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

1912

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1912.

TRANSACTIONS OF THE SOCIETY.

I.—*A Geometric Slide Photomicrographic Apparatus.*

By J. E. Barnard.

(*Read November* 15, 1911.)

The principle of the geometric slide is, perhaps, quite well known to the Fellows of this Society, but in case there should be any to whom the subject is not entirely familiar, I propose to very briefly indicate the principles involved. A full description of it is to be found in Lord Kelvin and Tate's treatise on "Natural Philosophy," p. 153. The description given there is in reference not only to the geometric slide, but also the geometric clamp, which is founded on the same general principles.

As you are all aware, nearly all photomicrographic appliances so far constructed require considerable accuracy of workmanship even apart from their design. In the apparatus now shown, quite the opposite idea has been in view. The object has been to depend on design almost entirely, so that the workmanship involved is not of a very high order, and is certainly not of the order usually required in scientific, and particularly microscopic, instruments.

The principle of the geometric slide depends in the main on the method of supporting any part of the apparatus on three points. Where any of the separate appliances require to be fastened down or restrained from moving, apart from the whole of the apparatus, the clamp is so arranged that it comes within the triangle formed by the three points of support. A typical example, therefore, of a geometric slide is to take two straight rigid metal rods as a main line of support. When any appliance has to be clamped on to

these, or to have freedom of movement in the direction of their length, it is supported on one side on two V-shaped grooves, and on the other side by a plane surface, which is intermediate in position between these grooves. The diagram (fig. 1) herewith illustrates the main points.

A A are the two metal rods, and the baseplate is seen lying on these. At C C the two V-shaped grooves are placed, the plane surface being on the side D. In section, A A are again the metal rods, and the relative position of the V grooves and the flat surface are seen. The position of the clamp should be as nearly as possible at E, so that when it is brought into use the pressure or downward strain is equal on each of the three points of support. The two faces of the V grooves are preferably at right angles to one another, so that when clamped down there is no tendency to jamb on to the rods, and it also ensures that the movement is perfectly free when the clamp is released.

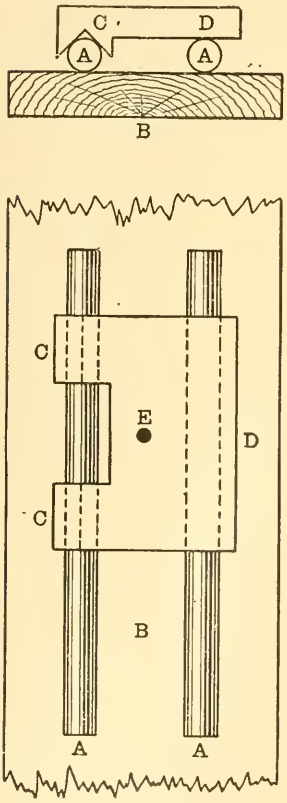

Fig. 1.

The principle of the geometric clamp is a variation on this, and in the apparatus here shown we have as a matter of expediency introduced it in a modified form. It is, however, so useful when setting up any small piece of apparatus, that it may be required to move and replace in the same position, that a short description of it may not be out of place.

If any piece of apparatus is supported on three points, and these three points themselves rest on a plane surface, there is only freedom to move or rotate on a vertical axis; and when this apparatus is clamped down it has no freedom to move perpendicularly to the plane on which it rests. To satisfy the requirements of the geometric clamp, the three points of support should be rounded; one of these points should be dropped into a shallow conical or trihedral hole; the apparatus then has only freedom to move about this point as a centre. The second point should be placed in a V-shaped groove, which is set in such a position that the groove runs in a direction away from the centre of the triangle formed by the three feet of the apparatus. The third point of

support is simply on a plane surface. It is clear that any apparatus supported in this manner has no freedom to move, and if it is taken off its base for any purpose, will, on being replaced, go back with absolute accuracy to its original position.

It may be that in a description of this sort the arrangement sounds a little complicated, but, as I have already mentioned, the accuracy of the component parts need not be of a high order; but the design is such that, even apart from such accuracy, the arrangement is absolutely positive in its results.

In the photomicrographic apparatus here shown (fig. 2), we have endeavoured to embody the principle of the geometric slide throughout, and, apart from that, the design of the apparatus is such that extreme rigidity is obtained. There is little or no liability of alteration of any of the parts of the apparatus as the result of climatic change of any description, and, owing to its rigidity, the whole apparatus would move together if subjected to any shake or vibration.

The base consists essentially of castings made from two patterns, a pair of each casting being used. These are designed on girder principle, and each part of the supporting castings may be resolved into a triangle, so

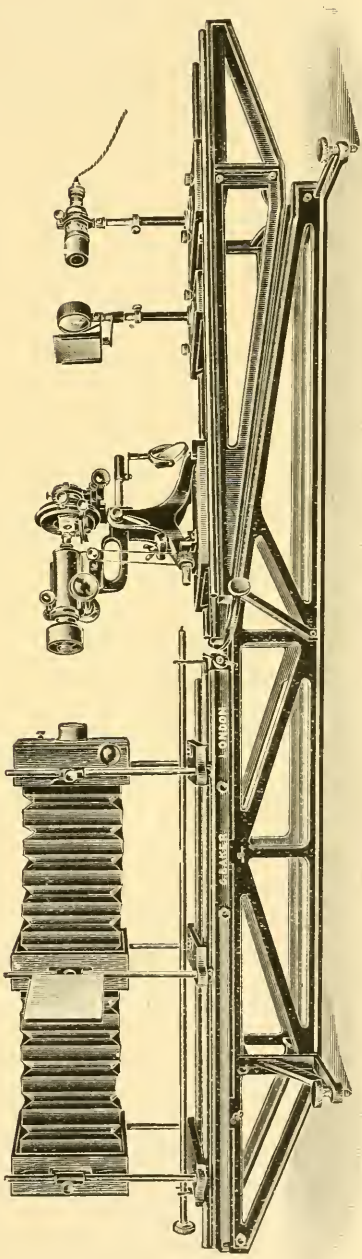

Fig. 2.

that the utmost stiffness is obtained. The two castings carrying the camera portion are braced together at each end, and at their middle, by small cast cross-bracing pieces. In each case the castings are fastened together by means of screws and bolts, holes being left in the castings to allow these to pass through. There is, therefore, no fitting or drilling of any sort required in putting these together.

The portion of the apparatus to carry the Microscope and illuminating apparatus is also on a pair of castings, these being triangular in shape, and again braced together in the same manner as are the main castings. The latter pair of castings are supported at the end away from the camera on a metal cone, which allows them to be swung out of alignment with the rest of the apparatus in the manner already well known in many designs of photo-micrographic apparatus. The female part of the cone is on the swinging tail-piece, whereas the male portion is carried at the end of the main castings. The other end of the swinging tail-piece is supported on a segmental arm, and is resting on two points. It therefore satisfies the requirements of the geometric clamp in so far as it requires to have one degree of freedom, allowing it to rotate on a vertical axis. It is supported at its centre on the cone, and its two other points of support are quite free. No shifting of the part other than in the direction required is possible, and it differs essentially in that respect from other arrangements generally used, where a bolt or metal pin is used as a centre of rotation.

On the top of the main castings, supporting the whole apparatus, two stiff metal rods are placed. In this case they are iron brass-cased, thus ensuring rather greater stiffness than can be obtained with brass rod alone. These rods are fastened down firmly to the castings, and the camera slides to and fro on two V grooves on one side and on a plane surface on the other in the manner already described, both the front and back of the camera being so supported. On the portion of the apparatus carrying the illuminating arrangement and the Microscope, the same method is adopted; the Microscope is carried on a cast-iron baseplate, the necessary V grooves and plane surface being all in one casting from one original pattern. No more work is done to this part than to file off the roughness of the casting from the inside surface of the V grooves, and from the plane surface on the opposite side. The plates carrying the illuminant, any subsidiary condensing lenses, water trough, colour screens, or cells, are all supported in the same manner, and each one has a quick-acting clamp rigidly fastening it down in any required position.

In all cases the clamp is of a simple character, and consists of a metal bar, which engages on each side of the casting on which it rests, a quick-acting screw passing through it and the base-plate;

the bar therefore, on manipulating the screw, is drawn by it against the inner edge of the casting, and the sliding portion is drawn down on to its supporting rods. Such a method of clamping is obviously superior to even that in which subsidiary appliances are carried on a triangular metal bar, as in the latter case the clamp is at the side; and those who have worked with such an arrangement realize that some displacement, however small, is unavoidable if the clamping screw has any slight undue strain put on it.

The camera itself is supported on vertical rods, which are firmly fixed to the geometric slides already described. This allows of the camera being moved in a vertical direction to any required position, so that where Microscopes of different sizes have to be used, or where it is not possible to specially fit the apparatus to a Microscope of a particular height, the camera can be raised to suit the required conditions. There is nothing special about the camera portion as such, except that on one side a small white screen is supported, so that when the Microscope is thrown out of alignment on its swinging tail-piece, an image may be projected on the small subsidiary screen. The preliminary adjustment of the instrument, either in the way of centring the substage condenser, the illuminant, or any subsidiary condensing systems, as well as altering the position of the object itself, may be effected by directly observing the projected image: final focusing must, of course, be done on the ground or clear-glass screen in the usual manner, but the advantage of this additional reflecting screen is considerable.

The apparatus here shown is designed to be as far as possible universal in its applications. It may be used as a horizontal or as a vertical camera; it may be inclined at an angle of 45°, should such for any reason be required; it may be used in a manner that I shall indicate, for metallography, in which the source of light is usually placed at right angles to the direction of the optic axis of the Microscope; or it may very conveniently be used for photographing large specimens which require to be in a horizontal position, or in photographing other objects which are conveniently supported in a vertical position.

If required for use as a vertical as well as a horizontal camera, the camera portion is carried on a subsidiary iron frame, which rests inside the main supporting castings. This frame is fastened at the end near the Microscope in such a way that it can be swung and supported vertically (fig. 3). To ensure rigidity while in this position, an additional strut is provided, which clamps on the side of the apparatus, so that the camera itself is supported on the vertical iron frame, which is again braced to the main castings. In this case it is obvious that the position of the camera in relation to the Microscope would require some alteration, and the manner in which the camera slides up and down on its metal rod supports provides for this. The illuminating appliances remain in the same

position as when the apparatus is used horizontally, but the standards carrying these are provided with hinged joints, so that

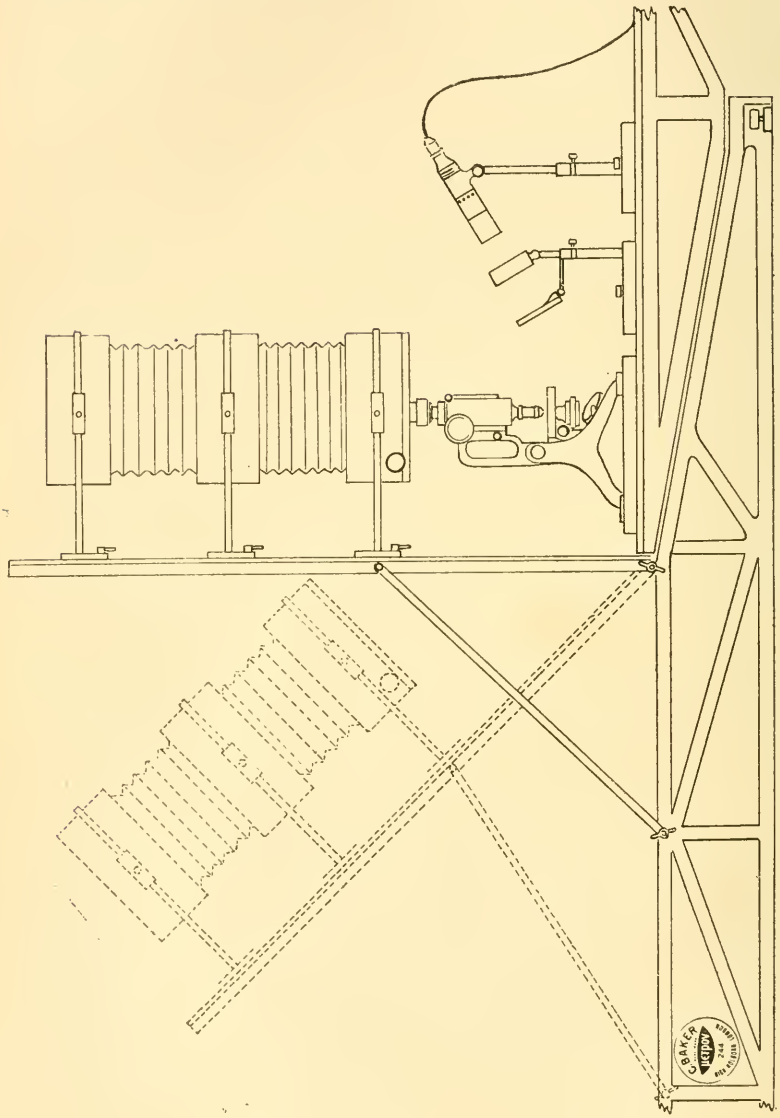

Fig. 3.

the illuminating beam can be projected on to the mirror of the Microscope when the latter is vertical.

For metallography the method adopted is to use the apparatus in the horizontal position, and to mount over the vertical illuminator attached to the Microscope a totally reflecting prism (fig. 4). This prism is mounted high enough above the stage of the Microscope, when the latter is horizontal, to receive a beam from the

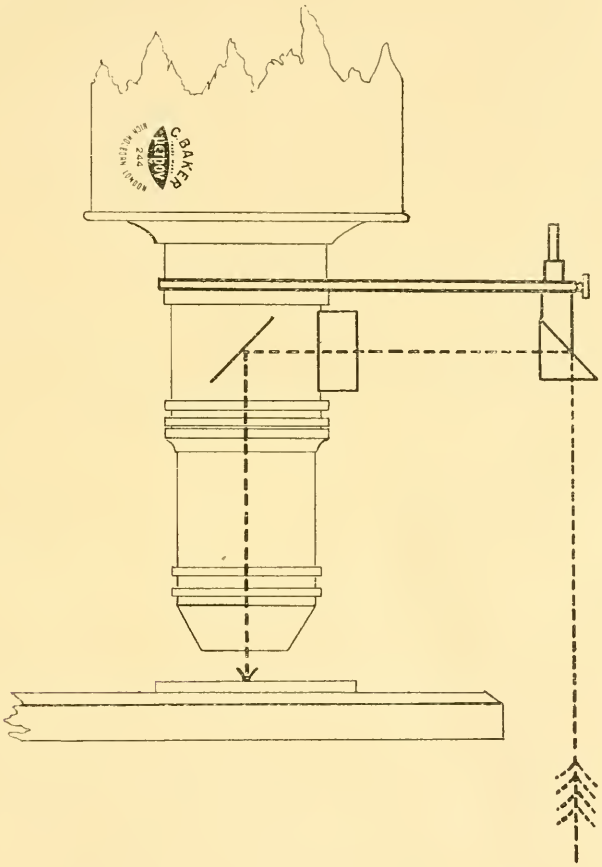

Fig. 4.

illuminant, and from any subsidiary condensers without obstruction. This arrangement I have myself used for many years, and it appears to me to be more simple, and certainly involves less alteration in any apparatus, than placing the illuminant at right angles to the optic axis. All adjustments are quite as easily made, and in this case also the proper illumination of the object can be

carried out without any difficulty by observing the reflected image on the subsidiary screen already described.

No unusual arrangement for controlling the fine-adjustment of the Microscope at a distance is suggested, as there does not appear to be any reason why any recognized method should not be adopted. The arrangement before you is a very simple one, on well-known principles. A central metal rod has a large milled head at the operating end, and a grooved pulley at the other, with a rubber ring stretched on it. This is pushed into contact with another wheel supported on a metal arm underneath the Microscope base-plate, and may be connected by a waxed silk thread, or by any other suitable arrangement with the Microscope. By varying the relative size of the latter wheels it is obviously easy to alter the fine-adjustment speed, making it faster or slower to suit the requirements of the user.

The base-plate designed to carry the Microscope is so arranged that almost any type of instrument, whether on a horseshoe or tripod foot, may be used at will. There is a clamp provided which renders it possible for the Microscope to be fastened down, although I venture to suggest that if the latter is designed as it should be for photomicrographic work, it should not require to be held at all. However, a clamp is provided and is available for any type of instrument.

The position of the Microscope on the base-plate is determined by a slotted right-angled piece of brass, which may be permanently fixed in the position required. The Microscope is therefore simply put down in position, and there is sufficient range of adjustment to enable it to be centred once and for all.

All the subsidiary apparatus carried on the geometric slides which move on the swinging tail-piece, are mounted so that they may be centred accurately to the optic axis of the instrument, and may be clamped down when once their position has been determined.

The apparatus is not in any sense an experimental one, as I have had a similar one in use for many years, which was originally designed by Dr. Carver and myself for the Lister Institute. It has certainly been modified and altered from time to time, and perhaps does not bear much resemblance to what it originally was, but the main principles remain the same. The one before you has been made by Messrs. Charles Baker. I wish to express my appreciation of the assistance and advice that Mr. Lees Curties has so readily given me, without which, I have not the least hesitation in saying, the apparatus before you would never have come into existence.

MICROSCOPY

A. Instruments, Accessories, etc.*

(1) Stands.

Improved Water Microscope.†—E. M. Nelson writes: "Stephen Gray, in 1696, invented a water Microscope, which consisted of a metal plate with a small hole in it. A drop of water placed in the hole formed the lens; there was a spike upon which to impale an object, and a focusing screw. Mr. T. Court has found, and kindly sent me an account of another form of Gray's Microscope, due to an anonymous author at Cambridge in 1750. In fig. 15 B C is a metal plate with thirteen holes of different sizes drilled through it. These, filled with drops of water, form lenses of various powers. F D is a spring holder for the needle

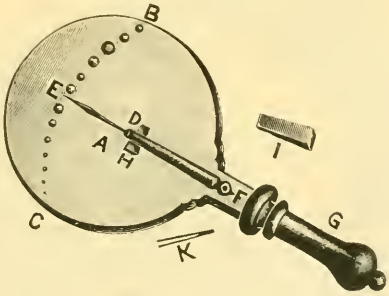

Fig. 15.

A E: this, in its normal position, lies close against the lens plate. In order to focus an object upon the needle-point, it is only necessary to insert the wedge I at H to the proper distance. The needle may be changed for a pair of forceps K. It is stated that this Microscope "will afford a great deal of pleasure to any curious inquirer, especially as the purchase of it will not much affect the pocket." So far as I am aware this Microscope has not been recorded in any list of ancient instruments."

Watson and Sons' "Bactil" Microscope.‡—In this instrument (fig. 16) the body-tube is 1½ in. in diameter, is suitable for photographic purposes, and the draw-tube divided to millimetres. The coarse-

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

† English Mechanic, xciv. (1911) p. 348 (1 fig.).

‡ Watson's Special Catalogue, 1912, 8 pp. (4 figs.).

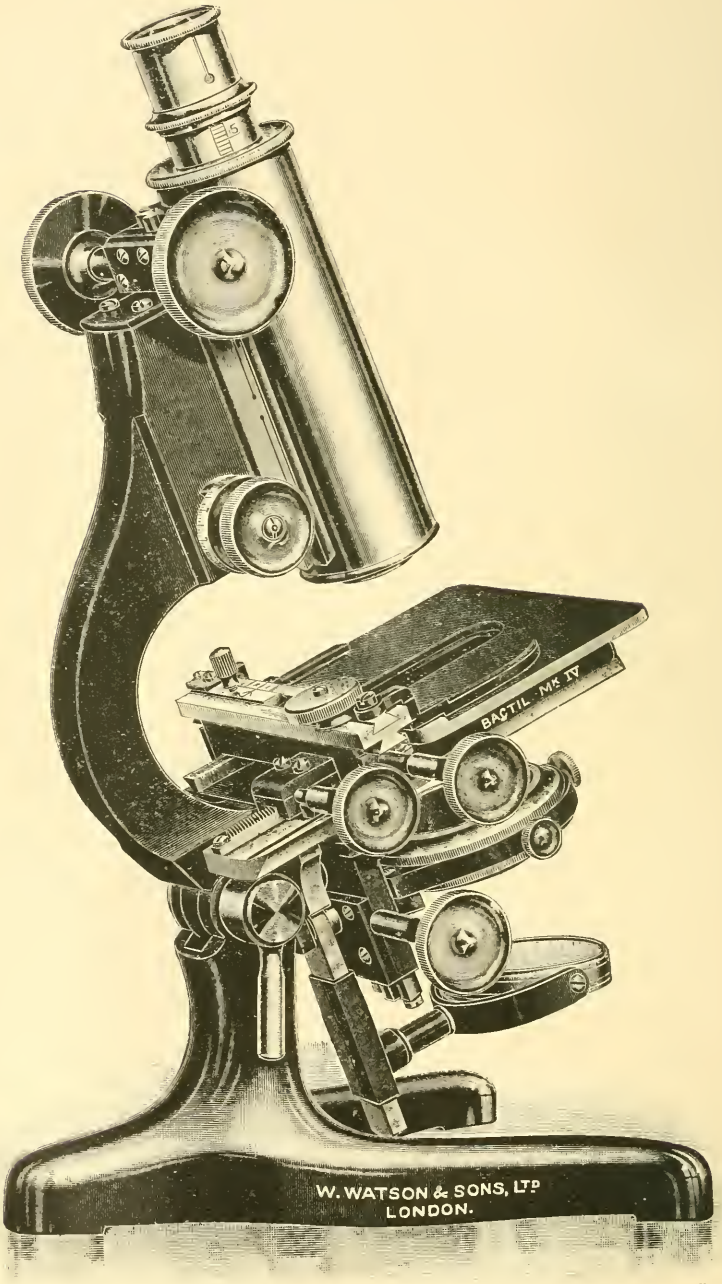

Fig. 16.

adjustment gives a free working distance between the nose-piece and the stage of $3\frac{3}{4}$ in. The fittings of the substage apparatus and also the eye-pieces and objectives are of the R.M.S. standard size. The mechanical stage is constructed as part of the instrument, but by an ingenious arrangement can be removed and a plain metal plate substituted.

The compound substage has centring screws so that the condenser may be rendered axial with any objective; it is fitted with rackwork to focus, and can be turned aside out of the optical axis when desired.

The fine-adjustment (fig. 17) is of the vertical lever pattern. A is the actuating milled head turning the screw B, on which is fixed a

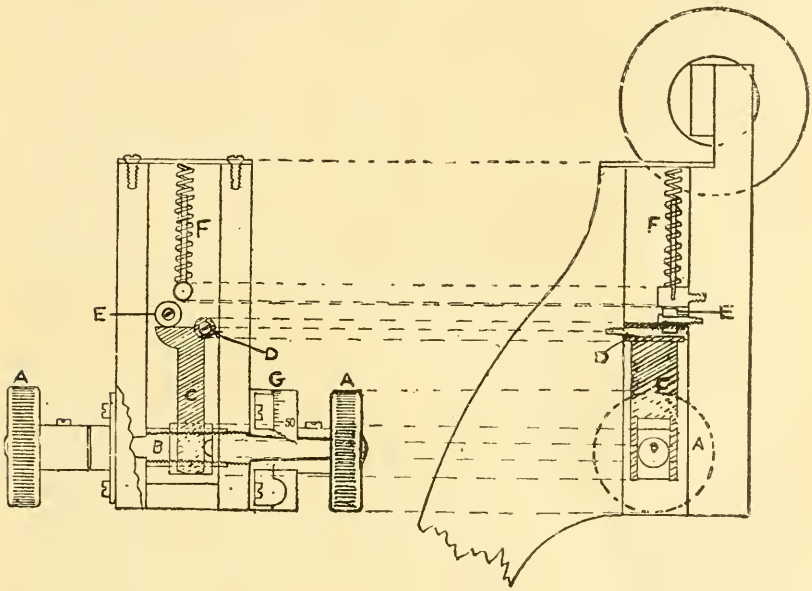

Fig. 17.

rounded nut: this presses against the lever C. The fulcrum is at D, and the sliding fitting is raised by pressing against the disk E. The reactionary effect is produced by the weight of the body and its fittings and the coil spring F. The long lever and the short distance between the fulcrum and the point of pressure produce a slow and sensitive movement. The milled head A occupies a fixed position and does not travel with this screw. The rate of movement of the adjustment is read on the divided drum G: a complete rotation of the milled head moves the body 0·1 mm.

Microscope Stands (English v. Continental). — Two articles on this subject have lately appeared in Nature.* They contrast the English

* Nature, No. 2199 (Dec 21, 1911); No. 2202 (Jan. 11, 1912).

and the Continental models as now existing, and they deal with the changes in process of evolution. The points, some nine in number, which go to constitute an "English" Microscope are carefully summarized, and admittedly render it an instrument of great precision. But it is argued that this very excellence renders such a Microscope too elaborate for an average worker, and that the simpler types evolved—too slowly, unfortunately, for the demand—compare unfavourably with the "Continental" type, which, having no past to speak of, was able to adapt itself the more readily to the wants of those who did not care so much how they saw so long as they could see. The writer considers that the old terms "English" and "Continental" will soon cease to have any real meaning, and are certainly not significant of the place of origin.

The two types, starting from opposite poles, have lately reached common ground as regards the majority of the instruments produced, and there is little to choose between them for mere demonstration of known structure. But to get the finest results out of any optical system, centration along the axis, and, in the case of a microscopical system, interchangeability of parts, not only above but below the stage, is essential; few Continental Microscopes possess the means of doing this, while every English stand of the first class is so provided. Therefore, considers the writer, the conclusion of any unbiassed observer must be that the English type is the better in the hands of the expert, who wishes not merely to demonstrate the known but to reach out, maybe, into the unknown; but what is best for the master of his instrument and subject is not always good for the average man, and there are minor details, such as the method of fixing the mirror, etc., in the Continental pattern which make it easier of use by those who merely look on the Microscope as a tool; and this, combined with the greater handiness in the vertical position when wet preparations are under examination, makes the Continental type more acceptable to the laboratory worker. The writer, however, points out, as redundances in the Continental model, the circular rotating stage and the excentric rotating movement of the iris-diaphragm below the Abbe condenser. The former can only be useful in petrology, and the latter renders no service to direct illumination. But the mode of fixing the mirror on a swinging tail-piece he considers a positive disadvantage. This mode of fixing the mirror is found also in practically all patterns of the English type, and it is, in the writer's opinion, the combination of the altogether undesirable swing tail-piece with the desirable (if understood) centring substage that has caused the prejudice (for such it amounts to) in certain quarters against the English type.

In a letter to the editor of Nature,* J. Rheinberg points out that in England substage illuminators were in general use long before this was the case on the Continent. They were originally intended, as their name implies, for concentrating light on the object. But the Abbe substage was primarily only designed by its originator for the testing of objectives and for experiments on the effects of diffraction; it was at first only chromatic and used for narrow cones of light. Although the utility of achromatic condensers and wide illuminating cones is now generally recognized on the Continent, most Continental makers still cling to the

* Nature, No. 2202 (Jan. 11, 1912) p. 348.

old form of substage construction, preferring to modify other arrangements to adapt them to this construction rather than change their model. In England the mechanically movable iris-diaphragm was not adopted by English makers. The simpler method of the shallow carrier above the iris-diaphragm into which stops for dark-ground illumination, for oblique illumination, or various stops for experimental purposes could be dropped, was found to render all the service necessary. Those, says Rheinberg, who have worked with both forms will be in little doubt as to which is the more convenient.

The correspondence is continued by J. E. Barnard,* who admits that the characteristics of the English and German models are, on the whole, fairly set forth, but that the section on comparison of the two types is so prejudicially drawn as to amount to little more than a eulogy of the productions of Continental houses, and that, if the concluding sentences were to be accepted, the English producers would have no alternative but to abandon the field and leave their Continental rivals in possession. In Barnard's opinion the original article was written from the point of view of the producer, the value of the user's experience being ignored. Hence it is that the criticisms on the substage arrangements are so unconvincing. In most Continental types these are far too cramped, and the absence of a fine-adjustment, so far from being an evidence of superior workmanship, merely testifies that it is unnecessary. An achromatic condenser, even of the finest optical construction, does not focus within such narrow limits that a fine-adjustment is required. A well-made rack-work will, in fact, give a sufficient degree of accuracy. He has no doubt as to the superiority of the tripod- in comparison with the horseshoe-foot. For photomicrograghy no well-designed stand should require clamping to its base at all, and the best of Continental Microscopes, even those specially designed for the purpose, are so unstable that they will not stand alone when horizontal, much less retain any degree of stability in that position. He points out that the statement that the larger stands of English makers require clamping-down is not in accordance with the facts, as he has recently had a Microscope made by a leading English manufacturer which was more stable in the horizontal than in the vertical position. He cites his own practical experience in support of his views.

The assertion in the original article that the Continental model is an evolution from an exceedingly simple and, by inference, highly satisfactory design, is sternly challenged. So far from this being really the case, the refinements on the model Continental stand have been almost entirely borrowed or copied from more perfect English models. As regards the alleged complexity of a high-class English Microscope, it has yet to be shown that the adjustment cannot be made in as many minutes as the writer would apparently postulate hours.

As regards the alleged superiority of the centration of the objective, as in the Continental instrument, over the centration of the substage condenser, the writer overlooks the facts (1) that the optician makes the eye-piece and objective as coaxial as possible; (2) that the condenser is an independent optical system, on a separate part of the instrument;

* Nature, No. 2204 (1912) pp. 412–13.

(3) that perfect adjustment of condenser with Microscope, even if set up, is exceedingly difficult to maintain. It would be interesting to know on what optical grounds it could be proved that a method of centring the objective in relation to an eye-piece and substage, which are themselves not in alignment, could be justified. Hence the English Microscope is supplied with centring screws to the substage.

The statement that instead of a mechanical draw-tube the Continental maker provides his objective with correction collars, seems to imply that correction collars are unknown to English manufacturers. Yet, as Barnard points out, Powell and Lealand fitted correction collars to their objectives some seventy years ago, and have continued to do so. Moreover, every English house does the same.

