixed, so that they lie centrically with the position-circle.

When it is desired to examine a micrometer screw, the glass plate is removed and replaced by a hollowed-out bronze plate with a circular aperture of 50 mm. diameter. This bronze plate is provided with a screw-thread, and receives the micrometer, whose ocular has been

* Zeitschr. f. Instrumentenk., xxvii. (1907) pp. 297–301 (1 fig.).

removed so as to expose the threads. The Microscope of the measuring apparatus is sharply directed on the threads, whose orientation is judged by the position angle of the stage. Illumination is by a mirror. The screw which operates the Microscope is an accurately worked micrometer screw, and thus also serves for measurement. Its thread-distance is 1 mm., its available range 80 mm., the whole rotations being read off on a straight-edged scale, and the hundredths on a drum at the lower

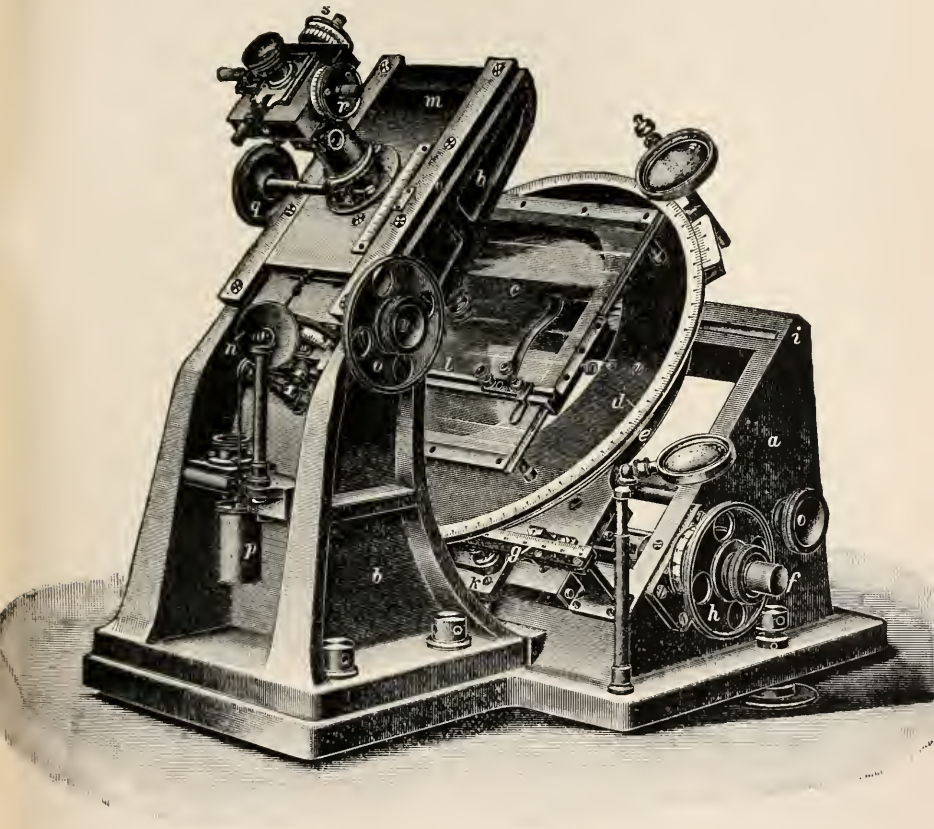

Fig. 128.

end of the screw; the accuracy is to $\frac{1}{1000}$ mm. A disk *o*, with finger openings, is provided for quick motions. The dead weight of the Microscope is taken off the bearings as far as possible by a suspended weight *p*, so that the sliding movement is extremely smooth. The Microscope has three objectives, and is focused by rack-and-pinion; the magnifying powers are known by reference to a graduated scale on the draw-tube. The upper end of the Microscope is defined by a circular flange, and has two independent rotations, one of which may extend to

360°, and the other is limited to 90°. Two pieces of measuring apparatus are applied to the flange, one being a simple eye-piece with two parallel threads. One of these threads is fixed, and the other can be adjusted to or from it ; a third thread is perpendicular to both. The movable thread can be set at any distance from the fixed thread, suitable for the examination of the object under consideration, and is used in connexion with the stage screws. It will be seen that this arrangement would facilitate, for example, the testing of a micrometer screw. The combinations of oculars and objectives allow of magnifications between 2 and 100-fold. In place of the above described ocular, an ordinary micrometer is also provided, having two double threads perpendicular to one another, and operated by two micrometer screws *r* and *s*, of 0·25 mm. range. Thus simultaneous measurements of right-angled co-ordinates can be made. There is an arrangement for bringing the origin of co-ordinates into the centre of the field.

GEBHARDT, W.—**Aus Optischen und mechanischen Werkstätten.**
[The author reviews the chief German modern microscopes and their auxiliaries—most of which have been already noticed in our Journal.]
Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 396–421 (15 figs.).

ROHR, M. v.—**Die binokulären Instrumente nach Guellen bearbeitet.**
Berlin : Springer, viii. and 223 pp. 70 figs. 1 tab.

SCHWARZMANN, M.—**Sammlungsmikroscope und Mineraliensammlungen.**
Centralbl. Mineral. Geol. u. Paläontol., 1907, pp. 615–24 (3 figs.).

(3) Illuminating and other Apparatus.

History of Mirror-Condensers.* — H. Siedentopf collects and describes all the various forms of mirror-condensers which have appeared since J. B. Reade invented the first in 1837. He enumerates in all some sixteen varieties, some of which have been more than once "discovered." Thus, J. W. Stephenson's "Catoptric Illuminator" (1879), came out as "Reichert's Speigelkondensor" in 1906. The author points out that, with the invention of Abbe's illumination apparatus, the catoptric condenser passed into oblivion, although it possessed the conspicuous advantage of not decomposing the light. The advent of ultramicroscopy has again drawn attention to the subject in the hope that the scope of the new method may thereby be widened. Zeiss' rock-crystal paraboloid for obtaining dark-ground illumination with ultra-violet light is described, but the author concludes his paper by remarking that mirror-condensers can only avail to a very limited extent, as compensation for the more complete installations for the examination of ultramicroscopic particles.

Reichert's New Large Projection Apparatus.† — In describing this instrument, O. Heimstadt says that great care has been taken to meet the three essentials of projection apparatus, viz. (1) that bright images should be obtained ; (2) that all kinds of projection in ordinary use should be obtainable ; (3) that the change-over from one kind of projection to another should be expeditious. The first requirement is met by the use of an arc lamp with the carbons mutually perpendicular,

* Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 382–93 (16 figs.), with a bibliography of some 30 references.

† Tom. cit., pp. 370–81 (7 figs.).

combined with the best optical appliances. As regards the second requirement, four kinds of projection have been provided—viz. diascopic, epidiascopic, megascopic, and microscopic. In the diascopic installation, diapositives up to 13 by 18 cm. can be used, and at a distance of 5 metres from the objective a magnification of 14 diameters is obtained. The epidiascopic and megascopic projections produce a flat surface of uniform expansion. The body of the apparatus is set on a strong cast-iron frame running upon rollers, and stiffened by a wooden inclosed utensil box. The projection apparatus is supplied with an automatic self-regulating arc lamp of special construction. The lamps are designed for a uniform current strength of 30 amperes. The upper

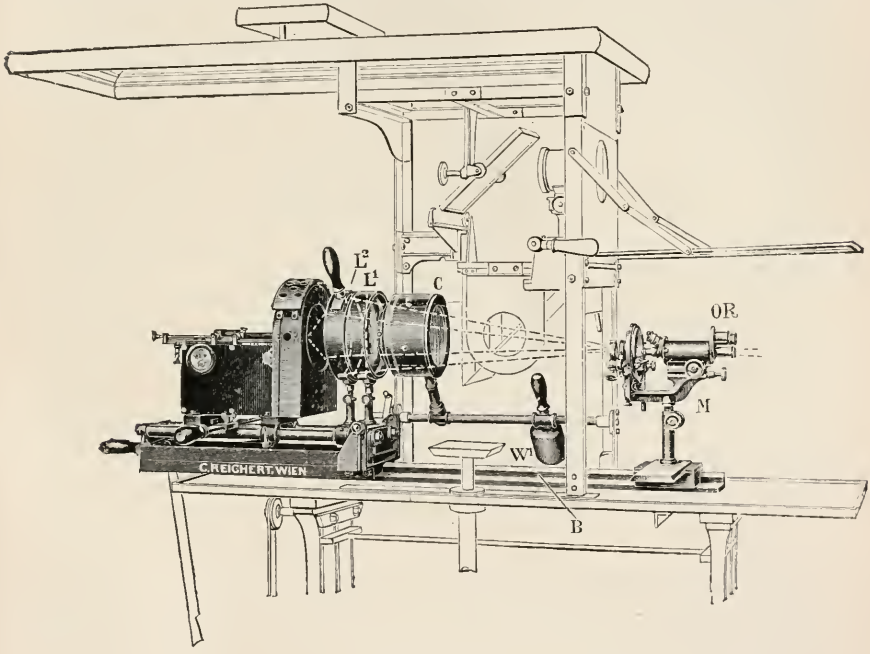

Fig. 129

and positive carbon, whose crater acts as the light source, is fixed in the optic axis, thus giving the great advantage of constant centricity as the carbon burns away. Moreover, as this crater is applied directly to the illuminating apparatus, a uniform current furnishes a higher intensity than is obtained with lamps of older make. As the negative carbon is vertical, the light source can be brought very close to the condenser, thus yielding another advantage, because the condenser can thus be made of higher aperture—a distinct gain to the brightness of the image. The special features of this lamp, therefore, make it very easy and convenient to manage; it moves on runners, and can be fixed by clamp-screws; there is a lever for operating it in the direction of the optic axis. Fig. 129 gives a good general view of the apparatus as a whole.

Leitz' Dark-ground Illuminator for the Examination of Living Bacteria.*—This dark-ground illuminator (fig. 130) is mainly intended for examining living and unstained bacteria under the Microscope. The method involved depends upon the contrast produced between the intensely illuminated bacteria and their dark surroundings. Two reflecting surfaces, one internal, the other external (see figure) are so shaped as to almost completely unite the rays in a point P, so that by the diminution of the astigmatism to its lowest limits an intense illumination of the bacteria is obtained. Since the apertures of the extreme rays *a* P and *b* P lie within the limits 1·1 and 1·45, it follows that a considerable amount of light is collected at P. When dry lenses are used all the rays which enter from below and converge towards P go to illuminate the bacteria (shown by lines and dots), and are totally reflected at the surface of the cover-glass. The light diffused by the bacteria (represented by dotted lines) enters the objective, and thus produces an image of the bacteria, which under these act as self-luminous bodies. As the rays are

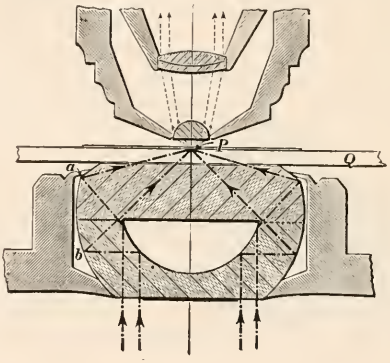

Fig. 130.

united at P by reflection instead of by refraction, there is no chromatic dispersion, and the annular illumination of the bacteria obviates diffraction. The optical portion of the dark-ground illuminator is contained in a mount provided with a centring arrangement, and slips from below into the sleeve which usually carries the Abbe condenser. Since the point P should lie within the preparation, it is necessary to use slides of uniform thickness, the proper thickness being 1·0 mm. The requisite correction is effected by raising or lowering the dark-ground illuminator by means of the movement forming part of the illuminating apparatus. It should in this connection be noted that the space below the object-slide Q should always be filled with oil. A Nernst lamp or incandescent gas lamp may be used, but the best source of light is a small arc-lamp. The Wetzlar firm have devised a special model, similar to that used for the Edinger apparatus, requiring a current of four amperes, and capable of attachment to any existing house supply. Immersion lenses may be

* Special Circular, English version, E. Leitz, London.

used, and they offer the advantages of comparative independence of cover-glass thickness and a brighter image.

The circular describes many of the details of manipulation necessary for success.

(4) Photomicrography.

Colour-screens for Colour-photography.*—An extremely ingenious method of producing colour-screens for colour-photography has recently been invented by S. D. M. Hauron and R. de Bercegol, of Joinville-le-Point (Seine), France.

A sheet of glass, celluloid, or other suitable material is covered with a material that is permeable to water, such as gelatin. Over this is spread a coloured varnish impermeable to water. Small parallel bands or tracks, separated by intervals equal to their width, are drawn by a ruling-machine. The sheet is dipped into a water-colour, which impregnates the gelatin exposed by the tracks. This produces a two-colour screen. To produce a third colour, a second protecting varnish is spread ; by the same ruling-machine tracks are hollowed out transversely and at intervals of double their width, deep enough to expose the lower layer of gelatin, which the water-colour above used has not penetrated. The sheet is dipped into a water-colour bath of a third colour, producing a three-colour screen. The process is variously modified. A thick coating, superficially coloured, may be employed, and the lines obtained by successive varnish coatings, rulings, and water-colour baths. A coloured celluloid base may be used, coated with gelatin, rulings made deep enough to expose uncoloured celluloid, and the exposed celluloid then coloured by a pigment dissolved in acetone, amyl acetate, or like liquid that bites into and penetrates the celluloid. The third colour is obtained by another gelatin coating and similar steps. The gelatin is then removed from the celluloid base, leaving the three-colour screen. Another method of manufacture is to make celluloid sheets with coloured gelatin, rulings made to expose the celluloid, colouring effected with pigment dissolved in acetone as above, a second colourless gelatin protecting layer coated on, and the third colour obtained in the same way. With this modification, two colours may be superposed at the intersections of the lines, if the rulings are made crossing each other. In a fourth modification, the coloured lines are printed from a plate engraved by a ruling-machine. Two sets of lines may be printed by a greasy colouring material, and crossing each other, the third colour being filled in by floating the sheet in a colour-bath to which the greasy colours are impermeable. The screens may be sensitised directly, or they may be detachably connected to the sensitive plate. The transparent support for the screens may be coloured slightly yellow, so as to moderate the activity of the blue-violet light.

(6) Miscellaneous.

Microscopical Matters.†—W. J. Wood describes some microscopical matters in a letter to the editor of the "English Mechanic," but the

* English Mechanic, lxxxvii. (1908) p. 295 (3 figs.).

† Tom. cit., pp. 110–11 (1 fig.).

chief feature of his communication consists in the fact that most of his subsidiary apparatus was made by himself. The illustration showing the writer's Microscope table and the disposition of the apparatus is interesting (fig. 131).

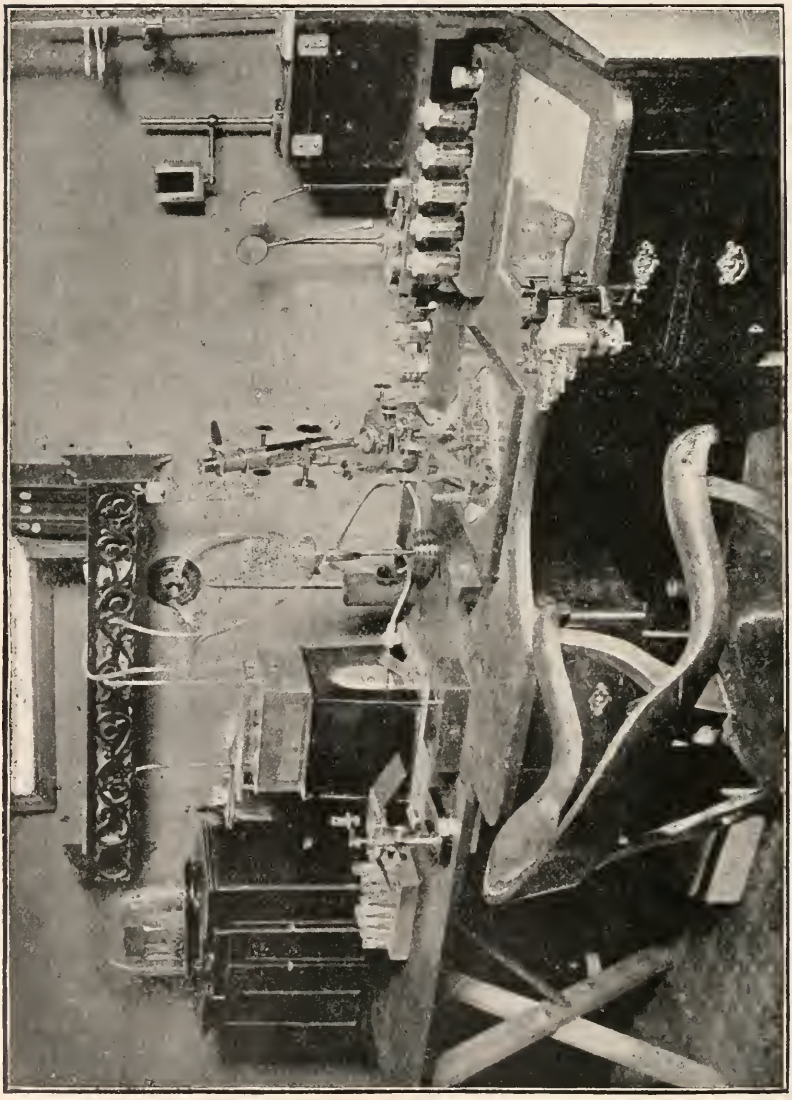

Fig. 131.

Quekett Microscopical Club.—The 449th Ordinary Meeting was held on June 19, the President, Prof. E. A. Minchin, M.A., F.Z.S., in the Chair. Mr. A. Earland exhibited and described a number of preparations of Foraminifera, in regard to which special reference may be made to a slide showing "triple isomorphism." The species were *Cornuspira* of the Porcellanous type, *Ammodiscus* of the Arenaceous group, and *Spirillina*, a Hyaline form. Mr. W. Wesché, F.R.M.S., contributed a paper on "The Proboscis of the Blow-fly, *Calliphora erythrocephala* Mg. : a Study in Evolution."

Ciceri Smith's Direct-reading Micrometer-gauge for Cover-glass. At the March Meeting J. Ciceri Smith exhibited and gave the following description of a direct-reading micrometer-gauge (figs. 132 and 133).

"The difficulty of reading a micrometer of the indirect type in a dull light is a well known fact, and as a short mental calculation is usually required to arrive at the proper result, an error is very liable to slip in, especially when the instrument is only used occasionally, or when the small graduations are indistinct.

"The improved instrument is of the caliper type, with the addition of a set of self-calculating or indicating dials, the chief feature being that the readings are seen at a glance. They are made in various sizes, from the smallest up to those of 1-in. capacity. I shall, however, confine my description to the smallest size, as this is the pattern which is best suited for the measuring of microscopical glass.

"The readings for this small work are indicated on two dials ; the first figure (reading from the left) indicates hundredths, and the second figure thousandths of an inch, which latter is our British unit measurement, so that one-thousandth of an inch is technically known as 'one mil'—therefore these units for conciseness are frequently described as 'mils.' The divisions on the bevelled edge of the thimble indicate $\frac{1}{2}$ mils. I may mention that the divisions on the shank are for larger measurements, and indicate tenths of an inch—capacity $\frac{3}{10}$.

"The gauge consists of a horseshoe-frame, having a screwed shank or fixed nut to carry the micrometer spindle, and a recessed portion to receive or contain the mechanism, which is in turn covered by metal plates. The front plate is pierced with apertures, through which the figures appear consecutively.

"Two principles are involved in the construction :—(1) A screwed spindle travelling in a fixed nut and fitted into the body of the frame ; (2) working in conjunction with, and operated by the micrometer spindle is the registering mechanism. When the instrument is manipulated so as to increase the gauge the counter moves forward, and if manipulated so as to decrease the gauge the counter moves backward.

"The recording mechanism is self-contained in an independent, cage-like frame, and is operated in the following manner :—The decimal figures appearing in bold relief on the index are automatically indicated in a step-by-step motion, actuated by the rotation of the micrometer spindle, which in turn drives a train of pinion-wheels and a cam-wheel, and upon the arbors are mounted white collars or dials, having black figures on their periphery. On the micrometer spindle is fitted a

slotted sleeve, on which is mounted the units-dial, and also the first pinion-wheel.

"The connection of the spindle to the registering gear is effected by means of a projecting stop or key fixed on the unthreaded portion of the spindle, which engages with the slotted sleeve, imparting a rotary motion, and at the same time the key is absolutely free to travel transversely in the slot when the screw spindle is rotated, so as to either increase or decrease the gauge. Therefore the pinion-wheel, which is mounted on the sleeve, drives the hundredths dial, operated through the intermediate pinion and cam-wheel, which imparts the step-by-step motion.

"The pitch of the micrometer screw is $\frac{1}{100}$ in. The rotating thimble, which is rigidly attached to the spindle and turns with it, is so disposed as to protect the micrometer screw against injury and also to exclude dust or dirt. A knurled head is fitted freely on the outer end of the

Fig. 132.

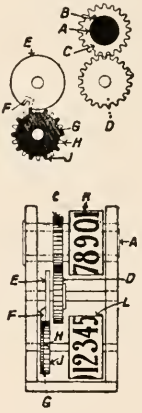

Fig. 133.

thimble, and when manipulated drives the spindle through the friction of a small spring, which is interposed; hence it is impossible, with ordinary care, to strain the screw, since as soon as the pressure becomes too great, the spring yields to the resistance and allows the thimble to slip.

"Fig. 132 shows the gauge when almost closed, with a reading of 0·023 inch.

"In fig. 133 is seen the internal construction of the instrument:—A, micrometer screw-spindle; B, projecting stop on spindle; C, first pinion-wheel and slotted sleeve combined; D, intermediate-wheel connecting E with C; E, cam-wheel; F, projecting lug on cam-wheel E, which gives the step-by-step motion to G; G, pinion-wheel, constructed with long and short teeth alternately; H are the short-teeth on wheel G; J are the long-teeth on wheel G; K is the thousandths or units dial; L is the hundredths dial.

"Note that when (1) the wheel G is locked against rotation by the cam-wheel E resting on the points of the long teeth, and is released and moves forwards or backwards when the lug F engages with the short teeth H. (2) The wheels E and D are rigidly fixed on the same arbor and revolve together. The wheels C D E G are mounted in a straight line on the frame, but for illustration purposes only; E and G have been separated from C and D to avoid any overlapping of E and D in the diagram."

Composition of Brass.* — The question asked by "Theodolite," What is brass? opens up an interesting and important subject to Microscopists. It is said that many modern Microscopes wear out in a very short time, in spite of their having adjusting screws to take up the wear, that the slides and V-grooves wear and the threads of screws strip, so that in a very little time the instrument becomes useless. From "Brassfounder's" communication it would appear that the modern Microscope is, like other scientific instruments, made of inferior or too soft metal. This writer says:—"When I was an apprentice brass was copper and zinc in different proportions, according to quality, with the addition of a little tin for the best metal; but cutting prices in competition have altered this, so that modern brass is any mixture of metals which will produce a yellow surface when polished. The introduction of automatic machines in the instrument trade is, however, very largely responsible for bad metal in instruments. Really good, age-lasting brass is very tough in working up; it is also rather hard. Owing to the way in which it pulls on to the tools in working, it becomes very hot, and has to be worked at a low speed. The brassfounder gets over the difficulty by mixing a metal which will work well in the machine, and it happens that a crisp, cool-cutting metal is very poor in quality. Good metal will stand nearly a white heat before melting, but the metal usually used will not stand the ordinary heat required for brazing."

Several other contributors write on this subject, and give the composition of various kinds of brass; for these the original may be consulted with advantage.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Cultivation of Algæ.‡ — C. Sauvageau takes small fragments of plant, and having cleaned and washed them, places them in a drop of filtered water in a Van Tieghem's moist cell. For the observation of the reproductive bodies the thinnest slips are, of course, the best. If it be proposed to follow the course of the germination, thicker slips are preferable. Ordinary slides are too smooth for the later stages of development, as the young plantules adhere badly and undergo abnormal

* English Mechanic, April 3, 10, 17, 24, May 1, 1908.

† 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.

‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 706–1.

development. The author roughens one surface of the slips by means of hydrofluoric acid. In a lead capsule, the lid of which is perforated by several holes, the diameter of which is equal to two-thirds of that of the slips, is placed a mixture of calcium fluoride and sulphuric acid. The hydrofluoric acid vapour corrodes the glass surface, and as soon as one slip becomes whitish it is replaced by another.

The fine and regular roughness thus produced interferes with observation much less than may be supposed, provided the illumination be suitable, and certainly allows the progress of growth to be watched satisfactorily.

Collecting and Preserving Planocera inquilina.*—F. M. Surface obtained the material from the branchial chambers of the large whelk, *Sycotypus canaliculatus*, during July and August at Woods Hole. About three or four worms were obtained for every whelk opened. The adult polyclads were transferred to dishes of sea-water, in which the water was changed by means of a system of balanced siphons. These siphons served to keep the water free from sand and dirt, and also prevented the overflow of the water and the escape of the worms.

The animals soon laid eggs in spiral, gelatinous capsules, containing from 100 to 2000 eggs apiece. The tough capsules are very difficult to penetrate with fixing and staining reagents.

Stages from the maturation of the ova to the free-swimming larvæ were obtained without difficulty under laboratory conditions. The adult animals, however, only lived for a few days.

Eggs were fixed in various solutions: sublimate-acetic, 95 p.c. alcohol, Gilson's mercuro-nitric, picro-sulphuric, picro-acetic, Perenyi's and Flemming's solutions. Of these Gilson's fluid and the sublimate-acetic were found to be the best. For staining whole mounts Conklin's picro-hæmatoxylin was used; but stronger solutions were found better for these eggs. The eggs were then clarified in xylol and mounted in balsam.