As to the want of uniformity in the Royal Microscopical Society standards, the original author has a fair cause for complaint. At the same time it must be pointed out that the chief cause of variability is not that the Society's standards are wrong, but that makers, whether English or Continental, have failed to conform to them. Although the Society has been for some time considering these standards, and has a sub-committee even now dealing with the subject, there is no doubt that it would welcome the co-operation or assistance of the National Physical Laboratory in the matter, as it is one not without difficulty, and the greater the weight of opinion which could be brought into combination the better.

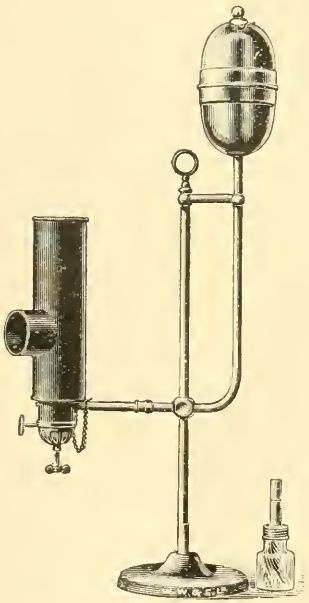

Fig. 18.

(3) Illuminating and other Apparatus.

Petrol-vapour Incandescent Gas Lamp.*—The container of this lamp (fig. 18) is filled with petrol; the burner is warmed by means of a small spirit lamp, and the light is obtained by the incandescence of a mantle. The light is brilliant and actinic and is easily controlled. It is recommended for photomicrography dark-ground condensers, etc., where gas and electric light are not available.

Reichert's New Universal Projection Apparatus.†—O. Heimstädt describes this apparatus, which was intended by its designers to possess in the highest degree—(1) complete security of apparatus, (2) extreme simplicity and light-strength in episcopic, and (3) diascopic projection under strong magnification. The realization of the first object is evi-

* Watson's Special Catalogue, 1912.

† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 161–74 (6 figs.).

denced by fig. 19, and of the second by the subsequent figures. To attain the third a new and essentially more powerful arrangement of arc lamp and reflector has been adopted.

The body consists of an enclosed massive wooden box 1·70 m. high, 1·70 m. long, and 70 cm. broad (fig. 19). It is supported on four fairly strong and high feet. When the apparatus is out of action all the interior parts can be kept away from external interference by storing them in the lower part, which acts as a cupboard. The upper part of the body is divided by a water-chamber, occupying almost the complete breadth

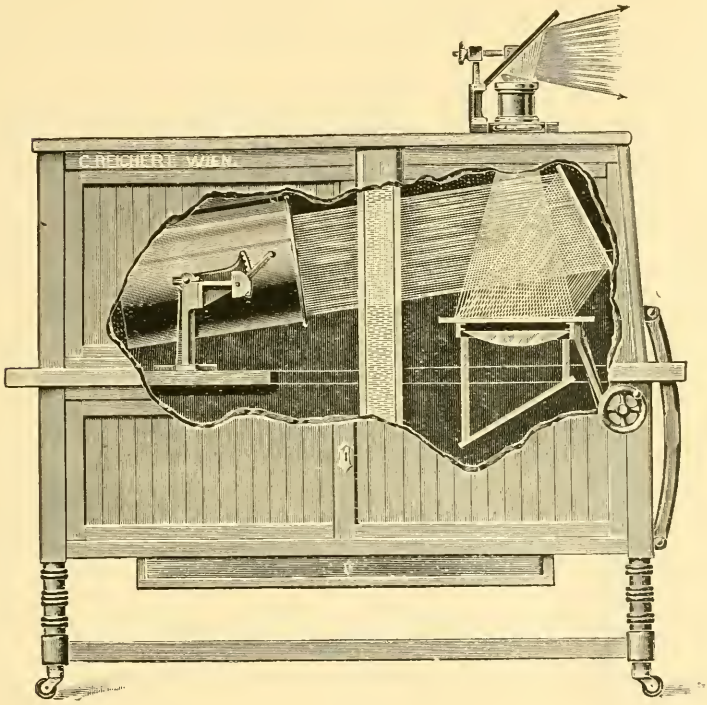

Fig. 19.

of the box, and dividing it into two approximately equal large parts. The left-hand part is the lamp space with the reflector and its apparatus; the right hand is the projection-chamber with the optical accessories. This bi-partition of the disposable space by means of the water-chamber guarantees a complete cooling of the whole apparatus. The water-chamber contains about 25 litres of water, and is easily and quickly emptied by means of a cock. A current of air entering at the floor of the lamp-space, and issuing through an opening in the lid of the box, increases the cooling efficiency of the water. The lamp chamber is only

opened for changing the carbon, all manipulation of the lamp being done from the rear. The right side wall is removable for adjusting the projection apparatus, which is screened off by a black light-proof cloth. For projection purposes the front wall is made to drop down and to form a small optical bench for receiving the projection Microscope and illuminating lens (fig. 20). On the roof of the box are the two projection

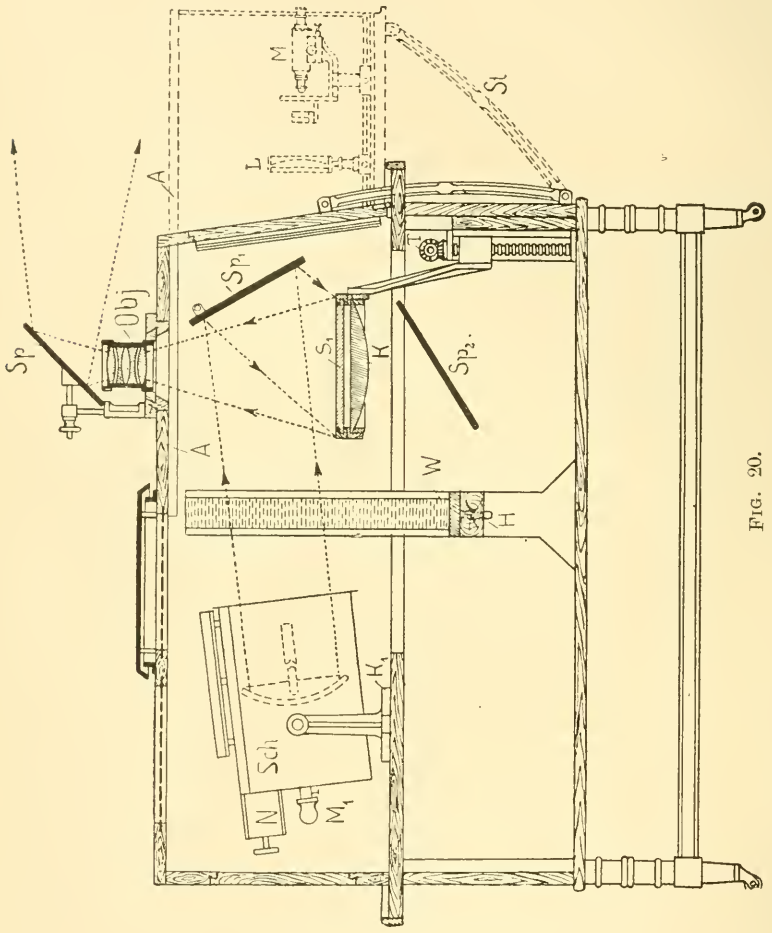

FIG. 20.

objectives of 200 and 400 mm. focal length and exterior projection mirror all secured to the same wooden attachment, which can be removed and packed away inside. When this aperture is closed by a lid and clamped, the apparatus has the external appearance of a strong well closed box.

If the apparatus is to be used for megascopic projection the right-hand side wall is provided with an opening into which the plate with mirror and objectives is inserted. This opening is also covered with a lid when the apparatus is out of use.

Instead of a glass condenser a hollow parabolic mirror is used. This arrangement offers great advantages. The light-source is an arc lamp with regulators and automatic control. It takes a current strength up to 40 amperes with a slightly adjustable tension of 65 volts. The carbons

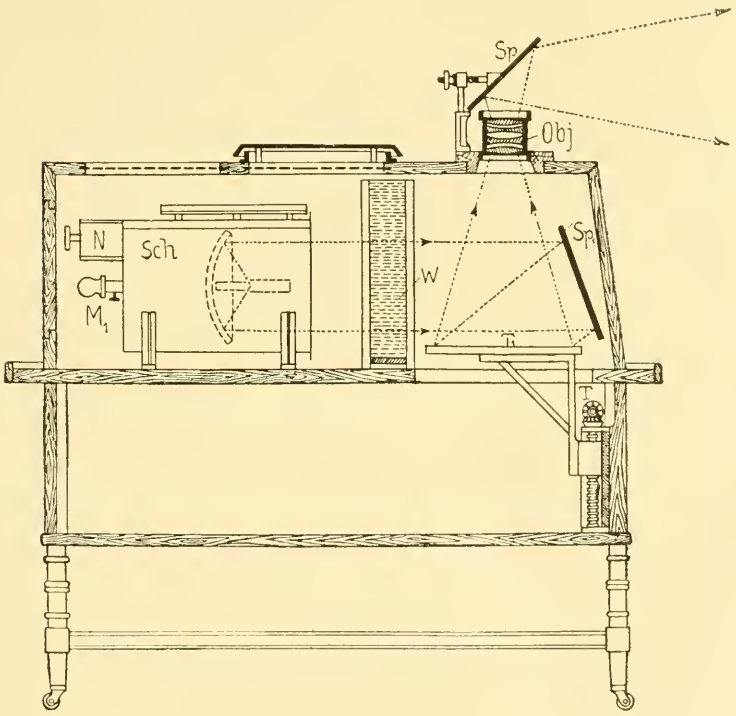

Fig. 21.

are horizontal, the carbon of the positive being turned towards the mirror in the lamp chamber. The mirror can be moved forwards and backwards by means of a pole-shaped handle projecting through the box ; in this way a greater or less convergence is communicated to the beam of rays. The reflector is vertically adjustable on a strong fork. For episcopic projection it is sloped about 18° upwards ; for diascopic projection about 15° downwards. In both cases a catch gives the right position. A similar contrivance also secures the true horizontal adjustment as required for microscopic and megascopic projections.

Figs. 20, 21, 22, show the apparatus as arranged respectively for episcopic and diascopic projections. The objective lens in figs. 20 and 21 is a 'Solar' of 400 mm. focus and an aperture of F : 4. In fig. 22 the rays reach the objective by diffuse reflection from the plate S_1. K appears to be a spherical reflector. The distance of the screen from the objective of the apparatus should be 5 m. in the centre with a 'play' of 2 m. With episcopic projection, however, good effects are not attain-

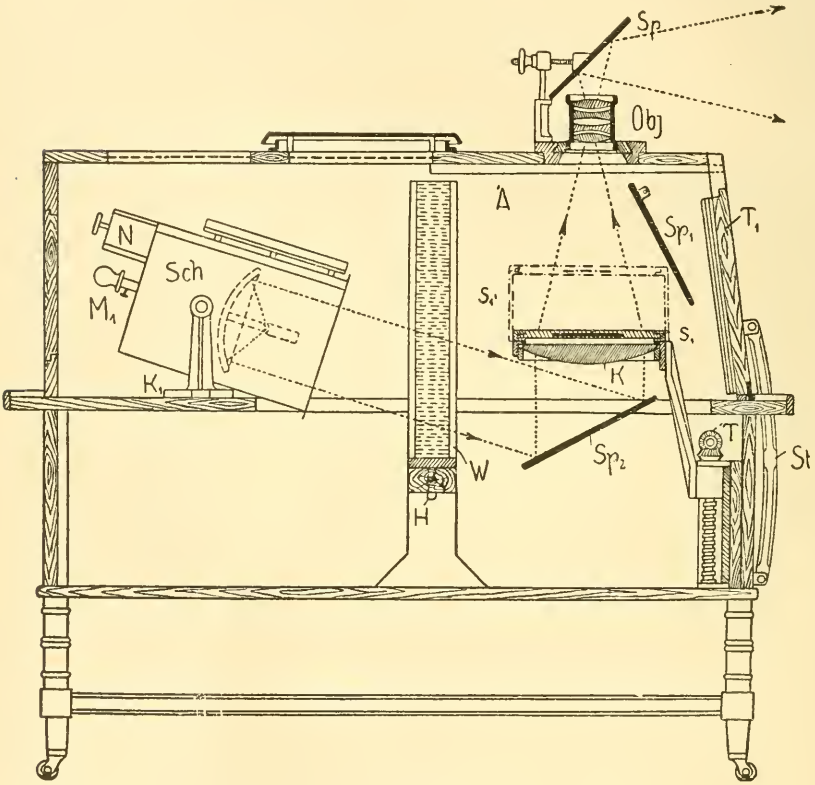

Fig. 22.

able beyond 6 m. The magnitude of the projected image at the middle distance of 5 m. with an object 18 × 24 cm. is about 2 × 2·7 m.

Fig. 22 shows the diascopic projection applied to small objects requiring strong magnification. The focal length of the objective is 200 mm. A lens, K, and a diapositive stage are placed in the ray-path as indicated. The intensity of the illumination is thereby considerably increased. The selection of lens and position of stage are such that the size and brightness of the screen-image are the same as with the lower-power objective.

Fig. 23 shows the arrangement for microscopic projection. It will be observed that the lens L and Microscope M can remain *in situ* while the apparatus is used for episcopic or diascopic work. The exit-pupil of the lamp reflector is not a complete circle but a circular ring. This

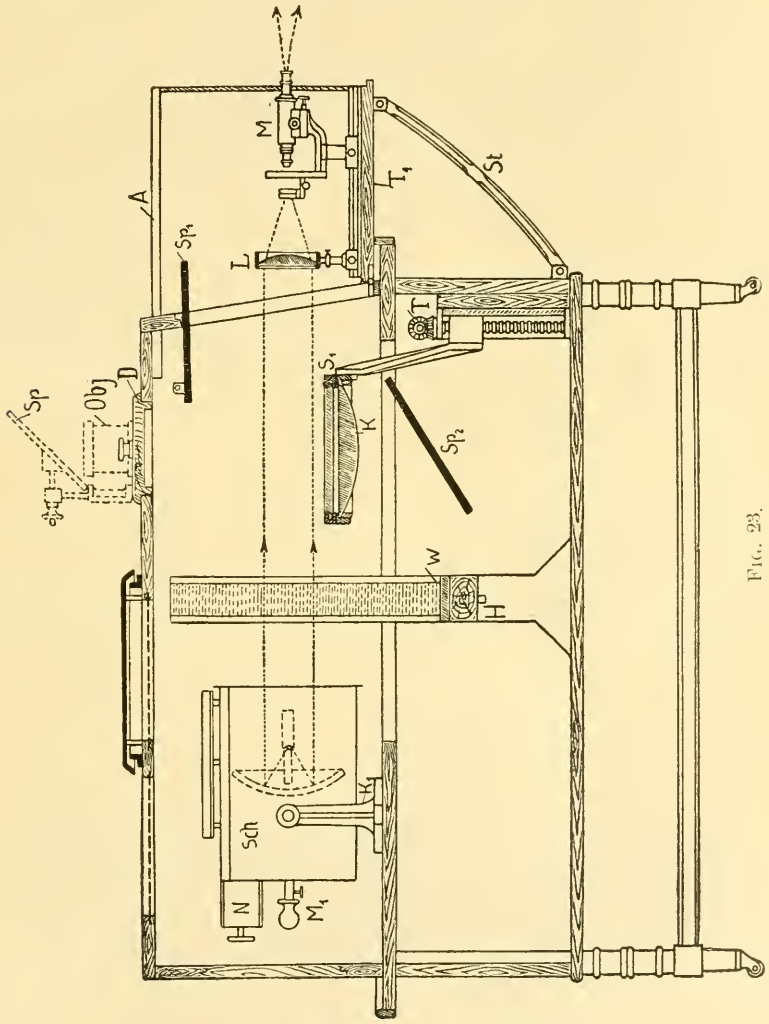

FIG. 23.

inconvenience is obviated in a simple manner. The Microscope axis is made to coincide with the axis of the lamp reflector, and by using a coaxial condensing lens L of large dimensions, so placed that it focuses upon the condenser of the Microscope, solid illumination is obtained.

Fig. 24 shows in plan the arrangements for megascopic projection The lamp is set horizontally as for microscopic projection, and the mirror Sp_1 is rotated 90° about a horizontal axis. The object *p* is placed opposite the objective Obj and mirror Sp, which are inserted, as previously

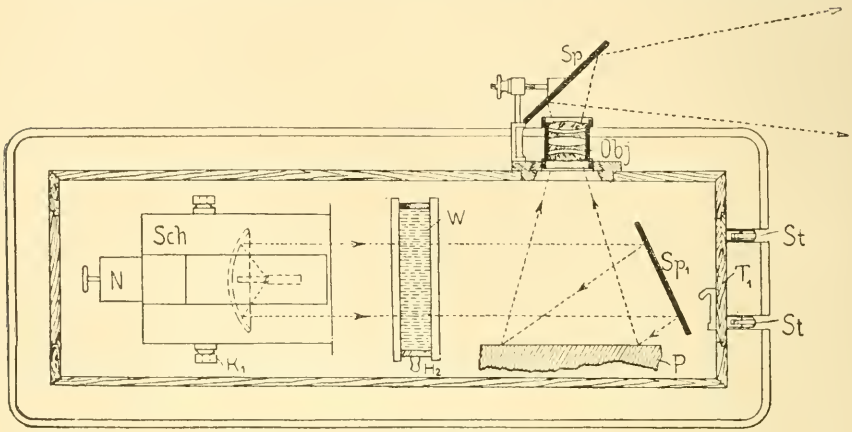

Fig. 24.

described, into an aperture of the right-hand side-wall. The screen pictures are inverted, but are corrrect laterally.

Critical Illumination.*—A. W. Blacklock says: "I find that I get the best definition with high powers when the object is illuminated in the way I will now describe. In the diagram (fig. 25) A is the objective, B is the slide, C is the substage condenser, D is the iris stop, E is a

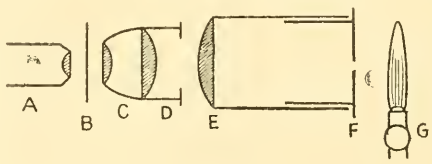

Fig. 25.

plano-convex lens about an inch in diameter (the field-lens of the Huyghenian part of the eyepiece of an old telescope), F is a metal plate with a small hole in its centre, and G is the flame of a paraffin lamp. The plate F is mounted on a slider, so that its distance from E can be adjusted to the solar focal length of E. The central hole is $\frac{1}{4}$-in. in diameter, and there is a metal plate which slides over it and which has three smaller holes of different sizes, either of which can be used as desired. The lamp G was either an ordinary flat-wick paraffin lamp or a two-wick lamp with flattened chimney, placed with the flat surface of the flame towards the hole in F, or an Argand gas-burner, or a Welsbach incan-

* English Mechanic, xciv. (1911) p. 370 (1 fig.).

descent mantle—in all cases a surface of flame large enough to illuminate every part of the lens E through the hole in F.

The adjustments are made by bringing the object to the centre of the field of a low-power objective and focusing it, then adjusting the substage condenser so that the image of the hole in F is sharply focused on the object, and then changing the objective for one of higher power and re-focusing, but without interfering with the illumination. The size of the hole in F should be such that its image in the field of view should just fill the field of the eyepiece in use. As the flame is some distance from the hole there is no danger of injuring the object by heat, even with an exposure of two or three hours, and for the same reason the threads of the Welsbach mantle do not show. With this arrangement I have produced photomicrographs with a Beck eighth and astronomical eyepieces giving a magnification of 3000 diameters with satisfactory definition."

Watson and Sons' Revolving Microscope Tray.—This is made to the design of A. J. H. Brown and the suggestions of E. Harcourt Tyrrell.

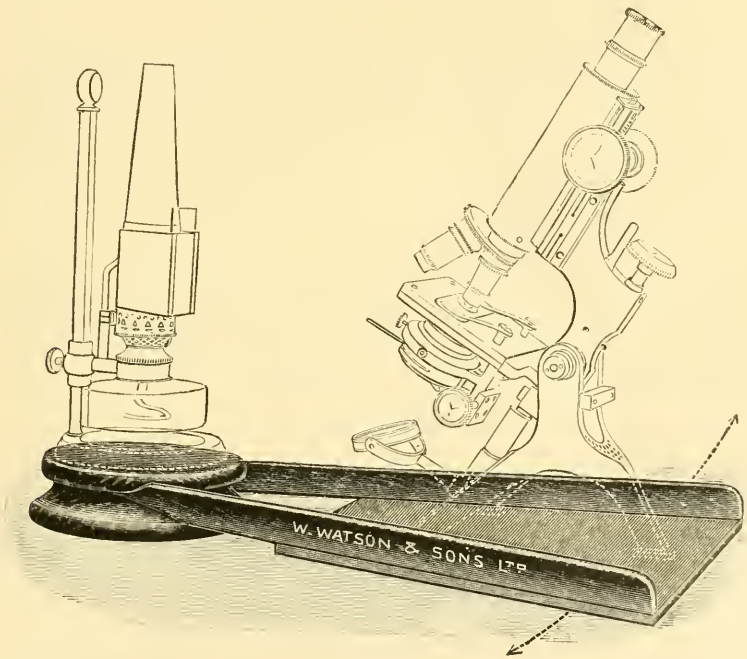

Fig. 26.

An oak-framed tray (fig. 26) carrying a Microscope on a cloth base, has two extended arms connected by a circular end, having on its under side a centre-pin. The pin fits into an oak base, which is cloth-lined on the

side in contact with the table. The under side of the tray is fitted with "domes of silence," and can be revolved on the centre-pin, the lamp being placed on the wooden circle over the centre and revolving with the Microscope, and therefore maintaining its position constantly in relation to the instrument. It will be readily seen that a device of this description allows of several people using the same Microscope in succession with the minimum of inconvenience. The whole tray and contents can be moved bodily without trouble when desired. It is constructed in oak wax polished.

(4) Photomicrography.

Photomicrography in Natural Colours.*—E. Wychgram gives an historical review of the progress in this branch of science, together with some practical advice. A plate of five coloured photomicrographic objects illustrates his remarks. He also adds a bibliography of the appropriate literature.

(5) Microscopical Optics and Manipulation.

Pulfrich's Stereoscopic Vision and Measurement.†— Under the title Steroskopisches Sehen und Messen, C. Pulfrich has brought out a German version of his article, The Stereoscope, contributed to the last edition of the Encyclopædia Britannica. He has, moreover, added to it a bibliographical index of all publications on Stereoscopy which have appeared during the last 11–12 years. Anyone wishing to consult earlier sources of information should have recourse to the similar article in M. von Rohr's Die binokularen Instrumente.‡

General Theory of the Microscopical Image.§—In this work of over 400 pages, J. M. Castellarnau y de Lleopart discusses present views of the microscopical image. In a somewhat lengthy preface he acknowledges his indebtedness to the Journal of the Royal Microscopical Society, especially to the discussions and papers therein recorded. He also acknowledges his obligations to well-known eminent German authorities. After describing the path of the rays in the Microscope and the dioptric properties of the image (Part I.), he deals with the genesis of the microscopical image and the laws of its correspondence with the object (Part II.). In Part III. he deals with the experimental demonstration of the theory of image formation. In a group of five appendices he discusses certain important optical properties. The book contains numerous diagrams, and has the appearance of having been very carefully compiled.

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 174–82 (1 pl. and 5 col. figs.).
† Jena: Fischer (1911) 40 pp. (17 figs.).
‡ Berlin, 1907.
§ Teoria general de la Formacion de la Imagen en el Microscopio por D. Joaquin Mª Castellarnau y Lleopart. Pub. by E. Arias, Madrid (1911).

(6) Miscellaneous.

Quekett Microscopical Club.—The 477th Ordinary Meeting of the Club was held on November 28, 1911, the President, Professor E. A. Minchin, M.A., F.R.S., in the Chair. A lecture on "The Relationship between Insects and Disease" was delivered by Dr. J. J. Simpson. No group in the animal kingdom is more intimately connected with the bionomics of the world at large than that designated by the general term "insects," and no group is so prolific in its effects, both for good and evil. On the one side we have the part played by insects in fertilization, their utility as scavengers, their natural products (such as honey, wax, silk, and colouring matters), etc. On the other side, the destruction of crops by locusts, the effect of weevils on cotton and grain, the immense harm to vines caused by *Phylloxera*, and, in addition, the almost infinite amount of suffering caused by insects, directly as being the actual cause of disease, and indirectly by mechanical dissemination of pathogenic bacilli, or by acting as intermediate hosts for other pathogenic organisms. The part played by insects in connexion with disease is threefold: (1) as actual parasites; (2) as mechanical transmitters; (3) as intermediate hosts of pathogenic organisms. These three groups were then dealt with at some length, and specimens of many of the species described were exhibited. In the case of relapsing fever it has been demonstrated that the spirochæte may pass from a pregnant female into the egg, thence to the larva and to the adult, so that the progeny of infective ticks may themselves be infective without having previously bitten an infected person. An interesting account of the various prophylactic measures recommended and adopted was given. These diseases can never be eradicated simply by medical treatment, and so long as the carrier exists, so long will the disease work its deadly way. One of the first things to be done in this connexion is to obtain a knowledge of the distribution of all blood-sucking insects—an enormous task, but one that is being slowly and surely accomplished.

Tutton, A. E. H.—**Rock Crystal: its Structure and Uses.**
Journ. Roy. Soc. Arts., lix. (1911) pp. 1049–54, 1063–1070, 1076–85 (36 figs.).

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Influenza Bacillus.†—E. Savini and T. Savini Castani have devised an improved medium for cultivation of organisms of the group represented by the influenza bacillus. In previous work they grew this organism upon hæmatin-agar in symbiosis with *Staphylococcus aureus*. The medium was opaque. By the present method it is possible to grow the organism in pure culture upon a transparent medium. Into an Erlenmeyer flask are poured 5 c.cm. of glycerin. This is then sterilized. When cool, there are added to this the scrapings

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Embedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservation fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig., lx. (1911) pp. 493–7.

of a number of 48-hour agar cultures of *Staphylococcus aureus*. This is well shaken and the flask is then placed over night in an oven at 58–60° C., in order to kill the growth. 3 or 4 c.cm. of freshly drawn blood, collected under aseptic conditions, are now added and the fluid is shaken until it becomes clotted. It is then placed in an oven at 56–58° C. This solution may be added to melted agar cooled to 45–50° C. in a proportion of 1 to 10. After these are well mixed, the medium is poured into plates. The medium is reddish, transparent and well adapted for the growth of *Bacillus influenzæ* in pure culture. The stock solution will keep in an ice-chest for several months.

Investigation of Leprosy Cultures.*—In this preliminary communication, H. Bayon refers to the ubiquity in nature of acid-fast organisms and the necessity for precise identification of cultures originating from leprous lesions. With this aim, he has carried out inoculations and extensive serological tests, and has shown that these methods are of use in demonstrating the specificity of these organisms. A non acid-fast diphtheroid organism, isolated from human leprosy, may acquire acid-fast properties when injected into mice and rats. In conclusion the author refers to rat leprosy, a disease which is endemic in this country. This disease is apparently identical with human leprosy, and it is suggested that the disease may, in rare cases, be communicated to man from the rat.

Selective Medium for Culture of Cholera Vibrios.†—P. Pilon describes a modification of Dieudonné's blood-alkali-agar medium in which potash is replaced by sodium carbonate. This is prepared in the following way. Equal parts of defibrinated blood and of a solution containing 12 p.c. crystallized sodium carbonate are mixed. To three parts of this mixture, which is not sterilized, are added seven parts of melted nutrient agar. This is carefully mixed and then poured into Petri dishes, which must be left open until the medium becomes solid. After half an hour the plates are ready for use. Dieudonné's medium cannot be used until 24 hours after their preparation. The present medium was sown with a number of organisms, and it was found that organisms other than vibrios were inhibited at least as strongly as they were upon Dieudonné plates. Vibrios, other than that of cholera, were inhibited more strongly upon the soda medium, and cholera vibrios grew well upon this medium and even upon one containing a 13 p.c. soda solution. The more strongly alkaline medium did not permit the growth of *Bacillus pyocyaneus*, which is capable of growth upon the ordinary Dieudonné medium.

Cultivation of Leishmania infantum and L. tropica.‡—C. Mathis has obtained very successful results in cultivating *Leishmania infantum* in heated rabbit-blood and agar. The medium may be prepared non-aseptically, for it is sufficient to sterilize it discontinuously at from 80° to 100°. If there be no condensation water, water can be added afterwards without impairing the cultural properties of the medium.

* Brit. Med. Journ. (1911) ii. pp. 1269–72.
† Centralbl. Bakt., 1te Abt. Orig., lx. (1911) pp. 330 3.
‡ C.R. Soc. Biol. Paris, lxxi. (1911) pp. 538–9.

Cultivating the Streptococcus of Impetigo contagiosa.*—J. E. H. Roberts has introduced a method to demonstrate this organism without the aid of differentiating conditions of cultivation. The cultures are made from a drop of the serum which oozes from the raw surface of the base of the lesion, after the crusts have been removed and the raw surface has been rubbed clean with alcohol. The drop of serum is put into the condensation water of the culture tube, which is then allowed to flow over the surface of the medium, and the tube is incubated for 24 hours. The fine streptococcus colonies are then easily distinguished from those of staphylococcus. Pure subcultures are thus easily obtained.

(2) Preparing Objects.

New Fixing and Washing Vessel.†—A. Breckner describes a piece of apparatus (fig. 27) devised by K. Kreigbaum for the fixing of tissues for microscopical purposes. This is a glass vessel with a capacity of about 250 c.cm., provided with a cover, and capable of being emptied through a stop-cock. A glass funnel is fitted inside this, which can hold the material to be fixed in its upper wider portion. Then when the apparatus is filled with fixative fluid all precipitates and heavy salts

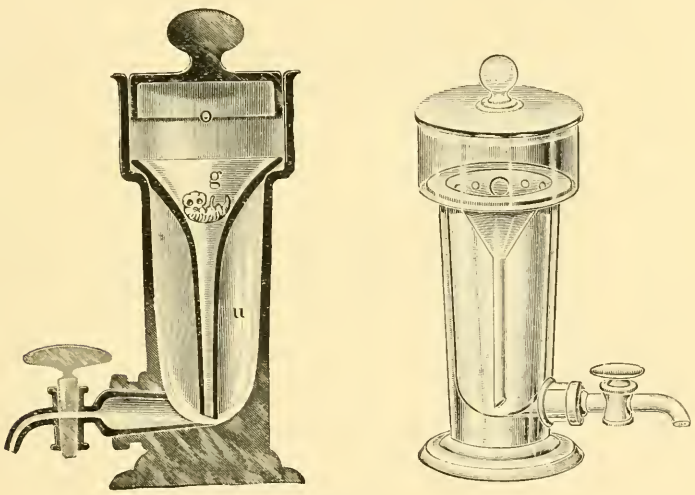

Fig. 27.

fall down the narrow part of the funnel to the bottom of the apparatus, and can be drawn off by means of the tap. It thus becomes unnecessary to change the fixing fluid entirely, but the small quantities drawn off may be replaced from time to time. The tissues rest all the time in fresh fluid. In theory the apparatus is excellent, but practically it is more suited for the washing than the fixing of material.

Zikes, H.—**Die Fixierung und Färbung der Hefen.**
[A review and recapitulation of numerous methods of fixing and staining yeasts.] *Centralbl. Bakt.*, 2te Abt., xxxi. (1911) pp. 507–34.

* Med. Review, xiv. (1911) pp. 81–7 (12 figs.).
† Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 504–6 (2 figs.).

(3) Cutting, including Embedding and Microtomes.

Improved Paraffin Oven.*—J. Lendvai gives a description of a new type of oven (fig. 28) in which certain disadvantages in the older patterns

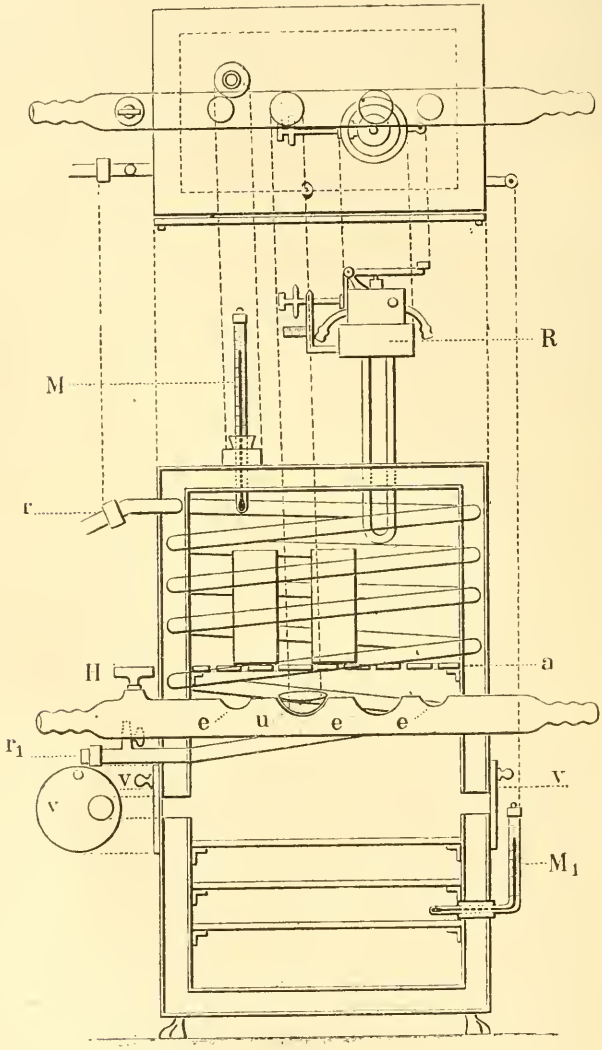

Fig. 28.

are overcome. The necessity of having two ovens at different temperatures is avoided, as this machine contains three chambers at various degrees

* Zeitschr, wiss. Mikrosk., xxvii. (1911) pp. 494–500 (fig.).

of temperature. The heat is applied by a steam coil between the outer and inner covers. In the top, hottest compartment, the coil is closer than in the lower cooler chambers. The coil is shown in fig. 28. The embedding apparatus is contained in the middle chamber. This is provided with a cooling jacket, connected with a cold water supply controlled by the tap H. The steam is supplied from a small kettle, to which access of gas is controlled by the regulator R. In this the gas valve is closed by the expansion of a U-shaped metal bar. The lowest and coolest compartment is provided with trays, and is suitable for the treatment of sections.

(4) Staining and Injecting.

Injection of Lymphatic Vessels.*—H. Baum has made a study of the lymphatic system of cattle, and has in previous communications given an account of his methods. In the present paper, he gives references to his former work, and mentions one or two points of importance in the technique of carrying out injections for the purpose of demonstrating these vessels. The author makes use for most purposes of a narrow metal cannula, 0·29 mm. in diameter. For the penetration of firm tissues this is superior to glass. For injecting the vessels of bones, except in the case of young animals, previous boring is necessary. The author further describes the methods of demonstrating lymphatics in the perirenal fat and in tendon sheaths. It is important for all work of this kind that the material should be absolutely fresh.

Demonstration of Tubercle Bacilli in the Blood.†—Y. Suzuki and Z. Takaki make use of the following method. One c.cm. of blood drawn from a vein is mixed with 2 c.cm. of sodium citrate. The mixture is shaken, and 5 c.cm. of 1 p.c. acetic acid is added to it. The red corpuscles become lysed, and the solution assumes a pale red colour, which darkens after two minutes standing. After centrifuging this mixture for ten minutes, the clear supernatant fluid is poured away, and to the sediment is added 10 c.cm. of 30 p.c. antiformin. These are well mixed together, and warmed for about three minutes. Then the mixture is centrifuged, the sediment washed with distilled water, and again centrifuged. The sediment now is greyish in colour, and of very small bulk. It is spread as a film upon a slide, fixed, and stained by the Ziehl-Gabbet method.

Rocking Staining Plate.‡—B. Galli-Valerio describes a small piece of apparatus which may prove useful in staining films with Leishman's stain and others which yield precipitates. It consists of a plate, 16 cm. square, attached to a wooden box containing clockwork. By means of this mechanism a gentle swinging movement is imparted to the plate. The slides to be stained are set out on the plate, which is set in motion. The stain is dropped upon the slides. The movement causes the stain to be distributed evenly upon the slide and prevents the formation of precipitates.

* Anat. Anzeig., xl. (1911) pp. 303–9.
† Centralbl. Bakt., 1te Abt. Orig., lxi. (1911) pp. 151–2.
‡ Centralbl. Bakt., 1te Abt. Orig., lxi. (1911) pp. 190–2.

Apparatus for Staining Tubercle Bacilli.*—H. Friese has devised an apparatus (fig. 29) by means of which the Ziehl-Neelsen and other methods of contrast-staining may be carried out without the risk of soiling laboratory apparatus. The diagram shows clearly the simplicity of the device. The upper platform carries a longitudinal central bar, upon which the slides to be stained rest in the manner shown. Stain is added and heat is applied, the source of heat—Bunsen burner or spirit-lamp—resting on the lower platform. At the edge of the upper platform is a gutter, draining into the glass bottle, which collects used stain and washings.

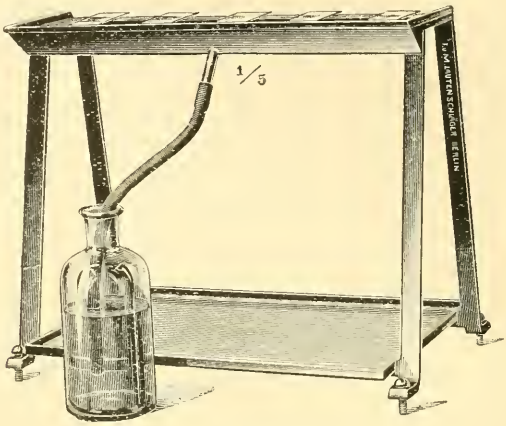

Fig. 29.

Demonstration of Spirochætes.‡—M. Phillips and E. E. Glynn have made a comparison of the relative merits of various microscopical methods for the demonstration of *Spirochæta pallida*. The material investigated was usually serum collected from the local lesion after the application of spirit. The methods of examination were of three kinds. Firstly, dark ground illumination, with Leitz condenser bullseye lens and a Nernst lamp was tried. Secondly, films were stained with Giemsa (1 in 8) for twelve hours. The third method was that of Burri, with Indian ink. It was found that the dark-ground method gave the best results, spirochætes being detected much more readily than by the other processes. The Indian ink preparations were rather more satisfactory than those stained with Giemsa stain.

Staining Tubercle Bacilli.‡—M. Herman discusses various methods of staining these organisms, and claims that the ammoninm-carbonate-crystal-violet method described by him in 1908 possesses many advantages over the methods of Ziehl or of Much. The procedure, recapitulated here, consists essentially in the staining of bacilli with warm 3 p.c. alcoholic crystal-violet, to which have been added three parts of a

* Centralbl. Bakt., 1te Abt. Orig., lx. (1911) pp. 333–5.
† Brit. Med. Journ. (1911) ii. pp. 1282–6.
‡ Centralbl. Bakt., 1te Abt. Orig., lx. (1911) pp. 600–3.

1 p.c. watery solution of ammonium carbonate. This last substance is a better mordant than phenol or anilin-water, and by this method more tubercle bacilli can be demonstrated than by the other methods described. Bacilli, which appear only in degenerate granular form in a Much preparation, are clearly seen in films stained in the way described.

Rapid Method of Staining Spirochætes.*—Tohl Shmamine fixes the smear on a cover-glass with heat or with methyl-alcohol. Three or four drops of 1 p.c. caustic potash are then added, after which some drops of ordinary aqueous fuchsin or of saturated aqueous crystal-violet solution are at once poured on. After about 3 minutes the preparation is washed with water, dried and mounted in balsam. Instead of potash, 4–5 p.c. solution of sodium carbonate or strong ammonia may be used.

Muci-carmin Staining Method.†—P. C. Cole remarks that this method attracted little attention until S. Handley used it for tracing the spread of carcinoma in the large bowel. The stain is prepared by mixing carmin 1 grm., aluminium chloride 0·5 grm., and distilled water 2 c.cm. These ingredients are heated in a flat dish over a sand bath until the steam acquires a pungent odour. Alcohol (50 p.c.) is then stirred in and the mixture is transferred to a stock vessel and diluted with 50 p.c. alcohol up to 100 c.cm. So prepared, the solution stains in about 10 minutes; it is better, however, to use it much diluted. In sections the nuclei should be first stained, e.g. by means of Ehrlich's hæmatoxylin. After 10 minutes or so in the muci-carmin, this stain is washed off in distilled water and may then be mounted in the usual way. The material is best fixed in formalin or in acetic-sublimate.

ARNOLD, J.—**Staining of Glycogen in Gastric and Intestinal Mucosa.** *Arch. Mikrosk. Anat.*, lxxvii. (1911) pp. 346–76 (1 pl.).

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

Mounting.‡—It is often desirable, says R. O. S., to prevent the cover-glass from sinking and crushing the specimens (perhaps delicate diatoms mounted on the slip). To do this I suggest the use of glass threads, which have advantages over the metal discs used by some diatom mounters, for they cannot oxidize and discolour the mounting medium, and, moreover, are easily prepared of almost any required thickness. They can be made as follows: Take a piece of ordinary glass-tubing about the thickness of a pencil or less, and, holding it with both hands, bring it gradually down over a spirit or Bunsen flame, at the same time twisting it with the fingers so that the glass may be equally heated all round. Heat the portion of the glass between the hands, but do not heat too large an area if a fine thread is wanted. When the glass has become thoroughly softened, remove it quickly from the flame and instantly give a quick but steady pull with both hands. The heated portion will then be drawn into a very fine thread, 3 ft. or 4 ft. in length. The glass must be removed from the flame before it is

* Centralbl. Bakt., 1te Abt. Orig., lxi. (1911) pp. 410–11.
† Proc. Roy. Soc. Med., Path. Sect., v. (1911) pp. 33–5.
‡ English Mechanic, xciv. (1911) pp. 326–7.

pulled or it will break. It is better, perhaps, to use glass rod for this purpose, as it cannot enclose any air and form bubbles. For mounting, two short pieces of the thread are fixed parallel to each other upon the slip with a minute quantity of gum, thus forming a support for the cover-glass. There is another purpose for which these glass threads may be used, viz. the picking up and transferring of diatoms. They have been strongly recommended for this by Professor Hamilton Smith. A little practice will enable anyone to prepare threads of almost any required fineness or length.

(6) Miscellaneous.

New Method of Counting Leucocytes.*—The advantage of the method here described, says H. A. P. Hill, is that a total and differential count may be done simultaneously, the whole process taking about ten minutes or less. The only apparatus needed besides the usual Thoma pipette and slide is a small cylindrical tube graduated and corked. The tube of a Haldane's hæmoglobinometer cut down to the level of the 120 mark is very convenient. Liquor potassæ will clean it after use. The diluent must be made up at the time. Its composition is: distilled water, 12 parts; acetone, 3 parts; methyl-alcohol, 1 part; and Wright's modification of Leishman's stain, 4 parts.

This reagent is used as the diluent for the blood in any dilutions from 1 in 200 to 1 in 10. The red cells become almost invisible, the leucocytes stain just as they do in a film, and can be distinguished without the least difficulty. A dilution of 1 in 100 will give some 80 cells on the big square of a Thoma-Zappert slide, which is quite a large enough number to give an accurate total count, and there is no difficulty in finding 300 cells in other parts of the field for the differential. In marked leucopenia a 1 in 10 dilution enables one to find as many cells as are needed in a few minutes. Three precautions must be observed: 1. The Wright's stain must be filtered; best at the time of making it up. 2. The mixture must be well shaken. 3. The various operations of mixing and putting the drop on the slide must be done with promptness: the drop must be covered as quickly as possible, as the cells settle rapidly and the acetone evaporates readily.

Metallography, etc.

Bearing Metals.†—E. Heyn and O. Bauer have made an extensive series of tests, including determinations of cooling curves and microscopical examination, upon white bearing metals (tin-antimony-copper alloys) and bronzes containing about 84 p.c. copper and 16 p.c. tin. The structure of the rapidly cooled alloys was found to be finer than that of the slowly cooled alloys, and as the mechanical properties are considerably affected by the rate of cooling the microstructure is a useful indication of the wearing qualities of a bearing. A high casting temperature tends to produce a coarse structure. The effect of the addition

* Lancet (1912) i. p. 20.

† Stahl und Eisen, xxxi. (1911) pp. 509–12, 1416–22 (31 figs.).

of small amounts of aluminium or magnesium, as de-oxidizers in remelting the white metal, was found to be small. The effect of small additions of arsenic to the bronzes was studied.

Properties of Brass.*—W. v. Moellendorf points out that commercial brass bars consist of the solid solutions α and β in varying proportions, and that as these two phases differ widely in their properties, the properties of a brass depend upon the relative amounts of α and β which it contains. The structure and properties of four copper-zinc alloys are described.

Crystallization of α-Iron.†—M. Ziegler advances theories to account for several familiar structural phenomena in steel, such as the localization of scoriaceous inclusions in the ferrite and not in the pearlite, the ring-form of the ferrite in medium-carbon steel, the effect of speed of cooling on grain-size, and the occurrence of "ghosts." At a high temperature in the cooling of steel crystals of γ-iron containing carbon are formed, and scoriaceous matter falls out of solution taking the form of envelopes surrounding these crystals. At a lower temperature the γ-iron solid solution decomposes into α-iron and carbide of iron. As commonly occurs when a body crystallizes from a solution, the α-iron forms upon the foreign particles—the scoriaceous inclusions—which act as nuclei for crystallization. Thus a final structure is produced in which the ferrite exists as bands of some width, forming a network enclosing the pearlite grains, while the scoriaceous inclusions run centrally as strings in the ferrite bands, also forming a more or less complete network. Such a structure is familiar in steel castings. In re-heated, forged, or rolled material, this structure is modified by such treatment. The scoriaceous matter is partially, but usually not completely, re-dissolved on heating to a sufficiently high temperature, and separates out on cooling, as before, in envelopes which are larger as the temperature of re-heating is higher. Thus the mesh of the ferrite network formed upon the scoriaceous inclusions is larger the higher the temperature of re-heating. "Ghosts" were originally regions in which a large amount of ferrite had crystallized upon scoriaceous matter. Subsequent re-heating is not sufficient to bring about a complete diffusion of this ferrite into the surrounding steel, and the "ghost" is found in the finished piece as a region, usually elongated by the forging, containing little carbon and a number of scoriaceous inclusions embedded in ferrite. Explanations of the brittleness of coarse-grained steel, of the effects of annealing and quenching, and of the property of red-shortness, are suggested. The author's conclusions are adequately illustrated by photomicrographs.

Tschernoff Point b.‡—A. Baboschin finds that no simple proportionality exists between the grain-size of pearlite and the temperature, in the range investigated, 700° to 1300° C. The curves obtained demonstrate the existence of a critical temperature, above which grain-growth is rapid. This temperature—Tschernoff's point b—does not appear to coincide with Ar 3.

* Stahl und Eisen, xxxi. (1911) pp. 325-6 (3 figs.).
† Rev. Métallurgie, viii. (1911) pp. 655-72 (22 figs.).
‡ Journ. d. russ. met. Ges., 1911, pp. 89-100, through Stahl und Eisen, xxxi. (1911) pp. 1061-2.

Heat-treatment of Hypereutectoid Steel.* — A. Jung has made tensile tests and hardness determinations of six pure Swedish carbon steels, containing 0·99 to 1·56 p.c. carbon, after different heat-treatments. The specimens were in the form of wire, and the treatments included quenching from different temperatures in various liquids, followed or not by re-heating to lower temperatures. The microscopical work was carried out chiefly on the steel containing 1·33 p.c. carbon. Hydrochloric acid in alcohol was the etching reagent used; the structure of the variously treated specimens is described in detail, and numerous photomicrographs are given. The conclusions relate chiefly to the methods by which the most desirable mechanical properties may be obtained.

Heat-treatment of Steel. —H. Hanemann has carried out a long series of heat-treatment experiments upon six steels in the form of wire, containing 0·99 to 1·56 p.c. carbon. The specimens were heated in a salt bath to various temperatures between 750° and 1100° C., and were quenched in water, oil, or a lead-tin bath. They were re-heated in oil or in a lead-tin bath, to temperatures up to 650° C. The treated specimens were submitted to mechanical tests and microscopical examination. The influence of length of time of re-heating was studied for a stee containing 0·87 p.c. carbon. Water-quenched specimens, re-heated for various lengths of time at temperatures ranging from 100° to 650° C., were tested for hardness, solubility in dilute sulphuric acid, and content of carbide, and were microscopically examined. The author concludes that hardened steel tends to change into α-iron and cementite at all temperatures below 695° C. The change proceeds almost infinitely slowly at ordinary temperatures; at 650° C. it is complete in a few hours. At any given temperature of re-heating the rate of change diminishes as the time of re-heating is prolonged.

Non-metallic Impurities in Steel.‡—H. D. Hibbard proposes the name "sonims" for the solid non-metallic impurities in steel, such as the oxides, sulphides, and silicates of iron and manganese. Such bodies tend to accumulate, as microscopic particles, along the contact surfaces of the grains formed when the steel solidifies.

Iron-carbon System.§—O. Ruff and O. Goecke have determined the limit of solubility of carbon in molten iron in the temperature range 1135°–2620° C. The iron was heated in a graphite crucible in an electric vacuum furnace, and maintained at the desired temperature sufficiently long to secure saturation. The crucible was then allowed to fall into a vessel of water. The combined carbon and graphite were determined in the specimen thus quenched from the known temperature. The temperature-solubility curve shows a maximum of solubility at 2220° C., corresponding to the formula Fe_2C, and a change in direction at 1837° C., corresponding to Fe_3C. The specimens were microscopically examined.

* Int. Zeitschr. Metallographie, i. (1911) pp. 209–55 (68 figs.).
† Stahl und Eisen, xxxi. (1911) pp. 1365–73 (11 figs.).
‡ Trans. Amer. Inst. Min. Eng., xli. (1910) pp. 803–22; through Journ. Soc. Chem. Ind., xxx. (1911) p. 898.
§ Metallurgie, viii. (1911) pp. 417–21 (8 figs.).

O. Ruff * applies the above experimental results and other recently ascertained facts to the extension of the equilibrium diagram. The compound Fe_2C exists, as well as Fe_3C; it dissociates rapidly at 2220° C. Both carbides are endothermic compounds above 700° C. Observations of the boiling points of iron and iron-carbon alloys permit the inclusion of the gaseous phase in a portion of the diagram. The equilibrium concentration of Fe_3C is always less than its saturation concentration. Graphite is the only solid phase which is stable in contact with the liquid phase. Solidification may take place according to the stable system or the metastable system.

Iron-carbon Alloys. —H. Hanemann has determined the limit of solubility of carbon in molten iron in the temperature range 1350°–1880° C. A very pure iron-carbon alloy, completely covered with carbon, was heated in a carbon crucible at the required temperature, and rapidly cooled by casting in a narrow metal mould. The percentage of carbon in the plate obtained was determined, and its structure investigated. Other methods of cooling yielded specimens containing some graphite. The alloy obtained by heating to 1880° C. contained 6·18 p.c. carbon, and thus approached the composition of cementite. The microscopical evidence indicated that when graphite was present it had separated directly from the melt, and thus pointed to the existence of two systems of equilibrium, the stable iron-graphite system and the labile iron-cementite system.

Iron-chromium Alloys.‡—P. Monnartz has investigated 21 alloys of iron and chromium, containing 3·8 to 98·2 p.c. chromium and free from carbon, prepared by the Goldschmidt reaction. Cooling curves were taken; a compound Cr_2Fe is indicated. The resistance of the various alloys to the action of acids was very fully studied. Some observations on the mechanical properties of the alloys are included.

ARNDT, K.—**Influence of Nature of Surface on the Rusting of Iron.**
Metallurgie, viii. (1911) pp. 353–8 (24 figs.).

BAYKOFF, A.—**Equilibrium Diagram of Iron-carbon Alloys.**
Journ. d. Russ. Met. Ges., 1910, pp. 344–55.

BROWN, W.—**Mechanical Stress and Magnetization of Nickel.**
Proc. Roy. Dublin Soc., xii. (1910) pp. 500–18 (6 figs.)
xiii. (1911) pp. 28–48 (6 figs.)

HAINES, W. B.—**Effect of Temperature upon the Ductility of Zinc.**
[The ductility of commercial zinc-wire was found to rise to a maximum at 90° C., to fall to a minimum at 108° C., and to rise with further increase of temperature to 200° C. The peculiarities in the neighbourhood of 100° C. may be due to the presence of 0·52 p.c. lead.
Proc. Roy. Soc., Series A, lxxxv. (1911) pp. 526–32 (4 figs.).

KOBAYASHI, M.—**Alloys of Tellurium and Zinc.**
[The existence of the compound TeZn, melting at 1238·5° C., was demonstrated by a thermal and microscopical investigation of the system.]
Mem. Coll. Sci. and Eng. Imp. Univ. Kyoto, iii. (1911) pp. 217–21.

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* Metallurgie, viii. (1911) pp. 456–64, 497–508 (2 figs.).
† Stahl und Eisen, xxxi. (1911) pp. 333–6 (17 figs.).
‡ Metallurgie, viii. (1911) pp 161–76, 193–201 (9 figs.).

KONSTANINOFF, N., & W. SMIRNOFF—**Alloys of Tin and Antimony.**
[The composition of the phases present in the solid alloys has been ascertained by thermal analysis and a study of electrical properties. The compounds occurring are SnSb, and Sn_3Sb_2.]
Journ. Russ. Phys. Chem. Soc., xliii. (1911) pp. 1201–20.

OSANN, B.—**Piping in Iron.**
[Piping is regarded as a consequence of the contraction occurring when the liquid passes to the solid state.]
Stahl und Eisen, xxxi. (1911) pp. 673–6 (2 figs.).

PRIMROSE, J. S. G.—**Micrographic Examination of Failures.**
[The microscopical investigation of cases of failure in wrought iron, mild steel, rail steel, cast iron, and other materials, is described and illustrated with photomicrographs.] *Engineering*, xcii. (1911) pp. 748–50 (15 figs.).

RADOVANOVITCH, D.—**Initial Susceptibility of Nickel as a function of the Temperature, and the variation of the Magnetic Transformation Point with the Field.** *Arch. Sci. Phys. Nat. Geneva*, xxxii. (1911) pp. 315–37 (11 figs.).

ROBIN, F.—**Pitch of Tone given by Alloys, and its variation with Temperature**
[The pitch of tuning-forks made of certain alloy steels is practically unaffected by change of temperature.]
Comptes Rendus, cliii. (1911) pp. 665–8.

ROSENHAIN, W.—**Case-hardening of Steel.**
[An account of the conclusions drawn by Giolitti and Carnevali from the results of their investigations on cementation by gaseous reagents.]
Nature, lxxxviii. (1911) pp. 122–3 (2 figs.).

STEINBERG, S.—**Structure of Steel containing Oxygen.**
[Characteristic veins and cracks were observed in the ferrite grains of samples of open-hearth steel taken from the bath before deoxidation.]
Journ. d. Russ. Met. Ges., 1911, pp. 117–20.

THOMSEN, K.—**Solubility of Graphite in Solid Iron, and Melting Phenomena in Grey Cast Iron.**
[The limits of solubility of graphite in iron at various temperatures have been determined. The equilibrium of the two systems, iron-graphite and iron-cementite, is considered.]
Stahl und Eisen, xxxi. (1911) p. 1061.

WEISS, P., & O. BLOCH—**Magnetization of Nickel, Cobalt, and Alloys of Nickel and Cobalt.** *Comptes Rendus*, cliii. (1911) pp. 941–3 (1 fig.).

WITTORP, N.—**Iron-carbon Alloys containing more than 4 p.c. Carbon.**
[An equilibrium diagram for the range 0 to 18 p.c. in the iron-carbon system is given, based on a study of the alloys containing up to 24 p.c. carbon.]
Journ. Russ. Phys. Chem. Soc., xliii. (1911) pp. 505–7.

ZAKRZEWSKI, C.—**Optical Properties of Metals.**
Bull. Int. Acad. Sci. Cracovie, Ser. A (1911) pp. 314–29.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Improved Compound Microscope by James Mann.†—This Microscope (fig. 30), which supplies three steps in the evolution of the modern Microscope, was kindly brought to my notice, says E. M. Nelson, by T. Court. The instrument is figured on a plate in a pamphlet ‡ (dated 1751) which accompanies it. The Microscope in the main is obviously a copy of J. Cuff's (1744),§ the improvements consisting in the mirror and its attachment, and in making the instrument portable. The first portable compound Microscope was made by George Adams in 1746, and in this instrument we see Mann's device for adapting Adams's idea of portability to Cuff's Microscope. Very probably this was the second portable compound Microscope.

There are, however, other and more important improvements :— (1) The mirror is plane and concave, thus predating that of François Watkins ‖ ; (2) the mirror is for the first time attached to the limb, and not either to the box or to the foot ; (3) the distance of the mirror from the stage can be varied, as there are two holes, one above the other about 1 in. apart, in the limb ; and the mirror, to which a pin is fitted, can be attached to either of them. The above improvements, of which these are the first examples, have remained to the present time. The limb is attached to the top of the box foot by a dovetail slide ; when the Microscope is packed in its box a plain plate of brass is placed in its stead to preserve the dovetail. The bullseye is attached to the right-hand side of the stage instead of the front as in Cuff's.

The figure in the pamphlet is a copy of Cuff's, for the ribbon on the fish-pan is wound in the same way and there are the same reflections in the various glasses ; the Microscope itself, with the exception of the details mentioned above, even in its ornamentation, is precisely similar to Cuff's.

There has always been a difficulty in dating Microscopes of this period owing to the uncertainty of the date of Cuff's death or retirement from business. Here we have an authentic and dated copy of one of Cuff's Microscopes in 1751. It is not conceivable that such a flagrant plagiarism would have been perpetrated. We know from Adams's illustrated

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

† Journ. Quekett Micr. Club, ser. 2, xi. (1911) pp. 317–20.

‡ Title : "A Description of the Compound (formerly called the Reflecting or Double) Microscope, with great improvements. London made and sold by James Mann, at the sign of Sir Isaac Newton's Head, and Two Pair of Golden Spectacles, near the west end of St. Paul's, 1751."

§ Journ. Quekett Micr. Club, ser. 2, vii. (1898) p. 116, fig. 23.

‖ See this Journal, 1908, p. 143, fig. 26.

catalogue that he was making all Cuff's models in 1771. We also have in Ellis's work on the Corallines (1755) a description of the aquatic Microscope Cuff made for him. So it has been customary to fix the date of Cuff's retirement from business between the years 1755 and 1771. But obviously the publication of Ellis's work in 1755 does not imply that his Microscope was made in that year; on the contrary the probability

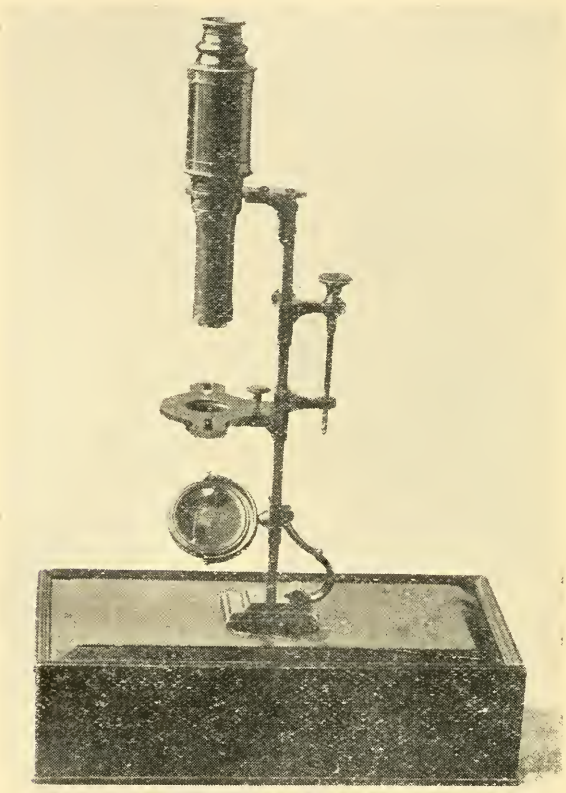

Fig. 30.

is that it was made much earlier, and that Ellis had been working with it some years in the preparation of his book. Similarly Adams may have made Cuff's Microscopes some time before the publication of his 1771 illustrated catalogue. The discovery of this dated Microscope affords, therefore, strong evidence that Cuff must have given up business or died before 1751. The name S. Johnson is engraved on the stage plate, and it is almost certain that this Microscope was the property of the celebrated Dr. Johnson.