Owing to their small size it was impossible to remove the eggs from their capsule, but they cleared better if the capsule was torn. It was found necessary to bleach the Flemming material with peroxide of hydrogen before sectioning. A number of stains were used for the sections, but Delafield's hæmatoxylin, either *in toto* or on the slide, proved most useful. A combination of thionin and acid-fuchsin also gave good results. There is too much yolk in these eggs to use Heidenhain's iron-alum hæmatoxylin to advantage.

Cultivating the Parasites of Kala-azar and Aleppo Boil.†—C. Nicolle has cultivated successfully the parasites of Aleppo boil and of Kala-azar on the following medium:—agar 14 grm., sea-salt 6 grm., water 900 grm. This is distributed in test-tubes and sterilised; next the tubes are liquefied at 55°, and one third of rabbit's blood obtained aseptically from the heart is added. The tubes are sloped for 12 hours and afterwards incubated at 37° for 5 days. They are preserved for future use at room temperature. The inoculations were made in the

* Proc. Acad. Nat. Sci. Philadelphia, lix., 1907, pp. 514–59 (6 pls.).
† Comptes Rendus, cxlvi. (1908) pp. 498–9, 842–3.

condensation fluid after the manner of MacNeal and Novy.* Cultures were also made on the medium used by these investigators, but the results were not so favourable as on those of the author's modification. The tubes were kept at about 22° (19°–23°), and examined on the ninth day. It is stated that in the case of Kala-azar sub-cultures were successful down to the sixth generation.

Separation of Bacillus typhosus and Bacillus coli.†—A. Guillemard has been able to separate *B. typhosus* and *B. coli* by adding certain alkaline salts to the culture medium. The author found that sulphates and phosphates of sodium caused broth cultures of *B. coli* to produce flocculi which were soon deposited, and the liquid medium became clear, but that cultures of *B. typhosus* were unaffected, and the uniform cloudiness of the broth remained. Chlorides and nitrates had no appreciable effect on cultures of *B. coli*. The author found that *B. paratyphosus A* Bryon-Kayser and *B. enteriditis* Gaertner behaved like *B. coli* in forming flocculent cultures, but *B. paratyphosus B* Schottmüller and *B. d'Achard* (*psittacosis*) behaved like *B. typhosus*.

Fermentation of Sugars by the Meningococcus and the Micrococcus catarrhalis.‡—J. Bruckner, employing litmus-broth mixed with ascitic fluid and various sugars, finds that one strain M 1 of the *Meningococcus* ferments cane-sugar, lactose, and mannite, but not glucose, or maltose; that two other strains, M 2 and M 3, ferment all five of these sugars. Of two strains of *Micrococcus catarrhalis*, one ferments cane-sugar, glucose, lactose and maltose, though more slowly than the *Meningococcus*, whereas the other only reddens the lactose broth very slightly and for a short time. The author considers that litmus media are not suitable for the differentiation of these micrococci.

By using slightly alkaline media containing neutral red, the two strains M 2 and M 3 behave identically in broth containing 1 p.c. maltose, there appears a slightly fluorescent cerise coloration which soon becomes ruby red; glucose broth becomes canary-yellow with green fluorescence, and broths containing other sugars are unchanged; M 1 gives the same reaction with maltose, but only after 5 days, whereas with glucose there appears a slightly fluorescent cerise coloration. It was noted that with litmus media this strain attacked neither glucose nor maltose. The two strains of *M. catarrhalis* attacked none of the sugars in ascitic neutral red broth. The author considers that this method offers an easy differentiation between the *Meningococcus* and the *Micrococcus catarrhalis*.

Aerobic Cultivation of Anaerobes.§—S. Hata finds that the cultivation of anaerobes in the presence of air occurs in broth which contains reducing agents and solid particles. In Smith-Torazzi's organ-broth, and Wrzosek's potato-broth, the reducing properties of the cells, and the cells themselves as solid particles act together. In broth containing 0·3–0·7 p.c. anhydric Na_2SO_3, anaerobes will grow in the

* See this Journal, 1904, p. 116.
† Comptes Rendus, cxlvi. (1908) p. 1177.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) p. 765.
§ Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 539.

presence of air, if pieces of agar are also present, and may produce as much or more toxin as in broth in an atmosphere of hydrogen. In broth containing a small quantity of iron filings or ferro-sulphate, bacilli grow well but lose their virulence. By the addition of a little fresh blood-serum to the Na_2SO_3, the toxin production is three to five times increased.

Investigating Apogamy in Nephrodium.* — Shigéo Yamanouchi raised the apogamous prothallia from ordinary spores, which were sown on sterilised soil consisting of vegetable mould and sand; these were placed in the greenhouse and kept growing with special care. The cultures, in pots placed on saucers filled with water, were exposed to direct sunlight after the prothallia had developed two or three cells. Excessive evaporation was regulated carefully, and the prothallia kept growing for a long period, exposed to direct sunlight, and at a temperature of from 28–32° C. The rate of growth of these prothallia, as compared with those under normal conditions, was quite slow. Fixation of the prothallia was made during all stages of development. The killing and fixing of the material, with washing, imbedding, cutting, and staining, was done by the method used in the study of spermatogenesis, oogenesis, and fertilisation.

Collecting and Examining the Eggs of Rhopalura ophiocomæ.† M. Caullery and A. Lavallée remark that Ophiurids infected with Orthonectid parasites are easily recognisable, as they are usually flabby and sterile. The ventral surface is greyish-white, instead of being pale orange; all parts of the host's body may be invaded. For their study it was necessary that the males and females should be mature, and this point was settled by observing that when ripe, the animals swam about freely when set free in the water by tearing open the host. The hosts, placed in flat glass vessels containing sea-water, and these vessels on the stage of a binocular Microscope, are torn open, and when a sufficient number of both sexes are obtained, the remains of the Ophiurid are removed. The contents of the pans are then poured into a glass vessel containing a thin layer of fresh sea-water. Herein fecundation takes place, and during the next 24 hours, while the eggs are developing, samples are removed from time to time for the purpose of examination *in vivo*.

For the study of the fixed material, the procedure was as follows: The animals were picked up with a capillary pipette and transferred to the fixative, usually Bouin's fluid, sometimes acetic-sublimate; after this, they were frequently washed by decantation, aided by the pipette. This done, each lot was placed in a small tube filled with 80° alcohol, and plugged with cotton-wool. The tube was then immersed in a bottle of 80° alcohol. The fecundated females were imbedded in the following manner: A tube 7–8 cm. long, with an internal diameter of about 5 mm., the lower end for a length of 2 cm. being oblong (fig. 134). In this rectangular portion are 2 holes (*f* fig. 134 A). The end is covered with

* Bot. Gazette, xlv. (1908) pp. 289–318 (2 pls.).
† Arch. Zool. Expér. et Gén., viii. (1908) pp. 421–69 (1 pl.).

fine cambric, or bolting silk, fastened on with thread ; this cap must come above the holes *f* ; the inferior surface is then dipped into collodion, in order to render the bottom of the tube impermeable to fluids, any interchange of menstrua taking place through the holes *f*. The Orthonectids, or other small organisms, are placed in the expanded portion of the tube by means of a capillary pipette, and then the tube inserted in the stopper of a small glass cylinder (fig. 134 B), which is destined for the various reagents. In this way the animals are fixed, cleared up, and paraffined, without loss or damage. When impregnated with paraffin, the tube is solidified with cold water, the cap is removed, and slight heat allows the block to be removed from the tube. The block is then sectioned. The sections, about 10 μ thick, were stained with iron-hæmatoxylin.

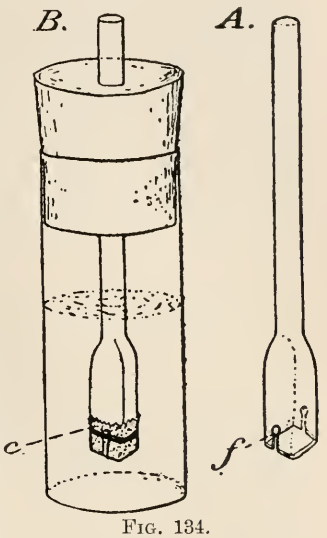

Fig. 134.

Collecting and Examining Larval Nephridia of Polygordius.*—C. Shearer obtained the material from the Naples Zoological Station in 1902 ; the adult worms containing the sexual products being broken up in small jars of fresh sea-water, when the ripe eggs and spermatozoa readily separate out. The sexual products remain suspended in the water while the broken fragments of worms and débris fall to the bottom of the jar, when they can be readily drawn off. The jars are set aside until fertilisation has taken place. The first signs of cleavage appear some three or four hours later. The eggs are then stirred up and washed in several changes of sea-water to remove unnecessary spermatozoa. Development proceeds rapidly and steadily till the third day, when they must be fed, otherwise they atrophy and eventually break up.

For sectioning, the combined celloidin-paraffin method was adopted, the material having been fixed in Flemming's strong solution or in Hermann's. The sections were stained with hæmacalcium or some hæmatoxylin solution ; while for larvæ to be studied whole, dilute picro-carmin, followed by slight acid-alcohol, gave satisfactory results.

The larva of *Polygordius* is found in the " tow " abundantly during the months of February, March, and April ; it is possible also to rear the larva from the egg throughout all the summer and winter months.

Collecting and Examining Dolichoglossus pusillus.†—B. M. Davis obtained the material from mud flats which at low tides are uncovered. When a favourable site is located a spadeful of mud is dug up and the burrow of each animal carefully examined for eggs. By breaking down one side of the burrow and gently lifting the animal out, or pushing it

* Phil. Trans., cxcix. (1908) pp. 199–230 (4 pls.).
† Univ. California Publications (Zoology), iv. (1908) pp. 197–226 (5 pls.).

aside, the eggs, if present, may be seen clinging to the unbroken side. They are usually closely packed and sometimes extend over an area of several square millimetres. The eggs are removed from the burrow by means of a fine pipette to a shallow dish filled with clear water; the eggs are then separated from sand and transferred to small bottles of sea-water; eggs from the same burrow are kept in separate bottles. On reaching the laboratory the eggs are placed in small dishes filled with fresh sea-water, occasionally changed to keep the animals alive. The animals were killed and fixed by means of Zenker's fluid, corrosive-acetic mixture, Lo Bianco's chrom-osmic mixture, and osmic acid. The specimens were preserved in 80 p.c. alcohol. The animals were killed from time to time at different stages of development, fifteen series being made. Numerous stains were used, the most satisfactory being hæmalum counterstained with Congo red for the early stages, and Mallory's connective-tissue stain for advanced stages that were fixed in Zenker's fluid. Living material was examined with a stereoscope Microscope.

Convenient Mode of Preparing Silicate Jelly.* — F. L. Stevens and J. C. Temple describe their method as follows: First ascertain the percentage of silicic anhydride on the sample of sodium silicate to be used; this consists in decomposing the silicate with hydrochloric acid, precipitating the silicic acid, evaporating to dryness, washing until wash-water contains no chloride, then heating to redness and weighing the silicic anhydride. Enough should be made at once to last for several years. After making the determination, dilute the silicate to be used until the solution contains 4–5 p.c. of silicic anhydride. Next prepare hydrochloric acid of such strength that 1 c.cm. neutralises 1 c.cm. of the sodium silicate solution, using methyl-orange as an indicator (litmus, phenolphthalein, and cochineal are not suitable).

To 104 c.cm. of acid add slowly, constantly stirring the while, 100 c.cm. of the sodium silicate solution, the excess of acid being used to prevent coagulation during sterilisation. This solution is then tubed and sterilised in an autoclave at 120° for 15 minutes. The silicic acid should come out clear. If there be any turbidity it is due to a deficiency of hydrochloric acid. The solution of silicic acid thus prepared constitutes the base of the medium. To cause it to solidify to a jelly, add to a tube of this base 1 c.cm. of a sterile concentrated solution of such salts as may be desired, but in every case containing enough sodium carbonate to a little more than neutralise the excess of acid present. In a few minutes after the addition of the salt solution, the whole will be solidified, giving a clear transparent jelly. If plate cultures be desired, it is well to inoculate the base before the addition of the salts, since after the medium starts to set, there is no time for proper mixing. If slants be desired, the tubes must be placed in the proper position before the medium sets. Prepared in this way, silicate medium is convenient and efficient for the isolation of nitrite and nitrate organisms. Instead of using sodium carbonate for neutralising, magnesium carbonate may be employed, as when the jelly is prepared by dialysis.

* Centralbl. Bakt., xxi. 2te Abt. (1908) pp. 84–7.

Nutritive Value of certain Peptones for different Species of Bacteria.*—H. Dunschmann compared three peptones: (1) Peptone Defresne, obtained from the action of the pancreas on beef; (2) peptone Martin, obtained by digesting the minced stomachs of pigs by means of the peptone they contain; (3) vegetable peptone, obtained from albuminoid substances extracted from leguminous vegetables, and peptonised by means of papaiotine. The solutions used consisted of 3 p.c. peptone, 3 p.c. lactose, and 1 p.c. lemco. These were inoculated with *B. typhosus*, *B. coli*, anthrax, and *B. diphtheriæ*. For typhoid, diphtheria, and anthrax, vegetable peptone gave by far the best results, while with *B. coli* there was but little difference. When the medium without lactose was tested by means of the same microbes, it was found that *B. coli* throve much better on the Martin and Defresne's peptones than on the vegetable, and that the vegetable peptone presents obvious advantages for differentiating *B. typhosus* and *B. coli*.

Kitt, Th. — **Bakterienkunde und pathologische Mikroskopie für Tierärzte und Studierende der Tiermedizin.**
Wien: M. Perles, 1908, fifth and much enlarged edition, v. and 578 pp., with more than 200 illustrations and 4 col pls.

(2) Preparing Objects.

Demonstrating Nervous Tissue of Hirudineæ.†—E. Mencl fixed Hirudineæ in the following solution :—(1) Saturated solution of sublimate and distilled water, of each 500 grm.; (2) chromic acid, 0·5–1 grm.; (3) a trace of glacial acetic acid. The preparations were stained with Heidenhain's hæmatoxylin, picro-magnesia-carmin, Delafield and Bordeaux red, or orange G, Apáthy's gold chloride method, and with Ramon y Cajal's silver method.

Examining Catenata.‡—V. Dogiel made intra vitam examinations by teasing out the intestine which contained the parasites in sea-water. The material was then transferred to a slide. Fixed preparations were obtained by means of Flemming's fluid, acetic sublimate and Carnoy's mixture (absolute alcohol 75, acetic acid 25). Sections made from material fixed in sublimate and acetic acid were stained with iron-hæmatoxylin. Those fixed in Flemming's fluid were treated mostly with safranin, but some with picro-carmin, while for those fixed in Carnoy's fluid hæmalum gave the best results.

Studying the Development of Teeth in Castor Fiber.§—P. Heinick decalcified the material in a mixture of 5 parts 96 p.c. alcohol, 1 part strong nitric acid. The fluid was re-made and renewed every 3–4 days. The material was not properly decalcified for from 8–11 weeks. After this time the preparations were freed from the acid by immersion in 96 p.c. alcohol, to which precipitated chalk had been added. This took from 6–8 weeks, the spirit being renewed every 3 or 4 days, until blue litmus paper showed no acid reaction. The next step was to obtain the

* Comptes Rendus, cxlvi. (1908) pp. 999–1001.
† Zeitschr. wiss. Zool., lxxxix. (1908) pp. 371–416 (2 pls.).
‡ Zeitschr. wiss. Zool., lxxxix. (1908) pp. 417–71 (3 pls.).
§ Zool. Jarhb., xxvi. (1908) pp. 355–402 (2 pls.).

jaws *in toto* by means of an alcoholic borax-carmin solution (4–6 days). The material was then dehydrated in upgraded alcohols and imbedded in paraffin, the intermediary being cedar oil. The sections varied from 20–25 μ in thickness. If the borax-carmin had not been successful the sections were also stained with blen de Lyon.

Fixation with Trichloracetic Acid and Uranyl Acetate.*—H. Friedenthal praises the action of a mixture of uranium acetate and trichloracetic acid for fixation purposes. Excellent results are obtainable from a fluid composed of equal parts of saturated uranium acetate solution and 50 p.c. trichloracetic acid. As a universal fixative which is said to satisfy the requirements of botanists and zoologists alike, a solution with the following composition is given :—Trichloracetic acid 20, uranium acetate 10, chromic acid 1, osmic acid 0·5, platinum chloride 0·5.

Studying the Histogenesis of Cysticercus pisiformis.† — R. T. Young obtained his material by feeding young *Lepus cuniculus* (Belgian hare) and *Lepus pinetis* with proglottids of *Tænia serrata.* The liver, omentum, lungs, and mesenteric glands were found infected. The best fixative was Flemming's strong chrom-aceto-osmic mixture, in which the larvæ were immersed for two to three hours. After washing in running water, they were passed through up-graded alcohols. The next best fixative was saturated sublimate in 70 p.c. alcohol, to which 1 p.c. glacial acetic acid was added.

Heidenhain's iron-hæmatoxylin, sometimes used with no counterstain, but more often in conjunction with eosin, Bordeaux-red, or saturated aqueous solution of water-blue and picric acid, gave the best results in staining. Vom Rath's, Apáthy's, and Golgi's methods were also tried, but none gave very satisfactory results.

Examining the Neuro-epithelium of the Auditory Apparatus.— N. van der Stricht‡ used bat-embryos chiefly, also those of guinea-pigs, cats, and one human embryo. This material was fixed in Flemming (2–4 weeks), Hermann (8 days), acetic-sublimate alcohol (1 day), Perenyi (1 hour), Bouin (1–2 days) ; Benda's method of fixation was also tried, and found to give excellent results. On the whole, the fluids which contained osmic acid gave the best results. Material when fixed, if left in iodine-alcohol (70 p.c.) for 5 months to 2 years, was found to stain intensely by the iron-alum method. The cochleas were decalcified in 3 p.c. nitric acid and afterwards imbedded in paraffin by means of the disulphide method. Pieces fixed in fluids not containing any osmic acid were stained *en bloc* in borax-carmin. The sections were mostly stained with iron-hæmatoxylin and Bordeaux red.

Examining the Tentacular Apparatus of Cephalopods.§—J. Guérin fixed the material in Flemming's, Bouin's, or Carnoy's fluids. In the

* S.B. Gesell. Natur., Freunde, Berlin (1907) pp. 207–11.
† Zoolog. Jarhb., xxvi. (1908) pp. 183–254 (4 pls.).
‡ Arch. de Biol., xxiii. (1908) pp. 541–693 (5 pls.).
§ Arch. Zool. Expér. et Gén., viii. (1908) pp. 1–178 (4 pls.).

two former the pieces should not be immersed longer than 12 hours, in the latter not more than one. Paraffin impregnation was effected by means of chloroform or *in vacuo* ; for the preliminary stages the melting-point of the paraffin was 42°, for the final 55°–60°. The sections, 3–10 μ thick, were best stained with magenta-red and indigo-picrocarmin, safranin and indigo-picrocarmin, or safranin and light-green. After fixation in Bouin's fluid hæmatoxylin, followed by some contrast stain, such as picro-fuchsin or eosin, gave good results, as also did picro-indigo-carmin and Mayer's carmin.

Demonstrating the Autolysis of Mitoses.*—Ad. Oes treated the material (root-ends, young anthers, etc.) in the following manner: They were incubated at 32°–40° C. in toluol or chloroform water ($\frac{1}{8}$–$\frac{1}{2}$ vol. p.c.) with or without the addition of neutral salts (usually $\frac{1}{2}$ p.c. ordinary salt). Instead of toluol or chloroform-water, carbolic acid was sometimes used, and in place of NaCl, the nitrates of potassium and sodium were employed. In some cases small quantities of acids or alkalies were added. The best results were obtained at 38° C. with toluol water, to which $\frac{1}{2}$ p.c. NaCl was added. After $\frac{1}{2}$–24 hours the objects were fixed in various media, of which Kleinenberg's picro-sulphuric acid and the strong Flemming's mixture were mostly used. The material was stained with safranin and gentian-violet, Delafield's hæmatoxylin, Heidenhain's iron-alum-hæmatoxylin, fuchsin, acid-fuchsin, and others.

Bleaching Technique.†—P. Mayer mentions a commercial solution of peroxide of hydrogen which is a very powerful bleaching reagent. Mixed with water or alcohol it gives off oxygen copiously, and still more energetically on the addition of a little potassium iodide. The bleaching power was tested on natural pigment and on tissues blackened with osmic acid, and its action compared with that of other reagents, such as hydrochloric acid and potassium chlorate, chlorine water, and Alfieri's method.

Hydrogen peroxide has a great tendency to cause the section to be separated from the slide, especially when the action is energetic, as it is when mixed with water. If the diluent be alcohol, then the action is not sufficiently strong.

Alfieri's method consists in treating the sections with permanganate of potassium (1 : 2000) until they become brown, and then dissolving out the oxide of manganese which has been precipitated in the tissues with oxalic acid (1 : 300). The process is repeated if the bleaching is not sufficient. As the oxalic acid is not altogether harmless, it should not be allowed to act longer than is absolutely necessary.

Chlorine water is often simpler and more convenient in its application than the author's cherished mixture of hydrochloric acid and potassium chlorate.

All these solutions appear to act quite as well before the paraffin is removed from the section as after.

* Bot. Zeit., 1te Abt. (1908) pp. 89–117 (1 pl.).

† Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 353–6.

(3) Cutting, including Imbedding and Microtomes.

Broek's Simple Microtome for Serial Sections.*—A. J. P. v. d. Broek, as the result of several years' experience, highly recommends the following instrument as being simple in construction and easy in manipulation. Fig. 135 shows the microtome as seen from the left and slightly from the front, fig. 136 is a longitudinal section, and fig. 137 is a horizontal section through *a b* in fig. 136. The instrument stands on a heavy cast-iron base which can be clamped down by a position-screw, 3. The trapezium-shaped slide, 4, is supported by two side pieces, 5, and a bar, 7, connects the slide with a crank, 6, whose movement imparts to

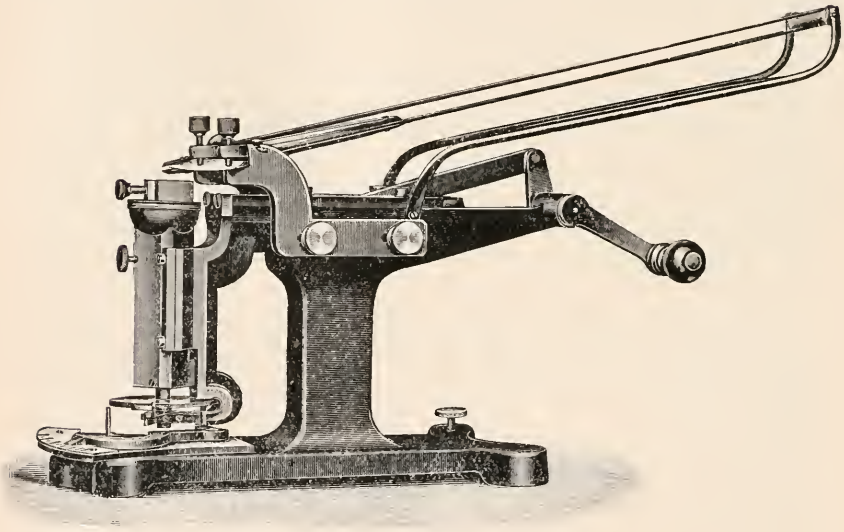

Fig. 135.

the slide the necessary backward and forward motion, and presses the object-holder against the knife. If the object is imbedded in paraffin, the paraffin is melted on to a brass plate, 26, which can be screwed on and off ; a celloidin preparation is fixed with a clamp (fig. 135). The hemisphere, 22, is hollow, and can by a special arrangement be fixed in any desired position, so as to give any suitable inclination to the preparation ; this effect being attained by a circular plate, 24, to whose lower side is attached a perforated rod. Through the perforation passes a kind of crank connected with the screw, 25, whose movement (see fig. 136) gives any desired inclination to the hemisphere. The sleeve, 9, containing the mechanism of the object-holder, rests on a micrometer-screw, 10, and is gripped on both sides by the rims, 8, of the frame. The micrometer-screw rests with its lower point on screw 13 and its upper end is fixed by the rod 14 ; the whole micrometer-screw is there-

* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 268–74 (3 figs.).

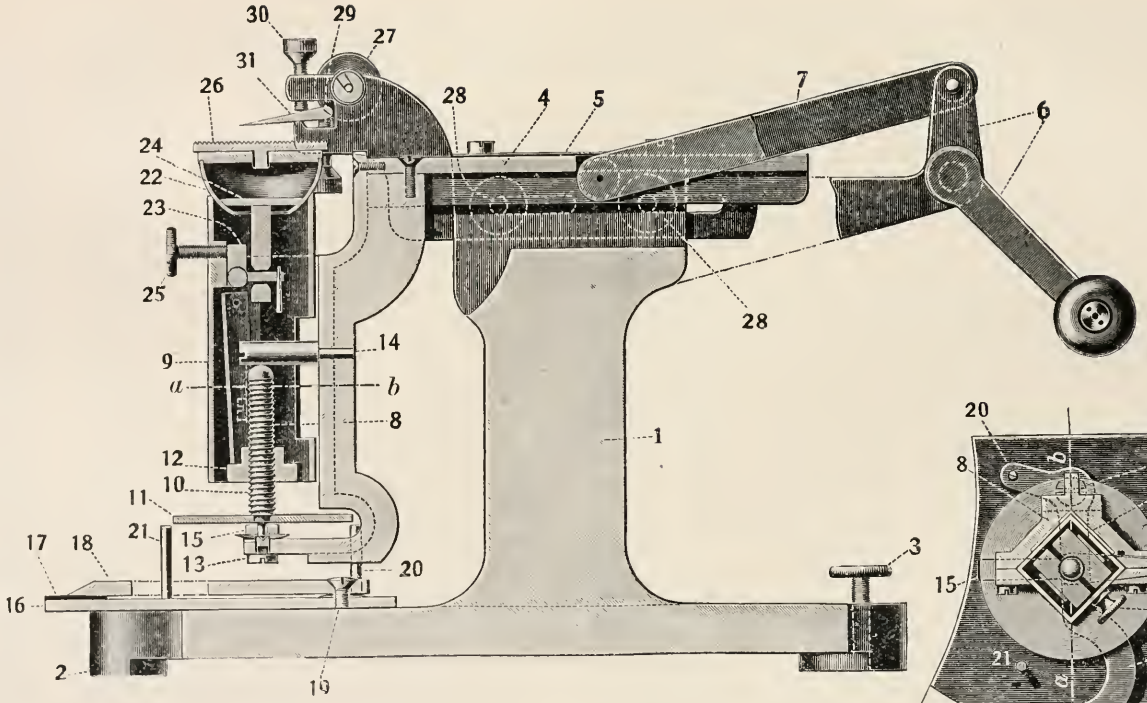

Fig. 136.

Fig. 137.

fore firmly connected with the frame 8. A cog-wheel, 11, is attached to the micrometer-screw, and under it is the rod 15, one end of which carries a small clutch which engages in the cogs. The apparatus 18, consisting of a bent bar rotatory about a plug screw, 19, is attached to the front part of the iron foot-plate. One end of this bar is set to the divided scale, 17, and regulates the thickness of the sections : the other end supports a vertical peg, 20. A similar vertical peg, 21, is set in the base-plate, and is shown in fig. 135. When the crank 6 is rotated towards the right, i.e. against the knife, the rod 15 at a certain moment strikes against the peg 20, whereupon the clutch 15*a* is urged back on the cog-wheel, the movement corresponding to the pre-arranged section-thickness. In the leftward movement of the crank 6 the object-carrier and object first pass the knife and then the bar 15 reaches the peg 21 and must halt. The end, 15*a*, of the same bar is then, by the further movement of the crank, pushed forward, and transfers its motion by the clutch to the cog-wheel 11, and so to the micrometer-screw. As this latter is fixed at both its ends, the sleeve fastened on it is movable, and is therefore slightly pushed upwards by an amount corresponding to the adjustment on the scale. An endless band can be attached to the instrument and made to receive the section-ribbon by rotating the handle 27. Screws 29 and 30 serve to slant the knife, a flat-ground razor, as required. The nut in which the micrometer-screw engages consists of two halves. If the knob 32 is rotated 90° then both these halves are separated and the whole sleeve 9 can be raised or depressed ; this arrangement is required at the commencement of operations so as to bring the object into proper position for the knife. The scale is so divided that the sections can be cut from 2 μ to 70 μ (even numbers).

(4) Staining and Injecting.

Staining Streptococcus mucosus.*—R. Hoffmann advocates the use of Jenner's stain for detecting and studying this organism when present in pure culture, or when associated with other organisms in purulent or other discharges, and especially for use for clinical purposes. Films are fixed and stained for two minutes in a methyl-alcoholic solution of acid eosin and methylen-blue, washed in neutral distilled water and dried. The bacterial body substance stains deep blue, the capsule light blue, and the mucus, adhering to the outer surface of the capsule, stains pale pink.

Demonstrating the Nervous System of Ascaris.†—D. Deineka finds that the methylen-blue-ammonium-molybdate method is the best for staining the nervous tissue of Invertebrates, the procedures of Golgi and Ramon y Cajal being quite useless.

Demonstrating Nerve-terminations in Teeth of Mammalia.‡—W. J. Law highly recommends Bethe's method for odontological work, and gives the following description of it as varied for use with teeth :—

"Small pieces of perfectly fresh tissue are fixed by placing upon

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 219.

† Zeitschr. wiss. Zool., lxxxix. (1908) pp. 242–307 (11 pls. and 7 text figs.).

‡ Proc. Roy. Soc. Medicine (Odontological Section) i. (1908) pp. 45–60 (7 figs.).

blotting-paper and covering with a 10 p.c. solution of commercial nitric acid. This serves to decalcify as well as to fix them, and also lessens the susceptibility of Nissl's granules to take the stain. They are left in the acid until decalcified (48 hours), and the acid is frequently changed so as to keep it of as uniform a strength as possible. They are then placed in 8 c.cm. of alcohol 90 p.c., 3 c.cm. of water, and 1 c.cm. of ammonia for 24 hours. If they turn brown, discard: this is due to impure nitric acid or too long immersion. Again place in alcohol for 6 to 12 hours, then in 1 c.cm. of HOl, 3 c.cm. of water, and 8 to 12 c.cm. of alcohol for 24 hours. Then alcohol again for 10 to 24 hours, distilled water for 2 to 6 hours (not longer), ammonium molybdate, 4 p.c., for 24 hours. Dehydrate as rapidly as possible and imbed in paraffin; cut sections as thin as possible; attach the sections to the slides with Meyer's albumin; wash out the paraffin with naphtha and alcohol; rinse the slide with distilled water; then cover the sections with distilled water and heat for 10 minutes at 50° to 60° C. The top of the imbedding bath is a very good place for this. Pour off the water and cover with toludin-blue 1 in 4000; replace in the paraffin bath for 10 minutes; dehydrate; clear and mount. Keep all the sections, and, if you are lucky, some of them will be found to have the nerve fibres duly stained."

Studying the Morphology of Spirochæta pallida.*—F. Krzystalowicz and M. Siedlecki wash open sores or ulcers with sterilised water or salt solution, but if the skin be unbroken the site of the lesion is cleaned with soap and water and then with the alcohol-ether mixture. A clear, slightly sanguinolent, fluid is obtained from open sores by squeezing the borders of the lesion. When the surface of the lesion is dry and intact, a blister may be raised by means of cantharides, ammonia, or chloroform, or even by heat. When the lesion is deep-seated, e.g. glands or gummata, juice may be withdrawn by means of a hypodermic syringe. However obtained, the juice is spread on a slide, dried in the air, and fixed with osmic acid vapour. Such films are stained with Giemsa (1 drop to 1 c.cm. of water) for several hours, and after washing with water are decolorised by immersion for several minutes in 25 p.c. tannin solution. After this they are again washed with water, while after this a rapid wash with absolute alcohol will not damage the staining and helps to clean up the preparation.

Instead of osmic acid, formol may be used for fixation; the results therefrom are not so good, but it has the advantage of allowing any staining method to be applied to the films.

Demonstrating Leucocytes in Tissues.†—H. Schridde fixes the material in formol-Müller, though other methods are also suitable. Thin paraffin sections (5 μ) fixed to the slide in the usual way are placed for 20 minutes in a solution consisting of Giemsa to 1 c.cm. of water. After washing in water they are mopped up with blotting-paper and then transferred to water-free aceton. After about a minute they are placed

* Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 173–234 (2 pls.).

† Zentralbl. f. Allgem. Pathol. u. Pathol. Anat., xvi. (1905) pp. 770–1. See also Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 212–14.

in acid-free toluol or xylol and mounted in neutral balsam. The preparations should be kept in the dark. It is claimed that by this method the leucocytes are demonstrable in post mortem material.

Staining Granular Red Corpuscles.*—F. Widal, P. Abrami, and M. Brulé fix blood-stains *intra vitam* in the following manner. A few drops of blood are received into a mixture consisting of 10 p.c. sodium chloride, 1 c.cm. 2 p.c. oxalate of potassium, 1 c.cm. Unna's blue or azur-blue 20 drops. After allowing the solution to act for some 10 minutes, the mixture is centrifuged and the deposit spread on slides and fixed by the aid of heat in the usual way.

Simple Method of Microbe Staining.†—A. Rosam recommends the following staining solution, composed of a mixture of $\frac{3}{4}$ safranin and $\frac{1}{4}$ methylen-blue. The pigments are first dissolved in alcohol, and this concentrated spirituous solution is further diluted with equal quantities of spirit and water. After this, 10 p.c. ammonia is added. The ammonia facilitates the penetration of the dye. In practice, a drop of the staining solution is placed on the slide which already carries the material to be examined. This latter has been moistened with water, and after a coverslip has been imposed, the preparation may be examined.

The staining solution easily deteriorates, and requires to be made afresh at least once a fortnight.

Simple Method of Spore Staining.‡—R. Wirtz fixes the films in osmic acid vapour and then floods the cover-slip with 5 p.c. malachite-green solution; heats to vaporisation and repeats the heating twice at short intervals. The film is then washed with carbol-fuchsin diluted five times and at once washed in running water. Treated in this way the rodlets are stained red and the spores pale green. The method is specially applicable to Tetanus.

Modification of the Romanowsky Stain.§—J. Bruckner dissolves by aid of heat 1 grm. methylen-blue in 100 c.cm. of distilled water; after cooling down, 15 c.cm. of decinormal soda solution are added, or 6 cgs. of sodium hydrate in powder previously dissolved in 10 c.cm. of distilled water. The mixture is incubated at 37° for five days to ripen the blue, and then 50 cgs. of eosin dissolved in 50 c.cm. H_2O are added. After being well shaken the mixture is allowed to rest for a couple of hours. The precipitate is gathered on a filter and then washed with 500 c.cm. distilled water. The filter with the precipitate is kept at 37° until dry (about 24 hours) and then the precipitate is dissolved in 100 c.cm. of methyl alcohol. After 24 hours the solution is filtered.

In order to stain blood 1 c.cm. of the stock solution is mixed with 5 c.cm. of methylic alcohol and poured over the dried but unfixed film, and after ten minutes 10–12 drops of distilled water are added. After a lapse of five minutes the film is washed with water, dried and mounted

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 496–9 (1 fig.).
† Centralbl. Bakt., 2te Abt., xx. (1908) pp. 724–5.
‡ Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) pp. 727–8.
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 968–9.

in thick cedar oil. Blood films may also be stained by the following method :—1 c.cm. of the stock solution is diluted with 20 c.cm. of distilled water, and the film which has been previously fixed in absolute alcohol immersed therein for 20–30 minutes, after which it is washed in water, dried and mounted in cedar oil. Rapid staining of *Treponema pallidum* may be effected by means of this stain in the following manner : 10 c.cm. of 5 p.c. glycerin are mixed with 10–12 drops of the stock solution. This mixture is boiled for a few seconds and poured hot over the preparation previously fixed in absolute alcohol. After 3 minutes the film is washed in water, dried and mounted in thick cedar oil.

Staining the Mycelium of the Dry-rot Fungus.* — W. Ruhland fixes the material for a few minutes in 0·8 p.c. chromic acid, to which 1 p.c. acetic acid is added, and then washes for 2–3 hours. The objects are then mordanted 6–24 hours in 1·5 p.c. iron-alum solution, and then heated with a formal hæmatoxylin solution of the following composition : 1 grm. hæmatoxylin crystals, 200 c.cm. distilled water, 4 c.cm. formalin. The solution is shaken and filtered. The mycelium flakes may remain herein for 12–24 hours, though less may suffice. After washing again, they are differentiated in 0·5 p.c. iron-alum solution. This takes a few minutes to half an hour. Then washing in water, alcohol, xylol, balsam. The plasma is bluish; the nuclei, bluish-black to black.

Theory of the Gram Staining Method.†—V. Brudny made an elaborate investigation as to the why and wherefore of the Gram staining reaction. He finds that it is due to the specific permeability of Gram-positive bacteria to iodine. This expresses in other terms that for certain bacteria the lugol solution acts as a mordant, and that the alcohol decolorises or not, though it must be admitted that there are intermediate stages in the reaction.

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

Technique of the Water Method of Sticking Paraffin Sections on the Slide.‡—J. F. Gudernatsch washes the slide with some good potash soap under the tap, and then picks up the section, which has been floated on the surface of water in a bowl. After arranging the section, the superfluous water is poured off ; the slide, covered with something to protect from dust, is placed in an incubator until all the water has evaporated. In this way the sections are not only flattened out, but are stuck on, and it only remains to dissolve out the paraffin in the usual way, and then pass the sections through the ordinary staining and other fluids. If there be any need for hurry, the sections, when arranged on the slide, may, instead of being placed in the incubator, be mopped up, and at the same time flattened out by means of blotting-paper. Then, after a stay of about 3 minutes in the incubator, the sections will be found to have adhered. This procedure, however, is frequently not so successful as the one previously described.

* Arb. biol. Anstalt. f. Land. u. Forstw., v. (1907) p. 492.
† Centralbl. Bakt., 2te Abt , xxi. (1908) pp. 62–79.
‡ Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 357–60.

Metallography, etc.

The Metallic Sulphides PbS, Cu_2S, Ag_2S, FeS.—K. Friedrich * has attempted an investigation of the equilibrium diagrams of the alloys of these sulphides with sulphur. He gives the melting points ($\pm 10^\circ$ C.) as PbS 1120° C., Cu_2S 1135° C., Ag_2S 812° C., FeS 1171° C. The solidification of all the alloys, including the pure sulphides, takes place through a considerable temperature interval. PbS, Ag_2S, and FeS do not appear to correspond to maxima in the solidification point curves. It might be inferred from these results that none of these four sulphides do in fact correspond to definite chemical compounds. The technical difficulties of investigation, however, are great, and the abnormal results may perhaps be explained otherwise.

Solubility of Graphite in Iron.†—C. Benedicks discusses the form of the equilibrium diagram of the stable iron-graphite system, from 0–2 p.c. carbon. Heyn's view is that graphite is completely insoluble in iron in the solid state, while Ruer's diagram indicates complete insolubility below a line running from 1000°C. at 0 p.c. carbon to 1140° C. (the eutectic temperature) at 2 p.c. Earlier workers put the limiting temperature much lower. The author gives some experimental results, and indicates the desirability of accurate determinations of the direction of the curve.

Crystals of Diamond and Carborundum in Steel.‡—D. C. Tschernoff in 1868 found small transparent crystals in an ingot of tool steel. A recent examination of some of the same crystals and the steel by F. Osmond has led him to believe they are carborundum.

Nickel-bismuth Alloys.§—A. Portevin gives a more complete account, with diagrams and photomicrographs, of his determination of the equilibrium diagram.‖ After pointing out how incomplete reactions occurring during the cooling of an alloy interfere with the application of thermal analysis, the author describes the experimental work, the results of which point to the existence of two successive and incomplete reactions in the nickel-bismuth system. These may be expressed by the equations—

(1) At 654° C.: liquid with 6·5 p.c. Ni + Ni $\rightleftarrows$ Ni Bi (?)

(2) At 462° C.: liquid with 3 p.c. Ni + Ni Bi ? $\rightleftarrows$ Ni Bi_3

At 269° C. the eutectic Bi – Ni Bi_3 forms.

Bromine water was used as an etching reagent.

Alloys of Silver.¶—This is the first of a series of papers by A. Portevin, in which is to be given an account of the researches on alloys carried out since 1904 in the laboratories of G. Tammann, at Göttingen, and of Kurnakow at St. Petersburg. The industrial metals will be taken in alphabetical order, and the various investigations of the

* Metallurgie, v. (1908) pp. 23–27, 50–8 (9 figs.).
† Tom. cit., pp. 41–5 (10 figs.).
‡ Rev. de Métallurgie, v. (1908) pp. 79–80 (1 fig.).
§ Tom. cit., pp. 110–20 (8 figs.). ‖ See this Journal, 1908, p. 124.
¶ Rev. de Métallurgie, v. (1908) pp. 144–66 (32 figs.).

alloys of any one metal grouped together. Though the work has all been published elsewhere * the collection in a more compact form of the accurate data obtained should prove useful.

Constituents of Steel.†—H. le Chatelier attempts a much needed definition of the constituents of the iron-carbon alloys. They are classified as elements (ferrite or pure iron, and graphite or pure carbon), compounds (cementite Fe_3C is the only example), solid solutions, aggregates, and possibly emulsions or colloidal solutions. The allotropic varieties of iron may also be classed as constituents. Two solid solutions are known, austenite (carbon, or carbide of iron, in γ-iron), and martensite (the same in α-iron). As constituent x, the nature of which is doubtful, the author deals with troostite, osmondite, troosto-sorbite, and the sorbite of Stead. Its general characteristic is that of assuming a deep black coloration upon etching with dilute acids. Constituent x may be a solid solution or an aggregate of very finely divided elements. The work of Charpy and Grenet would indicate that it is a very intimate mixture of ferrite and cementite. Pearlite and the sorbite of Osmond (incompletely formed pearlite) are aggregates, composed of ferrite and cementite. The part played by β-iron, and the constitution of x, are still open questions.

F. Osmond ‡ points out that the hard austenite obtained by some workers is in reality martensite. As to the constitution of martensite, its magnetic behaviour indicates that the whole of the iron is not in the α state, probably the remainder is β, while the carbon exists as a pseudo-solution. Stead appears to use the term sorbite in the same sense as Osmond. Constituent x may be identified with troostite.

Metallography at the National Physical Laboratory.§—The annual report contains a section describing the year's work in the metallurgical department. As a preliminary to the investigation of the ternary system aluminium-copper-manganese, the binary system aluminium-manganese has been studied. The alloys containing 30–65 p.c. manganese disintegrate spontaneously from the solid cast state into a fine crystalline powder. The results of the inquiry into the various methods of obtaining cooling curves have been published elsewhere. Crystalline silica has a well marked recalescence at 580° C. For the research on eutectic alloys the lead-tin system was chosen. Equilibrium was reached only by exposure of the alloys to a temperature of 175° C. for several weeks. The limit of solid solubility of tin in lead appears to lie near 17 p.c. tin—a much higher percentage than has hitherto been supposed. Oxide of chromium was found to give good results in the polishing of very soft metals. Some progress has been made in the photomicrography of metal sections by ultra-violet light; the Zeiss apparatus is described. Monochromatic blue light may be used for approximate focusing and for the other preliminary adjustments. The difficulties of the method are, however, serious, and sharp photographs at high magnifications have not yet been obtained.

* Zeitschr. Anorg. Chem., 1904, to present date.
† Rev. de Métallurgie, v. (1908) pp. 167–72. ‡ Tom. cit., pp. 205–6.
§ National Physical Laboratory Report for 1907.

Influence of Phosphorus on the Iron-carbon System.*—F. Wüst prepared and examined 30 alloys containing phosphorus, increasing from 0·02–21·56 p.c. and saturated with carbon in the molten state. The temperature of commencement of solidification is progressively lowered by increase of phosphorus up to 6·7 p.c., about 27° C. for each 1 p.c. phosphorus. Further additions raise the freezing-point. A pause in the cooling curves at 950° C. is due to the presence of phosphorus; it increases in intensity up to 6·7 p.c., then diminishes, and finally disappears at 15 p.c. (Fe_3P). At this percentage Ar 1 also vanishes; it is diminished in intensity though unchanged in position by smaller phosphorus additions. The solubility of carbon in iron is diminished by phosphorus. A ternary eutectic occurs in the iron-carbon-phosphorus system, phosphorus 6·7 p.c., carbon 2·0 p.c., iron 91·3 p.c., melting point 950° C. Its existence and that of the compound Fe_3P are amply confirmed by microscopic examination. A combined heat-tinting and etching method was used. Some reproductions of Lumière colour photomicrographs of sections treated in this way are given, in which the constituents of the ternary eutectic are clearly differentiated.

Solidification and Melting of Cast-iron.—To determine at what stage in the cooling of molten cast-iron the formation of graphite occurs P. Goerens and N. Gutowsky† have quenched two pure cast irons (carbon 3·91 and 4·72 p.c. respectively) at different temperatures, both rising and falling, and studied the micro-structure. Cooling and heating curves were also taken. The authors conclude that graphite formation in pure cast-iron takes place during the eutectic solidification interval. The longer the duration of solidification of the eutectic, the more abundantly is graphite formed. The graphite crystals are larger the more slowly they are formed. The eutectic forming on solidification is cementite-mixed crystals; graphite results from the decomposition of this cementite. These conclusions (agreeing with Wüst's) are supported by an interesting series of photo-micrographs.

Binary Systems, Platinum-arsenic and Bismuth-arsenic.‡—K. Friedrich and A. Leroux have determined the equilibrium diagrams for the ranges 72–100 p.c. platinum and 85–100 p.c. bismuth. Arsenic-rich alloys were not investigated. The first diagram points to the existence of a eutectic melting at 597° C., containing about 13 p.c. arsenic. Possibly the compound Pt_2As_3 occurs. There appear to be no mixed crystals. The diagram of the bismuth-arsenic system consists of two horizontal lines, one at 267° C. (melting-point of bismuth), and one between 480–490° C.

Cobalt-arsenic Alloys.§—K. Friedrich has determined the equilibrium diagram for the range 0–53·5 p.c. arsenic. The compounds are Co_5As_2 (α and β modifications) Co_2As, Co_3As_2, and possibly CoAs. The pure cobalt used melted at 1494° C. The diagram is too complex for brief description.

* Metallurgie, v. (1908) pp. 73–87 (38 figs.).
† Tom. cit., pp. 137–47 (32 figs.).
‡ Tom. cit., pp. 150–7 (27 figs.). § Tom. cit., pp. 148–9 (7 figs.).

Specific Heat of Iron-carbon Alloys.* — P. Oberhoffer and A. Meuthen have introduced some important improvements into the apparatus previously described.† A repeat determination gave a somewhat lower value for the specific heat from 0°–650° C. of the nearly pure iron used ; this causes the bend in the curve at 650° C. to be sharper. The mean specific heat of iron between 0 and 650° C. is raised by about 0·0011 by the addition of 0·5 p.c. carbon. The increase in specific heat is proportional to the percentage of carbon. The mean specific heat of pure iron is 0·1432 ; that of carbide of iron 0·1581, between 0 and 650° C.

Use of the Differential Galvanometer.‡—A. Portevin contributes some notes on the double galvanometer, and its use in taking heating and cooling curves. By theoretical reasoning he arrives at the conclusion that, if certain conditions be fulfilled, the amount of heat liberated is proportional to the horizontal distance of the point of the curve (showing difference of temperature) corresponding to the end of the liberation of heat, from the continuation of the part of the curve corresponding to the absence of critical points. A method of increasing gradually the current supplied to an electric furnace by increasing automatically the cross-section of a liquid resistance, is described. Great uniformity of heating may thus be obtained. A convenient method of standardising the pyrometer is given.

Influence of Nitrogen on Steel.§—A. Grabe states that Braune's method of estimating nitrogen gives too high results, due to the presence of nitrite in the potash. Estimations made by the author gave the following figures :—

12 Swedish bar irons ...	...	0·0020–0·0045
38 steels (miscellaneous)	...	0·0025–0·0125
20 cast irons (miscellaneous) ...		0·0010–0·0065

The author is of opinion that the minute percentages found in wrought and cast iron cannot have the least influence on quality. It is doubtful if percentages less than 0·015 in steel can have a harmful effect.

Phosphoric Steels.‖—J. de Kryloff has studied more than 250 samples of steel which have failed in use. The steels which contained much phosphorus showed a marked inequality in the distribution of carbon. Low carbon areas, constituted chiefly of ferrite grains high in phosphorus, were seen in the micro-sections. The author concludes that when the percentage of phosphorus does not exceed 0·07, a uniform structure may be obtained by suitable heat treatment ; but when more phosphorus is present, the initial heterogeneity persists after heat treatment.

* Metallurgie, v. (1908) pp. 173–7 (3 figs.).
† See this Journal, 1907, p. 757.
‡ Rev. de Métallurgie, v. (1908) pp. 295–305 (9 figs.).
§ Tom. cit., pp. 353–4. ‖ Tom. cit., pp. 355–60 (19 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Engel's Cross-stage with Automatic Adjustment.†—This apparatus (fig. 139), made by E. Leitz, is intended to facilitate the examination of sections and other objects arranged on the stage in rows and to lessen the attention which the observer usually has to bestow in order to insure that he does not pass by mistake from one row to another. The designer substitutes mechanical movement for ocular control. For this purpose he applies to an ordinary cross-stage a spindle screw connected with a toothed wheel of 50 teeth; the wheel having a lever and ratchet

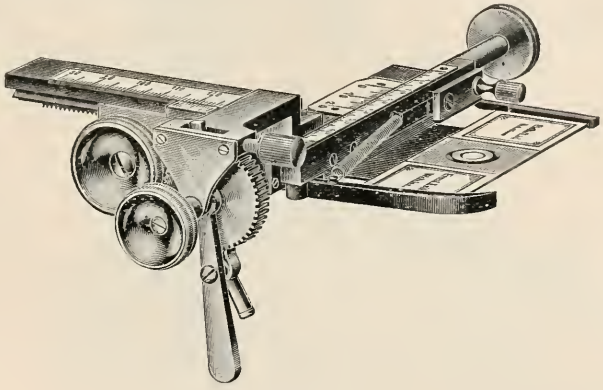

Fig. 139.

of two teeth by means of which a backward and forward movement can be imparted to the stage. The toothed wheel can be moved through as many teeth as desired. Thus when a horizontal row has been examined by rotation of the spindle screw, the lever movement will automatically bring another row under observation.

Improvements in the Ultra-violet Microscope.‡—W. T. Swingle and L. T. Briggs give a short historical sketch of ultra-microscopy with especial reference to Köhler's important introduction of quartz lenses and cadmium spark. As the ultra-violet light of the cadmium spark is absolutely invisible to the eye, Köhler devised a "seeker" consisting of a quartz lens and a fluorescent screen placed over the eye-piece. This

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

† Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 60–2 (1 fig.).