Home-made Microscope.*—A. A. M. shows a photograph (fig. 31) of a Microscope made by himself. The design is of no particular make. By cutting out his own patterns and getting castings thereof, and by exploring the odd corners of the workroom for other material, the total cost was kept well under ten shillings. Of course this total refers to the stand only, the eye-piece and objective being extra.

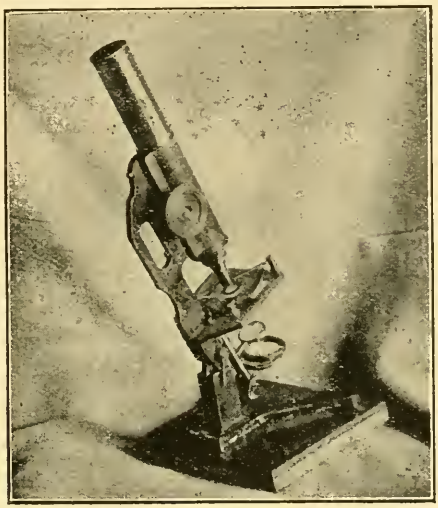

Fig. 31.

English v. Continental Stands.—The correspondence on this subject in Nature continues. H. C. Chadwick† does not agree with the criticism on the circular rotating and centring stage of the better class of Continental stands, "the use of which for anything but petrology it is difficult to guess." He has found this arrangement of the greatest assistance in studying certain biological objects. On the other hand, the excentric rotating movement below the Abbe condenser, and especially the cylinder diaphragm, appear to him to be perfectly useless.

C. Beck,† in a clearly reasoned letter, emphasizes the view that the Microscope is becoming a highly specialized instrument, and that the discussion will be of little service if it is directed towards the production of a universal type of instrument. He points out that to make but one form would be a fatal mistake. The metallurgist cannot use the instrument which is best suited for the bacteriologist, neither will the Rosenhain Metallurgical Microscope suit the biologist. The Dick Petrological Microscope is quite unsuitable for the entomologist, and the binocular instrument, which demands long tubes and a great range of focus for the use

* English Mechanic, Feb. 1912.
† Nature, No. 2205 (1912) p. 448.
‡ Nature, No. 2206 (1912) p. 480.

of the lowest powers, will not satisfy the chemist. For the use of botanists, zoologists and bacteriologists there is a certain similarity of requirements, but even here it would be unwise to endeavour to make all Microscopes on one model. The work of the student in the botanical laboratory is totally different from that of the research worker who is making photomicrographs with the highest power immersion lenses. Beck deals with many points in detail, and on the question of the form of a Microscope he considers that its stability does not depend upon whether the base is of the tripod or of the so-called horseshoe pattern. It is universally admitted that it should stand on three points, and the test of stability that should be applied is, at what angle will it upset, and what force is required to make it do so?

J. W. Ogilvy,* as the writer of the third section of the original article, replies to Barnard's and Sutcliffe's criticisms, and defends his own views.

F.R.M.S.† advocates the superiority of sub-stage centring over nosepiece centring, and is in favour of the mechanical draw-tube. As regards the standardization of sub-stage fittings he points out that difficulties naturally arise if the Royal Microscopical Society's gauges are not adhered to. While English makers loyally work to those gauges, Continental makers each have two or three different ones. The writer dwells on the necessity for systematic teaching in the elementary technique of the instrument. It is not unusual to meet men of eminence who are constantly working with Microscopes, and who do not even know that a sub-stage condenser requires to be focused. How is it possible that the refinements of the English Microscope can appeal to their students?

F. R. Brand‡ writes from the point of view of one who has had practical experience in both English and Continental factories in the actual manufacture and testing of Microscopes. He thinks that the recent extension of the rear toe in the horseshoe stand has given it a stability equal to that of the tripod form. No matter which stand is used in photomicrography, clamping is essential. The attachable mechanical stage is intended for certain classes of work only, and should not be used if found inconvenient. The necessity of a centring device to a substage condenser, in preference to the fixed form, is a matter for the individual worker to determine. With regard to the standardization of substage fittings, Brand points out that it is a mechanical impossibility to make smooth sliding fittings interchangeable where tubes are employed, one of which is sprung in order to maintain a certain constant tension, unless a pressure-screw is used, which arrangement could, however, only be used with a centring appliance. The standardization of objectives is a totally different matter, as greater latitude is permissible in cutting the threads, the tension being obtained on the shoulder of the objective mount—i.e. when the objective is screwed right home.

In respect to sprung slide-fittings *versus* ground-in slide bearings, Brand sums up in favour of the latter, especially as adopted on the best Continental Microscopes. He also points out that objectives provided

* Nature, No. 2206 (1912) p. 481.
† Nature, No. 2207 (1912) p. 515.
‡ Nature, No. 2208 (1912) p. 349.

with correction collars are now almost a thing of the past; cover-glasses of known thickness and the sliding draw-tube having obviated their necessity. The term "Continental" includes American.

J. A. L. Sutcliffe* replies to J. W. Ogilvie's remarks, and sums up the whole matter by the question, "Which instrument, the English or the Continental, is, by virtue of its design and workmanship combined, capable of affording the scientific worker the greatest facilities for work of a critical character?" He thinks that an answer by our most eminent workers would not be so much in favour of the Continental type as Ogilvie seems to imagine.

Gabel, C. E.—**Microscopy and the Microscopical Examination of Drugs.** *Des Moines.* Kenyon Co., 144 pp. (71 figs.)

(3) Illuminating and other Apparatus.

The Biotar, a Projection System with unusually large Aperture and Flat Field.†—M. von Rohr gives a description of this lens and an interesting historical sketch of its invention. Although at first sight it might have appeared that the Petzval portrait objective, with arc-light illumination, was capable of answering all requirements, yet there are many instances in which such a light is not available, and where, e.g. cinematograph displays in many private houses, incandescent gas light is the only resource. To the method of correction by which the great merits of projection lenses are usually attained, Abbe, in a paper read before our Society, ‡ gave the name of "allied-correction." But in the same paper he pointed out the value of a system of "independent-correction." He discussed the conditions for correcting the spherical aberrations of the convex lenses, or at least a part of these aberrations, by such other concave lenses as produce chromatic correction, and for this purpose searched for the appropriate means in systems not restricted to the low aperture of telescopic objectives. The general method could be easily indicated as everything appeared to depend on one essential condition, viz. concave surfaces which would introduce negative spherical aberration by the difference of the refractive index of consecutive media, as in ordinary binary lenses, but would either exclude chromatic aberration of perceptible amount, or admit chromatic aberration of opposite character. Glass of the necessary kinds was not at that date obtainable, but Carl Zeiss, at Abbe's suggestion, constructed a system with fluid lenses which, at any rate, showed the practicability of the principle of "independent-correction."

The only other worker in this field appears to have been Charles Piazzi Smyth, who, in 1873, by means of a compound system, completely eliminated the last of the five Seidel errors affecting the strong-light portrait objective. About a year and a half later he published a correction method whereby a system of high aperture yielded a plain

* Nature, No. 2209 (1912) p. 587.

† Zeitschr. f. Instrumentenk., xxxi. (1911) pp. 265–70 (5 figs.).

‡ "On New Methods for Improving Spherical Correction, applied to the Construction of Wide-angled Object-glass." See this Journal, 1879, pp. 812–24.

image-field free from astigmatism. Although the firm of Swift and Son manufactured the Smyth lens, it does not appear to have found a favourable reception, and it remained forgotten until the firm of C. Zeiss disinterred it and applied it to the method of "independent" correction.

In the case of the biotar lens, the application of a divergent correction lens in the neighbourhood of the objective was unsuitable, as the focus would thereby have been prolonged and the aperture proportions reduced; whereas, at the beginning of the analysis the need of an aperture as great as possible was emphasized. Hence the application of the old Smyth negative lens, close up to the image spot, exactly answered all requirements.

The author's diagrams and numerical quotations fully illustrate the effect of the Smyth lens.

Fluid Condensers of Large Aperture.*—For use with the biotar lens A. Köhler recommends the use of condensers of hyperboloid shape. Such a condenser consists of two thin glass laminæ, forming a trough which can be filled with water or other suitable fluid. If the shape of the whole is plano-convex, the convex facing the light source and having a hyperbolic curve, the refracted rays are parallel to the axis and are free from spherical aberration. Two such shapes with their plane surfaces parallel or in contact have the further property of forming an aplanatic lens. It is also a distinct advantage, besides economy, that the telecentric beam and the absorption of the heat-rays are attained by only two refractions at air, whilst the same effect with ordinary condensers requires six refractions at air, viz. two lenses with four surfaces in a duplex lens and two surfaces in the water chamber.

Arrangement for Circularly Polarized Light.†—A. E. Oxley points out that certain inconveniences arise when one tries to rotate the Fresnel rhomb about its long axis. He has therefore devised, on Fresnel's principle, two arrangements which are suitable for white light, and in which the emergent rays are not displaced with regard to the incident rays.

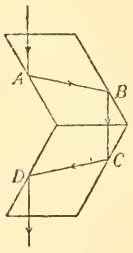

Fig. 32.

The first arrangement (fig. 32) consists of two glass parallelopipeds applied to one another, the incident rays being totally reflected at A, B, C, and D. If, then, the polarization plane of the incident linear polarized light makes an angle of 45° with the plane of the quadruple inner reflexions, then the emergent light is circularly polarized when the angle of the parallelopiped is suitably chosen. Assuming that the refractive index of the glass used is $\frac{n}{D_1} = 1{\cdot}5035$, a phase retardation of $\frac{\pi}{2}$ takes place between the two components vibrating either in the reflexion plane or perpendicularly to it, when the angle of the parallelopiped has the value 74° 38·2′, or 42° 34·8′. The larger of these values should be chosen, because in that case the dependence of the phase-difference

* Zeitschr. f. Instrumentenk., xxxi. (1911) pp. 270–6 (9 figs.).

† Chem. News, No. 102 (1910) p. 189. See also Zeitschr. f. Instrumentenk., xxxi. (1911) p. 355.

on the wave-length is but slight. For a given opening, however, the length of the parallelopiped is proportionally very considerable.

The arrangement represented in fig. 33 is much more advantageous. Here the rays undergo a triple internal total reflexion. The figure shows the course of the peripheral rays of the free aperture from A B. The two trapezoids are brought into juxtaposition, and a phase-retardation between the two components occurs if the acute angle of the trapezoid is 73° 48·6′. At the oblique path through the air-layer between the trapezoids the components polarized parallel to and perpendicular to the incidence-plane are, however, in great measure

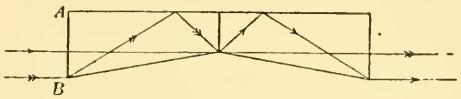

Fig. 33.

unequally weakened. Accordingly, all the emergent rays will be somewhat elliptically polarized if the angle made by the vibration-plane with the edge A B be chosen equal to 45°. The author calculates that if this angle be altered to one of 49° 2′, both components will finally emerge with uniform intensity, and will be circularly polarized.

If the two trapezoids are cemented on to one another with Canada balsam, then the unequal weakening of the two components still happens; but the light is circularly polarized if the angle between the polarization-plane of the incident light and of the reflexion-plane is again 45°.

Leitz Reflecting Condensers for Dark-ground Illumination and Ultra-microscopic Observations.*—In a descriptive and illustrated catalogue with the above title the firm of E. Leitz deal with (1) the Concentric Reflecting Condenser, for obtaining dark-ground illumination; (2) the Ultra Condenser, for bringing into view ultra-microscopic particles. These instruments have already been noticed in the Journal.† In the introduction to the pamphlet it is pointed out that dark-ground illumination and ultra-microscopical illumination are not necessarily the same thing, and that it is desirable that this distinction should be observed in the nomenclature used by makers for naming apparatus of this kind. Brightly illuminated objects can be seen more distinctly on a dark background than on one which is itself bright. The result is that objects which were visible on a bright ground become much more distinct, and other particles which could not be seen before will now come into view. These particles may be dimensionally well within the resolving power of the Microscope. So far the case is one merely of dark-ground illumination. But, in addition, other particles may become visible despite the fact that their dimensions are considerably smaller than the wave-length by which they are seen. Such particles are beyond the resolving power of the Microscope, and the case is then one of ultra-

* Descriptive Catalogue with above title. E. Leitz, London (8 figs.).
† See this Journal, 1910, pp. 761–2; 1911, pp. 97, 100.

microscopy ; they furnish no trace of detail and present an appearance of bright point-like disks, generally surrounded by bright and dark rings.

Half-shadow Interferometer as Photometer.* — C. Zakrzewski draws attention to recent methods for increasing the accuracy of measurements of phase difference by the interferometer. The principle of the measurement depends not so much on the displacement of the interference fringes as on the introduction of a half-shadow. The type of instrument used is therefore called a half-shadow interferometer. The author points out that without much difficulty it can also be applied to photometry.

Krüss Universal Arc Lamp, with steady Light-source.†—This apparatus (fig. 34) consists essentially of a lamp-chamber with carbons

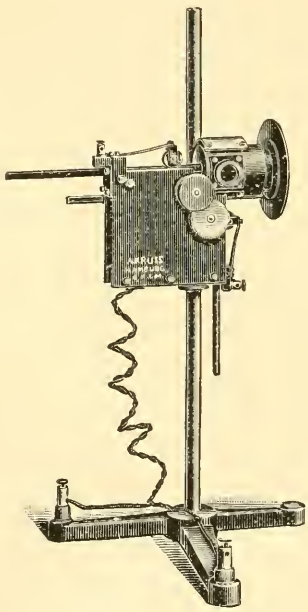

Fig. 34.

mutually perpendicular. This arrangement secures a steady light-source, the approximation of the carbons in the required proportion being effected by the lateral handwheel. The light-diffusing crater of the horizontal positive carbon therefore always remains in the optical axis of the small condenser lens. The carbons lie on two insulated rollers, and are urged

* Bull. Int. Acad. des Sci. Cracovie, Classe Sci. Math., 8A (1911) pp. 545–7 (1 fig.)

† Zeitschr. f. Phys. u. Chem. Unterr., xxiv. (1911) p. 283. See also Deutsche Mech.-Zeit., xxiii. (1911) p. 241.

on by a third clamping roller which conducts the current. The carbons can during the lamp-burning be extracted without previously switching off the current, and then replaced by fresh ones. As in the Liliput Arc Lamp a condenser lens of short focal length is used, thereby furnishing

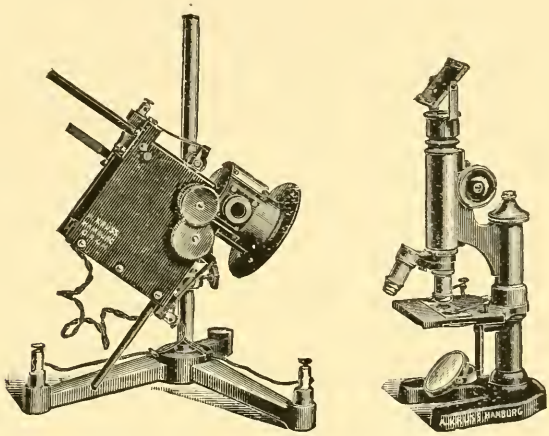

Fig. 35.

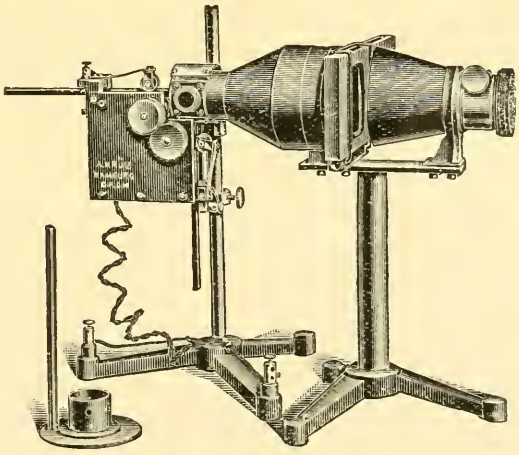

Fig. 36.

a beam of rays of very high intensity. By movement of this lens the beam is rendered parallel, convergent, or divergent. This movement takes place in a laterally applied groove, whereby a broad space for ventilation is left in front, and jamming of the heated condenser tube ren-

dered impossible. The stand is arranged so that the lamp can be easily turned and rotated in every direction, the small size of the lamp very much aiding the facility of such movement. The lamp burns best with a current-strength of 4 amperes; it can be adapted to any installation of 65, 110 or 220 volts, with the insertion of a suitable resistance. It can be supplied for direct or for alternating currents.

The lamp is suitable for optical demonstrations, microscopical work, micro-projection, and diapositive projection. Fig. 35 shows the application of the lamp to the purposes of microscopic objects with an ordinary microscope stand. In fig. 36 the apparatus is fitted up for diapositive projection. Both figures will be easily understood.

Radiant Efficiency of Arc Lamps.*—H. P. Gage undertook an investigation for the purpose of determining the radiant efficiency and the mechanical equivalent of the light from the right-angle carbon arc and the Bremer flaming arcs. His experiments led to the conclusion that the A line, $0{\cdot}76\,\mu$, is not a suitable point to take for the limit of the visible spectrum. An examination of luminosity curves showed that it would be preferable to assume this limit to be at $0{\cdot}68\,\mu$, and that if all radiation of greater wave-length than $0{\cdot}68\,\mu$ were removed the resulting decrease in light could be neglected. A modification of Ångström's method was used, and the greatest efficiency was found in the arc stream between yellow flame carbons, the carbon tips being shaded. With this arc the light energy constitutes 39 p.c. of the energy radiated.

Orueta y Duarte, Domingo de—**Nota sobre la nueva lámpara eléctrica Nernst, para microfotografía y proyección, del Dr. A. Kohler, con algunas consideraciones sobre el alumbrado del microscopio.**
Boll. de la Real Sociedad española de Historia natural (October, 1911) pp. 397–406 (1 fig.).

(4) Photomicrography.

Cinematography of the Embryonic Development of the Sea-urchin.† The details of the apparatus used for the above purpose by L. Chevroton and F. Vlès are essentially those described under the title Chronophotography in this Journal.§ The light-source is an adjustable voltaic arc of 20 to 50 amperes of continuous current. This light-source is adjusted on an optical bench in axial alignment with condensers, water-chamber, sector-disk, absorption-screen, and iris-diaphragm. The beam of light, after traversing the above, impinges on the mirror of the Microscope and is reflected upwards (the Microscope being vertical), through chronophotographic apparatus, into the camera. By means of a telescope-tube the stand and chronophotographic apparatus are brought into intimate connexion, and loss of light prevented; this is considered to be an essential condition. The Microscope ocular is either dispensed with,

* Physical Rev., ii. (1911) pp. 111–27 (12 figs.).
† Arch. Zool. Expér. et Gén., ser. 5, viii. (Paris, 1911) pp. 499–517 (6 pls. and 5 figs.).
§ See this Journal, 1909, p. 648.

or an ocular requiring a minimum distance of 24 cm. is used. Means are contrived for rapidly fixing the films in the proper positions. A micrometric objective photographed once for all defines each magnification. A prism is so placed that it is possible to follow the position of the object on the film for the purpose of keeping it in the field. This convenience is, naturally, very useful in the case of a rapidly moving body. The observations were in three stages: 1. From impregnation to commencement of the cavity of segmentation, 3 hrs. 2. From the cavity of segmentation to the first movements of the blastule, 3 hrs. 40 mins. 3. From the first movements of the blastule to its liberation, 1 hr. 20 mins. The lengths of film used were respectively 54, 67, and 26 metres. The images were 53 per metre. The plates accompanying the paper give selections of the results.

Axial Illumination in Photomicrography.*—D. J. Reid said, in order to obtain the best possible results in photomicrography, critical illumination should be employed; that is to say, that the image of the source of light, and the plane of the object to be photographed, should both be in the focus of the objective at the same time. There are, however, two requirements which are desirable, more especially in photomicrography, in connexion with this so-called "critical illumination," the first being that the field of view should be uniformly and fully illuminated; and the second that the whole of the back combination of the objective should be filled with light at full aperture—i.e. that the full aperture of the lens should be capable of being used if necessary, which is only possible with certain objects. For the purposes of photomicrography with critical illumination we must use a collecting lens, as here we require the whole field uniformly and fully illuminated. Granting this, there are a few fundamental principles relating to the illumination of the field, and concerning the filling of the aperture of the objective with light, that we ought here to refer to:—

1. As to the illumination of the field:—

A. The extent of the illumination, when using the same ocular and objective, depends:—(*a*) On the diameter of the collector. (*b*) On its distance from the Microscope. (The farther it is away the smaller is the area of the field illuminated.) (*c*) On the power of the substage condenser. The higher its power, the smaller will be the area of the field it will illuminate.

B. Next, the intensity of the light, when at a fixed distance, depends:—(*a*) On the nature of the source of light. (Whether kerosene lamp, acetylene or electric light, etc.) Personally, I use the Nernst lamp, with single filament, which is intense enough for most purposes. (*b*) On the way in which a flat flame is used, edge or flat. (*c*) On the angular aperture of the collecting-lens, and on its corrections. (*d*) On the angular aperture of the substage condenser.

2. In the same way as we considered the fundamental principles relating to the illumination of the field, we ought now to enumerate and shortly consider those that govern the filling of the aperture of the objective with light.

* Abstract of lecture delivered to the Photomicrographic Society, on Jan. 10, 1912, and reported at nearly full length in the "English Mechanic" of Jan. 19.

For the back combination of the objective to be uniformly filled with light at full aperture we must have the following conditions :—

(*a*) That the S.S. condenser should be capable of focusing on the plane of the object under examination an aplanatic cone of light, and should have a N.A. at least as great as that of the objective in use, and preferably a little more.

(*b*) That the image produced by the beam of light coming from the lamp, through the collecting-lens system, and focused on the back of the iris of the S.S. condenser, should be large enough to completely fill the opening necessary to allow of full aperture with the objective in use.

(*c*) That the S.S. condenser, the source of light, and the several parts of the collecting system in use shall be all exactly centred with the objective, and with one another.

We shall now proceed to consider in detail some methods of obtaining critical and effective illumination, with different powers of objectives, under the conditions I have laid down, using a Nernst filament lamp. These methods are suitable for the condensers employed by me (Watson's parachromatic dry condenser, and Beck dry and immersion achromatic condensers), and might have to be modified for other S.S. condensers.

The lamp I keep constantly at 21 in. from the substage iris, as that gives plenty of room for apparatus, and is also the distance which meets the conditions of illumination best.

For the collecting-lens system I use a Nelson lens, which is placed quite near the lamp, and can be used as a collecting-lens to produce converging rays, or as a collimating-lens, to produce parallel rays, as may be required, and also certain supplementary lenses, which will be detailed under Methods.

Methods.—With the high powers (from 4 mm. and upwards), taking as a type the 4 mm. dry apochromat of 0·95 N.A., I employ what might be called the Normal Method of Illumination, and I shall therefore describe it as minutely as possible.

Having arranged the Microscope in the horizontal position, with a dry condenser of 1·0 N.A. in the sub-stage, and with the mirror swung aside and the lamp at 21 in., and as nearly as possible in a line with the tube of the Microscope, using No. 4 compensating ocular, we proceed as follows :—

1. Focus the objective on the object.

2. Close the S.S. iris, and bring it into view in the field, by racking the sub-stage condenser up or down, as may be required, and centre it.

3. Open up the S.S. iris, and focus the filament of the lamp, and centre it by raising or lowering the lamp, and by moving it from side to side, as may be required, until it is quite in the centre of the field, as seen by keeping one's eye on the ocular.

4. Place the Nelson lens in front of the lamp, and adjust it as a collecting-lens, so as to throw a sharp, enlarged image of the lamp filament on the back of the S.S. iris, and adjust it roughly to the proper height, whilst keeping one's eye on the back of the sub-stage.

5. Interpose water-tank between the Nelson lens and the Microscope.

6. Close the Nelson lens iris, and centre it by moving it in the required directions, as seen by looking through the ocular, and then,

having opened up the Nelson iris, if there are reddish fringes at the sides, the Nelson lens must be moved a little nearer to the lamp until the whole field is illuminated with uniform white light, after which it is well to see that its centring has not been disturbed.

7. Adjust the opening of the S.S. iris to suit the object to be photographed.

8. All that now remains to be done is to interpose such screens as may be considered necessary; to estimate the exposure, introduce projection ocular, and we are ready to expose the plate.

Results.—We already know that the field is brightly, uniformly, and fully illuminated; but if we remove the ocular and look down the tube we shall see, if the sub-stage iris be opened fully, that the bright, circular, illuminated area fills the whole of the lens. If we measure the bright area we shall find that it represents about 0·95 N.A., which is the aplanatic cone usually obtained with a 1·0 N.A. dry condenser and the full N.A. of the objective.

If we wish to use a larger working aperture than 0·95 in the case of oil-immersion objectives, then we must exchange the dry condenser for an oil-immersion one, and the object must be mounted in balsam.

But with a 3 mm. objective of 1·30 N.A., and with the immersion condenser, you will find that, with the collecting system in use, the full N.A. of the objective is not even then utilized. On looking down the tube you will see that the back combination of the lens is crossed by a broad ribbon of light of a breadth equal to a N.A. of 0·95, although its length is equal to a N.A. of about 1·30. This incomplete, band-form of illumination is not to be recommended, especially with high powers.

If we want to find the explanation of such a result, we have only to see that the sub-stage iris is sufficiently opened up to obtain the full N.A. of the objective, and look at the image of the lamp focused on the back of it, and we shall see that it is not broad enough to completely cover the opening of the iris. To remedy this we can employ what we might call—

Modification of Normal Illuminating Method.—This consists in placing a concave 7 in. spectacle lens at about 7 in. behind the substage iris. This has the effect of broadening the image of the lamp filament on the back of the iris so that it is capable of completely covering the opening of the iris. After this lens has been centred, which is done by looking through the ocular and moving the spectacle lens about until the Nelson iris, which must be closed for the purpose, is right in the centre of the field, the Nelson lens must be moved a little farther from the lamp, so as to again give a sharp image of the filament on the back of the S.S. iris, and the sub-stage condenser must be re-adjusted so as to bring the Nelson iris again sharply into focus on the field. The back combination of the objective will now be found to be fully illuminated.

With medium-power objectives ($\frac{1}{4}$ in. and $\frac{1}{2}$ in.) we can still use the normal system of illumination; but we must use a low-power sub-stage condenser. Personally, I use the Beck dry condenser, with front removed (N.A. 0·40); and we get with that arrangement the whole field uniformly illuminated, and also the full N.A.

We come now to the low powers (1 in. and 2 in., etc.) For these two lenses we employ—

Illuminating System No. 2.—1. For the 1-in. lens, with which we use as condenser Watson's parachromatic dry condenser with front removed (0·35 N.A.) :—

(*a*) We adjust the Nelson lens as a collimating lens—i.e. so as to give nearly parallel rays. This requires its being brought nearer the lamp

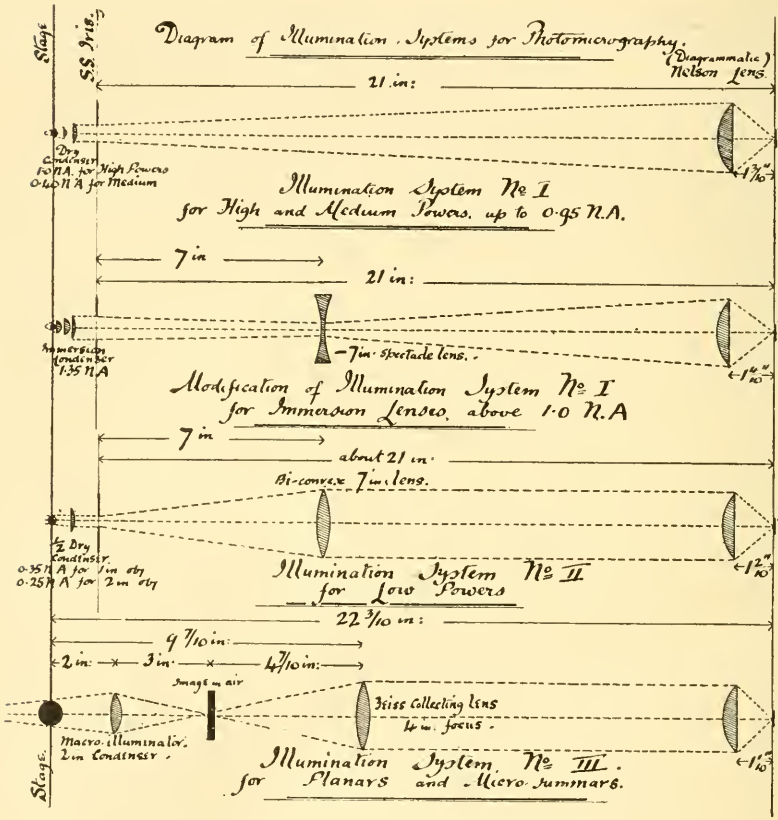

Fig. 37.

than in the normal method, and may be roughly done by throwing a beam of light, by means of an inclined plate of glass, so as to give a sharp image of the lamp filament on the roof.

(*b*) Centre it as before.

(*c*) Now interpose, at about 7 in. behind the S.S. iris, a bi-convex lens of about 7 in. focus, and centre it on the Nelson iris, as was done in the

case of the concave spectacle lens, and re-focus the substage condenser on the Nelson-lens iris.

2. With the 2 in.-objective the arrangement of the light is the same (method No. 2), except that the Beck immersion-condenser, with front removed (0·25 N.A.), is used instead of the dry parachromatic condenser. With very low-power lenses of the type of the planar of Zeiss and the micro-summar of Leitz, which are used without an ocular, another method must be adopted, which we may call—

Illuminating System No. 3.—Here we use as the substage condenser the macro-illuminator of Messrs. Watson. With lamp and Nelson lens giving parallel rays, as in System 2, we—

1. Focus the objective on the object by projecting the image on a white card.

2. Focus the S.S. condenser so as to show on the card a sharp image of the Nelson-lens iris.

3. Adjust the Nelson lens so as to show on the card a fairly sharp image of the filament running exactly across the centre of the image of the Nelson iris.

4. Then adjust Zeiss collecting-lens with iris on stand (4 in. focus), at about 9½ in. behind the stage of the Microscope, centre and adjust it.

5. Focus the S.S. condenser so as to show a sharp image of the Zeiss collecting-lens iris.

The field, with the exception of a narrow reddish fringe at the edges, is well illuminated, and this fringe can be eliminated by slightly closing the iris of the Zeiss collector. The full aperture of the objective is not, however, completely illuminated, so that for absolute perfection this method requires some modification.

(5) Microscopical Optics and Manipulation.

Theory of the Image-formation in the Microscope.* — H. Erfle reviews a book lately written by O. Lummer and F. Reiche, and entitled E. Abbe, Die Lehre von der Bildentstehung im Mikroskop. † One of these collaborators, O. Lummer, was an auditor of Abbe's lecture in the winter of 1887 when he propounded his theory. In association with F. Reiche he has extended and deepened Abbe's theory. While Abbe deduced his expression for the light-action in the secondary image from the Fresnel-Huyghens principle, the authors have made use of Kirchhoff's principle in combination with the equations of Maxwell's Theory of Light. It appears that by this second method Abbe's expression can be obtained in the case of limitation of the light to small convergence angles in the image plane.

The book is divided into four chapters, preceded by a short introduction dealing with geometrical optics based on the wave theory.

The first chapter deals with construction of the ray refracted through a spherical surface ; image-formation of an axial point ; image-formation through a centred system of refractive spherical surfaces ; Abbe's image-equations ; image-formation by means of wide-angled beams.

* Zeitschr. f. Instrumentenk., xxxi. (1911) pp. 358-60.

† Braunschweig : F. Vieweg und Sohn (1910) xii. 108 pp., 57 pp. and portrait of Ernst Abbe.

In the second chapter the image-formation of self-luminous objects on the principle of the wave theory is considered. This is followed by the literature of those cases in which strict calculation on Maxwell's light theory has succeeded with diffraction phenomena.

The third chapter is devoted to the image-formation of non-self-luminous objects.

The subject of the fourth chapter is the image-formation of a grating with artificial outline, and embraces the main results of a doctoral dissertation undertaken by M. Wolfke at the author's request, and dealing with a grating illuminated by a plane wave perpendicularly incident upon it. The dissertation does not extend to the case of a self-luminous grating.

The book concludes with a bibliography on the theory of image-formation of non-self-luminous objects.

Microscopical Work and Eye-accommodation.* — F. Brocher has investigated the amount of accommodation which an observer's crystalline lens exerts during microscopical work. He uses a camera lucida attached to the Microscope in the usual way, but the ordinary sheet of drawing-paper is replaced by a mirror, set at such an angle as to reflect the landscape. On this mirror, in the path of the Microscope rays, he places a small piece of postage-stamp paper. A person looking through the camera lucida now sees three images, viz. the object (an engraved scale) on the Microscope stage, the landscape, and the fragment of paper. Two of these images (the scale and the landscape) would by many people, especially by experienced microscopists, be clearly seen, whilst the paper image would be indistinct. As the landscape is a distant object, normally visualized with the crystalline lens completely relaxed, the conclusion follows that the Microscope image is seen under similar conditions, or, in other words, the eye functions microscopically without accommodation. If the observer's eye is normally conformed, an accommodation of about 2·5 dioptries would bring the stamp-paper into view, but the other two images would become indistinct. These observations seem to explain why it is that many persons can work with the Microscope for prolonged periods without eye-fatigue.

The author found, however, a second class of observers who do complain of eye fatigue, and these were usually comparatively inexperienced microscopists. In their case the same apparatus was used, but the two images clearly seen were now the scale and the stamp-paper: the landscape was indistinct. Thus it follows that eye-accommodation was exerted. By measurements the author estimated the magnitude of this accommodation, and found that it was not necessarily the maximum of which the eye is capable.

It is evident that a person of the first class wishing to use the camera lucida for drawing could not focus the Microscopic image on the paper without eye-accommodation. Such an one should place above the prism a lens whose refractive power is equal to the accommodation-effort necessary to see the paper.

Observers of the second class with practice frequently acquire in-

* Rev. Méd. Suisse Romande, xxxi. (1911) pp. 69 and 84 (2 figs.).

sensibly the facility of the first class. But in cases where such proficiency is not acquired, it is difficult to propose means of avoiding eye-fatigue. Perhaps the best means is to raise the level of the drawing-paper until a position requiring a minimum eye-accommodation is reached. This, however, naturally has an inconvenient influence on the size of the drawing obtainable. Another mode is the employment of certain lenses, but has the disadvantage of being complicated.

The study of the subject has suggested to the author that the camera lucida might be used for making a reduced drawing of a relatively large object. He fully describes his method, which essentially amounts to a reversal of the usual process.

PULFRICH, C.—**Stereoskopisches Sehen und Messen.**

[This is mainly a reprint of the article "The Stereoscope," contributed by the author to the Encyclopædia Britannica, and is enriched by a full bibliography of all works relating to the subject published during the last eleven to twelve years. Jena: Fischer (1911) 40 pp. (17 figs.).

(6) Miscellaneous.

Coscinodiscus asteromphalus.—At the meeting of the Quekett Microscopical Club on January 23, 1912, E. M. Nelson showed a photomicrograph of the eye-spot of *Coscinodiscus asteromphalus*, Maryland deposit, styrax mount, × 3000. There was a fracture passing through the cap; this fracture proves the presence of a membrane covering the eye-spot.

Quekett Microscopical Club.—The 478th Ordinary Meeting of the Club was held on January 23, 1912, the President, Professor E. A. Minchin, M.A., F.R.S., in the chair. Mr. James Burton read some "Notes on Algæ collected in 1911." He had to record several instances of "Breaking of the Meres"—June 24, at Totteridge, due to an unidentified species of *Anabæna*; August 9, at Hadley, the same organism was found. August 8, at Kew, in the pond near the palm house, the water was suffused at all depths with *Aphanizomenon flos-aquæ*. August 31, Welsh Harp reservoir, due to *Microcystis marginata*. Mr. A. Earland exhibited in the lantern a number of photomicrographs of Foraminifera prepared to illustrate the principal types of rhizopod shell structure.

The Annual General Meeting of the Club was held on February 27. The President delivered the Annual Address, dealing with "Speculations with regard to the Simplest Forms of Life and their Origin on the Earth."

Professor A. Dendy, D.Sc., F.R.S., F.L.S., was elected President for the ensuing session.

Vernier Micrometer. — At the Meeting of the Optical Society, October 26, 1911, J. W. Gordon demonstrated a new form of Vernier Micrometer. The scale consists of black lines on a white ground, with a thick black line at right angles to the divisions; this is viewed through a coarse transmission diffraction grating, by rotating which three scale images are formed which move relatively to one another in the direction of the length of the scale. These divisions are easily seen where they lie over the thick black line. By suitable marks arranged on the circumference of a circle printed with the scale, the amount of rotation of the diffraction grating is read without removing one's eye from the scale.

One line of the actual scale having been placed opposite one end of the length to be measured, one of the lines of a diffraction image is made to coincide with the other end; the fractions of a division are read on the circular scales.

Modern Microscopy.*—This handbook of microscopy for beginners and students, by M. I. Cross and M. J. Cole, has reached its fourth edition; it has been revised and much enlarged, and now contains chapters on special subjects by expert writers. Its general features are so well known that no further allusion to their merits is needed. Mention of the names of the writers of the special articles is sufficient to show that the subjects entrusted to them have been dealt with satisfactorily. These subjects and their exponents are: 1. The Petrological Microscope, by F. J. Cheshire. 2. Rotifera, C. F. Rousselet. 3. Fresh-water Mites, C. D. Soar. 4. Foraminifera, Arthur Earland. 5. Mosses and Liverworts, T. H. Russell. 6. Nature Study, W. M. Webb. 7. Foods, C. Andrews.

Determination of Refractive Index of a Liquid.†—The following simple method of finding the refractive index of a liquid available in small quantities is given by G. N. Pingriff. A plane mirror A (fig. 38) is placed on the base of the stand, and on it is put the double convex lens in such a position that its centre is beneath the needle-point B. With the eye directly above B, the observer adjusts the sliding arm until the needle-point and its image just coincide, as found by parallax. The distance from B to the centre of the lens is then accurately found—let it be f_1. The experiment is then repeated, after first placing a drop of the liquid upon the mirror, when it will be spread out to a plano-convex lens between the glass lens and the mirror—let the new focal distance be f_2; then evidently the focal length f of the liquid lens will be given by $1/f = 1/f_2 = 1/f_1$.

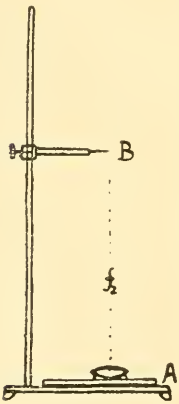

Fig. 38.

But since the focal length of the liquid lens is also given by the relation $1/f = (\mu - 1)/r$, where r is the radius of curvature of the surface of the glass lens, it is evident that from a knowledge of r the index of refraction of the liquid can be at once found. If r is not known it can be found by putting a sheet of paper between the lens and mirror, and again obtaining an image of B coincident with itself by reflection in the lower surface of the lens. If this new distance from the lens is called d, we have, since reflection is now only at the upper surface of the lens, $\mu/r - 1/d = (\mu - 1)/-r$, or $r = (2\mu - 1)d$, where μ now, of course, refers to the glass, and can, if necessary, be calculated. The apparatus is thus complete in itself, and three readings of the position of B give all the data required.

Weinschenk, E.—**Anleitung zum Gebrauch des Polarisations-mikroskops.** Freiburg: Herder, Dritte Verb. Aufl., 164 pp. (167 figs.).

* London: Bailliere, Tindal, and Cox, 1911, xviii. and 397 pp. (113 figs.).
† Nature, lxxxvii. (1911) p. 551.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Use of the Centrifuge in Pond-life Work.—The application of the centrifuge to the collection of minute organisms in water was apparently first suggested, says D. J. Scourfield,† by Cori in 1895, and very soon after, Dolley, Kofoid and Field were also experimenting in a similar direction. During the next ten years or more, however, the method was not at all widely adopted, probably because it was looked upon merely as an alternative to the more usual methods of concentration by means of fine gauze nets, etc. It was not until Lohmann in 1908 published his paper on the determination of the absolute quantity of plankton in sea-water that it was realized that the centrifuge was indispensable so far as the minutest forms of plankton were concerned. Immediately after the publication of Lohmann's paper, Woltereck and Ruttner took up the matter at the Lunz Fresh-water Biological Station, and have recorded some preliminary but extremely interesting results in the Internationale Revue der gesamten Hydrobiologie und Hydrographie.

The samples of water to be tested with the centrifuge should be taken directly from the pond or other piece of water into the collecting-bottle without the intervention of any net or other filtering appliance. Quite small quantities are sufficient for obtaining a fairly accurate idea not only of the various kinds of smaller organisms present but also of their relative numbers. With water from small lakes and ponds, tubes holding only 1½ c.cm. usually yield sufficient deposit for qualitative investigation, though not perhaps for accurate quantitative work.

As some organisms seem to remain suspended in the water for an almost indefinite time if the centrifugal force does not reach a certain amount, it is necessary, if these are to be concentrated, to run the centrifuge at a high speed. To obtain this with manual power the author has had the "haematocrit" head supplied with all two-speed centrifuges, somewhat altered so as to take elongated vase-shaped tubes holding no more than about 1½ c.cm. With such a head, speeds up to 10,000 revolutions per minute can be obtained, but the highest speed obtainable without too great an effort is about 7,000 revolutions per minute. At this speed a run of from one to two minutes seems to be sufficient for the purpose. It is useful sometimes first of all to centrifuge samples of water in the larger tubes usually supplied (holding about 15 c.cm.) at a comparatively low speed, and then to pipette off some of the clearer water into the smaller tubes for more rapid rotation with the high-speed gearing. This has the great advantage of separating to a considerable extent the larger from the smaller of these tiny organisms, and so rendering the examination of the latter more easy. It would probably be a good plan

* This division contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Embedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Journ. Quekett Micr. Club, ser. 2, xi. (1911) pp. 243–50 (1 fig.).

in every case to subject a sample of water to a second centrifuging at as high a speed as available.

The best method of removing the centrifuged organisms from either the large or small tubes is to pipette off all the water except a very small drop at the bottom, and then to suck up this remaining drop and forcibly expel it several times. In the case of the small tubes these operations are most easily performed with a Rousselet "thistle-head" pipette drawn out to a very fine point. A portion of the drop of water, or the whole of it if very small, is then transferred to a glass slip, live-box, or compressor. At this stage a further concentration of the organisms can easily be carried out if necessary by taking a drop of water two or three times larger than that actually required and allowing

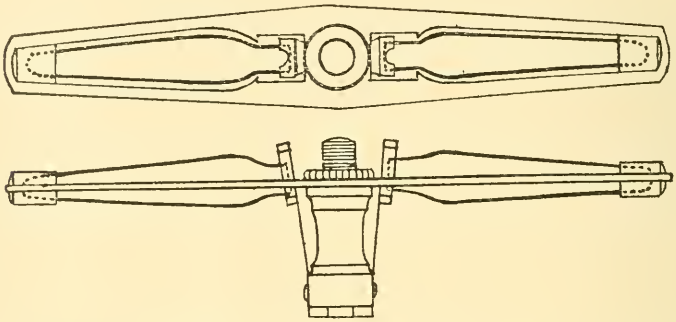

Fig. 39.—Plan and elevation of "haematocrit" head adapted to carry small vase-shaped tubes holding about 1½ c.cm. Two-thirds actual size.

it to evaporate to the desired size. In any case it is advisable to allow the drop to stand a few minutes before spreading it out with the cover-glass, as some at least of the organisms settle to the bottom and so do not escape so easily to the margins when pressure is applied to the cover-glass.

The principal use of the centrifuge in pond-life work, as in marine plankton work, is not to take the place of other methods of collection such as nets and filters, but to be accessory to them. As such an accessory piece of apparatus the centrifuge has evidently come to stay, and no method of collection depending entirely upon straining or filtering processes can be considered sufficient in the future.

New Medium for Cultivating Bacillus diphtheriæ.* — T. T. Rankin describes a medium for cultivating *Bacillus diphtheriæ*, by which the bacteria can be recognized without the aid of the Microscope. It consists of 3 parts sheep's-blood serum, 1 part bouillon, 0·5 p.c. glu-

* Journ. Hygiene, ii. (1911) p. 291. See also Centralbl. Bakt., 1te Abt. Ref., 1. (1911) p. 760.

cose, 1 p.c. potassium sulphocyanide, 2 parts aqueous 0·5 p.c. neutral-red solution.

Sporotrichosis.*—Pinoy and J. Magrou passed into the testicles of guinea-pigs, hairs, previously sterilized, and afterwards dipped into pus from some suppurating focus of cases of sporotrichosis. After two months the guinea-pigs were killed, and microscopical examination of the pus, which was present around the infected hairs, showed the presence of the yeast-like parasite. Pure cultivations were obtained in Sabouraud's medium. The best method for demonstrating the presence of the parasite was by the slow method of Claudius. The preparations were left for 20 minutes in a solution of gentian-violet or of crystal-violet, and then treated for 10 minutes with a half-saturated solution of picric acid. The differentiation was effected with chloroform. The authors suggest that this method of inoculating-guinea pigs may be found useful in doubtful cases of sporotrichosis.

R. L. Sutton † records a case of this infection communicated through the horse, which animal is often the subject of mycotic lymphangitis. The organism was cultivated in agar slopes—a pure culture being obtained from one tube, the rest being contaminated with other organisms. The pure culture showed the characteristic mycelia, varying in length from 3 to 5 μ, with numbers of oval conidia from 1 to 2 μ in diameter.

H. G. Adamson ‡ records a case of sporotrichosis which had been acquired in Brazil. The fungus was successfully cultivated in Sabouraud's medium (pepton Chassaing 1, glucose or maltose 3·7, agar 1·5, water 100). The growth was at first dirty white, moist, smooth, having acuminate elevation, with a finely-fringed margin. Colonies first appeared on the sixth day, and in subcultures on the second. In about a fortnight the growth had become dark brown. Microscopically the growth consisted of mycelium, with oval or round spores attached to the mycelium, singly or in groups, by a fine pedicle. The fungus was demonstrated in sections of the tissue affected by means of pyronin and methyl-green.

Cultivation of Bacillus abortus.§—T. Smith and M. Fabyan found that this organism, when freshly isolated from an infected animal, would not grow in pure culture upon the ordinary media. When planted upon agar in company with *Bacillus subtilis*, *B. megatherium*, or other similar organisms, it grew well, and after a few generations had thus existed in mixed culture upon an artificial medium, the organism became capable of independent growth. If isolated at this stage the bacillus would grow in pure culture. The freshly isolated organism would not grow in company of organisms of feebler growth than those named above. After acclimatisation it grows well upon potato, producing a brownish colour. It grows also in milk, causing no alteration in the medium. Sugars are not fermented.

* C.R. Soc. Biol. Paris, lxxi. (1911) pp. 378–8 (1 fig.).
† Boston Med. and Surg. Journ., clxiv. (1911) pp. 179–81 (4 figs.).
‡ Proc. Roy. Soc. Med., Dermatol. Sect, iv. (1911) pp. 113–21 (5 figs.).
§ Centralbl. Bakt., 1te Abt. Orig,, lxi. (1912) pp. 553–4.

(2) Preparing Objects.

Simultaneous Fixing and Staining.*—For the demonstration of mast-cells, F. Strecker recommends a fixing and staining bath, containing 100 parts of 40 p.c. formalin, 100 parts of 90 p.c. alcohol, and 6 parts of toluidin-blue (Grübler). Pieces of tissue remain in this bath for one or more days, according to size, and are then transferred to 70 p.c. alcohol, raised rapidly through the alcohols, cleared in benzol, and embedded in paraffin.

(3) Cutting, including Embedding and Microtomes.

New Brain Methods.†—E. Venderovič describes an improved method for cutting large sections of brain by means of the large submerged microtome. The brain, after three weeks or more in 5 p.c. formalin, is divided in two portions, so as to provide a flat surface for fixing to the microtome plate. This surface is dried with filter-paper. The microtome plate is gently warmed and coated with a thin layer of paraffin (melting point 47° C.). When this has solidified, the cut surface of the brain is applied to the plate, and melted paraffin is applied to the side of the brain to a height of 1 cm. Above this point the organ is free from the fixing material. After about half an hour the paraffin has set hard and the cutting begins. The slices should have a thickness of $\frac{1}{2}$ cm. It is unnecessary to fill the microtome with water. Cutting of the lower section is facilitated if the hand be gently pressed upon the top of the brain. These slices are then washed for 24 hours in distilled water to remove formalin. They are then placed upon glass plates with several layers of filter-paper on either side of each slice, and introduced into a cylinder for the osmic acid process. After remaining for a month or so in contact with Busch's osmic solution, they are washed for ten days in running water, rapidly dehydrated, and then placed for one day in thin, and one day in thick celloidin solution. The slices are then replaced exactly in their original relation to one another and treated with chloroform vapour. The celloidin block so prepared is cut in sections of a thickness of 20 μ. These sections are placed on tissue paper, heated with alcohol, dried with filter paper, cleared in xylol and mounted in paraffin.

Graphic Reconstruction in Oblique Positions.‡—N. Odhner describes a method of graphic reconstruction, which has the advantages of simplicity and speed of execution in comparison with methods of projection or plastic reconstruction. By this method, objects of any form can be observed in any desired magnification in any plane. The method is most valuable in embryological studies. The author illustrates his method by describing its application to the study of the developing upper jaw.

Manipulation of Serial Sections.§—In previous communications, H. Strasser has given accounts of his method of using strips of paper to facilitate work with serial sections. The sections as they are cut

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 268–70.
† Anat. Anzeig., xxxix. (1911) pp. 414–23.
‡ Anat. Anzeig., xxxix. (1911) pp. 273–81.
§ Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 339–44.

come into contact with a paper strip. They remain adherent to this during the subsequent manipulation until ready for mounting. The sections are made to adhere to the paper by means of a mixture of equal parts of castor oil and collodion. This is not dissolved by xylol, carbolxylol, alcohol, or water. It is dissolved by acetone, and an acetone bath is used for the purpose of detaching sections from paper. To make sections stick to the slide, the latter is covered with a thin film of photo-engraving glue. This is allowed to dry. The sections upon their paper base are brought out of carbolxylol and placed upon a slide so prepared, the sections being, of course, between paper and glass. The carbolxylol has the effect of making the glue moist and sticky, so that the sections are now adherent to slide on one side and to paper on the other. Gentle pressure is applied, and in one or two minutes the whole preparation is put in an acetone bath, which dissolves the collodion and loosens the paper. This may then be carefully removed.

The paper is kept in rolls, and a roll so placed that the sections come from the knife on to the roll, the paper advancing as sections are received. Celloidin sections pass from the microtome into a shallow bath containing 80 p.c. alcohol ; from this they are placed upon the paper strip, uniformly painted with a thin layer of castor oil collodion. The paper with sections is blotted, and placed in carbolxylol. From this bath the preparation is transferred to descending alcohols. The alcohol bath is a shallow rectangular bath, one side of which is a horizontally curved inclined plane. The preparations pass from the bath on to the plane.

JUILLET, A.—**Recherches anatomiques, embryologiques, histologiques, et comparatives sur le Poumon des Oiseaux.**

Arch. Zool. Expér., xlix. (1912) pp. 207–371 (5 pls.).

See also this Journal, 1911, p. 822, where the technique is given.

(4) Staining and Injecting.

New Osmic Acid Hæmotoxylin Method.*—O. Schultz makes some remarks upon the use of osmic acid as a fixative, pointing out that the reagent should not be kept in dark bottles ; that unless the portions of tissue are very small it should not be used in a concentration of less than 1 p.c., and that the time of action should be one or two days. He quotes the method described by Flemming, in which the tissues are treated with potassium bichromate, after the application of osmic acid. The following method is recommended :—Tissues fixed for a day or two in osmic acid are washed, and then placed in a 0·5 per cent. solution of hæmatoxylin crystals in 70 p.c. alcohol. The material remains in the stain for two days, the fluid being changed two or three times during the first day. It is washed in 70 p.c. alcohol, until the brown stain ceases to come away. After a day the tissues are transferred to 96 p.c. alcohol, cedarwood-oil and paraffin. An alternative procedure consists in the transference of the material from alcohol into a mixture of one part of 4 p.c. collodion and two parts 96 p.c. alcohol. After twenty-four hours it is transferred to a mixture of equal parts of cedarwood-oil and chloroform, and then to paraffin.

* Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 465–75.

Staining Living and Dead Bacteria.*—H. Kayser gives a brief account of his application of the method first described by Proca by which living and dead organisms may be distinguished. His procedure is as follows:—Thin coverglass films are prepared and gently warmed. When these are dry, methylen-blue is applied for two or three minutes and then carefully washed. The preparation is put into dilute carbol-fuchsin (1 in 10) for five or ten seconds, dried, and mounted. Living organisms take the blue stain, while those that have lost their vitality appear red. By this method variations in the power of resistance of different organisms to various poisons may readily be demonstrated. In old cultures of organisms, such as *Bacillus coli*, it may similarly be shown that a large number of devitalized forms are present. The process may be simplified by using a solution containing 8 c.cm. of carbol-fuchsin solution in 100 c.cm. of distilled water and 100 c.cm. of Loeffler's methylen-blue.

Bleaching of Hæmatoxylin Preparations.†—D. Carazzi discusses the phenomenon, frequently observed, that microscopical specimens stained with hæmatoxylin are liable to become bleached in the course of some months. He mentions the work of Metcalf, who attributed this to slight acidity of the Canada balsam, and recommended therefore that preparations should be exposed to ammonia fumes for a second or so before mounting. The present writer considers that the deterioration is due neither to the acidity of the balsam nor of the air, but to changes in hæmatoxylin preparations during dehydrating, clearing and embedding. The change occurs principally in sections of material stained in toto before embedding and cutting. No bleaching occurs in specimens stained with a hæmatoxylin solution described by the author. This contains hæmatoxylin 0·5 gm., potassium iodate 0·01 gm., alum 25 gm., glycerin 100 c.cm., distilled water 400 c.cm.

Staining Failures.‡—B. Rawitz gives an account of unsuccessful attempts to make use of sodium tungstate with cochineal, carmin or hæmatin, and of aluminium acetate with hæmatoxylin, hæmatin, or cochineal, as staining re-agents. Clear solutions of rich colours were obtained, but the staining power was absent. In the view that in the first case excessive alkalinity, in the second excessive acidity, might be responsible for these disappointing results, he corrected these conditions, but with no greater success than before.

Action of Ultra-violet Rays on the Staining of Acid-fast Bacteria.§ A. Rochaix and G. Colin exposed to the light of a mercury vapour quartz lamp the following bacilli: Bovine tubercle, Grass bacillus ii, Smegma, Milk bacillus, Bacillus ii Tobler, and the Butter bacillus. The bacilli were irradiated in the dry and wet state for times varying from 10 minutes to 4 hours, and their stainability was afterwards tested by the Ziehl, Much, and Gram methods. When irradiated in the dry state the microbes did not stain by any of the methods, though the resistance varied according to the species. There was no parallelism between the

* Centralbl. Bakt., 1te Abt. Orig., lxii. (1912) pp. 174–6.
† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 271–4.
‡ Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 261–7.
§ Comptes Rendus, clii. (1911) pp. 1253–6.

results from the three methods : thus by Much's method, which is only a reinforced Gram, the staining persisted for the longest time. One species (Grass bacillus) which lost its capability to stain by Ziehl's method after an irradiation of 5 minutes, was still stainable by Gram's method after 60 minutes' exposure. Bovine tubercle lost the power to stain by Gram's method in 20 minutes, but could be stained by the Ziehl procedure after 30 minutes' exposure. Exposure in the moist state, i.e. as emulsion, still further diminished the power to stain by Gram's method, while the capacity to stain by the Ziehl method was retained much longer.

Staining Capsulated Bacteria in Body Fluids.*—W. H. Smith gives the following procedure for staining capsulated bacteria :—1. A thin smear from sputum, lung, pleural or pericardial exudate is fixed in the flame and then covered with 10 p.c. aqueous solution of phosphomolybdic acid for 4 or 5 seconds. It is then washed in water. 2. If the bacterium be Gram-positive, the smear is treated by Gram's method and counter-stained with 6 p.c. aqueous solution of eosin for ½ to 1 minute, warming gently. The capsule is eosin-stained. 3. If the organism be Gram-negative after the phosphomolybdic acid and washing, proceed as follows : Stain with 6 p.c. aqueous solution of eosin, warming gently for ½ to 1 minute. Wash in water and counter-stain with Loeffler's methylen-blue solution for ¼ to ½ minute, then absolute alcohol and mount in balsam. The capsule is eosin-stained and the body of the bacterium blue. The illustrations to this paper show the capsules very distinctly.

Metallography, etc.

Magnesium-silver System.†—W. J. Smirnow and N. S. Kurnakow point out the difficulty of distinguishing, by thermal methods, between a solid solution and a definite compound in the case in which the compound forms solid solutions with the components on either side of it in the equilibrium diagram. Such a case occurs in the magnesium-silver system, and the authors show that the compound MgAg corresponds with a maximum in the curves of electrical conductivity and of temperature co-efficient of resistance. The existence of Mg_3Ag is also indicated. All the phases occurring in this system are of variable concentration. The results were confirmed by hardness measurements and microscopical examination. The general character of conductivity and hardness diagrams of systems containing compounds is discussed ; the compound may or may not decompose on melting ; both cases are considered.

Phosphor Bronzes.‡—M. Levi-Malvano and F. S. Orofino have investigated, thermally and microscopically, the ternary system Cu-Cu_3Sn-Cu_3P, which includes the commercial phosphor bronzes. The two compounds Cu_3P and Cu_3Sn are immiscible in the solid state ; the diagram of this binary system shows a eutectic point at 22 p.c. Cu_3P and 650° C. In the ternary system the phases present in the solid alloys are

* Publications Massachusetts Gen. Hosp., iii. (1911) pp. 488–92 (6 figs.).

† Zeitschr. Anorg. Chem., lxxii. (1911) pp. 31–54 (7 figs.).

‡ Gaz. Chim. Ital., xli. (1911) 2, pp. 297–314, through Journ. Soc. Chem. Ind., xxx. (1911) p. 1390.

ternary solid solutions, binary solid solutions of Cu_3Sn or Cu_3P in copper, the compound Cu_3P, and the eutectic of Cu_3P and a solid solution.

Aluminium Brasses.*—M. Levi-Malvano and M. Marantonio have studied a number of alloys containing 58–70 p.c. copper, 1–4 p.c. aluminium, the remainder being zinc, by thermal and microscopical methods. The alloys lie within the ternary system Cu-Zn-Cu_3Al. In the binary system Cu_3Al-Zn the liquidus curve falls from the melting-point of Cu_3Al, 1020° C., to that of zinc, and consists of four branches; the solid phases are all solid solutions. The ternary system Cu-Zn-Cu_3Al contains a number of solid solutions.

Silver-zinc-lead System.†—R. Kremann and F. Hofmeier have made a thermal and microscopical investigation of this ternary system. Only one of the binary systems contains compounds. These compounds, Ag_2Zn_5, Ag_2Zn_3, AgZn, and Ag_3Zn_2, together with the three pure metals, may be regarded as components of the five ternary systems into which the complete system may be divided. The system Pb-Zn-Ag_2Zn_5 was more fully studied, since it has a practical application in Parkes' desilverizing process, in which the crystals separating on cooling are solid solutions of Ag_2Zn_5 and zinc. The ternary eutectic contains about 97·5 p.c. lead and melts at 305° C. Measurements of the E.M.F. given by the alloys against zinc in a solution of zinc-sulphate, show that lead does not form solid solutions with zinc and silver.