‡ Science, xxvi. (1907) pp. 180–3 (2 figs..

screen lights up under the action of the ultra-violet rays, and focusing is then possible. Focusing high-power monochromatic objectives is, however, tedious and difficult; but the authors consider that they have devised a great improvement in this respect. Instead of employing a single pair of electrode holders, they recommend a double pair (four in all) arranged so that the cadmium electrodes can be instantly swung out and replaced by a pair of magnesium electrodes by means of

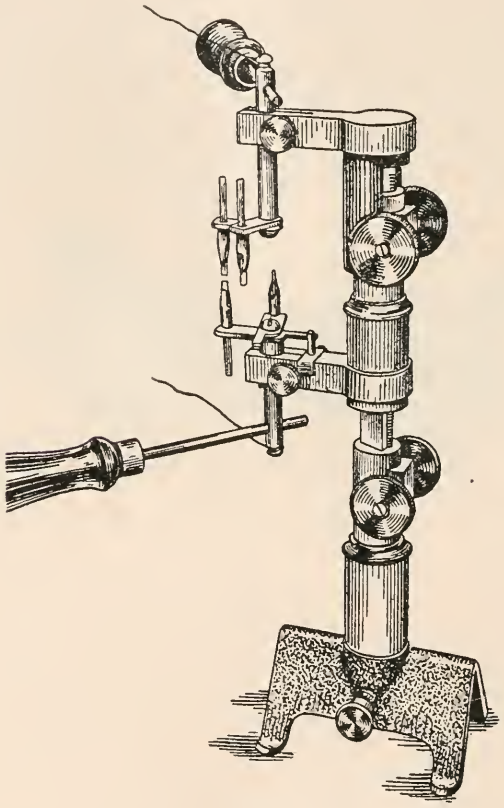

Fig. 140.

the handles shown in fig. 140. The cadmium eleotrode holders are longer than those for the magnesium, for a purpose explained later. There is an automatic stop on the lower pair of holders to insure the spark gap falling in the axis of the collimator lens. The swing-out electrode changer was suggested by the discovery that the monochromatic lenses, though giving only badly blurred and coloured images with ordinary light, did give very good images that could be focused sharply even to the finest detail providing strictly monochromatic visible light

were used. The object is, therefore, first found and centred with a low-power visual lens, using the magnesium blue light. Then the high-power monochromat is used and the spot found which it is desired to photograph. The camera is then moved into place, and the objective must be adjusted for the change from magnesium to cadmium light; this adjustment must be determined by trial and noted for future use. By making the arms of the magnesium electrode holders 5·5 mm. shorter than those for the cadmium, it was found possible to bring the blue light and the ultra-violet rays to a focus at the same distance beyond the prisms and the collector lens though not in the same spot, as the ultra-violet rays are refracted much more than the blue rays in passing through the prisms. It is found very advantageous to be able to do all the exploratory and focusing work with blue light and then to apply the ultra-violet light merely for the few seconds necessary for photography. Moreover, owing to the greater precision in focusing, it will be no longer necessary for the biologist to equip himself with a whole series of expensive monochromats.

Reichert's Movable Mechanical Object-stages.*—One type of these auxiliaries is shown in fig. 141. The two adjacent rack screw-heads

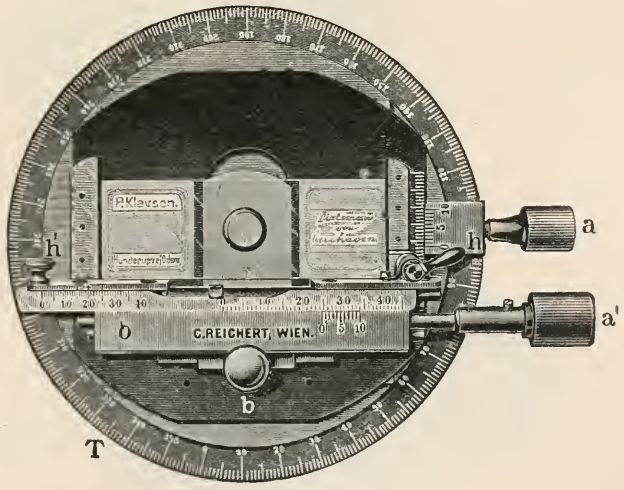

FIG. 141.

a a' act in such a way that the object can be easily and safely moved in two mutually perpendicular directions. Both co-ordinate edges are graduated and provided with verniers for convenience of orientation and for recovery of known positions. The circular periphery is radially divided. By lifting up the screw *b* the centre object-holder can be removed, so as to admit of the insertion of culture dishes. This stage is only applicable to stands A I and A Ic.

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) pp. 42–3, figs, 30, 32, 33

Another type is shown in fig. 142, and is only applicable to stands with rectangular stages. The movable stage is secured by two screws to the ordinary stage.

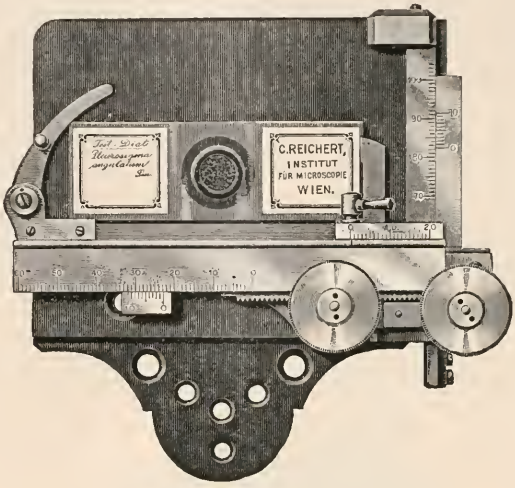

Fig. 142.

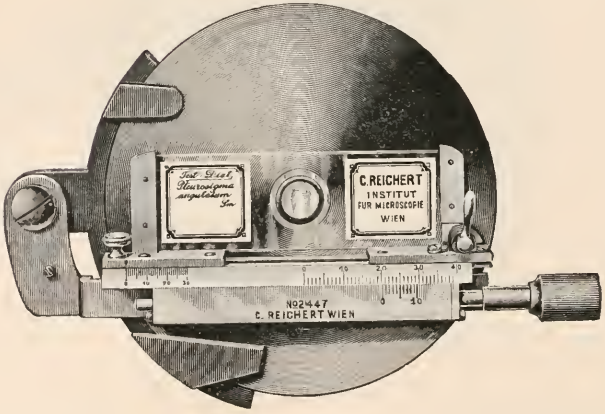

Fig. 143.

A third type is shown in fig. 143, and is only intended for stands fitted with strong circular brass stages. It will be noted that the transverse movement is mechanical, and that the vertical is by action of the jointed arm.

Reichert's New Large Stand B.*—This (fig. 144) is a little smaller than stand A ii by the same firm. It has a new horizontally-placed,

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 20, fig. 8.

and on its upper side protected, micrometer movement, with lateral action. The object-stage (110 mm. diameter) is circular and rotatory, and has centring screws. The instrument is fitted with Abbe's illuminating

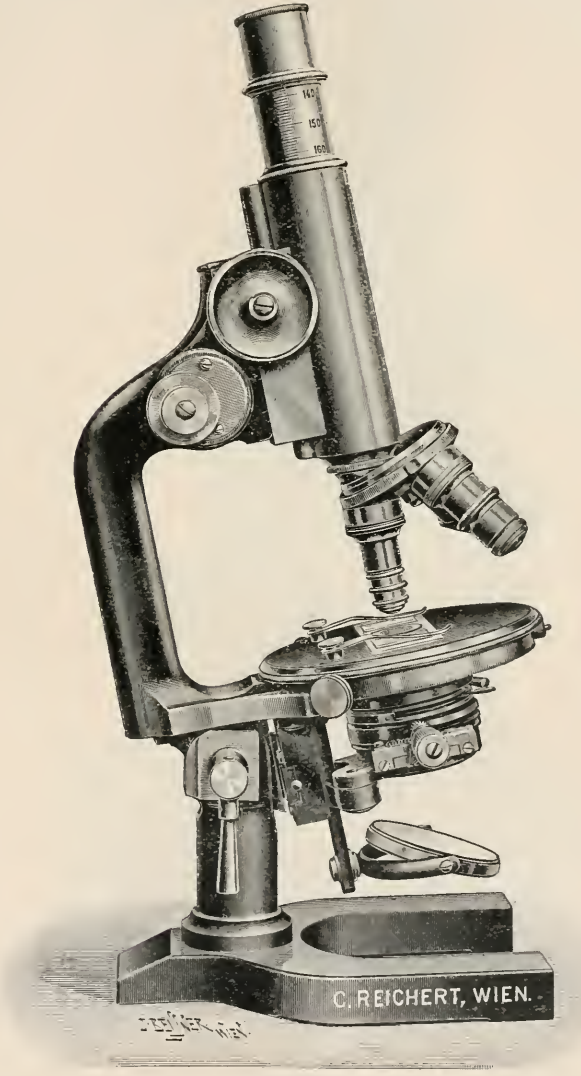

Fig. 144.

apparatus, with iris-diaphragm, and rack-and-pinion for raising and lowering the illuminating apparatus. The tilting is regulated and clamped by a lever.

Reichert's New Medium Mineralogical Stand A iii c.* — This stand (fig. 145) corresponds in general design to stand C (*vide supra*), with rotatory object-stage, divided into 360 degrees, and vernier readings to

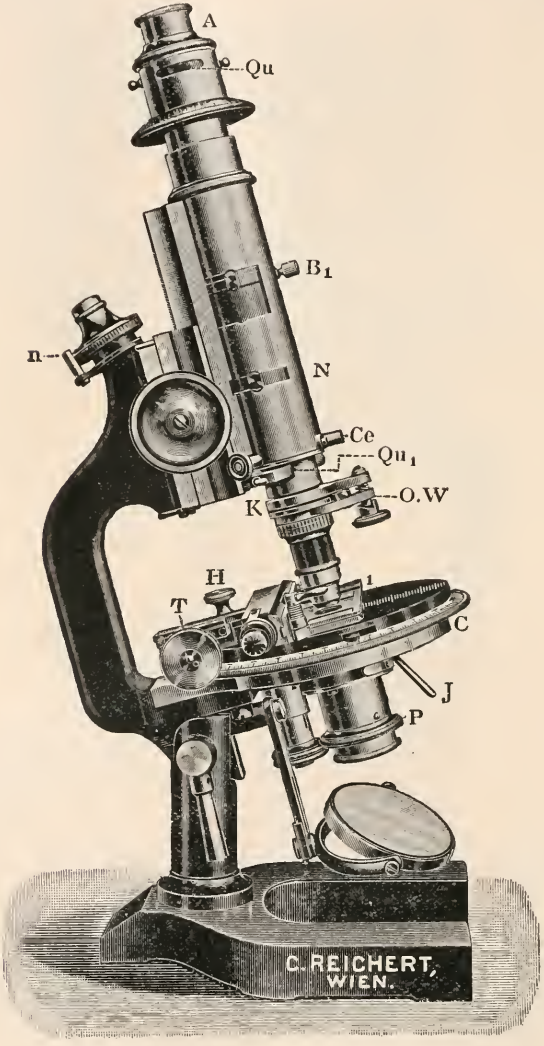

Fig. 145.

0·1°. It has cross-graduations for orientation of known preparations. The polariser is easily rotatory, and can be adjusted up and down by a screw; the four quadrants of rotation are marked by the engaging of a

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 39, fig. 26.

spring-tooth. There is an iris-diaphragm, and a removable illumination system. The analyser can be put in and taken out without interference with the adjustment of the instrument. There is a second analyser over the ocular, with a circumference divided into 360 degrees. The instrument has a quartz plate and an opening for inserting a quartz wedge. It is also equipped with Bertrand lens, Glans prisms, and an object-centring arrangement.

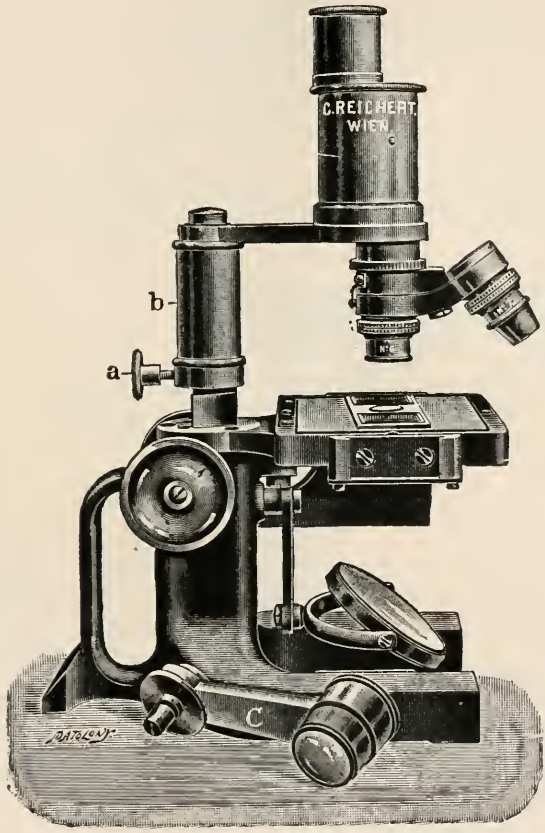

Fig. 146.

Reichert's Large Stand, A1.*—This stand, which was figured and described in this Journal for 1905 (p. 241) is now made with a graduation on the limb, to assist in the focusing of high-power objectives and to prevent injury to slides.†

Reichert's New Preparation Microscope.‡—This Microscope, listed as No. 131, has a prism tube (fig. 146), with erecting Porro-prisms

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 16, fig. 6.

† It is interesting to note that limb-graduation was first introduced by John Marshall in 1704.—Ed.

‡ C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 47, fig. 40.

and Ramsden ocular. The tube can be applied to several patterns of preparation stands supplied by the firm.

Photomicroscope for Ultra-violet Rays and its Significance for Histological Investigations, especially of Hard Structures.* — W. Dreck fully describes his methods, which seem to have been very successful. He gives several photographic plates of diatoms and of sections of teeth and bones.

MARX, H.—**Ein handliches Obduktionsmikroskop.**
Zeit. f. Medizinalbeamte Jahrg., xx. (1907) No. 21, pp. 744–5.

(2) Eye-pieces and Objectives.

Reichert's Spectral-ocular.†—This ocular (fig. 147) is due to Abbe, and has the prisms arranged rectilinearly. By means of a spiral movement the ocular lens can be focused accurately upon the slit which can

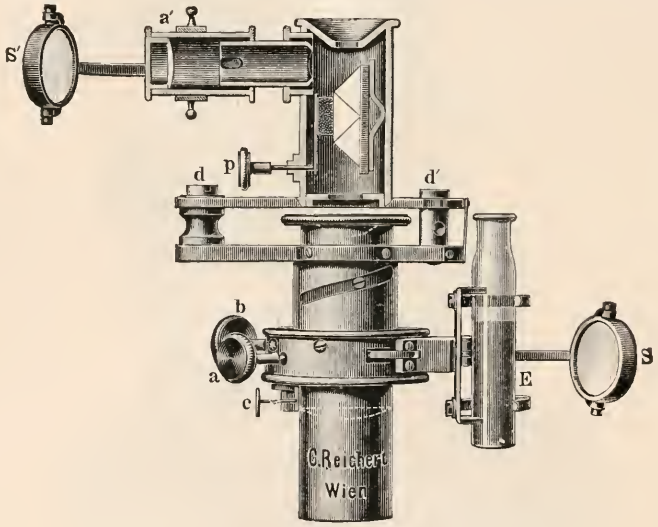

FIG. 147.

be regulated both in breadth and height. There is a comparison prism, a lateral stage, and illuminating mirror, as well as a measuring apparatus for Fraunhofer's lines.

Reichert's Index-ocular.‡ — This auxiliary, constructed after Bourguet's design, is shown in fig. 148. Its peculiarity consists in the externally adjustable index by means of which any point in the field of

* S.B. Gesell. Naturf. Freunde, 1906, No. 4 (April) pp. 108–25 (18 figs.).
† C. Reichert, Vienna, Catalogue, Mikroscope, p. 58, fig. 56.
‡ Tom. cit., p. 60, fig. 60.

view can be designated. It is especially adaptable for class-work, where the teacher wishes to demonstrate to his pupils.*

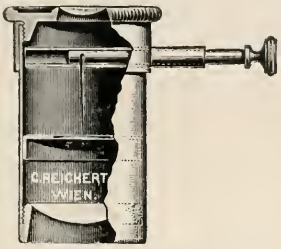

Fig. 148.

Reichert's Goniometer-ocular.†—This (No. 94 in maker's catalogue) is represented in fig. 149, and is intended for the measurement of angles of crystals.

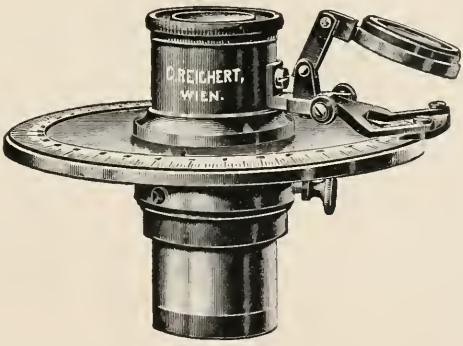

Fig. 149.

Reichert's Objective.‡—The 8 mm. objective of the Hart apochromat series has been increased in N.A. from 0·5 to 0·6. There is also a general reduction of prices. Among the achromats there is a new $\frac{1}{6}$ in. water immersion of N.A. 1·10–1·15; and among the semi-achromats a new $\frac{1}{10}$ in. homogeneous immersion of N.A. 1·3.

(3) Illuminating and other Apparatus.

New Easily Legible Micrometer Divisions.§ — Gebhardt has, with the help of the Zeiss firm, designed a micrometer with a novel style of graduation to lessen the difficulties felt in the application of the ordinary pattern to uncoloured objects, and to minimise the fatigue frequently experienced in continuous observations. The new ideas are

* It is noteworthy that this device is due to Quekett. See Quekett on the Microscope, first edition (1848) p. 130, fig. 91.—Ed.

† C. Reichert, Vienna, Catalogue, Mikroscope, p. 42.

‡ Tom. cit., pp. 11–12.

§ Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 366–9 (2 figs.).

shown in figs. 150 and 151, which represent respectively fine and coarse graduations. It will be observed that the ordinary strokes are replaced by small squares placed cornerwise. The squares may be black or red. Dr. Gebhardt speaks very favourably of his trials with these micrometers, and describes which of Zeiss' oculars he found most suitable for them.

Fig. 150.

Fig. 151.

Apparatus for Measuring Micrometer Levels.*—M. Gouy, in his investigations on the surface tensions of large drops, has found the cathetometer unsuitable for small measurements, and has contrived a micrometric method of measurement. His Microscope, provided with a thread micrometer, rests by its three feet on a polished, plain, and horizontal disk of glass. The Microscope is perfectly horizontal, and can be raised and lowered. A closely divided vertical glass scale is so arranged as to be also in the field of view. A point, A, on the micrometer can be thus identified on the scale, and the relation between A and the scale zero be obtained. This operation repeated on other points gives the differences of level desired. The author gives full practical explanations, and states that the probable error of observation is only about $0{\cdot}043\mu$.

Greenman, M. T.—**A New Laboratory Projection Apparatus.**
Anat. Record, No. 7, 1907.

Seibert, W. & H.—**Dunkelfeldkondensor und Dunkelfeldblende.**
Zeit. f. angew. Mikr., xiv. (1908) p. 4.

(4) Photomicrography.

Interference Fringes produced by Photographs in Colours.†—M. E. Rothé describes some observations on the above, sometimes called Talbot's False Fringes. It is well known that an interferential photograph illuminated by white light, and seen by reflection from the glass side, exhibits fringes extending over the whole spectrum, from the red to the violet. When the sensitive emulsion has been spread on a perfectly horizontal glass the fringes are arranged almost parallel to the spectral rays; but if the gelatin layer varies in thickness, the fringes are more or less inclined to the rays. These fringes can be more easily studied in proofs obtained without mercurial mirror, for the colours are

* Comptes Rendus, cxlvi. (1908) pp. 1191–3.
† Op. cit., cxlvii. (1908) pp. 43–5.

then less dazzling than those of mercurial photochromes. The author has systematically studied fringes due to deposits of silver by stationary waves. He shows that if the gelatin surface were absolutely parallel to the glass, the appearance, seen from the glass side, would be only a uniform tint due to the aggregation of strata of wave-length λ. But, practically, perfect parallelism is never obtained, and hence numerous gelatin surface planes must cut the glass plane. This fact, he shows, is sufficient to account for the effect produced.

Photography of Very Translucent Diatoms at High Magnifications.*—The President of the Quekett Club, after describing the difficulties encountered in the above research, recommends the following method. A first negative being taken on a rapid plate, say at some thousand or more diameters, is developed, preferably with hydrokinone, to obtain as much contrast as possible. If it is a good one, showing the dots or secondary markings sharply focused, it is left to dry. When examined it will be seen to show the veil which causes so much difficulty ; perhaps such will be well seen around the dots, and will give them the appearance of being immersed in a bath of fog. Perhaps the print may show this defect more definitely than the negative itself. A fast plate is then placed in contact (such a one as the " Flashlight " of the Imperial Company), and the printing frame is waved once before a 16 c.p. electric lamp, or some other powerful illuminant, placed about 2 ft. away. This is developed as if it were a negative, i.e. by time. The result is a very well exposed and developed positive, and not a very thin and transparent one. The dots appear very plainly and sharply focused, but there is a decided fog over the whole picture. This is specially noticeable between the dots, and serves to muddle them up in a very disappointing way. When dry, a copy of this is made upon a slow plate, such as a process or a lantern-plate, and again developed by time. This becomes the second negative. Even a cursory glance shows at once how much brighter it is than the first taken direct from the object ; but when the print or lantern-slide is taken from this the improvement becomes very apparent.

(5) Microscopical Optics and Manipulation.

WHITTAKER, E. T.—**The Theory of Optical Instruments.**
Cambridge: University Press, 1907, viii., 72 pp.

(6) Miscellaneous.

Influence of the Medium on Brownian Movements.†— V. Henri studied these movements by means of photomicrographs obtained kinematographically with magnifications of 600 diameters. The medium used was diluted latex, to which were added increasing quantities of hydrochloric or acetic acid, of soda, urea, and alcohol. The results obtained were that the Brownian movements are slowed by the addition of a coagulating agent before the phenomena of coagulation are apparent,

* Journ. Quekett Micr. Club, 1908, pp. 243–6.
† Comptes Rendus, May 18 and July 6, 1908.

In the presence of an alkali these movements are twice as slow, and in the presence of acid are nine times feebler than in distilled water.

Felgentrager, W.—**Eine einfaches Methode zur Bestimmung der periodischen Fehler von Mikrometerschrauten.**
Verhandl. d. Deutsch. Physik. Gesell., ix. (1907) p. 251.

Hager, H.—**Das Mikroskop und seine Anwendung.** (Zehnte, stark vermehrte Aufl. 463 figs.) Berlin: Jul. Springer (1908) 444 pp.

Jagie, N. v.—**Atlas und Grundriss der Klinischen Mikroskopie mit Berücksichtigung der Technik.** Wien: M. Perles, 1908.

Kaiser, W. — **Die Technik des modernen Mikroskopes.** (Zweite, gänzlich umgearb. Aufl., mit vielen Abbild.) Wien: M. Perles, 1908.

Kitt, Th. — **Bakterienkunde und pathologische Mikroskopie für Tierärzte und Studierende der Tiermedizin.** (Fünfte, wiederholt verbess. u. umgearb. Aufl.) Wien: M. Perles, 1908.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Colour Reaction for the Recognition of Bacillus typhosus.†—E. A. Kindbörg employs the following medium: neutral fleischwasser-agar 3 p.c. and lactose 5 p.c., heated in a water bath till completely dissolved; then add fuchsin, 5 c.cm. to 100 c.cm. of agar, and malachite-green, 4 c.cm. of a normal solution of 1 : 120, and plate out; the medium solidifies after 24 hours. A suspension of fæcal matter in salt solution or in broth is spread over the medium by means of a stout platinum loop. After 12–24 hours incubation the colonies begin to appear, and after 48 hours the decolorising reaction is well marked. The suspicious colonies are then submitted to further diagnostic tests.

Cultivating Bacillus typhosus and Bacillus coli.‡—H. Dunschmann has compared *B. coli* and *B. typhosus* with regard to the nutritive value of taurocholate and glycocholate of soda in combination with nutrose and malachite-green. The author finds that glycocholate does not increase the amount of growth of *B. typhosus*, but that taurocholate increases it considerably; on *B. coli* the influence of these two salts is intermediate to that on *B. typhosus*. Nutrose is a favourable nutriment for *B. typhosus*, but not for *B. coli*. Malachite-green exerts an antiseptic action on these two organisms.

Detection of Bacillus coli in Drinking-water.§—G. E. Gage, from a comparative study of media for detecting *B. coli*, draws the following conclusions. 1. Lactose neutral-red broth offers a good means of making

* 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.

† Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 554.

‡ Comptes Rendus, cxlvi. (1908) p. 1175.

§ Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) pp. 280–7.

presumptive tests for *B. coli*. 2. The bile-salt broth of MacConkey and Hill also is a good medium for making rapid tests when the organism is present in appreciable numbers. 3. The Smith solution is not so successful as the foregoing for rapid diagnosis. 4. Endo's medium is of inestimable value in determining the active presence of *B. coli*. 5. Lactose litmus-agar does not react readily to the small traces of acid produced by different strains of the colon bacillus.

Pipette-holder for Opsonic Work.*—E. C. L. Miller has devised a special holder for opsonic or other small-calibred pipettes (fig. 152).

FIG. 152.

The long handle gives a firm grip on the pipette, while the screw enables one to control the column of liquid very accurately. The glass pipette can be introduced into the soft rubber stopper as readily and quickly as

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) pp. 730–1 (2 figs.). See also Parke Davis and Co., Research Lab. Reports.

into a rubber nipple. In fig. 153 is shown a section of the pipette. 1 is the rubber stopper by means of which air-tight connections are made between the glass pipette 4 and the body of the holder 5*a*; 2 is the union by which the two parts of the pipette 5*a* and 5*b* are held together with the rubber diaphragm 6 firmly clamped between them. The screw-control 3 acts as follows: by turning the screw to the right, the disk 7 is lowered and the rubber diaphragm 6 made taut. Then a slight turn of the screw 3 to the left will draw liquids into the pipette, and a corre-

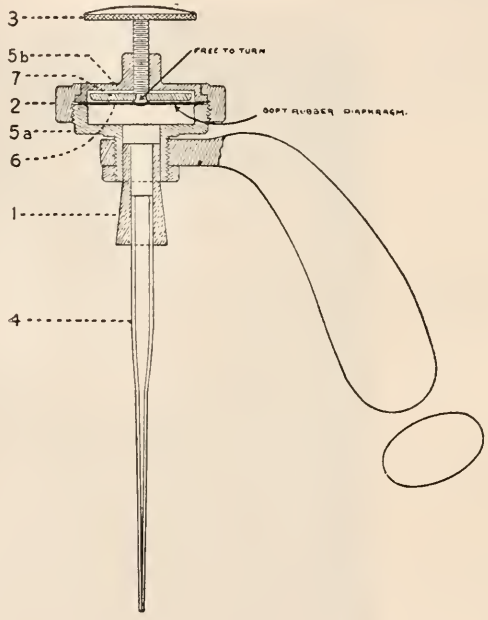

Fig. 153.

sponding turn to the right will expel them. The aluminium handle enables the fingers to obtain a firm grasp, leaving the thumb free to move the screw.

Plates for Growing Germs in Quantity.* — E. C. L. Miller uses enamelled pans 10 in. diam. and 1 in. deep. The cover consists of a round piece of wire screen of $\frac{1}{8}$-in. mesh, bound round the edge with tin. Over this wire mesh is placed a layer of cotton-wool, and over this a disk of thick paper. Under the wire screen a braid of coil cotton extends round the periphery. All these constituents are securely sewed together. These plates are sterilised by dry heat in the usual way, and afterwards melted agar poured on to form a suitable layer. Condensation-

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) pp. 731–2 (2 figs.).

water is absorbed by the cotton-wool. Inoculations are made in the usual way. By stacking these plates one on the other, considerable agar surface is secured. The covers with care may be used several times.

REIDEMEISTER, W.—**Ueber den Einfluss von Säure, usw. Zusatz auf die Festigkeit des Agars.** (Experiments showing the action of acids and other ingredients on nutrient agar.) *Zeitschr. wiss. Mikrosk.*, xxv. (1908) pp. 42–52.

RÖTHIG, P. — **Eine Verrichtung zum lebenswarmen Fixieren und lichten Transportieren der Eileitereier der Vögel.**
[Describes a box fitted with wide-mouthed stoppered bottles for supra-vital fixation and easy transport of birds' eggs.] *Tom cit.*, pp. 68–9 (2 figs.).

(2) Preparing Objects.

Studying the Eggs of Acanthodoris pilosa.*—B. Schaposchnikoff, when studying the eggs of *Acanthodoris pilosa* for the purpose of investigating the polycentric mitoses of maturation, fixed the animals during copulation. For this purpose he used sublimate-acetic acid and Gilson's fluid (sublimate-acetic acid, nitric acid, and alcohol). The fixed material was imbedded in paraffin and then sectioned. The sections were stained with iron-hæmatoxylin, either alone or after a previous staining with Bordeaux-red. Borax-carmin and Lyons-blue was also a good combination.

Demonstrating the Syncytial Appendages of Placental villi.†—W. L. H. Duckworth has found that the human placenta from the sixth or seventh month provides material for easily demonstrating the appearance of syncytial masses of protoplasm. Formalin-fixed material was treated with strong nitric acid (25 p.c.) for 3 days, and then after washing stained with Delafield's hæmatoxylin. After dehydrating and cleaning, the fragments were teased out on slides and mounted in balsam. Instead of Delafield's solution, borax-carmin (10 days) or a 10 p.c. solution of Grübler's hæmalum may be used. It was found later that the preliminary treatment with acid was unnecessary.

Examining the Nervous Elements of Osseous Fishes.‡—Anton Nemiloff used the following fixatives: chromo-acetic acid, Lenhossek's, Flemming's, Zenker's, and Hermann's fluids, trichlor-lactic acid, Carnoy-Gilson's mixture, and the silver method of Ramon-y-Cajal. The preparations were imbedded in paraffin, with bergamot-oil as clarifier, in celloidin, or more frequently in celloidin-paraffin. The stains most frequently used were safranin followed by light-green, iron-hæmatoxylin, toluidin-blue-erythrosin, Weigert's elastin staining, and some others. The observations on the fixed material were controlled by *intra-vitam* stainings with methylen-blue, the ganglia and nerves being stained *in toto* or by means of sections of fresh tissue in elder-pith.

Examining the Eggs of Ornithorhyncus.§—J. T. Wilson and J. P. Hill remark that, while it is relatively easy to manipulate the

* Anat. Anzeig., xxxii. (1908) pp. 369–85 (18 figs.).
† Proc. Camb. Phil. Soc., xiv. (1908) pp. 425–7 (7 figs.).
‡ Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 1–46 (2 pls.).
§ Phil. Trans., Series B, cxcix. (1908) pp. 31–168 (17 pls.).

earliest and latest stages of the uterine egg, the treatment of the intermediate condition, represented by the cellular wall of a blastodermic vesicle with fluid contents, is difficult. In the earlier years of their research the material was fixed with picro-sulphuric or picro-nitric fluids; latterly, the authors have generally used picro-corrosive-acetic solution. They regard double imbedding in cedar-oil celloidin and paraffin as indispensable for embryological work of a critical character. The sections, after having been stuck on the slides with Mayer's albumen and thoroughly dried, were coated with a thin solution (0·5–0·75 p.c.) of celloidin to insure perfect adhesion. When the celloidin has set, the slides are placed in a mixture of 90 p.c. alcohol, to which 10 p.c. of chloroform has been added, and this chloroform-alcohol must be used whenever alcohol is required. The sections were stained as a rule with hæmatoxylin or hæmatein, and counterstained with eosin. In surface observation great advantage was derived from the use of the binocular stereoscopic Microscope. The paper is illustrated by numerous photomicrographs and some drawings.

Studying the Structure of Œdogonium.* — C. van Wisselingh fixed and hardened the material in Flemming's fluid, and afterwards macerated it in 20 p.c. chromic acid. After the chromic acid had been thoroughly washed out, the preparations were stained with brilliant blue extra.

Demonstrating the Spermatogenesis of Hornets.†—F. Meves and J. Duesberg fixed the material in Hermann's and Flemming's mixtures (1 p.c. platinum chloride or 1 p.c. chromic acid 15 c.cm., 2 p.c. osmic acid 2 c.cm., glacial acetic acid (1 c.cm.), which were diluted with an equal quantity of distilled water.

The sections were stained with iron-hæmatoxylin.

For demonstrating mitochondria some of the testicles were fixed in the following modification of Flemming's fluid (1 p.c. chromic acid 15 c.cm., 2 p.c. osmic acid 4 c.cm., glacial acetic acid 3 drops); and further treated by Benda's method thus:—1. After an hour's washing the material was placed for 24 hours in a mixture of equal parts acet. pyrolig. rectif. and 1 p.c. chromic acid. 2. For 24 hours 2 p.c. pot. bichrom. 3. After washing for 24 hours in up-graded alcohols to paraffin, material treated in this way was stained with iron-alizarin and crystal-violet, and differentiated with acid as follows:—1. The sections were placed for 24 hours in a 4 p.c. solution of iron-alum. 2. After washing with distilled water they were transferred to a solution of sulphalizarinate of soda, made by diluting 1 c.cm. of a saturated aqueous solution with 80–100 c.cm. of distilled water. 3. After washing in distilled water the slide or coverslip is placed in a crystal-violet solution; this is warmed until it vaporises, and then allowed to act for 3 to 5 minutes longer. The crystal-violet solution is a 3 p.c. alcoholic solution, which is diluted with an equal quantity of anilin water. 4. After differentiating in 30 p.c. acetic acid for 1 to 2 minutes the preparations are washed in running water for 5 to 10 minutes, in order to remove all

* Beih. Bot. Centralbl., xxiii. (1908) pp. 157–90 (4 pls.).
† Arch. Mikr. Anat. u. Entwickl., lxxi. (1908) pp. 571–87 (2 pls.).

traces of acid. 5. The sections are then mopped up with blotting-paper, and after a momentary immersion in absolute alcohol are cleared up in bergamot oil, then xylol and balsam.

Micrographic Study of Leather.*—H. Boulanger gives the following methods for demonstrating the microscopic appearances of raw and tanned hide. In the former case pieces of skin are soaked for 12 hours in a solution composed of distilled water 5, glycerin 5, aceton 90. They are then allowed to dry, imbedded in hard paraffin, stained and mounted in the usual way. In the process for preparing sections of cowhide tanned with oak-bark and carried with dégras, a small strip of leather about 10 mm. wide is taken, and the flesh side shaved away until the piece has a thickness of about 2 mm. The shaved strip is placed in melted tallow, not too hot, for about a quarter of an hour. After cooling the strip is imbedded in hard paraffin, and cut in a Ranvier microtome. The sections are degreased with xylol, then washed two or three times in alcohol and stained with Weigert's fuchsin. The staining takes about 3 hours. The Weigert solution is poured off, and a few drops of absolute alcohol remove excess of dye and differentiate the various parts. Usually the section is dehydrated with alcohol, cleared up with xylol, and mounted in balsam.

(3) Cutting, including Imbedding and Microtomes.

Arrangements for Utilising the Entire Cutting-edge of Microtome Razors.†—C. Funck refers to the troubles frequently met with in pathological sections, arising from the notching or bluntness of the microtome knife, and points out the great advantage which would arise if the whole of the cutting-edge could be used: the precious time now required for re-sharpening could then be saved. The author describes two methods of attaining his purpose, the first of which depends on *supplementary jaws*, and does not involve any alteration in the microtome itself. Suppose that in fixing the razor the handle is turned towards the operator, and that it is the further end which one wants to be able to bring into use. But if the operator draws the blade towards himself the remote end becomes free. To overcome this difficulty the author suggests that, between the extremity of the razor and the fixed jaw, an additional jaw (fig. 154, *a*) could be inserted. This additional jaw would be fixed firmly by the prolongation P, whose sectional form would be analogous to that of the razor. If the razor should be turned in the way opposite to that described, the form of jaw would be analogous and symmetrical to that shown in fig. 154, *a*. If the microtome should not be provided with this upper transversal stem T, it would be convenient and less costly to make in one piece the two jaws connected to each other by their bases, as shown in fig. 154, *b*.

Although the method gives the use of an increased amount of edge, it does not effect anything for the handle end. For this purpose the author has designed his second method, which consists in modifying the

* Bull. Soc. Encouragement, Feb. 1908. See also Nature, lxxviii. (1908) pp. 18–19 (2 figs.). † Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 53–60 (4 figs.).

slider-support. Instead of a backward and forward motion of the knife, the author proposes a lateral movement (*vide* arrow *x* in figs. 155 and 156), in order to present to the object the parts of the razor

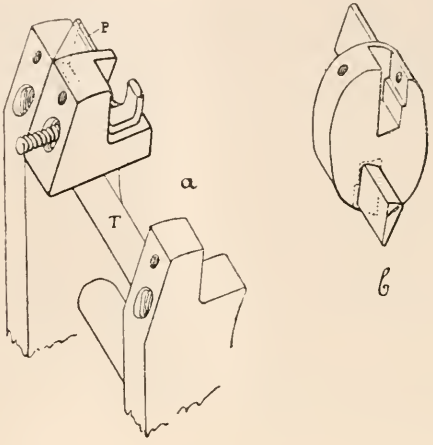

Fig. 154.

previously unused. The indispensable pieces of construction are shown in fig. 155. The rectangular plate A, with two fillets, R and R′, along its greatest sides, is pierced by a rectangular hole, whose longest axis

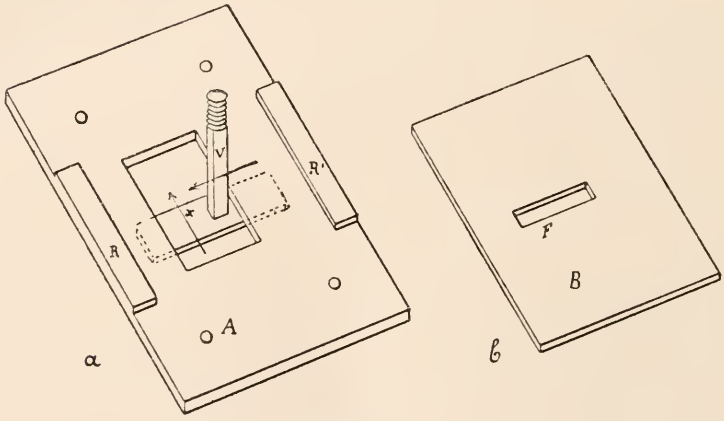

Fig. 155.

indicates the direction of the new lateral displacement, as shown by the arrow *x*. Through this hole passes the stem V of the raising and lowering gear, its head (as dotted) having a firm rest behind the plate

A. This screw will serve to give solid fixing to the razor support as the old type of raising gear. The support itself will be guided in its movements by the piece B (figs. 155 and 156), on which it rests, and the two little fillets *r*, *r'* will amply fix it. The plate B will be itself guided by the said lateral movement by the two fillets R R′ of the plate A, between which it will be placed. An inspection of fig. 156 will show the method of operation.

The lateral displacement in regard to the object will be effected by gliding this support in the direction of the arrow towards the desired spot. The two fillets *r*, *r'* of the support will engage the plate B, which, itself engaged by the fillets R, R′ of the plate A, will thus have

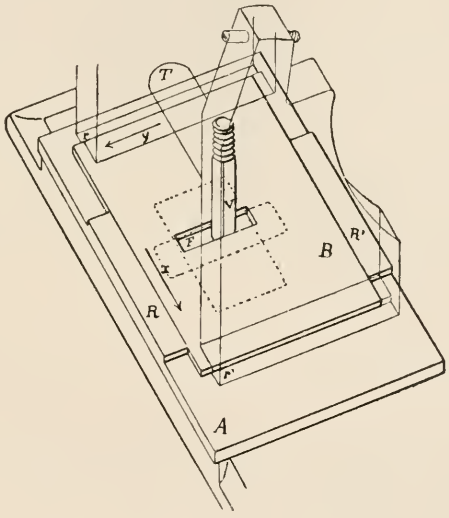

Fig. 156.

a direction strictly parallel to the axis of A. The screw of the raising gear V, retained and engaged by the transverse bar T of the support as well as by the hole F of the plate B, will perform all the movements communicated to it by the two pieces. The rectangular hole in A is of such dimensions that it does not interfere with the stem of the screw in this displacement. The older form of movement is not, however, obviated, for when B has arrived at the end of its course the usual antero-posterior displacement of the support will ensue, and can be used if desired. The author has had the Minot microtome more particularly in view, but with some modifications his design could be adapted to other types of instruments.

Celloidin Imbedding.*—L. Neumayer has obtained excellent results by carrying out the various stages of the impregnation in exsiccators

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 38–41.

which must be air-tight and contain some substance like copper sulphate or calcium carbide, for absorbing any moisture. After the imbedding is over, the pieces are covered with very thick celloidin, left exposed to air under a bell-jar for 15–20 minutes, then for 30 minutes to the vapour of 70–80 p.c. alcohol, and finally hardened in 70–80 p.c. alcohol. The author claims that by this method quite large pieces may be prepared.

Preparing Celloidin Sections.*—W. Dantschakoff discusses Rubaschkin's method of preparing celloidin serial sections,† and points out certain defects of the method. One is that instead of the 90 and 70 p.c. alcohol used for dissolving out the oily clarifying mixture, 96 p.c. and absolute alcohols should be employed. When the anilin-oil-of-clove mixture is dropped on there is a great tendency for the section to wrinkle and pucker, and this inconvenience may be lessened by using a mixture of 2 parts of oil-of-clove, and 1 part anilin-oil, instead of equal parts. Rubaschkin smoothed down the section with the brush, but the author finds that it is more efficacious and expeditious to do this with blotting-paper. The albumen-glycerin mixture should be wiped on with a clean rag instead of being smeared on with the finger. On removing the cleared-up sections from the absolute alcohol, they may be placed in ether-alcohol until the celloidin is dissolved, after which down-graded alcohols from absolute to water. They are then stained in the usual way.

(4) Staining and Injecting.

New Method of Staining Spores and Metachromatic Granules: a Substitute for Gram's Method.‡—L. Trincas stains spores as follows :—maceration for some minutes in 5 p.c. chromic acid; heat in carbol-fuchsin, wash, decolorise with 10 p.c. hypochlorite of lime, wash freely, pass through 40 p.c. formalin (a few seconds), wash freely, stain with 1–30 chrysoidin solution. The spores are red-brown, bacilli yellow, and the vacuoles lemon-yellow. For demonstrating the metachromatic granules, the author stains for 1 minute in the following solution :—toluidin blue 0·25, alcohol 5, acetic acid (2 p.c.) 100. The preparations are transferred without washing to 1 p.c. vesuvin solution for 1 minute. The granules are blue-black, the other parts of the cells pale green.

New Cold Injection Method.§—H. J. Hamburger has improved on Grosser's injection fluid ‖ by substituting horse or ox blood-serum for egg-albumen, and using a fluid preparation of indian ink, commercially known as Perltusche. Three volumes of serum are mixed with two of the ink. The material is fixed in sublimate-formalin, and after staining with alum-cochineal, paraffin-sections made. The results are stated to be excellent.

* Zeitschr. wiss. Mikrosk., xxv. (1901) pp. 32-7.
† See this Journal (1907) p. 633.
‡ Soc. Sci. Med. e Natur. di Cagliari, 1907. See also Centralbl. Bakt., 1te Abt Ref., xli. (1908) p. 316.
§ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 1–3.
‖ See this Journal (1900) p. 732.

Bielschowsky's Method for Demonstrating Connective-tissue Fibres.*—A. Zimmermann fixed the material in formalin and afterwards in alcohol. Paraffin sections were made and then the imbedding matrix removed with xylol. The sections were then placed for 48 hours in 2 p.c. silver-nitrate, and then, after a wash in water, in the ammonia-silver solution, prepared by adding 40 p.c. caustic soda solution to 10 p.c. solution of silver-nitrate until no more precipitate falls. The precipitate is then dissolved in as little ammonia as possible, filtered and diluted four times with distilled water. In this solution, which must always be freshly prepared, the sections remain for ½-hour. On removal they are washed rapidly in water and placed in the reducing fluid, 5 p.c. formalin, for ½-hour. On removal the sections are washed and then immersed in a 1 per 1000 gold-chloride solution to fix the silver. After another wash in water the sections are placed in 5 p.c. sodium-hyposulphite in order to remove any unreduced silver. After this they are washed in running water for 6–12 hours, then dehydration in upgraded alcohols, xylol, balsam. The foregoing procedure, which is very successful for locating connective-tissue elements, differs only in detail from Bielschowsky's original method.†

Demonstrating the Presence of Tannin.‡—L. E. Cavazza recommends chloride of vanadium for demonstrating the presence of tannin in vegetable sections. It imparts a dark indigo hue, due to the formation of tannate of vanadium. Vanadium chloride is preferable to iron-chloride in that the reaction occurs more readily and with greater intensity. The greater part of the author's paper is purely chemical.

(6) Miscellaneous.

Examining Seminal Stains.§—F. N. Windsor soaks a small piece of cloth with the suspected stain in Müller's fluid for 24 hours, preferably at 37° C. On removal the piece is well washed in water and then picked up by forceps, is drained on blotting paper, after which it is laid flat on a slide. Next both surfaces are scraped with a scalpel or another slide. The piece is then picked up and squeezed between thumb and finger, the exuded fluid being allowed to fall on the slide already used. The film is then dried and fixed with heat or saturated sublimate, after which it is stained in 1 p.c. aqueous solution of eosin for 3 minutes. After washing in water, the film is dried and mounted. This method is specially suitable for old dried stains or those subjected to a tropical climate.

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 8–13.
† See this Journal, 1906, p. 735; and 1907, p. 498.
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 13–20.
§ Prit. Med. Journ. (1908) ii. p. 501.

Metallography, etc.

Formulæ of Metallic Compounds.*—Much of the formerly accepted information regarding the composition of compounds of metals with each other has been derived from the chemical analysis of insoluble residues. W. Guertler points out that the application of the methods of physical chemistry has proved this information to be to a large extent erroneous. While, however, the method of thermal analysis has so largely superseded the older methods, abnormal behaviour of some elements renders conclusions uncertain in some cases; in these instances chemical methods may be profitably employed. The author discusses the discrepancies between the formulæ of silicides of copper as given by Philips and by Rudolfi—the method of residue analysis being used by the former, while the latter employed thermal methods. E. Rudolfi † continues the discussion.

Selective Colouring.‡—R. Böhler remarks on the advance in metallographic methods resulting from the introduction of Lumière colour-photomicrography. A section of an 83-p.c. ferro-wolfram, when etched with 2 p.c. hydrochloric acid in alcohol for 30 minutes, showed two constituents. Further etching with a dilute solution of potassium ferrocyanide in water brought out the duplex character of one of these substances, colouring one of the two constituents of which it was made up a deep blue.

Cobalt-sulphur Alloys.§—K. Friedrich has studied the equilibrium diagram from 0–35 p.c. sulphur. A eutectic line occurs at 879° C. The constitution of the compounds is uncertain: Co_3S_2, Co_4S_3, Co_6S_5, CoS, are suggested. Iodine in potassium iodide solution and concentrated nitric acid were used for etching.

Antimonides of Iron and Cadmium.‖—N. S. Kurnakow and N. S. Konstantinow give the equilibrium diagrams of the systems antimony-iron and antimony-cadmium. In the former system the compounds $FeSb_2$ and Fe_3Sb_2 occur, and two eutectics. The limit of solid solubility of antimony in iron is about 5 p.c.; this is confirmed by microscopic examination. In the range 0–70 p.c. cadmium of the antimony-cadmium system, stable equilibrium is obtained by inoculating the melt with crystals of CdSb. If the molten alloys are allowed to cool undisturbed, without inoculation, a labile state is established. The diagram corresponding to labile equilibrium differs from the stable diagram in that both the eutectic and "dystectic" (maximum) temperatures are lower. The compounds are CdSb and Cd_3Sb_2. Some heating curves were taken. The crystal angles of the compounds of both systems were measured. Characteristic photomicrographs are given.

Copper-tin Alloys.¶—O. Sackur and H. Pick have investigated the action of solutions of lead chloride and other metallic salts upon

* Metallurgie, v. (1908) pp. 184-6.
† Tom. cit., pp. 257–9.
‡ Tom. cit., pp. 201-2 (2 figs.).
§ Tom. cit., pp. 212–15 (14 figs.).
‖ Zeitschr. Anorg. Chem., lviii. (1908) pp. 1–22 (18 figs.).
¶ Tom. cit., pp. 46–58.

powdered copper-tin alloys, with the object of measuring the chemical affinities existing between the two metals. The alloys containing 0–56 p.c. copper precipitate lead from lead chloride solution in the same way as pure tin does: they therefore contain free tin. By similar reasoning from their other experimental results, the authors deduce the existence of two compounds, Cu_3Sn and Cu_5Sn_2, or Cu_2Sn.

Tellurides of Arsenic and Bismuth.* — In the tellurium-arsenic system H. Pélabon finds minima at 329° C. and 355° C., maxima at 362° C. (As_2Te_3) and 358° C. In the tellurium-bismuth system there are two eutectic points, 410° C. (15 p.c. bismuth) and 263° C. (1 p.c. tellurium). A maximum at 583° C. indicates the compound Bi_2Te_3. The author calculates the cryoscopic constant of tellurium from the lowering of its melting point by solution in it of As_2Te_3, Bi_2Te_3, and other tellurides, arriving at the mean value 520.

Occluded Gases in Special Nickel Steel.†—G. Belloc has determined the composition of the gases evolved from a steel containing 45 p.c. nickel, 0·15 p.c. carbon, at different temperatures.‡ The occluded gases were CO_2 (all given off below 520° C.), CO (increasing to 75 p.c.), N (all evolved above 520° C., and only found in small amount), and H. When the steel was in the form of wire, the total volume of gases was 10 times that of the steel, while with drillings from the ingot the volume was 3½ times the volume of the steel. The greater part of the gas was evolved while the iron was in the γ state and the nickel in the β state.

Factors of Safety in Marine Engineering.§—J. O. Arnold points out that, although in structural steel the ratio of maximum stress to elastic limit is approximately 2 to 1 in the majority of cases, yet in an important number of instances the ratio differs very widely from this. Over-annealed steel has a very low elastic limit, and the factor of safety calculated from the maximum stress of such steel would be dangerously low. Over-annealing (excessively slow cooling from a high temperature) causes the formation of pearlite in which the lamellar structure is highly developed, and the partial separation of pearlite into massive cementite and ferrite. The author explains the formation of decarbonised "ghosts," on the theory that dissolved phosphide of iron expels carbon from a segregated spot. The author's alternating stress test is described, and though its theoretical defects are admitted, it is recommended in preference to Wöhler or similar tests in which the elastic limit is not exceeded, for the detection of brittle material. The possible danger in using steels of high elastic limit is indicated.