Zinc-lead-tin System.‡—M. Levi-Malvano and O. Ceccarelli have examined, thermally and microscopically, more than ninety alloys, and give an equilibrium diagram of the ternary system. There are two liquid phases of limited miscibility. The ternary eutectic contains 71 p.c. tin, 24 p.c. lead, 5 p.c. zinc, and melts at 177° C. Needle shaped zinc crystals can be easily detected microscopically even when present in small quantity. The hardness of the alloys was measured.

Formation of Metallic Solid Solutions by Diffusion in the Solid State.§—G. Bruni and D. Meneghini have obtained binary solid solutions by heating by means of an electric current, wires consisting of one pure metal coated electrolytically with another metal. In each case the highest temperature reached was below the melting point of either metal. The pairs of metals were nickel-copper, gold-copper and gold-silver. The formation of the solid solution was indicated by the great increase in electrical resistance.

Porosity of Iron.‖—J. A. N. Friend concludes that the surface of iron is slightly porous, from experiments carried out upon Kahlbaum's pure iron foil. Cleaned pieces were immersed in sodium hydrate solution, were then thoroughly washed, and allowed to stand in distilled

* Gaz. Chim. Ital., xli. (1911) 2, pp. 282–97, through Journ. Soc. Chem. Ind., xxx. (1911) p. 1390.

† Monatsh. Chem., xxxii. (1911) pp. 563–95, 597–608, through Journ. Soc. Chem. Ind., xxx. (1911) p. 1120.

‡ Gaz. Chim. Ital., xli. (1911) 2, pp. 269–82, 314–18, through Journ. Soc. Chem. Ind., xxx. (1911) p. 1391.

§ Int. Journ. Metallography, ii. (1911) pp. 26–35 (4 figs.). Atti R. Accad. Lincei, xx. (1911) pp. 927–31. See also this Journal, 1911, p. 712.

‖ Journ. Chem. Soc., ci. (1912) pp. 50–56 (2 figs.).

water. The presence of sodium in the water could not be detected until ten hours after; in 24 hours, the flame test gave a well marked indication. Similar results were obtained when potassium hydrate solution was used instead of sodium hydrate. Plates of iron which had been "pickled" in sulphuric acid, washed and dried, were found to corrode more rapidly than plates not so treated. The more rapid corrosion was apparently due to retention of acid in the pores of the metal. It is suggested that the passivity of iron induced by immersion in alkaline solutions is due to the retention of minute quantities of the solution in the pores of the iron. It is probable that there are more kinds of passivity than one.

Magnetic Properties of Heusler Alloys.*—An account is given of several researches carried out upon the magnetic copper-manganese-aluminium alloys. E. B. Stephenson found that the alloys had melting points between 910° and 970° C., and gave cooling curves characteristic of solid solutions. Transformation points were observed at 615° C. No relation was established between microstructure and magnetic properties. E. Take studied the effect of heat-treatment upon the magnetic properties of alloys containing about 17 p.c. manganese and 9 p.c. aluminium. A. A. Knowlton also investigated the effect of heat-treatment of similar alloys, and studied their microstructure.

Annealing of Metals.†—Matweeff has determined the hardness of zinc, aluminium, copper, silver, brass, and aluminium bronze, hardened as much as possible by cold work, and annealed for stated lengths of time at different temperatures. The Brinell method was used, with a glass ball one millimetre in diameter. It was established that the cold-worked pure metals did not begin to diminish in hardness until a certain well-defined temperature was exceeded, 100° C. for zinc, 300° C. for copper and silver, 350° C. for aluminium. A great fall in hardness then took place, and was completed in a small range of temperature. The presence of other elements forming alloys modified the hardness of the annealed specimen, and the temperature at which softening began, and increased the range of temperature within which annealing proceeded.

Cementation of Iron by Solid Carbon.‡—G. Charpy and S. Bonnerot have investigated this question further. Graphite and mild steel were maintained in close contact by high compression mechanically applied, and were heated a little above 950° C. for times varying from 10 to 38 hours in six different experiments, the gas pressure varying from 0·01 to 1·5 mm. of mercury. About one-third of the minute amount of gas present was carbon monoxide. In the high vacua no cementation occurred, but when the pressure rose above 0·5 mm. mercury, cementation was observed. With pressures 1·0 to 1·5 mm. patches of easily recognized pearlite were produced, and the carbon content of the steel rose to 0·5 per cent. The authors conclude that in the complete absence of gas, no cementation whatever of iron by solid carbon can take place at 950° C.

* Engineering, xcii. (1911) p. 739.
† Rev. Métallurgie, viii. (1911) pp. 708-16 (13 figs.).
‡ Comptes Rendus, cliii. (1911) pp. 671-3.

Rolling Figures in a Rail Section.—R. Loebe* has examined a section of an old steel rail, in which a singular pattern was developed by a long etching with hydrochloric acid. Standing in relief above the dark-etched surface were two lighter-coloured bands, about 1·5 mm. wide, running approximately parallel to each other and to the edge of the section. The microstructure indicated that these bands were almost carbonless iron. The conclusion is drawn that two concentric wrought iron tubes had been placed in the centre of the ingot mould before the rail ingot was cast; the tubes became incorporated with the ingot, but retained their identity throughout the subsequent heating and rolling, in which their form was distorted until in section it roughly resembled the outline of the rail section.

A. v. Dormus,† discussing Loebe's article, describes experiments carried out fifteen years ago, in which concentric rings of wrought iron were placed in ingot moulds before casting.

System Manganous Oxide-Silica.‡—F. Doerinckel has investigated this system in the range 20–60 molecular p.c. silica. Cooling curves of the fused mixtures were taken, but the conclusions are drawn chiefly from the microscopical examination of thin sections in ordinary and in polarized light. The crystalline constituents observed are manganosite MnO, tephroite Mn_2SiO_4, and rhodonite $MnSiO_3$.

Injury caused by Cold-working.§—O. Bauer and E. Wetzel have investigated some tyres of tenders which failed through the cracking and flaking off of the wearing surface. The microstructure of the defective parts, and their greater hardness as shown by hardness measurements, indicated that the tyres had been severely cold worked at the wearing surface, probably in use. The cold-working is held to be the cause of failure.

Effects of Pressure on Metals.‖—G. Spezia has subjected to a pressure of 8000 atmospheres for one month, fine powder of silver, copper, and a mixture of silver and copper. The compact masses formed could be cut and polished, but microscopical examination showed that welding or alloying had not occurred. The author doubts the accuracy of conclusions arrived at by Spring and by Kahlbaum, as to certain other effects of hydrostatic pressure on metals.

Arnold, J. O.—**Fourth Recalescence in Steel.**
Int. Zeitschr. Metallographie, i. (1911) pp. 192–205 (13 figs.).

Boudouard, O.—**Electrical Resistance of Special Steels.**
Comptes Rendus, cliii. (1911) pp. 1475–8.

Burgess, C. F., & J. Aston.—**Electric Resistivity of Iron Alloys.**
[A table showing the relative resistivity of forty-three alloys of electrolytic iron with chromium, nickel, silicon, and other elements is given.]
Met. and Chem. Eng., ix. (1911) p. 539.

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* Stahl und Eisen, xxxi. (1911) pp. 792–4 (6 figs.).
† Stahl und Eisen, xxxi. (1911) p. 1187 (2 figs.).
‡ Metallurgie, viii. (1911) pp. 201–9 (12 figs.).
§ Stahl und Eisen, xxxi. (1911) pp. 226–9 (7 figs.).
‖ Atti R. Accad. Sci. Torino, xlv., through Journ. Soc. Chem. Ind., xxx. (1911) p. 550.

CERMAK, P., & H. SCHMIDT—**Thermo-electric Forces in the Transition from the Solid to the Liquid State of Aggregation.**
[The thermo-electric potential of thermocouples of tin-constantan, tin-iron, and lead-constantan showed no sudden change at the melting point of tin or of lead upon heating or cooling.]
Ann. Physik, xxxvi. (1911) pp. 575–88.

DUCELLIEZ, F.—**Alloys of Cobalt and Zinc.**
Bull. Soc. Chim., ix. (1911) pp. 1017–23.

GREENWOOD, H. C.—**Specific Heats at High Temperatures, and Latent Heats of Fusion of Metals.**
[British Association, 1911.] *Engineering*, xcii. (1911) p. 419.

GUERTLER, W.—**Aims of Metallography.**
Int. Zeitschr. Metallographie, i. (1911) pp. 1–15.

HILPERT, S., & T. DIECKMANN.—**Arsenides of Iron and Manganese.**
[The compounds $FeAs_2$, FeAs and MnS were prepared by heating iron or manganese with arsenic.]
Ber. Deutsch. Chem. Ges., xliv. (1911) pp. 2378–85.

" " " **Ferromagnetic Compounds of Manganese with Phosphorus, Arsenic, Antimony and Bismuth**
Ber. Deutsch. Chem. Ges., xliv. (1911) pp. 2381–5.

JOHNSON, T. H.—**Influence of Work and Finishing Temperature on the Physical Properties of Steel.** *Eng. News*, lxvi. (1911) p. 52–3.

NESSELSTRAUS, H.—**Structure and Critical Points of Chromium Steel.**
[Chromium favours the formation of austenite in hardened steel, and of troostite in annealed steel. Chromium additions to steel lower Ar2, raise Ar1, and tend to retard the transformation of γ into α-iron and the decomposition of the solid solution of carbon in iron.]
Journ. Russ. Met. Soc., 1911, pp. 627–59.

PALITSCH, D.—**Allotropic Form of Silver.**
[Peculiarities in the properties of silver obtained by dissolving the zinc out of zinc-silver alloys with hydrochloric acid point to the conclusion that the silver in question is an allotropic modification.]
Bull. Acad. Roy. Belg., v. (1911) pp. 395–414.

PARRAVANO, N., & G. SIROVICH—**Thermal Analysis of Quaternary Systems.**
[A tetrahedral method of representation is described; each face represents one of the component ternary systems.]
Atti R. Accad. Lincei, xx. (1911), 2, pp. 206–11, 331–7, 412–17.

" " " **Phenomena of Crystallization in Ternary Systems. I., II., and III. Isomorphous Ternary Mixtures with a Miscibility Gap.**
[A theoretical discussion of equilibria in ternary systems of the type indicated.]
Gazz. Chim. Ital., xli. (1911) 1, pp. 417–53, 478–89, 569–620.

PARRAVANO, N., & P. DE CESARIS.—**Arsenides of Tin.**
Int. Journ. Metallography, ii. (1911) pp. 1–12 (10 figs.).

PÉCHEUX, H.—**Resistivity and Thermo-electric Force of Tantalum.**
Comptes Rendus, cliii. (1911) pp. 1140–1.

PORTEVIN & NUSBAUMER—**Influence of Annealing upon cold-worked Bearing Bronzes.**
[The development of twinning in strained bronzes when annealed has been observed.] *Comptes Rendus*, cliv. (1912) pp. 213–5.

PRIMROSE, J. S. G.—**Foundry Metallography.**
[The structures of several varieties of cast iron are described.]
Foundry Trade Journal, xiv. (1912) pp. 44–6 (10 figs.).

SIEVERTS, A., & E. BERGNER.—**Absorption of Hydrogen by Tantalum and Tungsten.** *Ber. Deutsch. Chem. Ges.*, xliv. (1911) pp. 2394–2402.

STROMEYER, C. E.—**Reliability of Mild Steel.**
[The cracking of strained mild steel when heated in contact with caustic-soda solution, and the effect of nitrogen on steel are discussed.]
Iron and Coal Trades Review, lxxxiii. (1911) pp. 884–5.

TURNER, L. B.—**The Strength of Steels in Compound Stress, and Endurance under repetition of Stress.**
Engineering, xcii. (1911) pp. 115–7, 183–5, 246–50, 305–7 (57 figs.).

TURNER, T.—**Solidification of an Iron Casting in the Mould.**
Iron and Coal Trades Review, lxxxiii. (1911) p. 975.

WEDEKIND, E., T. VEIT, & K. FETZER—**Further Ferromagnetic Compounds of Manganese.** *Ber. Deutsch. Chem. Ges.*, xliv. (1911) pp. 2663–70.

ZUKOWSKY, G. J.—**Lithium Amalgams.**
[Thermal analysis of the lithium-mercury system indicates the existence of five compounds, Li_3Hg, LiHg, $LiHg_2$, $LiHg_3$, and one the formula of which has not been established.]
Zeitschr. Anorg. Chem., lxxi. (1911) pp. 403–18 (3 figs.).

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

James Swift's Fine-adjustment.†—E. M. Nelson contributes an interesting historical memorandum on this fine-adjustment, which he considers to be the best ever fitted to a body with a long slide. It was made by the late James Swift in 1881 for his "Wale's Students'" Microscope, and consisted of a vertical lever which moved the nosepiece only. From figs. 56 and 57, which show the Microscope set up

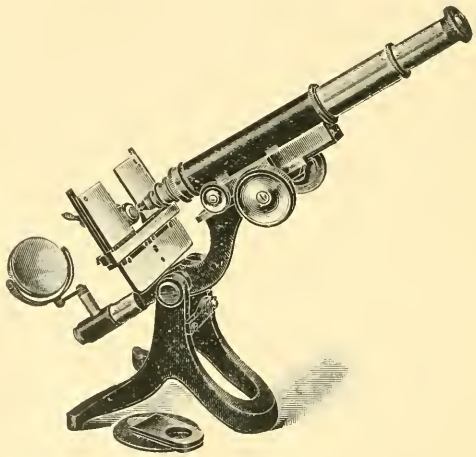

Fig. 56.

for critical work with substage condenser, it will be seen that the instrument had a bent-claw foot, a large-cut horseshoe stage, a sliding bar, and a substage with rectangular movements formed by a Swift's centring nosepiece with rack-work focusing attached. This substage, fitted with Powell's celebrated side-angled achromatic condenser, had a swing-out rotating carrier below, and Nelson considers that this condenser, excepting Powell's apochromatic, is still the best made either here or on the Continent. Swift shortly after brought out his "Challenge" Microscope, in which the same form of lever moves the whole body and coarse adjustment, after the Zentmayer model. This may, perhaps, cost some

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

† English Mechanic, xciv. (1912) p. 603 (3 figs.); xcv. (1912) p. 60.

five shillings less to make ; but, in the author's opinion, efficiency of the adjustment is sacrificed by the alteration.

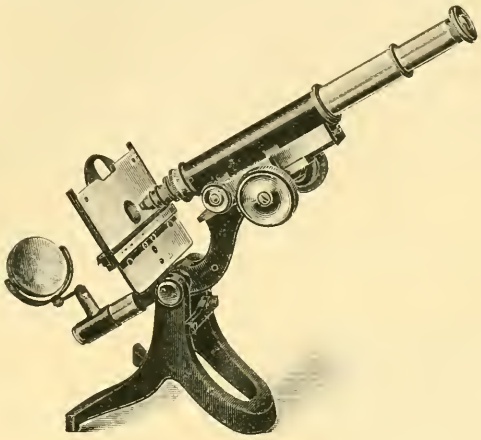

FIG. 57.

Figs. 58 and 59 are drawings (not to scale) of Swift's fine-adjustment. A is a prism-bar carrying the nosepiece, B, and is placed in a box attached to the body of the Microscope. The triangular lever C is

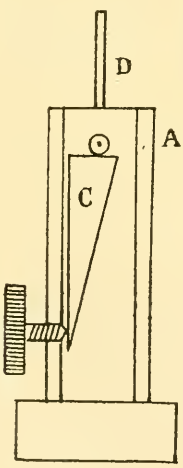

FIG. 58.

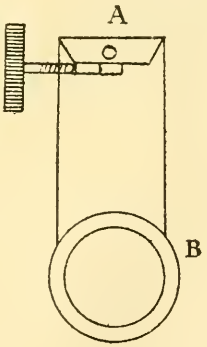

FIG. 59.

pivoted to this box, and by means of the micrometer-screw presses against the little wheel and raises the prism-bar, A, against a spring wound round D. The V-grooves in the box which hold A are made capable of adjustment by capstan-headed screws.

Nelson's article incidentally includes personal and other references to many important steps in Microscope evolution during the last forty years. Among them may be mentioned:—Swift's three-pin facility nosepiece (figs. 56 and 57); rack-work draw-tube for objective adjustment; Michael Foster's report on "Modern Microscopes, with a special view to the requirements of Medical Students and Practitioners," with criticisms of the chief types of his day; the Zentmayer fine-adjustment and its application to various Microscopes; the swinging substage as designed for the so-called resolution of diatoms by oblique light; Abbe's opposition to full-cone illumination; springing in Microscope construction.

Reichert's Fluorescence-Microscope.*—A fluorescence-Microscope gives a new means for the examination of bodies in a condition of self-luminosity. The light-source is obtained as the result of passing a

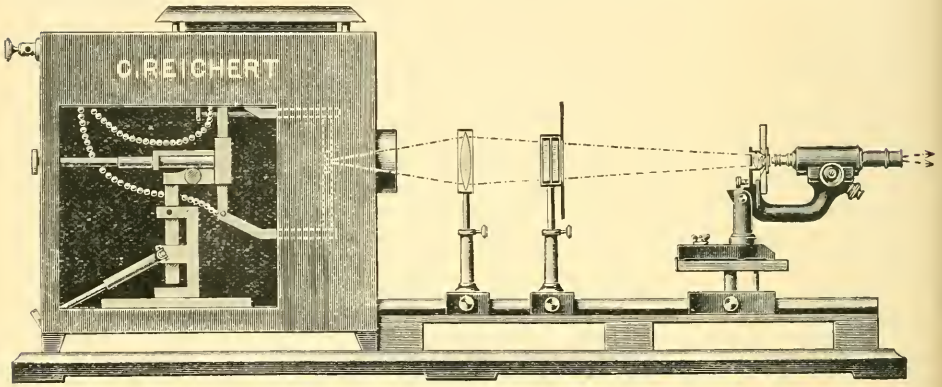

Fig. 60.

strong beam from an arc-lamp through a Wood's filter, as improved by Lehmann, which cuts out all visible light, and only transmits ultra-violet rays up to 350 $\mu\mu$. The parts of the apparatus are set up in the following order:—Light-source (as above), quartz-illuminating lens, filter, Microscope with quartz-condenser and dark-ground illumination. The arrangements will be understood from fig. 60. For the observation of the fluorescence-image ordinary objectives and oculars are employed. The light issuing from the source, freed by means of the filter from the visible rays, and concentrated by means of the quartz-illuminating apparatus on the preparation, brings the object into a condition approximating to self-luminosity. If the dark-ground apparatus were not introduced, the image would appear as if viewed through a blue veil. A quartz mirror condenser is found, however, to be unsatisfactory, as the silver layer has but small reflective power for ultra-violet. A new condenser of magnalium, designed by von Weimarns, has been tried,

* Zeitschr. f. wiss. Mikrosk., xxviii. (1911) pp. 330–7 (1 fig.); Physikalisch. Zeitschr., xii. (1911) pp. 1010–11.

but is not altogether satisfactory. The method of stopping-off in the immersion-condenser has, so far, been found to be the best. The triple Abbe quartz-condenser, N.A. 1·45, is equipped with a star-diaphragm which stops off the middle part of the condenser to an aperture of 1·0.

With accurate centring, the preparation shines out brightly and clearly in its specific fluorescence-light on a black-grey ground.

The importance of the new method lies in the fact that it supplies a new means of differentiating between similar bodies. Thus organic

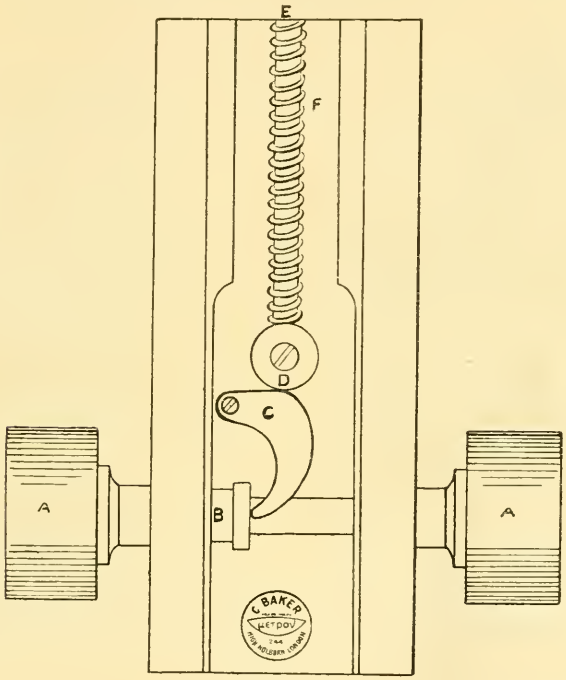

Fig. 61.

substances of similar morphological, but of differing chemical, nature are found to have distinctive characteristics. Small quantities of ergot in flour are readily detected by a striking difference in colour.

Reichert has in preparation a phosphorescence-Microscope depending on a combination of the ordinary microscope with Becquerel's phosphoroscope; but the technical difficulties involved are greater than in the design of the fluorescence-Microscope.

Baker's New Lever Fine-Adjustment.*—Fig. 61 shows a curved lever fine-adjustment lately adopted by Messrs. C. Baker & Co. A A are milled heads actuating a micrometer screw whose motion is conveyed by

* C. Baker and Co., London, W.C., Catalogue; Knowledge, xxxv. (1912) p. 515.

a nut at B to the curved lever C. The thread of the micrometer-screw is 50 to the inch, and the ratio of the curved lever is 1 in 4. The small wheel D is intended to minimise friction. The curvature of the lever is so arranged as to ensure that D is lifted by an amount exactly equal to the horizontal movement of B. A spring F on the guide-pillar E keeps the wheel down to its work and causes the downward motion. Each revolution of the milled heads corresponds to 0·125 mm., or $_{2}\frac{1}{0\,0}$ths of an inch. All slides are sprung and screwed.

Williams' "Wonder" Microscope.* — This instrument (fig. 62), though extremely cheap, is constructed on the lines of high-class models. It is intended for low powers, focusing being effected by means of a rack-and-pinion coarse-adjustment. A 1 or 2 in. objective is supplied, and No. 2 eye-piece and mahogany case.

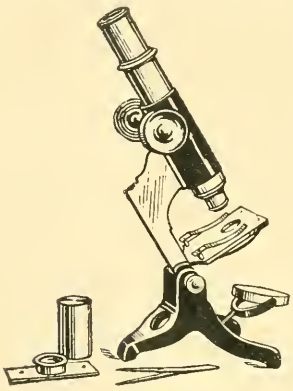

Fig. 62.

(3) Illuminating and other Apparatus.

Macro-projection by use of the Microscope.†—F. K. Studnička has been successful, by a simple method, in obtaining macro-projection and micro-projection by use of the same Microscope. He inserts the diapositive at a certain distance from the lower lens of the Abbe condenser belonging to the Microscope in use. This lens faces the light source, and the diapositive is placed in the optic axis between the Microscope and the large condenser of the projection apparatus. The diapositive in this position yields a small delicate image on which the tube can be adjusted, and which can be projected with the same accuracy as a microscopical preparation. For perfect success much depends on the proper choice of objective and ocular. The author selects his objective, which produces the minimum distortion in the image through the Abbe condenser and his weakest ocular. In his case these happen to be Reichert's objective No. 2 and ocular No. 1. It is important to draw out the tube, and as far as possible to disregard peripheral parts of the image-field. The image of the diapositive is clear, and the only fault to be found with it is that it is not perfectly flat. But this objection is unimportant if one limits oneself to the centre of the field. The magnification depends on the distance of the diapositive from the Abbe condenser, and the holder must be pushed backwards or forwards on the bench until the most favourable position has been secured. A simple double fork is found to be a satisfactory form of holder.

U V-Filter and U V-Filter-lamp as Aids in Luminiscence Analysis.‡—H. Lehmann describes the progress made in ultra-violet

* Williams and Co.'s Special Catalogue, 1911.

† Anatom. Anzeig., xl. (1912) pp. 652–4.

‡ Zeitschr. f. Instrumentenk., xxxii. (1912) pp. 43–54 (6 figs.).

analysis, and in particular gives an account of Zeiss's specially-designed apparatus.

Fig. 63 represents a suitable filter, the optical part of which consists of a kind of two-chambered cuvette formed of three glasses cemented together and kept in proper position by a brass frame. The glass used is Jena blue-violet glass, one chamber being filled with a 20 per cent. aqueous solution of copper-sulphate. A small glass syringe with an indiarubber-tube extension is found to be the best means of carrying out the filling and emptying, which should be done on each occasion of use.

Fig. 63.

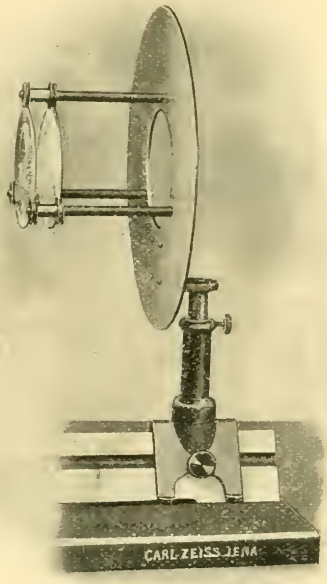

Fig. 64.

The other chamber contains a dilute aqueous solution of nitrosodimethylanilin. The ultra-violet transparency of the whole arrangement lies in the interval from 400–300 $\mu\mu$, the maximum being about 350 $\mu\mu$. In cases where the heat is likely to cause vaporisation of the copper-sulphate a circulating arrangement of the sulphate (fig. 68) is substituted for the above. The apparatus is adjustable in height, and may be used with a circular base or with a rider on an optical bench.

Fig. 64 shows the lenses best adapted for the U V-filter. The best material is quartz, but for many purposes Jena U V-glass does very well, and is much cheaper. The lenses recommended have a diameter of 40–100 mm. and a focal length of 80–200 mm.

As a light-source an electro-incandescent lamp is of little use. A

quartz-mercury lamp gives a very quiet and uniform light. An ordinary arc light is more intense in ultra-violet rays, but causes difficulties by reason of the great heat emitted. It is found better to replace the ordinary carbons by Siemens' iron carbons, the effect being to diminish the heat-rays, and therefore to increase the light-energy. Moreover, the lines peculiar to the iron spectrum serve as guides in mapping out results. These iron carbons are carbon impregnated with iron sulphate, and at first throw off numerous particles of incandescent iron whose heat would be detrimental to the filter. After a few moments they subside, however, and the filter should then be inserted. Investigators are warned that the light from the iron carbons is dangerous for unprotected eyes.

Figs. 65–67 show different arrangements of the whole apparatus in a suitable light-proof box B. F is the filter, K the condenser, L the

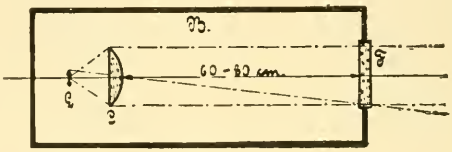

FIG. 65.

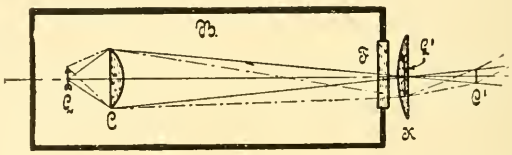

FIG. 66.

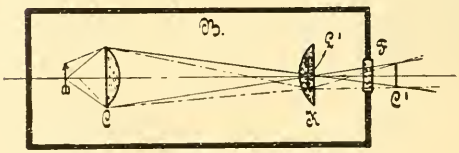

FIG. 67.

light-source, L′ the image of the light-source, C the collector, and C′ the image of the collector. Fig. 65 is the arrangement for the illumination of a rather large surface. Fig. 66 represents a powerful effect on a rather small surface, and fig. 67 is an adaptation to small lenses and surfaces.

The U V-Filter-lamp is shown in figs. 68–70. Fig. 68 shows the arrangement for an optical bench, while in fig. 69 the lamp is fitted to a tripod stand. Fig. 70 is the external view of the complete tripod-lamp. The carbon-holders are governed by rods connected by chain-work with an external milled head on each side of the iron box-case (fig. 70). In order to overcome irregularities in combustion the carbons are inde-

pendently regulated, the regulation for one carbon being performed by the butterfly-nut in the centre of the milled head. Very dark glass windows are placed in the front part of the case, and serve for observing

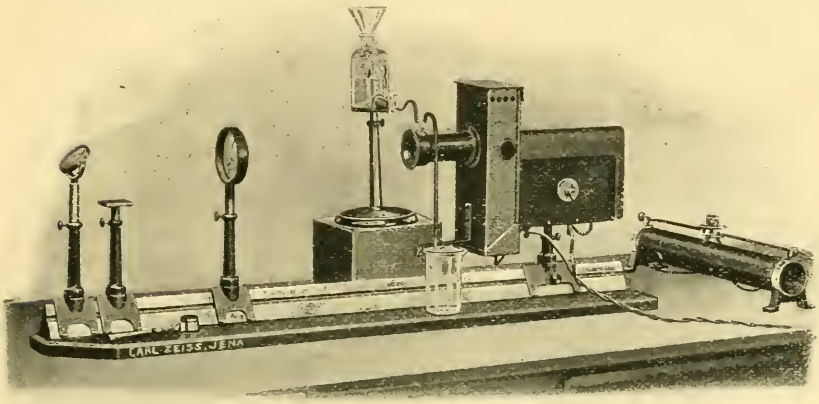

Fig. 68.

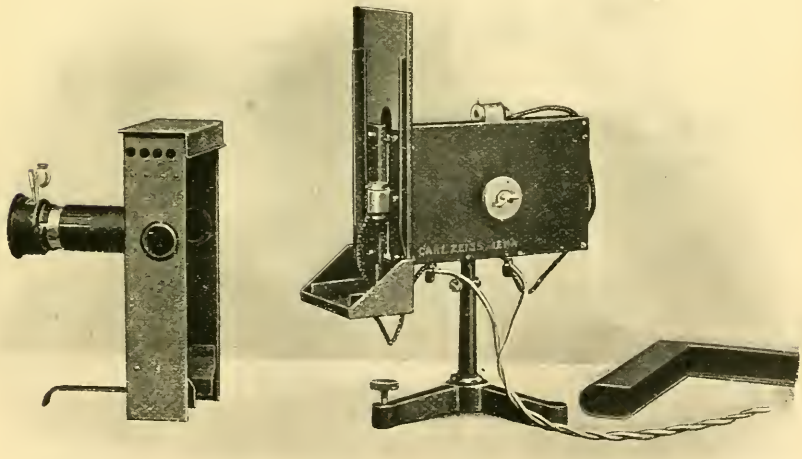

Fig. 69.

the combustion of the carbons. This front is removable for convenience of replacing the carbons. It contains an adjustable tube in whose inner end is fitted a collector of two quartz lenses. The removable filter-

arrangement is placed at the outer end of this tube. As already mentioned, when fresh carbons are inserted they must be allowed to burn off for one to two minutes before replacing the front and filter. The length of the arc should be about 10 mm. ; the horizontal carbon should be the positive. The current is introduced by two binding-screws

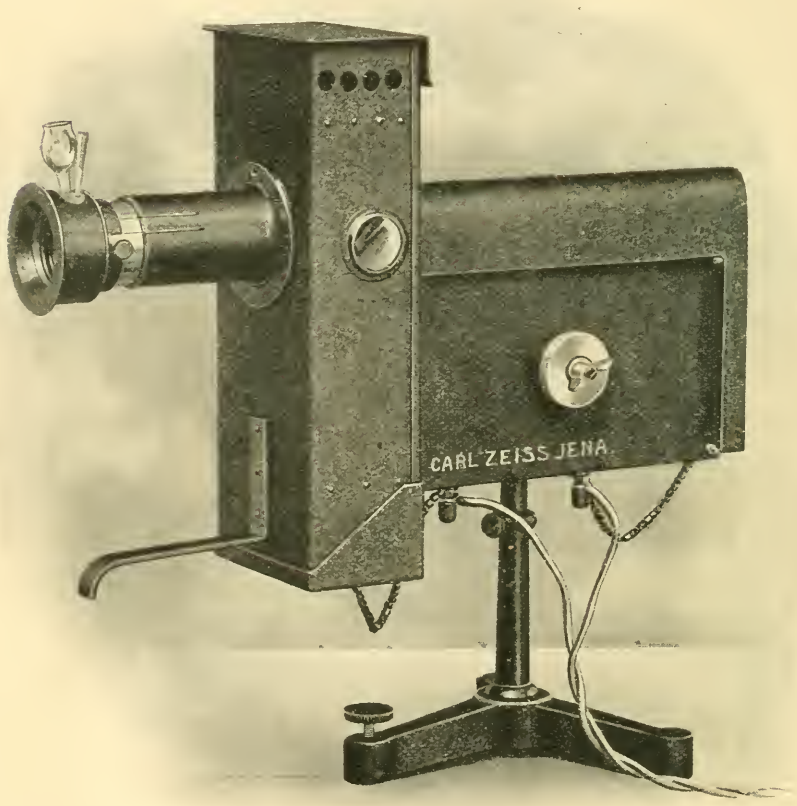

Fig. 70.

below the lamp-case (fig. 69) If the lamp is used without a cooling-arrangement, the current should not exceed 5 amperes. In this form the lamp may be regarded as transportable (fig. 70), and may be moved about for the examination of such articles as mineralogical collections. For the examination of small objects and surfaces it is best to adopt the arrangement of fig. 68, when the current may vary from 3–10 amperes.

If the substance to be examined is a powder or a body which can only be placed horizontally, the inclined mirror and small stage (fig. 68) are used. Although silver is transparent to ultra-violet in the neighbourhood of 320 $\mu\mu$, yet it is found that this method is usually successful.

The author has found the apparatus answer admirably for demonstrating the properties of fluorescence and phosphorescence to a large audience. He has obtained excellent results from such objects as fluorescent varieties of Jena glass, cathodic rays and gems.

Methods of Illumination.*—By the term "mirror illumination," says E. M. Nelson, is meant the illumination of an object by transmitted light with a plane or concave mirror without any substage condenser. This form of illumination was, up to a few years ago, very extensively employed, the use of a condenser, especially upon the Continent, being quite exceptional. The plane mirror is for use in conjunction with a substage condenser, and the concave for use by itself.

The ideal illumination for transmitted light is obtained when the object is at the apices of two conjugate solid cones of light. An illumination such as that by parallel, or nearly parallel, rays is to be avoided. Even that kind of illumination, now much in vogue with photomicrographers, which may be termed "lantern illumination," because the illuminating cone is focused upon the front lens of the objective, is to be deprecated; for it is only a method of obtaining an evenly illuminated field at the expense of loss of definition in the image.

But how does many a student examine an object? He places his preparation on the stage and then fumbles about with the mirror until he succeeds in obtaining an evenly lighted field, and when he has got this he is quite satisfied. As many treatises on the Microscope say, "Put it under, and, by moving the mirror, obtain an evenly lighted field"! But the proper method of procedure is very simple. Focus the object; remove your eye from the eye-lens and look at it, not through it, and, by moving the mirror, bring the image of the light-source, be it window or lamp-flame, central in the eye-spot, or Ramsden disk Now, when the image is tested by focal alteration, the coma will spread out equally on all sides of the image, and delicate hairs will appear like sharp little thorns. Naturally the image will be inferior to that when a condenser is used, but a great difference will be noticed between those obtained with a centred and decentred mirror-image in the Ramsden disk. The student should remember that it is far better to have a centred illumination, even at the expense of an incompletely lighted field, than an evenly illuminated field and decentred illumination.

To illustrate this subject further, let the flat of the flame of a paraffin lamp be used as an illuminant, then, with concave-mirror illumination improperly arranged by a fumbler, the image in the Ramsden disk would very probably appear as in fig. 71, No. 1. The image of the flame resembles a decentred slit of light, notwithstanding that the flat of the flame is presented to the mirror.

It is this decentring of the illumination which causes the coma to rock upon focal adjustment. It is the asymmetrical arrangement of the

* Journ. Quekett Micr. Club, ser. 2, xi. (1911) pp. 289-98 (1 fig.).

beam passing through the objective which destroys the sharpness of the image, and it is the small W.A. (i.e. too large an unutilized area in the objective) which coats the image with black-and-white diffraction images. This image in the Ramsden disk (fig. 71, No. 1) should be compared with No. 2, which shows that the concave mirror is in correct adjustment, therefore the flat of the flame is imaged properly and centred to the disk.

No. 3 illustrates a properly set-up illumination with the plane mirror. The only difference is that the image of the flat of the flame is smaller, and the unutilized portion of the objective larger ; which is, as we have just seen, disadvantageous. With daylight illumination we must substitute image of window for image of lamp-flame. This image will vary according to circumstances. It may be, for instance, a gap between chimney-pots or perhaps between houses. It is remarkable that these fundamental principles of elementary microscopical manipulation have never been explained in any text-book on the subject.

The Ramsden disk is an image of the back lens of the objective. If

Fig. 71.

the Ramsden disk be too small for examination by the unaided eye, the eye-piece may be removed and the back lens itself be examined ; but probably the simplest and quickest method is to employ a "loup," for it saves the trouble of removing and replacing the eye-piece.

Ground Glass.—I became first acquainted with ground glass in 1875, by purchasing a Swift's excellent Universal Condenser, which he had brought out the previous year. This condenser (an improvement on Hall's, made by Swift in 1868) I still have, and use.* The top lens is removable ; the back, consisting of two doublets, form the best possible condenser for low-power work ; a blue-glass light-modifier for lamplight fits below these lenses, and a ground glass (which is never used) fits above them in place

* So far as I am aware, these condensers were the first for low powers ever constructed, and the microscopical world is greatly indebted to the late James Swift, not only for them, but also for many excellent improvements, both in the brass and glass of the Microscope.

This particular condenser is, I understand, no longer made ; therefore a fuller description, showing wherein it differs from its modern substitute, is necessary. This condenser has an uncorrected front lens, and a pair of achromatized doublets at the back ; therefore, when used as a whole, it is under-corrected, but nevertheless it makes a useful condenser for ordinary work with the medium powers (say, $\frac{1}{3}$ and $\frac{1}{2}$). When, however, the top is removed, a perfectly achromatic combination is obtained, which is, as I have already stated, the best ever constructed. Its modern substitute, for which that particularly fine combination of Baker's may be taken as a type, has also an uncorrected front lens ; but the backs are over-corrected, and so the condenser as a whole is perfectly corrected. Now, when the top of this modern condenser is removed you do not find such a perfect low-power condenser as with the old form, because the combination is now over-corrected.

of the top lens. Even to-day no better condenser is made for powers from $\frac{1}{10}$ in. downwards. Ground-glass can be used with or without a substage condenser, but we are told that the orthodox method is to place a piece of finely ground-glass upon the stage immediately below the slip.* Ground-glass scatters the light it transmits in all directions, and therefore the objective will be working at full aperture. So far it would seem that, with daylight and the concave mirror, all control over the working aperture is lost; of course the light may be reduced by the iris, but obviously there is no means of varying the W.A. to, say, $\frac{3}{4}$ or $\frac{1}{2}$ cone. But if the unorthodox method of placing the ground-glass behind a substage condenser is adopted, we shall find, by inspecting the back of the objective, that with the help of the iris we can regulate the working aperture of the objective. It would seem, therefore, that this position for the ground glass is a better one than that usually recommended.

With regard to its use with high powers the case is somewhat different: if with a 4-mm. apochromat a ground-glass screen, placed immediately behind the object, be illuminated by a substage condenser, and the iris fully opened, an image not very dissimilar to that when ordinary critical illumination is employed will be seen at the back of the objective (No. 4); but when the iris is closed a marked difference takes place, for the image then will not be of the ordinary form as in No. 5, but will be an image of the source of light, in this case the edge of the flame (No. 6). This illumination is asymmetrical with regard to the aperture of the objective and therefore should be avoided. Now, what is the effect of the ground-glass: does it improve or spoil the image? It is found that while ground-glass does not give the best results, it simplifies the manipulation; with medium and high powers a substage condenser should be used, otherwise the images will be poor.

With low powers, window bars, moving clouds, chimney-pots, etc., are a trouble which ground-glass will get rid of, but—and this should not be forgotten—at the expense of good definition. There is one more point before the trial of this kind of illumination is exhausted. It may be urged that while ground-glass does not give such a good image as that obtained with a first-rate condenser, yet, if the condenser is a bad one, it will improve the image by neutralizing some of its defects, such as chromatism and errors of centricity. To determine if this were so a very cheap condenser, consisting of two single plano-convex lenses, was tried with an achromatic $\frac{1}{4}$ in., with and without ground-glass, and the image was found to be better without the ground-glass.

Screens.†—Formerly we all made a mistake by pitching our illumination too high up in the spectrum (I am now speaking of visual, not of photographic work). There can be no doubt about this, because fine detail is lost if the light is too high up in the spectrum. The cause is probably a physiological one. Experiments show that a normal eye is more sensitive in picking up fine detail when the light is a peacock-green. Although with light high up in the spectrum the resolving power of a lens is increased, yet the sensibility of the eye is diminished.

* Invented by John Keates, of Liverpool.

† Screens were first introduced by Sir D. Brewster in 1836. His screen was a red one.

The art is to strike a happy mean between the two. The following are three of the lessons I have learnt :—

1. Not to work with light too high up in the spectrum.
2. Not to form an opinion entirely by spectroscopic results.
3. Not to imagine that one screen is sufficient.

Colours must be seen, but the following descriptions of screens which prolonged experiments have proved to be the best may be of assistance. For daylight, a piece of peacock-green, worked down so that it is not too deep in tint, is combined with a very light-blue glass not deeper in tint than a rather pale lilac petal. For lamplight, a thicker piece of peacock-green is combined with a blue glass, somewhat of the tint of a blue flower (*Centaurea cyanus*) common in cornfields.

The ideal screen for visual microscopical work is one which, filtering out the too pronounced red, softens down, but does not entirely cut out, the orange and yellow lights. Twenty-five years ago any screen which did not pass certain spectroscopic tests, by absolutely cutting out all lights longer than a definite wave-length, was rejected ; now we know better. The fact is that our heads were swelled by the "table of resolving powers" published on the cover of the R.M.S. Journal, where the three selected lights had wave lengths of 5,269 for visual, line F 4,861 for screen, and 4,000 for photography.* I altered the visual to Gifford's maximum 5,607, and photography to 4,341 ; this last should be brought still lower down the spectrum to the photographic maximum through glass of 4,603, and the screen placed at least as low down as *b*, or 5,184) if not lower.

Spectrum.—A prism spectrum is better for this purpose than a grating, for a prism forms only one spectrum, and all the light which is dispersed goes into it ; on the other hand, a grating makes several spectra, and, as only one of them can be used, much light is lost, but the dispersion of a Rowland's 14,400-line grating between E and G lines in a spectrum of the first order is more than double that of an ordinary flint prism.

(4) Photomicrography.

Ernemann's Cinema Micro-apparatus for Production of Serial Pictures of Living Micro-organisms.†—This apparatus is so designed that it may be applied in either a horizontal or a vertical position. An essential condition for the production of useful serial photographs is quick working and a harmonious co-ordination of movements, for many preparations are only available for brief periods or are damaged if exposed to intense light-rays. This necessary rapidity of movement is attained by a handle which enables the operator to swing the camera into or out of action as required. When the apparatus has once been correctly centred, so that the optical axis of the Microscope passes through the middle of the film-image, the camera is swung aside, and the object can then be suitably illuminated and adjusted. When the operator thinks fit he swings the camera back into its old position and

* See this Journal, 1885, p. 972—where the photographic resolving limit is put at 127,000 lines for N.A. 1·0!

† Special Catalogue.

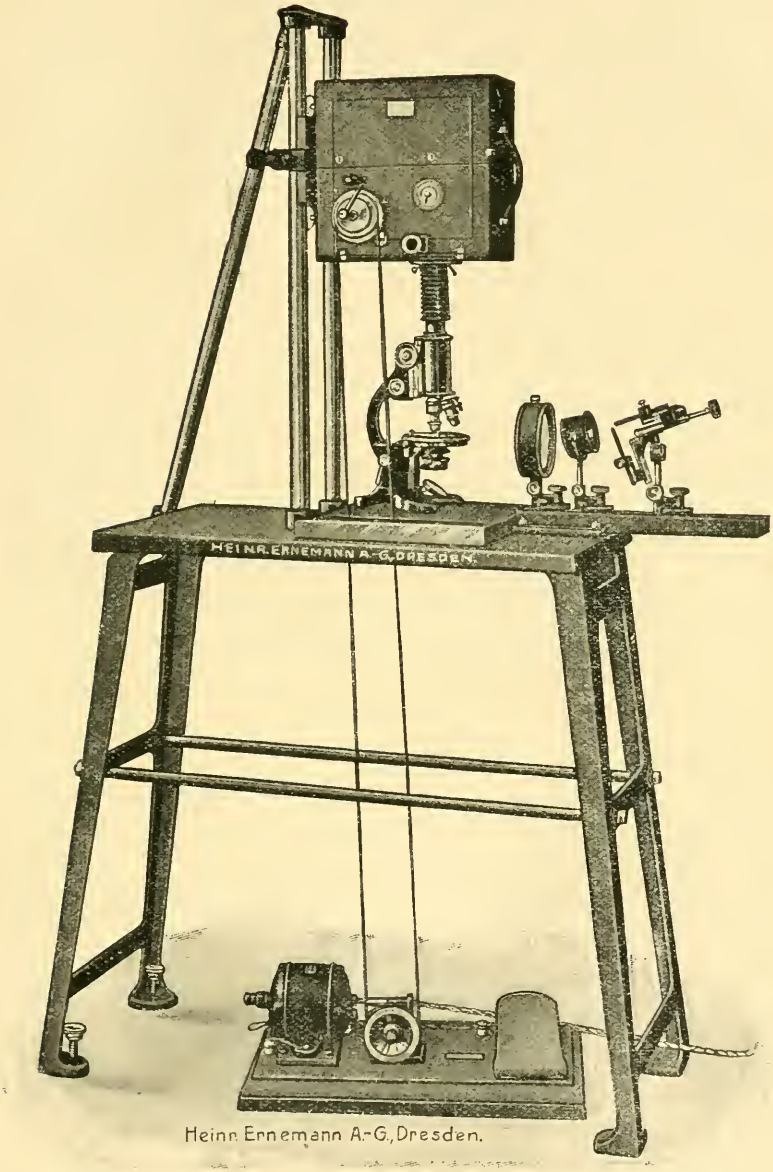

FIG. 72.

takes the photographs. In order to see that the arrangements are collectively working satisfactorily a lateral tube is fitted to the camera so that the film-image can be viewed direct. To enable the operator to have both his hands free for the fine-adjustment or for any emergency, the gearing of the camera is not governed by hand motion, but by a motor controlled by the operator's foot. As a light-source a suspended incandescent gas-lamp, or an electric arc-lamp, is recommended. If the latter be used, it should be one of the so-called fixed-point arc-lamps with automatic feed-motion.

Fig. 72, which shows the apparatus as arranged for vertical use, will easily be understood.

(5) Microscopical Optics and Manipulation.

Circular Polarization of Liquid Crystals.*—P. Gaubert points out that O. Lehmann has noticed circular polarization in the case of epipolic light reflected by liquid crystals; while F. Giesel has demonstrated that transmitted and reflected rays are polarized in inverse senses. Investigation of these effects has led Lehmann to observe the following phenomenon due to this circular polarization:—If pressure be applied with the point of a needle on the coverslip of a microscopic preparation of a birefringent liquid whose molecules are oriented in such a manner that the optic axis is perpendicular to the glass slip, a black-cross spherolite is formed whose centre coincides with the point touched by the needle. The fibres have a positive or negative prolongation, according as the liquid crystals are optically positive or negative. In reality, by reason of the pressure, the molecules (at least those which are not in immediate contact with the glass) orient themselves parallel to the glass slip. The phenomenon is easy to obtain with viscous liquids.

(6) Miscellaneous.

Displacement of the Particles in Brownian Movement.†—S. Lifchitz gives experimental reasons for concluding that a very rapid sonorous shock produces in a gas microscopic whirlwinds whose rotatory speed depends on the period of the shock.

Microscopic Anatomy.‡—This text-book of Microscopic Anatomy, by E. A. Schäfer, forms part of the eleventh edition of Quain's Elements of Anatomy. It is unnecessary to say more than that the text is by the Professor of Physiology and Histology in the University of Edinburgh, that it is thoroughly up-to-date, and is illustrated by numerous coloured plates and over a thousand engravings. We mention this as a guarantee of its trustworthiness and general excellence, for the conditions of the journal preclude criticism. Fortunately this is not required, and the task of noticing the volume is an easy one. It will form a useful and important addition to our Library, especially to those interested in the subject of human histology and cytology.

* Comptes Rendus, cliv. (1912) pp. 995–7.

† Comptes Rendus, cliv. (1912) pp. 1084–5 (4 figs.).

‡ Text-book of Microscopic Anatomy, being pt. 1 vol. ii. of Quain's Elements of Anatomy, 11th ed. Longmans, Green and Co. (1912) pp. 738 (1001 text figs. and 24 col. pls.).

The get-up of the volume is most excellent, and the price extremely moderate.

Quekett Microscopical Club.—The 480th Ordinary Meeting was held on March 26, 1912, the President, Professor A. Dendy, D.Sc., F.R.S., in the chair. Notes by Mr. E. M. Nelson, F.R.M.S., on "An Aplanatic Spot-lens," "An Improved Chromatic Condenser," and "The Rousselet Compressor," were read by the hon. secretary. Mr. Henry Sidebottom contributed an important paper on "The *Lagenæ* of the South-West Pacific." This appears in the current (April) issue of the Club's Journal, and is illustrated with eight plates. Mr. C. F. Rousselet, F.R.M.S., read "Some Notes on Rotifers." One new species, *Brachionus spatiosus*, from Devil's Lake, North Dakota, U.S.A., was described. Mr. D. Bryce described three new species of *Callidina*. There were *C. nana*, *C. concinna*, and *C. decora*. Mr. A. E. Conrady, F.R.A.S., made some remarks on the resolving power obtainable with dark-ground illumination. No higher resolving power can be obtained, with such illumination, than will be given with an objective having a N.A. of 0·47. Photomicrographs of *Navicula Smithii* sent by Mr. A. A. C. Eliot Merlin, F.R.M.S., and by Dr. T. W. Butcher were exhibited.

The 481st Ordinary Meeting was held on April 23, 1912. Mr. A. W. Stokes exhibited and described several methods of employing electric lighting for Microscope illumination. Mr. John Stevens, F.R.M.S., sent a note on the rotifer *Notommata gigantea*, Glascott. This is a true parasite and inhabits the ova of water-snails. Dr. Duncan J. Reid communicated some very useful notes on "Illumination in Critical Work with the Microscope." Mr. C. D. Soar, F.R.M.S., exhibited coloured drawings of the fifty British species of the Hydrachnid genus *Arrhenurus*.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

"Westminster" Shaking Apparatus.—This new shaker is expressly designed to give quiet and smooth running (fig. 73). It was exhibited at the May Meeting. A carrier or tube-holder, supported on an oscillating rocker, is attached by a rigid bar to the outside member of an excentric carried on a countershaft. The countershaft is driven by a small electric motor. By using an excentric instead of a crank or pin for driving the carrier a very quiet and smooth (practically noiseless) movement is obtained. The excentric has a much larger bearing-surface than a crank or pin, thus reducing the amount of wear very greatly. The apparatus has been proved to be highly efficient by rigid tests with various micro-organisms. The shaker (for which registration has been applied for) has been designed by F. R. Chopping, Assistant

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Embedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservation fluids, etc.; (6) Miscellaneous.

in the Laboratories of the Westminster Hospital, and is manufactured by Baird and Tatlock, Ltd., Cross Street, Hatton Garden.

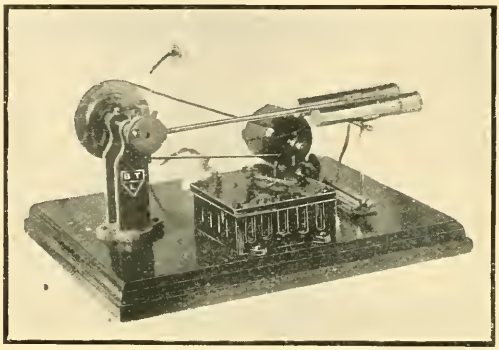

Fig. 73.

Aerobic Cultures of Anaerobes.*—F. Marino, after remarking that it is usual to cultivate anaerobes on media containing large quantities of glucose, states that 2 p.c. or less of glucose has an inhibitory effect on anaerobes. He has found that anaerobes develop very well in quite fresh broth, while in broth several days' old no development takes place. Old broth may be activated in the following way: 5 c.cm. of serum are mixed with 15 c.cm. of broth, and the tube heated for 20 minutes at 100°; a temperature much lower or higher than this is deleterious. These media should be inoculated as soon as possible after the heating. By means of this procedure abundant cultures may be obtained after an incubation of 24 to 48 hours. Tetanus spores 4 or 5 years' old will develop after 5 or 6 days, and abundant cultures obtained therefrom. The toxin in these cultures is very powerful. The age and quality of the serum used seems to be of little or no importance. The author then proceeds with another phase of the cultivation of anaerobes. He shows that anaerobes will grow well in symbiosis with other organisms, such as *Amylomyces Rouxii*, *Aspergillus oryzæ*, yeasts, *Mucor racemosus*, *Aspergillus*, and some pathogenic and saprophytic organisms.

New Method of Hanging-drop Examination.†—M. Owada has worked out the following method for examining bacteria in hanging-drop. He uses a solution composed of carbon powder or lamp-soot 0·04 grm., gelatin 0·1 grm., 0·8 p.c. sodium chloride solution 20 grm. After mixing the ingredients, the mixture is sterilized and well shaken before use. The solution, which is intended as a guide-mark, is used as follows: A drop containing the bacteria is placed on a cover-glass, and then a loopful of the solution, the two being well mixed together.

* Centralbl. Bakt., 1te Abt. Orig., lxii. (1912) pp. 298–303.
† Centralbl. Bakt., 1te Abt. Orig., lxii. (1912) pp. 537–8.

As the drop is blackish it is easily seen and focused. The solution is said to be harmless to bacteria.

Bacteriological Examination of Suspected Cholera-carriers.*—A. J. Bendick advocates the use of the following procedure:—To a litre of water add 10 grm. of peptone and 5 grm. sodium chloride; boil; titrate with phenolphthalein to a neutral reaction; add 1 grm. of anhydrous sodium carbonate; boil; filter through double filter-paper; add 5 grm. of saccharose and 5 cc. of a 50-p.c. alcoholic-saturated solution of phenolphthalein; tube and sterilize by fractional sterilization in an Arnold sterilizer. The technique is as follows: (1) Inoculate fæces into Dunham's peptone and incubate at 37° for 6 hours; (2) subculture 1 loop from the surface-growth into the sugar-peptone and incubate for 5 to 8 hours; (3) plate suspicious cultures.

If cholera vibrios be present, they are enriched by the peptone medium. In the second they rapidly ferment the saccharose, the acid produced neutralizes the alkali, and the red colour of the phenolphthalein disappears. As soon as a tube decolorizes—which in the case of cholera comes to pass within from 5 to 8 hours—a smear is made from the surface, and if vibrios be present plates are made. It is stated that two to three thousand specimens can be examined in one day by this procedure.

Selective Action of Media on Organisms of the "Coli" Group.† C. Revis draws the following conclusions from numerous observations on the "Coli" group:—1. The types of "coliform" organisms which appear on inoculation of dilutions of milk, etc., into bile salt-glucose tubes are the result of a combination of mutual toxic action, acid development, and the nature of the medium. 2. There is undoubted suppression of feeble organisms, particularly of those which can only produce acid and not gas from glucose. 3. The aspect which at present obtains of the varieties of "coliform" organisms is an aspect determined by our media and its concomitants. 4. That atypical forms of "coli" are not degenerate forms, but stages in the variation of organisms belonging to the "coli-typhoid" group.

Cultivation of Iron Bacteria.‡—After a general account of the researches carried out upon this group by various workers, particularly Molisch and Ellis, since the time of his own investigations upon *Crenothrix polyspora* in 1907, W. Rullman describes his recent work upon the cultivation of this organism. Upon agar and gelatin plates, to which have been added iron or manganese in such forms as iron ammonium citrate or nitrate, manganese peptone and other such substances, cultivations of *Crenothrix* have been obtained. Attempts to cultivate this organism upon material derived from its natural source have had some measure of success. Pure cultures have, however, not been obtained, as contaminations with other iron bacteria, simple bacteria or aspergillus have been encountered.

* Centralbl. Bakt., 1te Abt. Orig., lxii. (1912) pp. 536–7.
† Centralbl. Bakt., 2te Abt., xxxiii. (1912) pp. 407–23.
‡ Centralbl. Bakt., 2te Abt., xxx. (1912) pp. 277–89.

Synthetic Culture-Medium for Tubercle Bacilli.*—P. Armand-Delille, A. Mayer, G. Schaeffer and E. Terroine have made an analytical study of glycerin-peptone broth, and have applied the information derived from this to the prescribing of a synthetic medium of precise chemical composition, suitable for the cultivation of *B. tuberculosis*. They found that, whereas purin bases had no influence upon the growth of the organism, certain extractives (particularly creatin, carnosin and sarcosin) favoured growth, and sugars, such as inosit and glucose, were essential. Study of protamines led them to include diamido acids such as arginin and histidin, and these had a markedly favourable influence upon growth. Several satisfactory broths were obtained, and one of the following composition gave perhaps the best results :—

Sodium chloride	1·25 grm.	Sarcosin	0·1 grm.
Magnesium citrate .. .	0·6 ,,	Glucose	0·5 ,,
Monopotassium phosphate	1·25 ,,	Inosit	0·1 ,,
Glycocoll	0·5 ,,	Glycerin	10·0 ,,
Aspartic acid	0·5 ,,	Sodium hydrate (Centi-normal)	1·0 c.cm.
Carnosin nitrate	0·1 ,,		
Creatin	0·1 ,,	Water...	250 grm.

Cultivation of Mycobacterium Enteritidis.†—F. W. Twort and G. L. Y. Ingram have succeeded in growing this acid-fast bacillus, the causal organism of Jöhne's pseudo-tuberculous enteritis of cattle, upon media which contain the dried and powdered growth of certain killed acid-fast bacilli. The most suitable bacillus for incorporating in the medium is the timothy-grass bacillus ; the smegma bacillus, the nasenschlein bacillus of Karlinski and the human tubercle bacillus may also be used. Negative results were obtained with bovine and avian tubercle. The essential substances may be extracted from suitable bacilli by means of hot ethyl alcohol. Successful results were obtained even in cases where the dead bacteria had been kept for eight years and autoclaved for one hour at 115° C.

(2) Preparing Objects.

Preparation of Medullary Sheath Sections.‡—Rappricht has employed Spielmeyer's method—a modification of Heidenhain's iron-hæmatoxylin process—with success, but found difficulties in making the frozen sections adhere to the slide. By the use of tissue-paper, treated with a mixture of collodion (3 parts) and castor-oil (1 part) dissolved in alcohol-ether, he obtained satisfactory results. The sections were transferred from the mordant solution to 70 p.c. alcohol, and from this to the prepared paper strip. If smoothed carefully on to the paper, the sections will adhere to it during subsequent staining and dehydrating processes. From carbolxylol the paper and sections — sections downwards—are placed upon slides, and the paper is freed by treating with acetone according to Strasser's method. The sections will remain fixed to the slide for the clearing and mounting processes.

* Comptes Rendus, cliv. (1912) pp. 537–9.
† Proc. Roy. Soc., Series B, lxxxiv. (1912) pp. 517-42.
‡ Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 278–85.

Orientation of the Embryo.*—It is often necessary, in dealing with very young embryos, to carry out fixing and hardening processes upon the entire Graafian follicle. This prevents undue risk of injury to the embryo, but has the disadvantage that the membrane becomes opaque, and it is then impossible to ascertain the exact lie of the contained embryo. Thus, if it be desired to cut serial sections of the whole structure in any particular plane, some means of determining the orientation of the embryo is necessary. O. Zajicek, working upon mole embryos, removes a Graafian follicle, together with part of the uterus. In order to facilitate access of the fixing fluid the uterine muscle is gently stretched. After fixing in Zeuker's fluid, the preparation is passed through rising alcohols, and then put into aniline oil. In this reagent the follicular membrane becomes transparent, and the exact position of the embryo may be observed. With a fine pair of forceps a small window, indicating the position of the head, may be cut, so that the orientation remains obvious during the subsequent embedding process, in which the follicle-wall again becomes opaque.