Planimetric Analysis of Alloys.‖—A. K. Huntington and C. H. Desch describe the method of determining the proportions of the component metals by microscopic examination of alloys. A constituent

* Comptes Rendus, cxlvi. (1908) pp. 1397–1400.
† Op. cit., cxlvii. (1908) pp. 244–5.
‡ See this Journal, 1908, p. 124
§ Engineering, lxxxv. (1908) pp. 565–6, 598–601 (16 figs.).
‖ Tom. cit., p. 589.

may be of fixed composition (a pure metal, a definite compound, or a eutectic mixture), or its composition may vary within a certain range (a homogeneous solid solution). If the alloy is in a known condition of equilibrium, reached by slow cooling or by quenching from a given temperature, and the composition of the constituents is known, the proportions of the metals present may be determined by measurement of the areas of the constituents. It is often necessary to enlarge photomicrographs or to project them on to drawing or tracing paper. A planimeter is used to measure the area of any particular constituent, or if the pattern is complicated the drawing may be divided into squares of 1 cm., and the proportion of one constituent, which may be shaded in the drawing to distinguish it, estimated in each square. By the planimetric method the composition of Muntz metal might be determined with remarkable accuracy in half an hour; this includes all operations, from grinding to planimetric measurement. The method failed to yield satisfactory values for copper-phosphorus alloys, the explanation being the segregation of copper from the eutectic. The correction to be applied was calculated, and the method then gave reliable results.

New Fatigue Test for Iron and Steel.* — T. E. Stanton has devised a test which gives a combination of rolling abrasion and alternate bending. A hollow ring of rectangular section, cut from the steel to be tested, is placed between three hardened steel rollers. The upper roller is loaded with a weight and rotated, thus imparting rotation to the test-piece and the two lower rollers. The outer surface of the test-ring is thus subject to rolling abrasion, and every radial section of the ring is subject to alternate bending stresses which go through a complete cycle three times in one revolution. A number of steel rails were tested in this manner, at 800 reversals per minute. In the course of the test the outer surface of the ring is worn down and spread over the edges. In time small cracks appear parallel to the axis, and failure takes place through the development of one of these cracks. The number of reversals endured varied from 25,000 to 370,000.

Metallurgical and Chemical Laboratories in the National Physical Laboratory.†—W. Rosenhain, in the course of this paper, describes the metallographical outfit. The following details may be noted. A Zeiss stereoscopic binocular Microscope is used for examination of fractures. Two small rooms are provided for preparation of metal sections, one is devoted to grinding (for which two carborundum wheels are used), and emery rubbing, while the other is reserved for the last stages of polishing and etching. A horizontal disk 9 in. diameter, covered with cloth, is used for polishing. For etching steel sections picric acid in alcohol and nitric acid in amyl-alcohol are employed. The author describes his method of heating and quenching metal specimens without contact with air: the metal is heated in an evacuated tube of fused silica, through which a heavy stream of water may be directed when the specimen is at the desired temperature.

* Journ. Iron and Steel Inst., lxxvi. (1908) pp. 54–70 (9 figs.)

† Tom. cit., pp. 87–108 (9 figs.).

Application of Colour-photography to Metallography.* — E. F. Law draws attention to the unsatisfactory character of ordinary photographs of metal sections in which the constituents have been distinguished by differential colouring. Coloured sections are obtained by heat-tinting, by allowing the polished surface to tarnish by exposure to the atmosphere, or by heating the specimen in air containing iodine, bromine, or sulphuretted hydrogen. Photomicrographs of such sections in their natural colours are given by the Lumière process. A colour-photograph can be taken, developed, dried, and bound as a lantern-slide in less than one hour.

Microscopic Features of Hardened Supersaturated Steels.†—E. Hess heated three bars of crucible steel containing 1·01, 1·41, and 1·77 p.c. carbon respectively, in such a way that one end was white-hot while the other end was below the critical temperature. The bars were then quenched, and sections cut from each at points 1 in. apart. The difference of structure between edge and centre leads the author to doubt whether the real condition at high temperatures is preserved by sudden cooling. Howe's theory that supersaturated steels at temperatures above the critical range consist of austenite is held to be confirmed. The austenite undergoes partial decomposition when the steel is quenched.

Iron, Carbon, and Sulphur.‡—D. M. Levy has made a very complete investigation of the effect of sulphur on iron-carbon alloys. A number of alloys were prepared by melting pure cast iron with sulphide of iron, cooling curves were taken, and physical and chemical properties and microstructure were studied. In cast-iron free from silicon and manganese the saturation limit is about 0·8 p.c. sulphur ; it exists as FeS (melting point above 1180° C.). A certain excess of FeS may be mechanically retained. Sulphur lowers the melting-point of cast iron. At about 1130° C. the sulphide separates from a solidifying alloy, as a constituent of a triple austenite-cementite-sulphide eutectic. In sulphur-free cast iron the cementite segregates into large masses which decompose at high temperatures, giving rise to graphite : grey iron is thus produced. When iron sulphide is present it forms layers and films in the eutectic. These appear to prevent the coalescence of the cementite, which is a necessary preliminary to its decomposition. Thus the iron is retained in the white form. No evidence of any chemical union of the sulphide with the carbon or carbide was obtained. The influence of sulphur in retaining the carbon in the combined state appears to be purely physical or mechanical.

Constitution of Iron and Phosphorus Compounds.§—B. Saklatwalla has made a thermal and microscopical investigation of the iron-phosphorus system. Pure electrolytic iron was used. Much difficulty was experienced in preparing a high phosphorus alloy free from im-

* Journ. Iron and Steel Inst., lxxvi. (1908) pp. 151–4.
† Op. cit., lxxvii. (1908) pp. 1–4 (30 figs.).
‡ Tom. cit., pp. 33–91 (31 figs.).
§ Tom. cit., pp. 92–103 (10 figs.).

purities; it was finally made by melting pure iron with phosphorus in an atmosphere of nitrogen, in a carbon resistance furnace. A tantalum-wire resistance furnace was also used. Up to 1·7 p.c., phosphorus forms a solid solution with iron. This solid solution forms a eutectic with Fe_3P, melting-point a little over 1000° C., and about 10·2 p.c. phosphorus. Fe_3P forms a eutectic with Fe_2P, 16·2 p.c. phosphorus, melting-point 960° C. Another eutectic appears to exist, and melts about 1218° C. The micro-sections were heat-tinted.

XIX.—*An Auxiliary Illuminating Lens.*

By Edward M. Nelson.

(*Read October* 21, 1908.)

An objection, repeatedly raised against my method of critical illumination, ever since its introduction more than thirty years ago, is that the image of the edge of the flame does not fill the field. This is a great drawback to biologists in general, who use a Microscope merely as a glorified magnifying glass, and prefer to search over specimens beautifully clothed in the woolly garments of diffraction fringes on a fully illuminated field, to any careful examination of an object when seen in the image of the edge of the flame. Some years ago I tried to remedy this defect of an incompletely illuminated field by placing in the path of the illuminating rays a small plano-convex lens at a distance of about its own focal length from the edge of the flame.

When this lens is properly adjusted it appears as a luminous disk, and this disk, projected upon the plane of the object by the substage condenser, yields a full and evenly-lighted field. This method was, however, abandoned because any object partaking of the nature of a minute lens, when examined upon this fully illuminated field, appears with a diminutive image of the edge of the flame in it: whereas, when the same object is viewed in the image of the edge of the flame, it appears as a small disk. This small disk is, in reality, an image of the back lens of the substage condenser. These phenomena may be studied upon an *Actinocyclus Ralfsii*, or other suitable diatom.

Another, and more serious objection, is that unless care be exercised, the W.A. may be considerably reduced. The state of the case is this:—(1) If the auxiliary lens is focused upon the edge of the flame, the rays which fall upon the substage condenser are parallel. The substage condenser will, therefore, require to be focused up a little nearer to the object. The W.A. will be of full size, the field will not be illuminated by an even disk of light but by a magnified image of the edge of the flame. (2) If the auxiliary lens is arranged so that it will give an even disk of light upon the field, it must be placed closer to the lamp flame. A divergent beam will fall upon the substage condenser, which must be focused down until the image of the auxiliary lens appears quite sharp in the field. The W.A. will be reduced and the field evenly illuminated. When the auxiliary lens has been placed in

position, it is advisable to remove the eye-piece and examine the W.A. at the back lens of the objective. The auxiliary lens is supplied with a single diaphragm, having a $\frac{1}{4}$-in. hole. It is obvious that the use of this diaphragm in no way influences the size of the W.A.

If the auxiliary lens had increased the resolution by a single jot, it would not have been laid aside, so no one need expect the Thames to be set on fire by its re-introduction. For certain objects, such as bacteria and their flagella, it may prove serviceable owing to increase of contrast through the brightening of the field. Mr. Baker has made me a lens from my formula to take the place of the crude plano-convex of former years, and has mounted it in a short tube to hold the single diaphragm. This lens has been tested both by Mr. Merlin and myself, and has been found quite satisfactory.

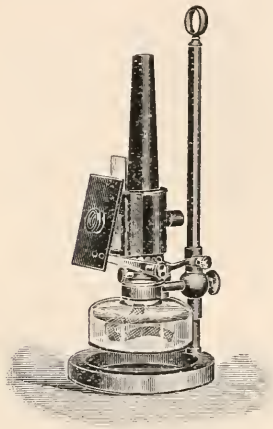

Fig. 158.

Mr. Baker has sent me one of his lamps fitted with my auxiliary lens. Fig. 158 shows the auxiliary lens mounted in a metal screen, and in the position it would occupy when illuminating an inclined Microscope "direct" without a mirror. The arm which holds the screen consists of two parts, held together by a pinching-screw working in a slot; this allows the lens not only to be focused, but also to be placed at right angles to the path of an upward, horizontal, or downward beam. This arm is not attached to the pillar itself, but to the sleeve of the arm which holds the lamp-cistern: it can therefore be raised or lowered with the lamp. When its pinching-screw is released, the arm can be moved to one side. It will be noticed that the lens has the diaphragm in position.

Some of the Microscope lamps sold by opticians differ in essential particulars from the one I designed thirty years ago, and are quite inefficient. I had nothing whatever to do with the design of several lamps which are named after me.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Ross' New Micrometric Mechanical Stage.†—This apparatus (fig. 159) is adapted for micrometric measurements, and enables the user to ascertain the exact size of an object with any power. In conjunction with a fine-adjustment of known rate, the depth, length and width of metal fractures are measured at one operation. The micrometer move-

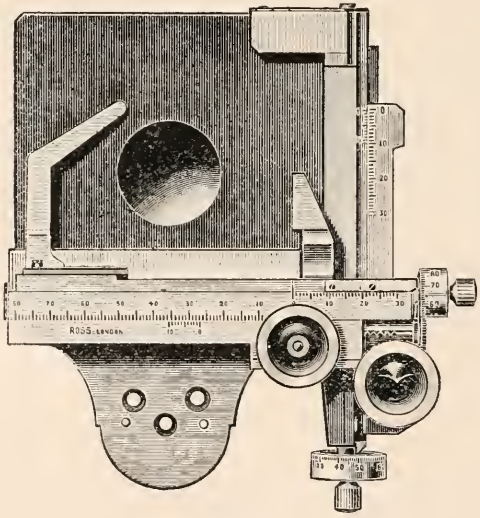

Fig. 159.

ments depend on slides built into the stage, actuated by milled heads attached to delicate micrometer screws with divided drums read against pointers or verniers. The bearing-points of the micrometer screws press against steel surfaces, and are kept up to contact by spiral springs.

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

† Ross' Catalogue, 1908, pp. 18–19 (1 fig.).

This movement has not only measuring capabilities, but also acts as a fine-adjustment to the mechanical stage, and this, when objectives with high magnification are used, is of great value. The quick movements by rack-and-pinion cover a range of 3 in. by 1 in. The stage-screws have threads $\frac{1}{3}$ mm., and the drum has 100 equal divisions, thus permitting measurements up to $\frac{1}{300}$ mm., or $\frac{1}{7620}$ in.

Ross' No. 2 "Standard" Metallurgical Microscope.* — The adjustments and construction of this stand (fig. 160) are on the same

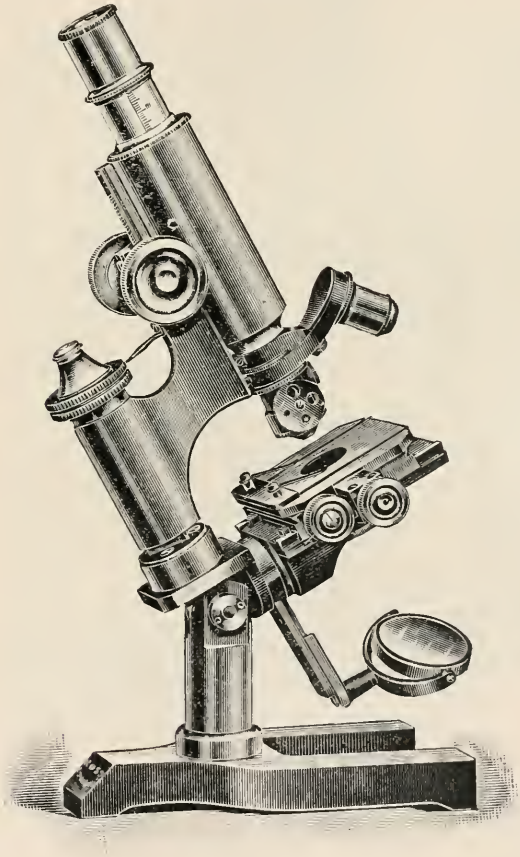

FIG. 160.

lines as those of the Ross' No. 2 Standard, but the instrument is specially adapted for metallurgical work. One revolution of the milled

* Ross' Catalogue, 1908, pp. 10–11 (1 fig.).

head of the fine-adjustment is equal to $\frac{1}{50}$ in., and the head has divisions to read to $\frac{1}{1000}$ in., for fracture measurements. The mirrors, in addition to their universal motion, swing over the stage upon a centre behind it, for the illumination of opaque objects. For high power-work an opaque illuminator is attached to the $\frac{1}{6}$-in. objective, mounted as short as possible to secure a maximum of light upon the specimen. There is

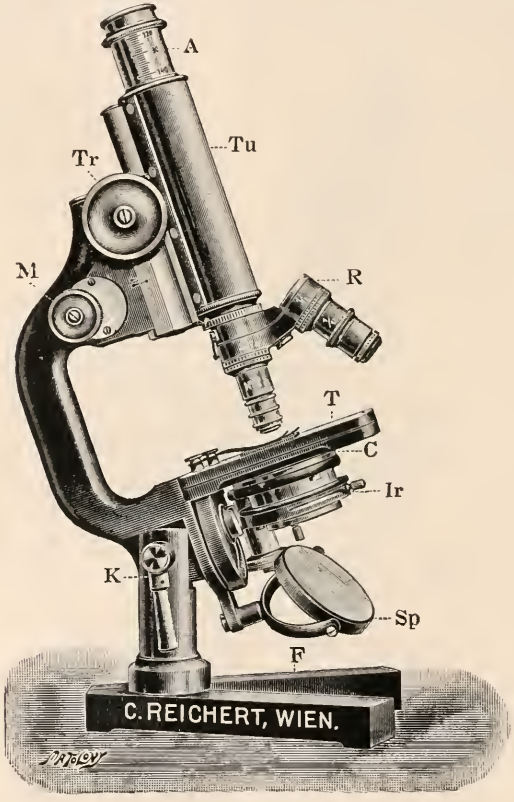

Fig. 161.

also a 1-in. objective, with parabolic illuminator and angle silver reflector combined, and a substage iris-diaphragm for observation of transparent objects.

Reichert's Travelling Microscope.*—This apparatus is shown in figs. 161 and 162. The stand (No. 52 in the Catalogue) is practically

* C. Reichert, Vien a, Catologue, Mikroscope, No. 26 (1908) p. 32, figs. 19-20.

the same as Stand A ii, which only differs from Stand A i (see October Journal) in being a little smaller. The prongs of the foot are hinged, and can be shut together, and the stage and mirror can be swung round, for packing in box. The size of the box is 9 × 19 × 29 cm., and the weight complete is 4·7 kilos.

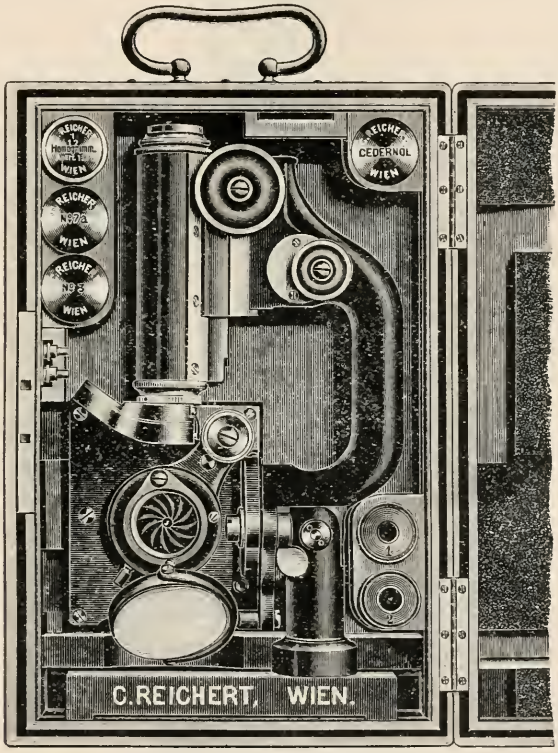

Fig. 162.

Reichert's New Steinach Stand C.*—This stand (fig. 163) is fitted with a large circular brass stage of about 105 mm. diameter. The projection of the inclinable upper part is considerable, and affords a convenient grip in carriage. The tilt of the inclination is regulated by a lever-clamp. The coarse-adjustment is by rack-and-pinion, and the fine by micrometer screw. The Abbe condenser has a screw for quick

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 22, fig. 9.

raising and lowering; the iris-diaphragm is fitted with a ring for the insertion of a blue glass. The mirror is plane and concave, and laterally adjustable.

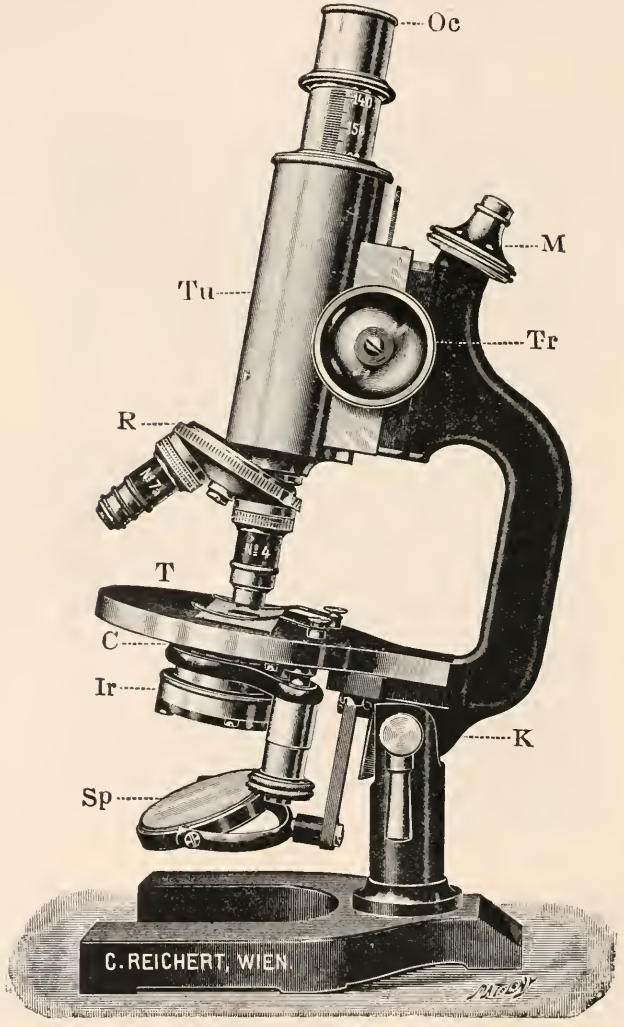

Fig. 163.

Reichert's New Stand vi.*—This stand (shown in fig. 164) is inclinable to 45°. It has a large circular brass stage of about 105 mm. diameter, and considerable upper stage projection. The coarse-adjust-

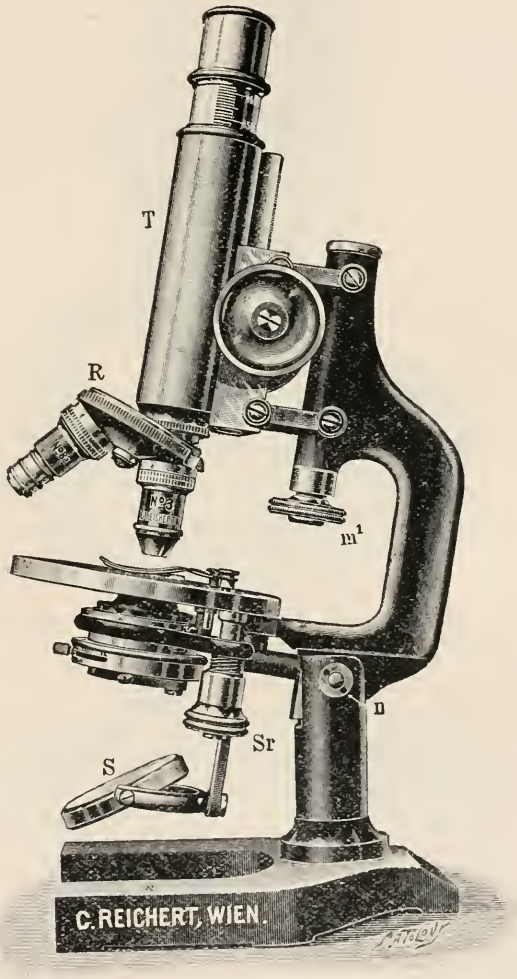

Fig. 164.

ment is by rack-and-pinion, and the fine by micrometer screw, which may, if desired, be placed under, as shown in figure. This under-screw

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 28, fig. 14.

is recommended for beginners, as it practically removes all risk of injury to objective and slide. Fig. 165 shows a non-inclinable form of the same instrument.

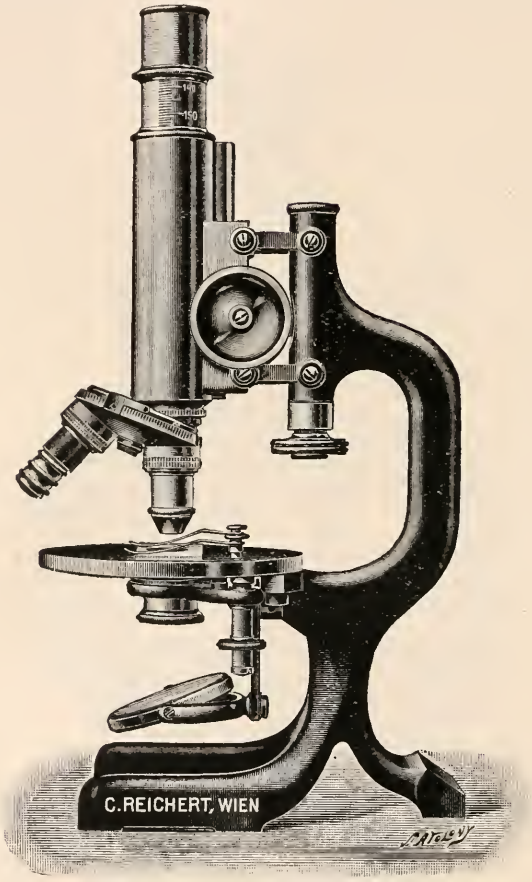

Fig. 165.

Heusner's Object-stage with Exchangeable Plates.*—H. L. Heusner has endeavoured to meet an inconvenience frequently experienced in working with the ordinary vulcanite stage when a weakly coloured preparation is apt to become invisible on the dark under-ground. Although the operator may cover his stage with blotting-paper, the result in many cases is unsatisfactory. The author has therefore arranged with Messrs. Leitz so that the vulcanite stage can be replaced by a

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 62–4 (1 fig.).

similar stage of ground opal glass of equal thickness (fig. 166). After four years' experience the arrangement is found to answer well.

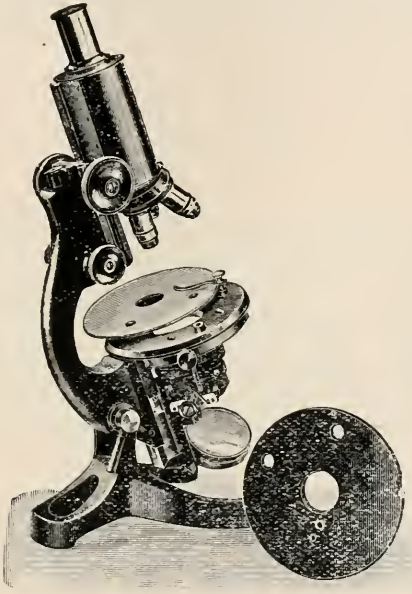

Fig. 166.

(3) Illuminating and other Apparatus.

Mercury Vapour Lamp for Microscopical Work.*—In this mercury vapour lamp (fig. 167) designed by J. E. Barnard, the illumination is obtained from an exhausted tube partially filled with mercury, the passage of the current through which renders the vapour luminous. The light emitted is confined to a few wave-lengths widely separated, which permits of the use of monochromatic light, by the aid of screens, in several regions of the spectrum, thus affording good contrast with different stains. Even without screens the light is more efficient than other forms of illumination giving a continuous spectrum, there being no red rays emitted. The size and shape of the tube permit of its use for critical illumination.

The tube A, with resistance B, which can be supplied to suit any voltage from 80 to 250, is inclosed in a metal cover C, 16 × 7·5 × 12·5 cm. (6¼ in. × 3 in. × 5 in.), mounted on a heavy base with square upright, adjustable for height and tilt for starting the lamp, which is simply effected by pressing up the lever E, thus cutting out a portion of the resistance and depressing the left side, until that portion of the tube is filled with mercury; on slowly bringing the tube back to the horizontal, still keeping the lever E pressed up, an arc will be formed,

* C. Baker's Special Catalogue, 1908.

and this will extend along the tube as the mercury retreats to the lower reservoir. As the lamp is somewhat sensitive to pole connections, the plug should be reversed should the surface of the mercury appear to boil as it retreats along the tube. This procedure usually has to be repeated two or three times before the lever E can be released.

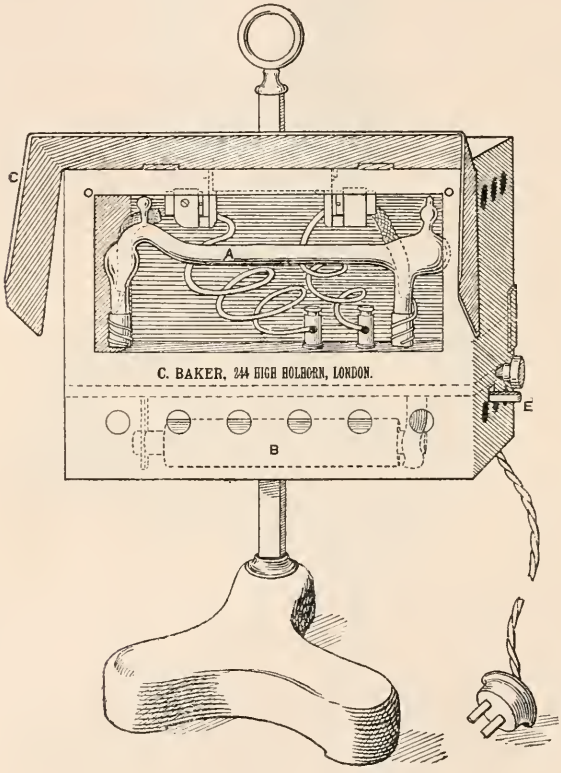

Fig. 167.

New Reflecting Condenser.*—W. von Ignatowsky describes a new reflecting condenser which has been made at the works of E. Leitz. The necessary data were supplied by the author, and the condenser has been in use since October 1907. The fundamental principle of the method of observation in a dark field is the modification of the incident pencil in such a way as to establish a marked contrast between vividly illuminated particles, e.g. bacteria, and a dark ground. As the details to be distinguished become finer, it is necessary to increase the intensity of the illumination so as to enable the particles to emit a sufficient amount of diffused light. Reflecting condensers and

* Zeitschr. wiss. Mikrosk., xxv. (1907) pp. 64–7 (2 figs.).

other appliances designed for the same purpose may be regarded as objectives which form an image of the source of light in the plane of the particles, but solely through the instrumentality of rays prevented from passing directly into the objective. The observer, therefore, sees diffused light only at those points which are occupied by particles

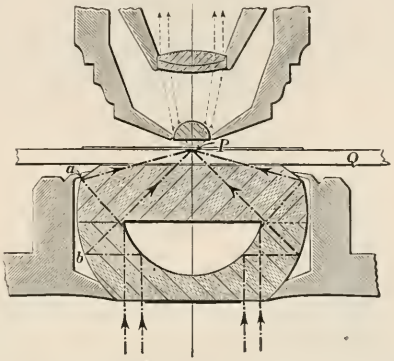

Fig. 168.

differing optically from the surrounding medium, whereas the rest of the field remains dark. Those rays which go to form an image of the source of light occupy within the condenser the space bounded by two cones having their apices and axes in common. The aperture of the inner cone is slightly greater than the angle subtended by the object

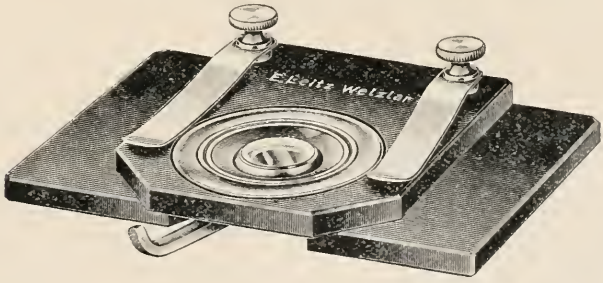

Fig. 169.

under observation, so as to make sure that no direct rays enter the objective. In order to secure an increased illumination when the magnitude of the particles is diminished, three conditions are necessary : (1) the difference between the apertures of the inner and outer pencils should be as great as possible ; (2) the image of the source formed at the apex of the pencil should be as well defined as possible ; (3) the

image should be free from spherical difference of magnification, by satisfying the condition of sines, with respect to all the rays passing through the space bounded by the two cones. Chromatic errors are eliminated by the fact that the image is formed by reflection, not by refraction. As will be seen from fig. 168, the author's condenser has two reflecting surfaces, one internal, the other external. This tends towards a complete satisfaction of the second and third conditions, and the author claims that his condenser more fully satisfies these conditions than any other yet brought out. The illuminating rays have a numerical aperture of about 1·1 to 1·45. The reflecting condenser is contained

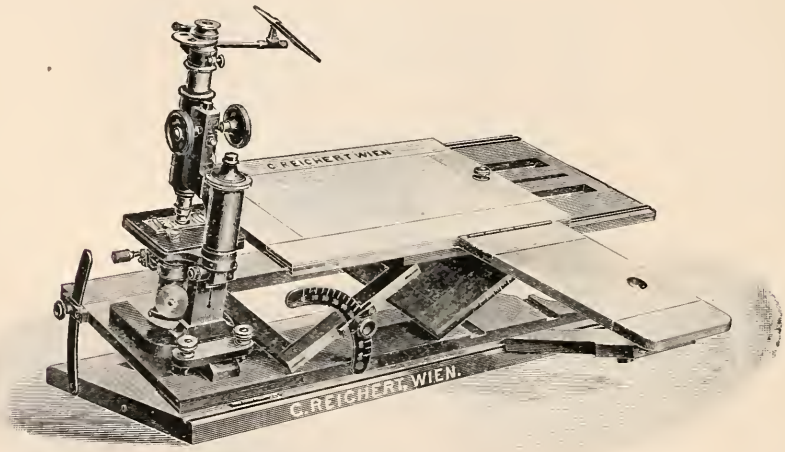

Fig. 170.

in a centring mount, which slips into the sleeve of the Microscope substage in the place of the ordinary condenser.

There is another and simpler form of this condenser mounted within a plate, which is merely laid flat upon the stage of the Microscope (fig. 169). This arrangement dispenses with the necessity of specially adapting the reflecting condenser to the Microscope. By means of a lever the condenser may be raised and lowered within the limits necessitated by variations in the thickness of object slides. In conjunction with an arc lamp of 4 amperes the condenser is sufficiently intense to obtain an instantaneous photograph of living bacteria.

Reichert's Drawing Apparatus.*—This apparatus, designed by Bernhard, appears as in fig. 170. The drawing plane can be raised to

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 61, fig. 63.

a height of about 17 cm., and can be inclined at any angle up to 35° to the horizontal. The Microscope is screwed on to the ground-plate. Arm supports are provided to rest the draughtsman's hand.

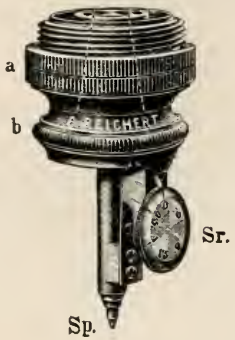

Fig. 171.

Reichert's Marking Apparatus.*—This is constructed with a diamond point, and will be easily understood from the illustration (fig. 171).

6. Miscellaneous.

Paraffinum liquidum (B.P.) as an Immersion Oil.†—C. Rowntree, after alluding to the drawbacks of cedar-wood oil, points out that paraffinum liquidum (B.P.) is an efficient substitute. It is a colourless and transparent fluid, inexpensive, and keeps in any climate indefinitely. As it is non-volatile, it does not dry up, and is easily wiped off from cover-glasses and objectives. Its index of refraction is somewhat lower than that of cedar-wood oil, but for the ordinary purposes of histology and bacteriology the optical results are at least as good. Both with apochromatic and achromatic lenses the definition and illumination are excellent, even with a magnification of 1600 diameters. It is especially valuable for the examination of film preparations.

Quekett Microscopical Club.—The 450th Ordinary Meeting was held on October 2, the President, Professor E. A. Minchin, M.A., F.Z.S., in the chair. Mr. T. A. O'Donohoe exhibited and described some photomicrographs of *Podura* scale × 2000, taken with condenser cones of aperture 0·35–0·65, and expressed the opinion that a small cone gave an altogether wrong impression. Mr. C. F. Rousselet, F.R.M.S., exhibited and described a new species of Rotifer, *Notholca bostoniensis* sp. n., he obtained in Boston, U.S.A., in August 1907. Mr. D. J. Scourfield, F.Z.S., F.R.M.S., made a few remarks on Entomostraca Mr. Rousselet had brought from Boston, mentioning points of similarity

* C. Reichert, Vienna, Catalogue, Mikroskope, No. 26 (1908) p. 62, fig. 66.
† Journ. Pathol. and Bacteriol., xiii. (1908) p. 28.

and differences in American and European forms. Mr. T. B. Rosseter, F.R.M.S., gave an historical account of the family Tæniidæ, and a sketch of his own work on *Hymenolepis*, and the methods he employed in obtaining and preparing specimens of these Platyhelminths for examination.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Influence of the Composition of the Medium on the Solvent Action of certain Soil Bacteria.†—C. W. Brown has studied the influence of the composition of the medium upon the solvent action of certain soil bacteria. The materials experimented upon were finely powdered rock phosphate, bone, tricalcium phosphate, dicalcium phosphate, and calcium carbonate. These were shaken up in water, and a little of the washed powder put into a flask of medium and sterilised for 15 minutes; after cooling to 60° C. the particles of powder are distributed through the medium by shaking, plates are poured, and inoculated by a stroke on the surface of the solidified medium, and incubated at 22° C. With ordinary nutrient agar there was no visible dissolution of any of the five minerals. With agar containing 2 p.c. dextrose, several germs showed an action upon calcium carbonate, dicalcium phosphate, and tricalcium phosphate, but there was no visible action on bone or rock phosphate.

A synthetic agar medium composed of 0·02 p.c. magnesium sulphate and ammonium sulphate and 2 p.c. agar, was then used both with and without sugars. The results showed that no germs had any action in the plates containing no sugar, but with 1, 2, and 4 p.c. dextrose, some germs acted on calcium carbonate, and on dicalcium and tricalcium phosphate; there was no action on bone or on rock phosphate.

The solvent action of some germs was greater in the presence of a large percentage of sugar; that of others being as great with 1 p.c. as with 4 p.c. If meat infusion was substituted for the water in the synthetic medium, the solvent action of the germs was less. On using a medium composed of soil leachings with 2 p.c. agar, no action was noticed, but on the addition of sugar to this medium, the results were similar to those obtained with the synthetic medium. It was found that those germs which in the presence of sugar were the most active acid producers, were those that showed the greatest solvent action.

Plate-cultivation of the Streptobacillus of Ducrey.‡—R. Stein finds that the streptobacillus of soft chancre will grow well on rabbits' blood agar plates if kept in a moist chamber to prevent drying. The waxy, shining, whitish-grey colonies have no growth in the depth of the medium, and can be easily removed from the surface of the plate.

* 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.

† Mich. Acad. Sci. Rep., ix. (1907) p. 160.

‡ Centralbl. Bakt. 1te Abt. Orig., xlvi. (1908) p. 664.

Potato Broth for the Culture of Tubercle Bacilli.*—W. Jurewitsch recommends the following preparation of potato broth for the cultivation of tubercle bacilli. Potato is cut in slices and washed and pressed through a sieve; to 500 c.cm. of this potato mash is added about 500 c.cm. of tap water; on the following day the mixture is shaken and pressed through linen; after ¼ to ½ hour the infusion is poured off from the deposit and an equal amount of ordinary "fleischwasser" is added, and also ½ p.c. of pepton and ¼ p.c. of salt solution or calcium phosphate; the whole is warmed to make a complete solution, boiled for an hour in a Koch's steam apparatus, and filtered. To the filtrate is now added 3 p.c. glycerin and a requisite amount of carbonate of soda to attain the desired alkaline reaction, and the whole is then placed in an autoclave for ¼ to ½ hour at 118–120° C., cooled, filtered, and finally sterilised for ½ to 1 hour at 115° C. The broth thus prepared should have a dark brown colour; if it is dark red in tint, it is not sufficiently alkaline, and should be corrected.

Malachite-green Agar and the Bacilli of the Typhoid Group.†—L. Padlewsky recommends the following medium for isolating the bacilli of the typhoid group. Ordinary 3 p.c. nutrient agar is mixed with 2 p.c. pepton and 3 p.c. ox-gall and 1 p.c. chemically pure lactose; the sugar is previously dissolved in a small quantity of distilled water; the gall is steamed in a Koch's apparatus and filtered through wool; the reaction of the medium should be slightly alkaline; it is then divided into 200 or 100 c.cm. flasks and submitted to fractional sterilisation. To 100 c.cm. of the fluid agar, cooled to 60–65° C., is then added the following mixture:—0·5 c.cm. of 1 p.c. aqueous solution of malachite-green, 0·5 c.cm. of gall, and 1 c.cm. of a 10 p.c. aqueous solution of sulphate of soda. This mixture is not sterilised, but, after thorough mixing, it is poured into dishes and allowed to stand in the open until the agar is solidified, and is then dried in an incubator for 15 minutes. The agar must be transparent yellow in colour and without a trace of green. The fæcal matter is spread on the surface of the agar with a suitable glass spatula. The author claims for this medium that it is the most favourable for a quick and vigorous growth of the bacilli of the typhoid group; that it has an antiseptic action on many of the other fæcal microbes: and that the colour reaction, whereby the colonies of *B. coli* and other acid-producing organisms are stained an intense green, and the colonies of the typhoid group remain colourless, enables the organisms of this group to be readily differentiated; it is especially useful when large quantities of fæcal matter have to be dealt with; it is easy and inexpensive to prepare.

Culture in vitro of Avian Plague.‡—E. Marchoux has inclosed blood from a fowl dead of avian plague in a sealed capsule, and found that the virulence was retained for a longer time in an ice chamber at 7–10° C. than at the temperature of the laboratory or of an incubator, suggesting that in the virulent blood, the antibodies, whose activity is

* Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 664.
† Tom. cit., p. 540. ‡ Comptes Rendus, cxlvii. (1908) p. 357.

suspended in the cold, can alter the germs and hinder the development at ordinary temperatures. In the ice chamber the blood remains virulent for a less time in an open tube than in a closed one; but though the virus maintained its strength for at least three months in a sealed capsule, it became inactive after three days in a vacuum. In colloidin capsules placed in the peritoneum of a rabbit, the virus perished within four days. The addition of glucose and pepton in varying proportions enables the virulence to be retained for a longer period. For purposes of culture, therefore, the author limits the quantity of blood, and uses glucose-pepton-agar as a medium.

Detection of Indol in Microbial Cultures.*—G. Buard has adopted the following method for the detection of indol: 10 c.cm. of culture are mixed in pepton water, and after 15 to 20 hours' incubation, 5–6 c.cm. of absolute alcohol are added, and after mixing there is added 1 c.cm. of alcoholic solution of vanilin and 3 c.cm. of pure hydrochloric acid. If indol is present it develops a pink coloration which becomes more intense, deepening to a red-magenta or violet-red, especially on the application of slight heat. The author experimented with several varieties of pepton. With the pepton of Defresne the pink colour changes to saffron. The author claims for this method great certainty of results and much saving of time.

Method of Fixing the Eggs of Ascaris megalocephala.†—C. Artom leaves uteri in salt solution until most of the eggs reach the desired stage of development. Little heaps about 0·5 cm. high are placed on a carbonic acid freezing-microtome, and when frozen the mass is sectioned. Though many eggs are of course irretrievably damaged by this procedure, yet a good few will be found with only a thin slice removed from the shell. The sections, which should be about 30 μ thick, are transferred while still frozen from the knife to the fixative, such as Flemming's strong solution, sublimate-acetic acid, formol-alcohol, picro-acetic acid. The blackening from osmic acid must be removed by immersion for several days in turpentine oil. Borax-carmin and dilute Delafield's hæmatoxylin give good results for preparations fixed in Flemming's solution. The fixed eggs were examined *in toto* or imbedded in paraffin and sections made.

Celloidin Decalcification and Desilication.‡—C. F. Bödecker gives the procedure for removing lime and silica from organic material in minute detail.§ After fixation the material is passed through the following fluids: alcohol 40 p.c. (1 hr.); alcohol 70 p.c. ($\frac{1}{2}$ hr.); alcohol 96 p.c. ($\frac{1}{2}$ hr.); absolute alcohol (12 hr.); ether and absolute alcohol (1 hr.); thin celloidin (12 hr.); acidulated celloidin (1 week to 2 months). (This mixture consists of celloidin solution, to which 10 p.c. nitric acid is added. The acid is mixed with ether and alcohol and gradually added to a celloidin solution, stirring the while.)

During decalcification it is necessary that evaporation should be

* C.R. Soc. Biol. Paris, lxv. (1908) p. 158.
† Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 3–7.
‡ Tom. cit., pp. 21–9 (1 pl.).
§ See this Journal, 1905, p. 764.

avoided by careful closure of the vessel. The author advises a special jar, the lid of which is kept taut by a spring.

When the lime or silica is removed, a block with sides 3 mm. broad is cut out, and having been coated with celloidin is submitted to the following procedure: alcohol 70 p.c. (6 hr.); alcohol 40 p.c. (2 hr.); aqueous alum solution 5 p.c. (12 hr.); running water (12 hr.); alcohol 40 p.c. (1 hr.); alcohol 70 p.c. (½ hr.); alcohol 96 p.c. (½ hr.); absolute alcohol (10 min.) Then follows a mixture of pure carbolic acid 1 part and chloroform 2 parts, or anilin oil (12–24 hr.). These must be frequently changed.

After this an equal bulk of chloroform is added (6 hr.), then pure chloroform (12 hr.); followed by chloroform and paraffin (6 hr.), soft paraffin m.p. 45° (6 hr.), hard paraffin m.p. 58° (12 hr.). The sections made in the usual way, are stuck on by the "Japanese method." The paraffin and celloidin are successively removed, and then the sections may be stained by any desired method, though iron-hæmatoxylin is advocated.

Examining Stylaria lacustris.*—G. Dalla Fior, when examining the asexual reproduction of *Stylaria lacustris*, first benumbed the animals with cocain and then fixed them in one of the three following fluids:—(1) sublimate-acetic acid 6 p.c.; (2) Perenyi's fluid; (3) Flemming's fluid. The first gave the best results. Transverse and longitudinal sections 4 μ thick were made. The preparations were stained with Delafield's hæmatoxylin, acid-fuchsin, orange, and Heidenhain's iron-alum.

Examining the Poison-glands of Salamandra maculosa.† — A. Nierenstein fixed the material, the poison-glands of *Salamandra maculosa* (adult animal and larvæ at various stages of development) in Zenker's fluid and 1 p.c. osmic acid. The latter gave better results when it contained 0·6 p.c. sodium chloride. Sections made by the freezing method from osmic-fixed preparations gave very good results. For staining purposes, Mayer's muci-carmin was superior to other dyes.

Combined Imbedding in Celloidin and Paraffin.‡ — A. Breckner takes the pieces, which have been fixed, out of absolute alcohol and transfers them to 2–3 p.c. celloidin solution, wherein they remain, according to size, from a few hours to days. The pieces are then picked out and placed in chloroform for 5–10 hours, after which they are passed successively through benzol, a warm mixture of benzol and paraffin, and pure melted paraffin. In the latter they remain until completely saturated. Blocks are made in the usual way. The sections are treated as if made from paraffin blocks, and made to adhere to the slide by the albumen or water method. In the further treatment, absolute alcohol should be avoided, and dehydration effected by means of a mixture of 3 parts xylol and 1 part water-free carbolic acid, or by a mixture of equal parts of chloroform and absolute alcohol.

* Arb. Zool. Inst. Wien, xvii. (1908) pp. 109–38 (2 pls.).
† Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 47–140 (3 pls.).
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 29–32.

Examining the Oocyte of the Fowl.*—Sonnenbrodt obtained material from birds found dead in the fowl trains which come from Russia to Berlin. For the ovaries of young animals sublimate acetic acid was found to be the best fixative, but for ovaries with large follicles calcium bichromate 2 p.c., sublimate 2 p.c., and acetic acid (20 : 10 to 1) was superior. After having been passed through upgraded alcohols the pieces were immersed in water-free aceton (¼ to 1 hour), then in xylol or chloroform (10 minutes to ½ hour), followed by a mixture with paraffin (¼ hour), and finally pure paraffin twice changed (½ to 3 hours). The sections according to the size of the follicles were cut from 2–10 μ thick. For sticking the thicker sections to the slide Olt's phenol-gelatin was used; the superfluous adhesive was removed by means of blotting paper, and then the slide placed on edge was allowed to dry at room temperature. When quite dry the preparations were treated with 10 p.c. formalin. Several staining methods were tried, but Heidenhain's iron-alum-hæmatoxylin was the only really successful one. Contrast-staining was effected with orcein, rubin, orange, picric acid, acid-fuchsin-picric-acid.

(4) Staining and Injecting.

Differential Staining Method for Acid-fast Bacilli.†—L. v. Betegh recommends the following method for staining acid-fast bacilli. Smears are made and dried and fixed in the flame; they are then treated with 2 to 3 drops of 15 p.c. nitric acid and heated over a flame until slight steam arises, and then washed with water; they are then treated with 2 to 3 drops of methylen-blue or methylen-violet and 2 to 3 drops of carbol-fuchsin, and again heated over a flame until the steam arises, after which they are thoroughly washed and decolorised with 60 p.c. alcohol, washed with water, dried, and mounted in balsam.

For tubercle bacilli, perlsucht bacilli, avian tubercle, and leprosy bacilli in sputum, the author recommends treating the specimen (after the last washing with water) with a thick layer of water into which a drop of malachite green solution has been added, and this to be followed again with a washing with water.

The bacilli stain red, the spores blue; the nuclei of the leucocytes are blue-violet or green-blue according to the duration of the action of the malachite-green; the cell plasma and other adventitious bacteria stain light green.

Silver Method for Differentiating the Bacilli of Leprosy and Tubercle.‡—J. Yamamoto recommends the following process. Cover-slip preparations of leprosy bacilli are made from nodules, after incision with a sharp knife, care being taken to disinfect the skin, and to avoid as much as possible the admixture of blood by pressure. Cover-slips of tubercle bacilli are prepared from sputum or from pure culture spread in egg-albumen. The preparations are dried and fixed in the flame; heated for 10 minutes in 5 p.c. nitrate of silver solution at 55–60° C. They are then placed for 5 minutes in the reducing solution, which is

* Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 415–80 (4 pls.).
† Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 654.
‡ Tom. cit., p. 570.

composed of pyrogallic acid 2 p.c., tannic acid 1 p.c., and distilled water to 100. The slips then become covered with a black deposit, which is carefully removed by several applications of filter paper moistened in water; they are then dried and mounted in balsam. Examined with an oil-immersion lens the tubercle bacilli are found to be stained black, whilst the leprosy bacilli remain transparent and clear, and may be subsequently stained by Ziehl-Nielsen's carbol-fuchsin method.

Studying the Sexual Organs of Cestoda.*—H. H. Balsz found that *Anoplocephala magna* was the best material, though he also used *A. perfoliata* and *Solenophorus* sp. The worms were fixed in sublimate, and paraffin sections made. The sections were stained with: 1. Iron-hæmatoxylin and eosin. 2. Methylen-blue safranin: the sections removed from water were first stained on the slide by means of Nissl's methylen-blue method, the stain being gently warmed for about ½ minute. After a wash in water, the slides were quickly passed through 40 p.c. alcohol and then to safranin solution (200 c.cm. distilled water, 0·5 grm. safranin, 79 c.cm. absolute alcohol), wherein they remained for ¼–1 minute, according to the thickness of the section. They were rapidly passed through upgraded alcohols to xylol and balsam. 3. For demonstrating the basal membrane, Mallory's triple stain was used. The sections were first stained with acid-fuchsin, then washed, and afterwards mordanted for 1 or 2 minutes with ½ p.c. solution of phosphomolybdic acid and then placed in the following solution:—anilin-blue, 0·5 grm.; orange, 2 grm.; oxalic acid, 2 grm.; distilled water, 100 grm. In this they remained for from 2–5 minutes, and after a wash in distilled water they were placed in 40 p.c. alcohol. This brings out the blue. If not sufficiently dyed, the sections may be re-stained. Next, upgraded alcohols to xylol. 4. Bleu-de-Lyon with ammonium-picrate and Hein's thionin methods were also used, but the results were not better.

Staining Spirochæta pallida.—M. Gottberg† fixed this material in Zenker's fluid and then stained the paraffin sections by Heidenhain's iron-hæmatoxylin method. The sections were mordanted for 24 hours in 2·5 p.c. iron-alum solution and immersed in Weigert's hæmatoxylin for one or two days. The differentiation in 0·75 p.c. iron-alum solution took a few minutes.

H. Ehrlich and J. T. Lenartowitz‡ find that *Spirochæta pallida* stains in Ziehl-Nielsen and in carbol-gentian-violet in from ½ to 2 minutes; in carbol-methylen-blue or carbol-dahlia in 5 to 10 minutes; in Loeffler's methylen-blue and carbol-thionin in 25 to 30 minutes; in saturated aqueous solution of safranin, Bismarck-brown and vesuvin in 1 hour or more.

Gradle§ recommends as a clinical stain:—(1) methylen-blue 0·5,

* Zeitschr. wiss. Zool., xci. (1908) pp. 266–96 (2 pls.).

† Archiv f. Hygiene, lxv. (1908) pp. 243–51.

‡ Wiener Med. Wochenschr., 1908, p. 1018.

§ Journ. Amer. Med. Assoc., l. (1908) No. 16. See also Centralbl. Bakt. Ref., xlii. (1908) pp. 290–2.

potassium carbonate 0·5, water 50 ; (2) cyanide of potassium 1, water 50 ; (3) potassium iodide 1 p.c. Mix equal parts before staining.

Alizarin, a Vital and Specific Stain for Nervous Tissue.*—H. Fischel has found in alizarin a pigment which will stain *intra-vitam* the nerves of *Cladocera*. The simplest method is to drop some of the powder into the water in which the animals live, and in a few hours to a few days the nervous system of some of the animals will be found stained a dark violet. Better results are obtainable by means of a solution of alizarin made by dropping the powder into boiling water and continuing the boiling for some time. The clear filtrate is used and an equal quantity added to the water in which the animals are. When successful the staining results are said to be excellent. The method, however, has certain disadvantages :—(1) the action of the stain is somewhat uncertain, thus under similar conditions some animals will be found well stained, others not at all ; (2) the stain seems to be specific for *Cladocera* only, other animals having failed to be affected by its action.

Vital Staining of Fresh-water Animals.—The same author gives an interesting account of the results of his researches on the vital staining of fresh-water animals, with especial reference to *Cladocera*. The dyes were used in extremely dilute solution. The principal pigments used were neutral-red, neutral-violet, Nile-blue, Bismarck-brown, methylen-blue, and tolnidin-blue. Combinations of these stains were also used. Coloured illustrations show the effect of the pigments, and special attention may be drawn to the action of alizarin on the nervous system. The author also alludes to the influence of light. He found that rays of long wave-length intensified the action of the stain, and quotes the result of lithium-carmin in combination with ruby glass as a light-filter. In the last section he discusses the theory of vital staining.

Flemming's Triple Staining Method.‡—H. v. Winiwarter and G. Sainmont allude to the unfavourable criticisms of this method, and then state that unsatisfactory results are due to the insufficient directions given in the original. They have adopted the procedure for twelve years, and have found that, with the following slight modifications, it gives excellent results.

Though the triple staining is specially adapted for material fixed with Flemming's solution, it may be used after other fixatives provided that the sections are immersed in Flemming's solution for 24 hours, and afterwards washed for about 20 minutes in running water.

After fixation for 24 hours in Flemming's solution, it is indispensable that the pieces should be thoroughly washed in running water for 24 hours. After this they may be passed through up-graded alcohols to paraffin. The paraffin should be removed by means of xylol unaided by heat. The sections are next treated with a mixture of xylol and absolute alcohol, then twice with absolute alcohol, followed by 95 p.c. and 65 p.c. alcohols. The slides are placed for 24 hours in safranin

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 154–7.
† Internat. Revue ges. Hydrobiol. u. Hydrograph., i. (1908) pp. 73–141 (2 pls.).
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 157–62.

solution (1 p.c. safranin in absolute alcohol to which a few drops of anilin-water have been added), diluted with an equal bulk of distilled water. After frequent washings in distilled water, the sections are placed in 1 p.c. aqueous solution of gentian-violet for 24 hours; then, after more washings in water, immersion in an aqueous solution of orange G for about one minute. The strength of this solution varies with the object to be stained, and the result must be controlled under the Microscope. The sections are next immersed in absolute alcohol to which 6 to 8 drops of a mixture of equal parts of absolute alcohol and pure hydrochloric acid have been added; they are removed directly violet clouds are given off. Then absolute alcohol again to remove the acid. The special differentiation is effected in oil of cloves, which may be thinned down with a little absolute alcohol. This is a slow process, and should be controlled under the Microscope, and is usually ended when the nuclear portions are blue and the non-nuclear yellow. Then pure oil of cloves; then drain in vertical position on blotting-paper; xylol, xylol-balsam.

The authors end their remarks by pointing out the importance of using the best safranin, for if this pigment does not work well the violet and orange also produce useless pictures.

Localising Purin Bodies in Animal Tissues.*—C. Ciaccio demonstrates the presence of purin bodies in the organs of Vertebrates under normal and pathological conditions by the following method, the technique of which depends on two principal facts, viz. the formation of urate of silver, and the property possessed by purin bodies of reducing ammoniacal solution of silver nitrate. Three forms of procedure are given.

1. To a 1½–2 p.c. solution of silver nitrate is added ammonia drop by drop, until the precipitate formed is dissolved. After filtration ammonia is again added until the odour is clearly perceptible. The filtrate, placed in a perfectly clean vessel, is kept in the dark. In this solution small pieces (4 or 5–100 c.cm.) are placed for from 1 to 5 days, according to the temperature, the optimum being 37–40°. On removal the pieces are placed in 1 p.c. ammonia for 24 hours, the fluid being changed every 2 or 3 hours. They are next washed, and then passed through upgraded alcohols to xylol and paraffin in the usual way. The sections are stained with thionin, toluidin-blue, methylen-blue, or polychrome blue, or with the author's eosin-orange-toluidin stain. Acids and hæmatoxylin must be avoided.

2. The material may be fixed in 96 p.c. or absolute alcohol, or in Carnoy's fluid. If in alcohol the pieces must be small, and after fixation soaked in water; if in Carnoy's fluid, they must be treated afterwards with alcohol and then water. In both cases the subsequent treatment is the same as in procedure (1).

3. Fixation in alcohol or in Carnoy's fluid; imbedding in paraffin. The sections having been freed from paraffin are passed through downgraded alcohols to distilled water (a few seconds). They are then

* Anat. Anzeig., xxiii. (1908) pp. 298–320 (18 figs.).

immersed in the ammoniacal silver nitrate solution at 37–40° in the dark for 24 hours. On removal they are washed in 1 p.c. ammonia for 10 to 15 minutes, followed by distilled water and staining as before.

Though the results are the same in all three procedures, the author recommends fixing in Carnoy's fluid, and treating the pieces *in toto* with the ammoniacal silver reagent. The purin bodies are seen in the cells or within the tubules as black granules, which vary much in size.

HANSEN, F. C. C.—**Ueber die Ursachen der metachromatischen Färbung bei gewissen basischen Farbstoffen.**
Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 145–53.

„ „ **Ueber Eisenhämatein, Chromalumhämatein, Tonerdealaunhämatein, Hämateinlösungen und einige Cochenillefarblösungen.** *Op. cit.*, xxii. (1905) pp. 45–90.

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

Farrants' Medium.*—Farrants' medium, says H. S. Ogilvie, is very apt to give trouble by the formation of air-bells in the mounts. These often originate in the making of the medium, through stirring it too vigorously. Before use, filter it through a fine linen or spun glass-cloth, previously washed in distilled water. This process takes some time, therefore protection from dust and undue evaporation should be provided. The secret in mounting with this medium is to use a very liberal supply; it is also advantageous to use a rod for transferring it instead of a pipette. The specimen, having previously lain two or three days in some of the mountant, is placed on a slide, carefully arranged, and then a comparatively large quantity of the medium is placed upon it. Air-bells may then be removed either to the edge with needles, or by bursting them with a hot needle. Apply the cover-glass very gently, and do not press it down for two or three days, and even at the end of that period do so very gradually. After a week or two the excess of medium may be cleaned away, and the slide allowed to dry. If the edges refuse to dry, use less glycerin in the preparation of the mixture. The same remarks apply to Dean's medium, and glycerin-jelly; excepting that, in the case of the last-mentioned, the cover-glass should be pressed home at once, the superfluous jelly cleaned away when cold, and the slide ringed. The advantages derived from any of the foregoing are chiefly: 1. Their low refractive index, which renders delicate unstained tissue more easily seen than would be the case were balsam used. 2. By their use, previous dehydration, which sometimes causes contraction, is avoided. In either of these respects one medium is practically as good as the other. 3. In many cases such media are as useful as a liquid, with the advantages that they are easier to use, and the risk of subsequent leakage is avoided. In the preparation of any of these mixtures, be careful to avoid glycerin that has been diluted with water.

* English Mechanic, lxxxviii. (1908) p. 240.

(6) Miscellaneous.

Pipette for Microscope Work.*—M. Wolff describes a pipette (fig. 172) which he has found useful in Microscopical work. It is made on the lines of the Stroschein syringe, and consists of a glass tube of 4 mm. bore which is provided with a point in the usual way, whilst at its upper end it has two welts by means of which it may more conveniently be held between two fingers. The aspirator consists of a small cylinder of a bore of 5·5 mm. and 40 mm. long, and is hermetically sealed at its upper end.

The open end of the cylinder has a piece of rubber tubing 1 cm.

Fig. 172.

long, 4 mm. bore, and 8 mm. external diameter slipped over it. The tubing is accordingly narrower than the body of the pipette. A length of 7 mm. of the rubber tube is slipped over the cylinder and the remainder embraces the pipette so that an airtight joint is insured.

The pipette is charged by drawing the cylinder up. The pipette should be held between the thumb and the middle finger, and by slowly pressing upon the cylinder with the index finger the fluid is very easily ejected in single drops. The apparatus has been placed on the market by E. Leitz, of Berlin.

Mesophotography and its Application to Delicate Unfixed Embryos.†—C. J. Patten defines mesophotography as the photography of objects of natural size, or but slightly enlarged or reduced. The apparatus used consists of a camera with an ordinary front, but arranged to take different sized lenses by a series of adapter flanges. The lens used was a Zeiss microplanar of 75 mm. focal length. Most of the photographs which the author took were of embryos which five minutes before were within the uterus of the living parent. Having detached the embryo from the uterus of a freshly killed animal, all that has to be done is to fill a glass capsule with cold distilled or boiled water, drop in the embryo, place the capsule on the stand in a position under the lens, bring the embryo into the field with a touch of a soft camel hair brush, focus it, cap the lens, draw the dark slide, wait a few seconds until all objects seen reflected in the water appear perfectly motionless, remove the cap gently, and expose the plate.

The advantages claimed for this procedure are its simplicity, rapidity, and usefulness for making illustrations of the external form of the embryo for plate reproductions.

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 648 (1 fig.).
† Brit. Med. Journ. (1908) ii. pp. 593–4.

Metallography, etc.

Cohesion of Steel.*—Assuming that resistance to deformation is due to simple friction, and that the coefficient of friction is independent of the load, G. H. Gulliver calculates the ratio of the yield-point in tension to the yield-point in compression, for mild steel, as 0·705 to 1. Experimental results give a ratio nearer to unity. Assuming, further, that a cohesive force acting between the metallic particles gives rise to a frictional resistance which may be added to that due to the effect of the external load, the author deduces the value of this cohesive force to be 3·384 times the stress which corresponds with the tension yield-point.

Function of Chromium and Tungsten in High-speed Tool-steel.† C. A. Edwards has made hardness tests, cutting tests, determinations of thermal critical ranges, examinations of microstructure, and tempering experiments on two series of iron-carbon-chromium-tungsten alloys (sixteen samples). The composition of one series was approximately C 0·65, Cr 6·0, W 3 to 19 p.c., that of the other series C 0·65, W 19, Cr 1 to 8 p.c. The author concludes that the critical point at about 380° C., existing in steels with more than 3 p.c. chromium and 6 p.c. tungsten, is a change occurring in a carbide of tungsten which is slowly formed at about 1200° C. At 1320° C. or above, a double carbide of chromium and tungsten is formed, and no low critical point is found. The function of the chromium is the formation of the double carbide.

Test of Plates from an Old Boiler.‡—M. Longridge gives details of tests of material cut from a boiler which had been in continuous use for 72 years. The iron plates were found to be extraordinarily brittle, and could be broken up with a hammer.

Copper-aluminium Alloys. — After briefly reviewing the earlier work, including his own, L. Guillet § discusses the equilibrium diagrams obtained by Carpenter and Edwards, ‖ and by Gwyer.¶ The author questions the assumption, almost universally made, that a maximum in the curve always corresponds to a definite compound. He supports Gwyer in asserting the existence of CuAl and denying that of Cu_4Al. The position of the transformation points, and the constitution of the quenched alloys, are still undecided.

Hardness of Constituents of Alloys.**— Ziegler describes an optical method for measuring relative hardness. When a section is polished on a soft body such as thick cloth, the harder constituents are left more in relief, and the relative hardness is indicated by the

* Proc. Roy. Soc. Edin., xxviii. (1908) pp. 374–81 (2 figs.).
† Journ. Iron and Steel Inst., lxxvii. (1908) pp. 104–32 (37 figs.).
‡ Mechanical Engineer, xxii. (1908) p. 305 (2 figs.).
§ Rev. Métallurgie, v. (1908) pp. 413–24 (3 figs.).
‖ See this Journal, 1907, pp. 755–6. ¶ Op. cit. 1908, pp. 260–1.
** Rev. Métallurgie, v. (1908) pp. 565–70 (2 figs.).

differences in level, which can be measured. Applying this method to alloys produced by heating iron in boiling sulphur, the author obtains further evidence that FeS is first formed, then FeS_2. Sulphur appears to form solid solutions with both compounds FeS and FeS_2.

Troostite.—H. le Chatelier* remarks that in his article on the constituents of steel† troostite was purposely described vaguely as constituent X in order to avoid controversial matter. The author agrees with Charpy, Grenet, and Benedicks in regarding troostite as pearlite of extremely fine structure. But this has not yet been proved, and is only the most probable hypothesis. The fineness of structure, introducing effects due to surface tension, is the cause of the difference in properties between troostite and pearlite. The thickness of the cementite lamellæ in pearlite is of the order of $0{\cdot}01\mu$, while the dimensions of the cementite particles in troostite probably do not exceed $0{\cdot}001\mu$. The description of troostite as a colloidal solution is unsatisfactory. The term is applied to widely differing mixtures which have the common characteristic of not separating under the action of gravity, while they lack the properties of true solutions. It is difficult to see how a solid body, such as steel, can be correctly described as a colloidal solution.

Corrosion Tests of Iron and Steel.‡—C. Frémont describes the methods of etching for developing the macrostructure of iron and steel, and gives numerous examples of their application. He employs pure hydrochloric acid for rapid etching and dilute sulphuric acid for slow etching. For rendering visible effects due to piping and segregation, the author prefers iodine solution. Examination of macrostructure should be supplemented by shock tests on small notched bars taken from segregated parts. The employment of segregated steel, which has caused many serious accidents through fracture, might be avoided by submitting the metal before use to testing by corrosion.

Metallography of Quenched Steels.§—Kourbatoff has studied the transformations of austenite at temperatures up to 445° C. He did not succeed in obtaining pure austenite, but austenitic steels were produced by rapid quenching from high temperatures of samples containing 1·1, 1·6, and 1·9 p.c. carbon. Austenite appears to contain about 2 p.c. carbon. The samples used in the tempering experiments were small bars, one end of which had been heated to fusion in the oxyhydrogen flame, and quenched. Treated in this way, each piece contained several constituents. No change resulted at temperatures below 100° C., even when the heating was continued for two or three months. At 137° C. a change of structure quickly occurs. At 218° C. austenite is completely transformed in 12 to 18 hours, and at 248° C. in a few minutes. Austenite appears to change directly into troostite, not passing through the intermediate stage, martensite. The author's reagents A and C were used for etching.

* Rev. Métallurgie, v. (1908) p. 639. † See this Journal, 1908, p. 523.
‡ Rev. Métallurgie, v. (1908) pp. 649–703 (41 figs.).
§ Tom. cit., pp. 704–10 (13 figs.).

Quenching and Tempering of Iron and Steel.* — E. Maurer has quenched a number of steels of varying carbon content, at temperatures 800–1100° C., and reheated each sample successively at temperatures rising from 100–750° C. After each heating, the structure, physical properties, and chemical condition of the sample were studied. Some physical measurements were also made on pure iron. The author inclines to the view that in an etched section, whatever the reagent used, martensite normally appears white. Only when the transformation to troostite has commenced does martensite assume a darker colour than austenite. Among the author's conclusions are the following : (1) the effect of quenching on the physical properties of pure iron is due to deformation of *α*-iron ; (2) homogeneous austenite may be obtained by rapidly quenching high carbon steel containing sufficient manganese ; † (3) austenite changes directly to troostite between 150° and 250° C., or at higher temperatures when much manganese is present. In mixtures of austenite and martensite, the change first begins in the martensite, but proceeds more slowly than in the austenite. Cooling (as in liquid air) causes austenite to be transformed into martensite.

H. le Chatelier ‡ remarks that Maurer's work on the constitution of quenched steels is possibly the most important since Osmond's first investigations. The changes which take place when a quenched steel is heated are :—1. Mechanical (removal of elastic strain). 2. Physical (change in size of grain, change of troostite into pearlite, removal of cold work effects). 3. Chemical (transformation of austenite and of martensite into troostite). A mathematical treatment of the problem of rate of change of physical properties with temperature, is attempted.

Alumina for Polishing.§—Aluminium alloyed with a little mercury is readily oxidised in air or water. Robin utilises this property in the preparation of powder for polishing. Strips of pure aluminium foil are shaken up with mercury and are then exposed to moist air. White tufts of alumina form on the surface and may be observed to grow. After about four hours no further oxidation takes place. The alumina thus produced may be used for final polishing without further preparation. It does not appear to be better than that obtained by lengthy and laborious levigation methods, but is speedily and easily prepared in quantity at a small fraction of the cost.

Heat-treatment of Muntz Metal.‖—G. D. Bengough and O. F. Hudson supplement their former paper ¶ by the results of impact and other tests. The Izod test is not considered to be sufficiently discriminating to give useful information about this alloy. Four types of structure are distinguished :—(1) the rolled ; (2) the island ; (3) the network ; (4) the cast type. The effects of cold work appear to persist even after long annealing at a high temperature.

* Rev. Métallurgie, v. (1908) pp. 711–50 (65 figs.).
† See this Journal, 1908, p. 394.
‡ Rev. Métallurgie, v. (1908) pp. 643–7. § Tom. cit., pp. 751–7 (8 figs.).
‖ Journ. Soc. Chem. Ind., xxvii. (1908) pp. 654–8 (11 figs.).
¶ See this Journal, 1908, p. 262.

Carbon-iron Diagram.*—H. M. Howe explains and supports at considerable length the double diagram of the iron-carbon system, indicating metastable equilibrium between iron and cementite, and stable equilibrium between iron and graphite. The evidence for and against this diagram is fully considered. The constituents austenite, cementite and ferrite are subdivided, and new terms are defined and employed by the author to indicate the genesis of each subdivision. For instance, cementite is classed as primary, eutectic, pro-eutectoid, or eutectoid cementite. Though graphite usually results from the decomposition of cementite, the author considers that eutectic graphite is sometimes formed directly from the molten state. In solidification the habitual order is through the metastable to the stable system. While cementite often changes directly into graphite and iron, graphite can only change into cementite through an intermediate state of solution in iron as austenite.

Vanadium-iron Alloys.†—R. Vogel and G. Tammann found that alloys with more than 30 p.c. vanadium could not be prepared by melting the metals together. High vanadium alloys were accordingly made by reduction of mixtures of the oxides with aluminium. Silicon was also reduced in the reaction from the crucible. A diagram is therefore given for a series of vanadium-iron alloys containing 7·5 p.c. silicon. By using magnesia-lined crucibles for the alumino-thermic reduction, the authors obtained alloys nearly free from silicon. Iron and vanadium form a continuous series of mixed crystals. The solidification point of the vanadium used was found by the Wanner pyrometer to be 1750 ± 30° C.; probably pure vanadium solidifies at a somewhat higher temperature.

Silicon-aluminium Alloys.—W. Fraenkel has determined the equilibrium diagram. No compounds are formed. Silicon and aluminium are completely miscible in the liquid state; in the solid the limits of solubility appear to be not greater than 0·5 p.c. silicon in aluminium and 2 p.c. aluminium in silicon. The eutectic contains 10 p.c. Si, and melts at 578° C. Microscopic verification of the composition of the mixed crystals was difficult.

Composition of Saturated Mixed Crystals.§ — W. v. Lepkowski has investigated, in two series of alloys, the production of supersaturated mixed crystals by rapid cooling. The microstructure of samples cooled in the furnace was compared with that of samples cast in iron moulds standing in ice. While in the tin-bismuth series the concentration of tin in solid solution in bismuth could be raised from 0 to between 1·1 and 1·5 p.c. by rapid cooling, no effect of this kind could be produced at either end of the copper-silver series. The equilibrium diagram of the tin-bismuth series was re-determined.

* Bull. Amer. Inst. Mining Engineers, xxii. (1908) pp. 461–529 (10 figs.).
† Zeitschr. Anorg. Chem., lviii. (1908) pp. 73–82 (2 figs.).
‡ Tom. cit., pp. 154–8 (1 fig.).
§ Op. cit., lix. (1908) pp. 285–92 (8 figs.).

Binary Alloys of Cobalt.* — K. Lewkonja has determined the equilibrium diagrams and studied the magnetic properties and structure of the alloys of cobalt with the nine elements named below. Cobalt is miscible with tin and also with antimony, in all proportions in the liquid state. The compounds are Co_2Sn, CoSn, CoSb, and $CoSb_2$. With lead, bismuth, and thallium, cobalt is miscible in the liquid state only to a small extent, the molten alloys separating into two layers except for short ranges at both ends of each system. The cobalt-zinc system was studied only in the range 0–18·5 p.c. cobalt. The existence of $CoZn_4$ is probable. Cobalt and chromium are mutually soluble in all proportions in the liquid and solid states. Cobalt and silicon are miscible in all proportions in the liquid state, and form five compounds. The diagram for the cobalt-cadmium system is incomplete. The results now available concerning the binary alloys of iron, of nickel, and of cobalt are carefully analysed and summarised in tabular form.

Manganese and Carbon.†—A. Stadeler has made a thermal and microscopic study of manganese and its alloys with carbon. The melting-point of the purest commercial manganese obtainable (96 p.c.) was found to be 1207° C. No evidence of allotropic modifications was obtained. The saturation point of carbon in manganese is 6·72 p.c., corresponding to Mn_3C. The solidification point curve rises to 1271° C. at 3·32 p.c. carbon, then falls to 1217° C. at 6·72 p.c. From 0·72–3·60 p.c. a critical point at 817–855° C. was found. Manganese probably forms with Mn_3C a series of mixed crystals which is continuous above 855° C. At lower temperatures, in the range 0–3·6 p.c. carbon, two series of solid solutions exist. Cementation of manganese with carbon does not appear to be possible.

Alloys of Zinc, Copper, and Nickel.‡—V. E. Tafel has determined the equilibrium diagrams for the three binary systems and partially for the ternary system zinc-copper-nickel. The microstructure of the alloys was also studied. The diagrams given by Guertler and Tammann for the copper-nickel system, and by Shepherd for the copper-zinc system, are, on the whole, confirmed. In the zinc-nickel system the compound $NiZn_3$ (melting-point 876° C.), and two series of mixed crystals containing respectively 12·2–23·0 p.c. and 39·7–49·0 p.c. nickel were found. The constitution of other phases is uncertain. The range 0–50 p.c. nickel only was studied, as zinc-nickel alloys with more nickel could not be prepared. The ternary system is very complex. No ternary compound or ternary eutectic was found.

Copper-arsenic System.§ — Considerable differences between the diagram given by Hiorns and that determined by K. Friedrich, have led the latter to carry out a further investigation. The author's results were confirmed in essential points. The compounds are Cu_5As_2 and Cu_3As. Evidence for Cu_2As was not obtained. Copper may contain

* Zeitschr. Anorg. Chem., lix. (1908) pp. 293–345 (41 figs.).
† Metallurgie, v. (1908) pp. 260-7, 281–8 (52 figs.).
‡ Tom. cit., pp. 343–52, 375–83, 413–30 (100 figs.).
§ Tom. cit., pp. 529–35 (16 figs.).

up to 4 p.c. arsenic in solid solution at 700° C. The curve showing the relation between composition and electrical resistance has an inflection at 4 p.c. arsenic.

BELLOC, G.—**Occluded Gases in Steel.**

„ „ **Occluded Gases in a Special Nickel-steel.**

[More complete accounts of work previously summarised. See this Journal, 1908, pp. 124 and 661.]

Rev. Métallurgie, v. (1908) pp. 469–88 (5 figs.); and pp. 571–4 (2 figs.).

FRIEDRICH, K.—**Contribution to the History of Metallography.**

Metallurgie, v. (1908) pp. 408–10.

FRIEDRICH, K., & A. LEROUX—**Binary Systems Cu–Cu_2Se, Ag–Ag_2Se, Pb–PbSe.**

Tom. cit., pp. 355–8 (11 figs.).

GUERTLER, W.—**Electrical Resistance of Alloys.**

[The bearing of recent researches on technical applications of alloys is indicated.] *Tom. cit.*, pp. 292–6.

PORTEVIN, A.—**Alloys of Aluminium.**

„ „ **Alloys of Copper.**

„ „ **Alloys of Iron.**

„ „ **Alloys of Manganese and Alloys of Magnesium.**

[Further instalments of Portevin's account of the Göttingen researches. See this Journal, 1908, pp. 522–23.

Rev. Métallurgie, v. (1908) pp. 274–94 (25 figs.); 361–95 (40 figs.); 535–60 (28 figs.); and 762–90 (38 figs.).