(3) Cutting, including Embedding and Microtomes.

New Rotary Microtome.†—H. N. Ott gives a description of the Spencer Microtome, a new type of instrument, which possesses certain advantages over older patterns of rotary microtome. The importance of securing a satisfactory rotary microtome for laboratory workers who are embedding in paraffin and embedding in serial sections is great. The construction of this instrument is very solid and rigid. The whole of the feeding mechanism is covered, thus protecting the wearing parts from dust. When it is necessary to get at the working parts the hinged cover may be thrown back. The block which carries the specimen moves up and down upon the support, while the object-clamp moves freely backwards and forwards upon the block. By this combination the difficulty of fitting a block capable of moving in all these directions, without any chance of lateral displacement, is obviated. Full details of the mechanism are given.

Classification of Injection Methods.‡—B. Možejko gives a detailed classification of the various methods for obtaining injected preparations of animal tissues. These fall generally into three classes—the interstitial and intravital methods and those described as "Selbstinjektionen." The author discusses at length the intravital methods, giving an historical *résumé* of different procedures that have been employed, and deals also with the types of material that have been found suitable for injection. Tissues are said to undergo self-injection when, upon treatment with a chemical substance which possesses affinities with certain constituents of the tissues, a demonstrable differentiation of specific cells or systems is produced as a consequence of the treatment.

* Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 424–6.
† Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 451–5 (fig. 1, p. 452).
‡ Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 432–44.

Hoyer's Method of Microscopic Injection.*—B. Možejko contributes a note upon this method. Glass cannulas drawn out carefully and evenly to a fine point and bent at a right-angle are used. These are filled with injection material by means of a pipette. For finest work Grübler's Berlin blue, for coarser work some of Lefranc's preparations are employed. The open end of the cannula is then connected by means of a rubber tube with a gas-pressure cylinder. The object to be injected is dipped in 70 p.c. alcohol containing a few drops of cocaine or chloretone, and then placed on a glass slide or a Petri dish under a binocular microscope. The end of the cannula is pushed through the integument and into the desired vessel ; the stopcock of the cylinder is turned so that the injection may be made at constant pressure. By this means a threefold injection—arteries, veins, and lymphatics—of a frog embryo may be accomplished. The preparations are fixed in formalin or formalin-acetic acid, and preserved in 70 p.c. alcohol.

New Freezing Microtome.†—L. Ssobolew discusses a new model of student's freezing microtome made by the firm of Sartorius in Göttingen. He commends the solidity of construction, and the increased range of excursion of the knife. He also finds that there are improvements in the automatic adjustments, and that the ether spray is more conveniently arranged. On the other hand, he finds that the arrangements for fixing the apparatus to the table are unsatisfactory, and suggests that the surface of contact should be larger and rougher. Improvements in the ether spray with regard to the disposition of the tubes are suggested. The earlier instruments were more conveniently adjusted for the cutting of 15, 20 and 25 μ sections.

(4) Staining and Injecting.

Staining Mitochondria of Cancer-cells.‡—M. Favre and C. Regaud employ the following technique for demonstrating the presence of mitochondria in cancer-cells. Pieces taken from the breast intra vitam were fixed in a mixture of formalin, 20 vols., and in a 3 p.c. solution of bichromate of potassium, 80 vols. After this the pieces were mordanted in 3 p.c. potassium bichromate for a variable period, and the sections stained with iron-hæmatoxylin. The fixation time for the specimens described is given as three days ; the mordanting time fifteen days. The authors point out that it is necessary to test every specimen, in order to ascertain the optimum mordanting time.

Demonstrating the Microbe of Peripneumonia of Cattle.§—E. J. Martzinovski found the best way to stain this organism was to stain unfixed smears with Giemsa's solution for from 4 to 6 hours. Carbol fuchsin, Gram, and the Indian ink methods were failures. Microscopical examination under magnifications of not less than 1000 showed large numbers of rodlets, the majority being coccobacillary in form. The organism is very pleomorphic, many rodlets being swollen in the

* Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 427–31.
† Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 448–50.
‡ C.R. Soc. Biol., lxxi. (1911) pp. 658–61 (6 figs.).
§ Ann. Inst. Pasteur, xxv. (1911) pp. 914–17 (1 pl.).

middle, others joining to form filaments, and others resembling spirilla. They are most frequent in the parts in condition of grey hepatization. The author mentions that in some of the preparations a Gram-positive streptococcus was present. Cultivations were difficult; in only one tube was a pure growth obtained, the rest being contaminated with the streptococcus. The medium used was agar mixed with bouillon Martin and calf's blood. There is no record of animal experiments.

Enrichment and Staining Methods for Tubercle bacilli.* — W. Frei found that the best enrichment method for demonstrating tubercle bacilli in sputum was that of Hammerl (dissolving the sputum in a mixture of ammonia and caustic potash, shaking up with acetone and centrifuging). Other less effective methods were (1) the antiformin (sputum dissolved in 20 p.c. antiformin, centrifuged); (2) antiformin-ligroin (sputum dissolved in 20 p.c. antiformin, shaken up with ligroin; sedimented); (3) antiformin-chloroform (sputum dissolved with heat in 50 p.c. antiformin, shaken up with chloroform-alcohol, centrifuged). For staining, besides the Ziehl-Neelsen, Much's modification of Gram's method, and Herman's method were used. The Much-Gram procedure adopted was as follows: Stain with solution of 10 c.cm. of saturated alcoholic solution of methyl-violet B.N. in 100 c.cm. of 2 p.c. carbolic acid water for 24 to 48 hours in an incubator at 37°, or by boiling over the flame. Then treat for 1 to 5 minutes with iodo-potassic iodide solution, followed by 1 minute in 5 p.c. nitric acid, 10 seconds in 3 p.c. hydrochloric acid; aceton-alcohol āā, contrast-stain with dilute carbol-fuchsin. The tubercle bacilli are seen as rows of 4–6 granules.

Herman's staining method: a freshly made mixture of 3 parts of 1 p.c. ammonium carbonate in distilled water and 1 part of 3 p.c. crystal-violet solution in 95 p.c. alcohol, is poured over the smear and heated in the flame until steam is given off: the preparation is allowed to stain for a minute, after which it is treated for several seconds with 10 p.c. nitric acid and then with 95 p.c. alcohol. This last procedure is repeated until the preparation assumes a pale blue hue. A 1 p.c. aqueous or alcoholic solution of eosin is used as contrast-stain. Other methods of counter-staining may be adopted.

Staining Blood-plates in Sections of Organs.†—L. Le Sourd and P. Pagniez describe a method for staining the blood-plates in sections. The pieces are fixed in Dominici's fluid for 12 to 15 hours, and then embedded in paraffin. The sections are stained twice in Giemsa's solution. The first time for 12 to 15 hours, Giemsa 5 drops to 15 c.cm. of distilled water. The second time for 4 to 5 hours in Giemsa 15 drops, distilled water 15 c.cm. On removal the sections are at once treated successively with the following mixtures of acetone and xylol: 1. Acetone 18 drops, xylol 2 drops. 2. Acetone 14 drops, xylol 6 drops. 3. Acetone 6 drops, xylol 14 drops. These mixtures are dropped over the section, and when there is good differentiation the preparations are treated with pure xylol and mounted on balsam. The staining is not very permanent.

* Centralbl. Bakt. 1te Abt. Orig., lxi. (1911) pp. 411–16.
† C.R. Soc. Biol. Paris, lxxi. (1911) pp. 308–10.

Staining Negri's Corpuscles.*—M. Stutzer stains paraffin sections with dilute Loeffler's solution for 5 to 10 minutes; differentiates with 10 p.c. tannin solution for from 1 to 5 minutes, according to the thickness of section. The differentiation is watched under the Microscope, and as soon as the outlines of the nuclei are plainly visible the preparation is washed with water, mopped up with blotting-paper, passed rapidly through absolute alcohol to xylol and balsam. The Negri bodies are reddish violet, the nerve-cells blue.

Demonstrating Connective-tissue Fibres.†—Snessarew adopts the following procedure:—A piece of fresh tissue fixed in formalin is placed for some days in a 2½ p.c. solution of iron alum $\{(NH_4)_2\ Fe_2\ (SO)_4\}$. After a wash it is treated with 2 p.c. formalin for 2 hours. It is then washed in running water for 30 minutes or longer, and then frozen sections are made. The sections are placed for 24 to 48 hours in 10 p.c. silver nitrate solution. Each section is quickly washed in distilled water, and this is followed by silver-ammonium solution for 5 minutes. After a rapid wash in distilled water it is placed in 10 to 20 p.c. formalin. After this follows presumably the ordinary technique—this is only indicated by the formula, etc.

The silver-ammonium solution is prepared by mixing 5 parts of 10 p.c. silver nitrate and a similar number of drops of 40 p.c. caustic soda: after a good shake 20 to 25 parts of distilled water are added. The solution is again thoroughly shaken and the precipitate allowed to settle. The supernatant liquid is decanted off, and this forms solution A. To it are added drops of ammonia until it becomes clear. Solution B is prepared from the precipitate by adding ammonia until it is all dissolved and the solution is quite clear; it is then diluted to 20–25 parts (sic). Solution A is not active; in it the solutions become only blackish-brown: the proper reaction is obtained by means of the fluid B. How much of B should be used can be ascertained only by trying the effect.

Methods of Staining Tubercle Bacilli.‡—J. Böhm has studied the various methods that have been recommended for the purpose of staining tubercle bacilli, particularly for the purpose of assessing their relative values in the routine examination of sputa. Of the modern processes those discussed most fully are the methods of Ziehl-Neelsen, Herman, Much and Gasis. The last-named method, that of Gasis, possesses a scientific interest, illustrating the alkali-fast property of tubercle bacilli. The technical difficulty of the method, however, and lack of constancy in the reaction render it unsuitable for routine purposes. Much's modification of Gram's method has yielded important results in the study of tuberculous lesions, where organisms, not otherwise found, have been demonstrated by its means. For the present purpose, however, the results obtained by this method may lack the precision required for rapid diagnosis. The Ziehl-Neelsen method has stood the test of time,

* Zeitschr. Hygiene u. Infektions., lxix. (1911) p. 25.
† Anat. Anzeig., xl. (1912) pp. 522–40 (12 figs.).
‡ Centralbl. Bakt., 1te Abt., Orig., lxii. (1912) pp. 497–520.

and remains beyond all others the most suitable for routine purposes. Herman's ammonium-carbonate crystal violet is also an excellent method. In principle it resembles that of Ziehl. The staining mixture, however, does not keep well, and has to be made up fresh at short intervals.

Staining Medullary Sheath of Nerves.*—W. Gilbert recommends the following method :—Treat with iron alum for 4 to 6 hours. Stain with molybdic acid hæmatoxylin for 12 hours at 37° C., or for 24 hours at room temperature. Differentiate in Weigert's sodium ferricyanide borax solution for a period varying from a few seconds to 2 minutes, according to the depth of the stain and the thickness of the section. Wash in tap water. The differentiation must be controlled by microscopic examination.

Cell-staining in Weigert-Pal Preparations.†—For staining ganglion-cells in such preparations, C. U. Ariëns Kappers and I. Ketjen recommend the use of a paracarmine stain (acid carmine 1 grm., aluminium chloride ½ grm., calcium chloride 4 grm., dissolved in 100 c.cm. of hot 70 p.c. alcohol). The sections treated by the Weigert-Pal method are soaked for 2 or 3 hours in distilled water containing 5 c.cm. of saturated lithium carbonate solution. Then, after remaining overnight in water, the material is placed in 50 p.c. alcohol (made up with distilled water) for 24 hours, and then placed in a second 50 p.c. alcohol bath. The sections are stained with paracarmine for 5 or 10 minutes, washed in 70 p.c. alcohol, transferred to 96 p.c. alcohol, cleared in carbolxylol and xylol and mounted in Canada balsam.

Staining-cells in Chromicised Material.‡—C. U. Kappers, in view of the unsatisfactory results obtained with aniline dyes in working with material of this type, has experimented with a number of vegetable dyes. After quoting the work of Claudius and others, he describes his experiences with stain prepared from elderberries. The expressed juice is allowed to ferment for some days, and is then boiled for 10 minutes or so. The addition of 1 p.c. carbolic acid renders this fluid most satisfactory for histological purposes. The method is as follows :—After staining overnight in the carbolized fermentation product, the material is washed, differentiated in 3 p.c. liquor ferri sesquichlorati, washed, dehydrated and mounted. Good preparations of cells and axis-cylinder staining are obtained by this method.

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

Mounting Old Museum Specimens as Microscopical Slides.§—G. A. McKechnie says that satisfactory results may be obtained by the following procedure :—1. Soak the insect for a few days in solution of carbonate of soda (¼ oz. to 10 oz. water). 2. Soak for a few days in caustic soda (¼ in. of stick to 2 oz. water). 3. Wash in water for many

* Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 279–80.
† Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 275–8.
‡ Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 417–24.
§ Micrologist, i. (1912) pp. 116–7

hours. 4. Immerse in up graded alcohols (25, 45, 75 and 92 p.c.). For this stage it is advisable to place the insect between two slides, arranging the various in suitable position, fastening the slides together by means of rubber bands. 5. Cedarwood oil. 6. Thin balsam in benzol. 7. Thicker balsam in benzol. 8. Mount in balsam under oblong cover.

Terpineol.*—H. Womersley finds in terpineol a medium for clearing microscopical sections which will replace all other oils at present in use. Its virtues are that it does not dissolve celloidin, it has a perfect clearing action, its refractive index is 1·49, it does not dissolve aniline pigments, it will dissolve paraffin on warming to about 20° C., and so will serve for infiltrating specimens. Terpineol is manufactured synthetically from oil of turpentine. Another merit is that it is fairly cheap.

(6) Miscellaneous.§

New Apparatus for Wax-plate Reconstruction Work.†—L. Neumeyer describes two new pieces of apparatus for this type of work. The first of these is an electrically-heated roller, the temperature of which is capable of accurate adjustment. Further, an account is given of a sliding bar, automatically regulated, by means of which the thickness of the plate is determined. The instruments are made by the firm of C. Koch and N. Iblherr, of Munich.

New Method of Counting Blood Platelets.‡—J. H. Wright and R. Kinnicutt have devised the following method for counting blood platelets:—The blood is mixed with a diluting fluid in the proportion of 1 to 100 by means of the pipette used for counting red corpuscles, and the counting is done in an ordinary blood-counting chamber with a high-power dry objective.

In order to render the platelets more clearly visible, the extra thin slips with central excavation (No. 146 Zeiss) are used. The diluting fluid consists of an aqueous solution of brilliant cresyl-blue (1–300), 2 parts, and aqueous solution of potassium-cyanide (1–1400), 3 parts. These two solutions are kept separate and mixed and filtered immediately before use. The pipette, as in blood counting, must be well rolled and shaken before withdrawing a portion for counting.

After the counting chamber is filled it is left to rest for about 15 minutes to let the platelets settle. The platelets appear as sharply outlined, round, oval, or elongated lilac-coloured bodies. The red corpuscles are decolourized, and the nuclei of the whites are dark blue. The average count for normal individuals came out at about 275,000.

* Micrologist, i. (1912) pp. 115-6.
† Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 291-300.
‡ Publications Massachusetts Gen. Hosp., iii. (1911) pp. 505-11.

Metallography, etc.

Structure of Ternary Alloys.*—G. H. Gulliver points out and explains a difference in structure between a binary eutectic occurring in a binary alloy, and a binary eutectic occurring in a ternary alloy when a ternary eutectic is also present. In a solidifying binary alloy primary crystals are surrounded by liquid during their gradual growth, and thus become relatively large, while the eutectic, solidifying at a constant temperature, has a relatively much finer structure. But the solidification of a binary eutectic separating from a ternary alloy takes place throughout a range of temperature, and liquid is always present. The crystals of which this binary eutectic is composed are thus enabled to grow to a considerable size. It is shown that the bismuth-tin eutectic in a lead-bismuth tin alloy consists of well-formed crystals of each metal. The ternary eutectic solidifies at a constant temperature and has accordingly a fine structure.

Magnesium-cadmium Alloys.†—G. G. Urasow confirms by microscopical examination of these alloys the conclusions drawn from a study of their hardness and electrical conductivity, and from thermal analysis. The sections were etched with water. At the ordinary temperature two series of solid solutions exist, (1) of the compound β–Cd Mg, (2) of α–Cd Mg, in their components.

Ternary System Copper-silver-gold.‡— E. Jänecke has determined the equilibrium diagram by thermal methods, and confirmed it by microscopical examination of numerous alloys. The majority of the alloys contained only one constituent, a homogeneous solid solution The remainder contained the eutectic composed of two ternary solid solutions ; this may be regarded as the copper-silver eutectic with gold present in solid solution in each phase. The eutectiferous alloys were readily etched with dilute nitric acid, while long etching with aqua regia was necessary for some of the other alloys.

Life-history of Cells and Grains in Steel.§—H. M. Howe sharply distinguishes "grains" from "cells" as structural forms in steel. The individual islets of ferrite or cementite are grains, while the cells consist of envelopes of ferrite or cementite, containing kernels of pearlite intermixed with or replaced by other constituents. Grain-size and cell-size increase with increase of temperature and time of heating above the critical range. The effect of high and long heating in coarsening the cell-size represents the coarsening of the austenite grains during that high heating, each such grain being later represented by a single cell. The effects of high temperatures and of different rates of cooling upon the form assumed by the ferrite, are described and explained.

* Proc. Roy. Soc., Edin., xxxii. (1912) pp. 36–9 (2 figs.).
† Zeitschr. Anorg. Chem., lxxiii. (1911) pp. 31–47 (14 figs.).
‡ Metallurgie, viii. (1911) pp. 597–606 (27 figs.).
§ Int. Journ. Metallography, ii. (1911) pp. 13–25 (11 figs.).

Constitution of Steel.*—W. Rosenhain gives an account of the constitution of steel from the point of view of the allotropic theory. Austenite, ferrite, pearlite and cementite are defined with some precision and allotted their places in the equilibrium diagram. The other decomposition products of austenite do not permit of precise definition. Martensite probably contains β-iron, and owes its hardness partly to this and partly to the fact that it is in large part a supercooled solid solution. In troostite the iron is probably still in the β condition, but the carbide of iron is in suspension, not in solution.

Influence of Gases upon the Critical Ranges of the Iron-carbon Alloys.†—In the course of this investigation, J. H. Andrew has examined microscopically specimens of wrought iron and 0·5 p.c. carbon steel which had been heated in ammonia gas at 1000° C. for forty hours. Well defined Neumann lines were seen in a ground mass of polygonal crystals.

Carbon-molybdenum Steels.‡—T. Swinden has included in a comprehensive investigation of eighteen steels containing 1 to 8 p.c. molybdenum, 0·13 to 1·36 p.c. carbon, a study of their micro-structure after five different heat-treatments. The pearlite is highly emulsified, and the carbon content of the eutectoid is lowered with successive increments of molybdenum. Molybdenum does not give rise to the presence of any new constituent.

Microscopic Examination of the Depression made on Steel by a Conical Point.§—F. Robin finds that an examination of the deformed area surrounding the impression made by forcing a hard conical point into a polished specimen is capable of yielding useful metallographical results. Six types of deformation are distinguished and described. The presence of interstrain in the original specimen may be detected by the test.

Influence of Cold-working.‖—P. Goerens has studied the influence of cold-working and annealing on the structure and on many other properties of iron and steel. The progress of distortion of ferrite crystals and of pearlite grains is described and illustrated. When the drawing of a wrought-iron, containing slag, had proceeded sufficiently far, it was observed that the edges of the slag inclusions, originally even, became broken and jagged. The non-ductile slag had broken when the specimen was strained, and the iron had flowed into the spaces and cracks thus formed. The broken edge of the slag inclusions persists after annealing, and may serve to indicate that a specimen has undergone cold-work at some stage in its history. It was found that

* Proc. Inst. Mech. Eng. (1911) pp. 241-308 (89 figs.).

† Iron and Steel Institute, Carnegie Scholarship Memoirs, iii. (1911) pp. 236–48 (10 figs.).

‡ Iron and Steel Institute, Carnegie Scholarship Memoirs, iii. (1911) pp. 66–124 (12 figs.).

§ Iron and Steel Inst., Carnegie Scholarship Memoirs, iii. (1911) pp. 216–35 (14 figs.).

‖ Iron and Steel Institute, Carnegie Scholarship Memoirs, iii. (1911) pp. 320–434 (69 figs.).

the distorted structure of cold-worked material was replaced by a normal granular structure when the temperature of annealing reached or exceeded 520° C.

Manganese Sulphides and Silicates in Iron and Steel.*—In the course of this investigation D. M. Levy has studied the microstructure of the fused sulphides of iron and manganese, pure and alloyed together in various proportions, and of the sulphides and silicates occurring in pig-irons and steels containing different amounts of sulphur, manganese, and carbon. Manganese sulphide can hold iron sulphide in solid solution up to about 50 p.c. Three varieties of manganese sulphide occurring in iron and steel, differing in their content of iron sulphide, are distinguished; the dark-coloured variety is the most free from sulphide of iron and is the most infusible.

Internal Structure of Martensite and Pearlite.†—By the previously-described method of examining serial sections ‡ M. Oknof has studied the structural details of martensite in quenched steels containing 0·5 and 0·7 p.c. carbon, and of pearlite in the same 0·7 p.c. carbon-steel annealed. The thickness of the layers removed in successive grindings and polishings was as small as 0·001 mm. The martensite was observed to be composed of plane lamellæ about 0·001 mm. thick. The pearlite consisted of a ground mass of ferrite in which were embedded curved parallel lamellæ of cementite, about 0·001 mm. thick and 0·01 mm. broad.

Solubility of Iron Carbide in γ Iron.§—N. J. Wark has prepared ten pure iron-carbon alloys containing 1·21 to 1·96 p.c. carbon. Small sections of these were heated in a salt bath at 1100° C., cooled slowly to various desired temperatures, quenched in water and microscopically examined. A 4-p.c. solution of nitric-acid in amyl-alcohol was used for etching, and also sodium-picrate solution. From the presence or absence of cementite in the sections of a given alloy quenched at different temperatures, the temperature-limit of solubility of a concentration of cementite corresponding to the carbon content of the alloy was determined. Thus the solubility-curve of cementite in solid γ-iron in the range 1·2 to 2·0 p.c. carbon was determined. The maximum solubility was found to be 1·70 p.c. carbon. The solubility-curve, ascertained by quenching specimens heated slowly to the given temperature, agreed with that determined as above.

Constitution of Portland Cement Clinker.‖—In the course of this investigation E. Jänecke has shown by the examination of thin sections by transmitted light that alite ($8\,CaO,\ 2\,SiO_2,\ Al_2O_3$) has a simple structure; he concludes that it is a compound.

* Iron and Steel Institute, Carnegie Scholarship Memoirs, iii. (1911) pp. 260–319 (17 figs.).

† Metallurgie, viii. (1911) pp. 539–41 (18 figs.).

‡ See this Journal, 1911, p. 828.

§ Metallurgie, viii. (1911) pp. 704–13 (14 figs.).

‖ Zeitschr. Anorg. Chem., lxxiii. (1911) pp. 200–22 (14 figs.).

MICROSCOPY.

A. Instruments. Accessories, etc.*

(1) Stands.

Fennel's Vernier-Microscope.†—Delicacy of measurement is, as is well known, usually attained by the use of verniers, but it is frequently necessary that the vernier should be a scale of considerable length. To avoid the inconvenience arising from this length Fennel has revived an old idea of Hensoldt's, and has introduced the vernier into the little reading Microscope generally attached to graduated instruments. The whole vernier is easily contained in the centre of the Microscope field, and there is no difficulty in reading off the graduations to 30″ or even in estimating to a further 15″. The designer calls this apparatus the Microscope-nonius. Examples and full details are given by E. v. Hammer. the author of the article.

Nachet's New Stereoscopic Microscope with a Single Objective.‡ In describing the stereoscopic binocular Microscope lately brought out by Nachet (fig. 74), A. Quidor states that it is able to throw objects into relief with a magnification of 10 to 400 diameters, whilst binocular microscopes with two objectives cannot exceed 80 diameters. It has also the double advantage over the latter class of instrument of not only using objectives of very short (and consequently powerful) frontal distance, but also of using ordinary microscopic objectives.

The ray bundles produced by the objective are divided into two symmetric parts by the rhombs P_1 and P_2, and the observer obtains the relief by the fusion of the two conjugate images A_1B_1 and A_2B_2 of the object AB. As in all stereoscopic instruments, the distance of the oculars must be equal to the pupil width of the observer's eyes. This adjustment is obtained by the simple rotation of the prisms P_1. Nachet's stereoscopic Microscope, however, by the use of special oculars, also suppresses all tendency to convergence and consequently fatigue. This is a precious advantage both for myopia and for hypermetropia. The instrument is essentially a development of the binocular Microscope of Nachet père, and is in accord with the principles of stereoscopy elsewhere advanced by the author.§ The conjugate images of a micrometer object subdivided into tenths are such that, when drawn successively by 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.

† Zeitschr. f. Instrumentenk., xxxii. (1912) pp. 148–54 (2 figs.).

‡ Comptes Rendus, clv. (1912) pp. 68–70 (1 fig.).

§ Ann. de Phys. et de Chimie, 1910.

camera-lucida free from deformations, the divisions of the micrometer grow regularly from left to right for the right eye and from right to left

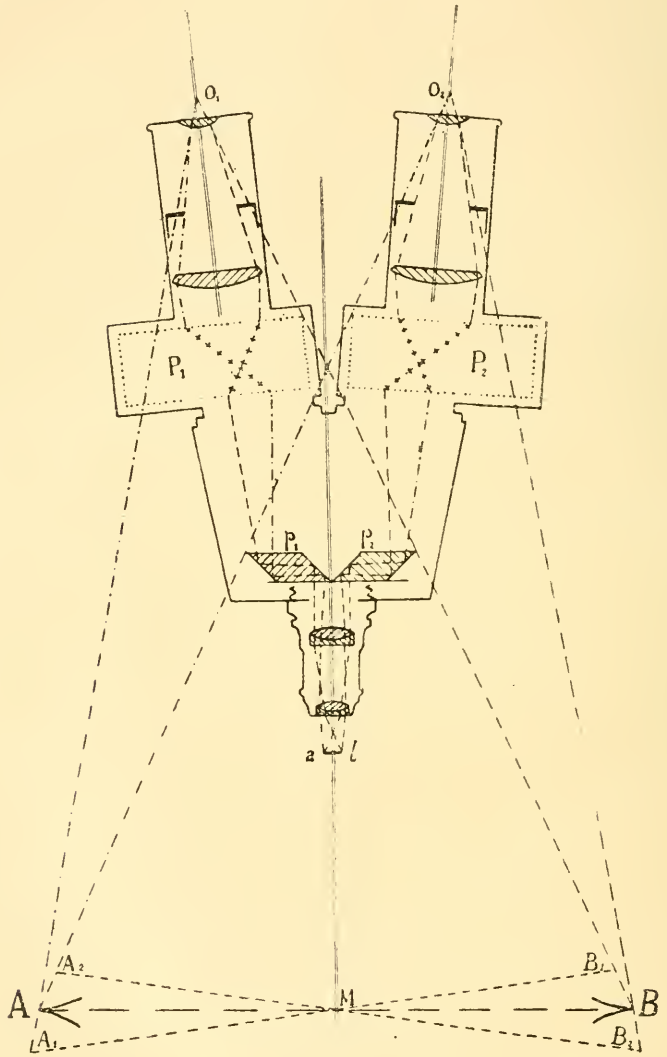

Fig. 74.

for the left eye. Certain experiments performed by the author show also that the images obtained of objects stand out in their true relief.

Old "Double-reflecting" Microscope.—This instrument (fig. 75) was exhibited and described by Mr. Rousselet at the January Meeting (see *ante*, p. 125).

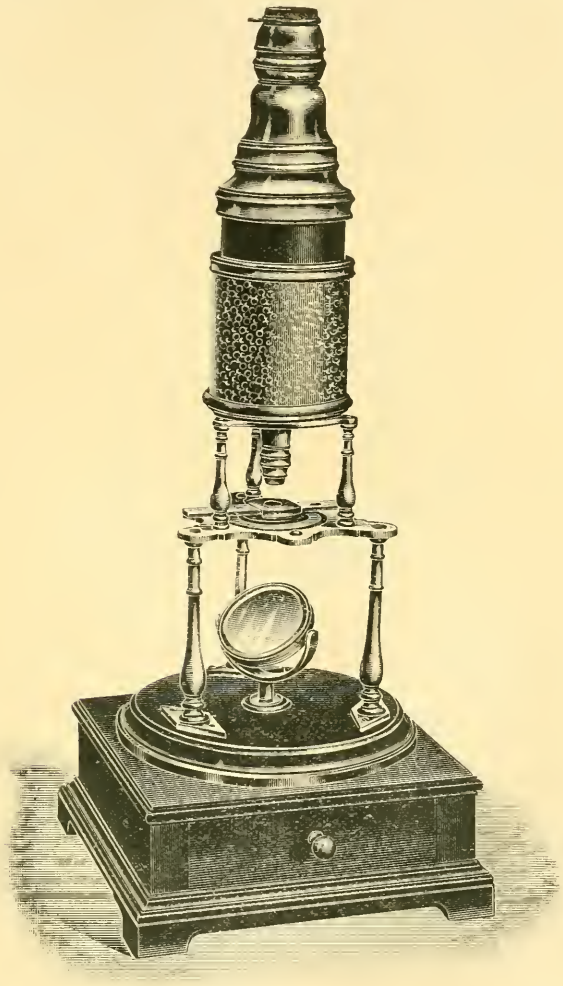

Fig. 75.

Cheap Microscope Stands.*—C. C. Kiplinger describes how a simple and efficient Microscope of the "Continental" type may be made without any machine-work and for a small outlay. It is illustrated

* English Mechanic, xcv. (1912) p. 267 (3 figs.), from the Scientific American.

in fig. 76 and subordinates figs. 1–4. The base is the lid of an ordinary tin can about 4 in. in diameter, into which molten lead has been poured. Through the base passes a $\frac{1}{4}$-in. bolt $7\frac{1}{2}$ in. long, and forms the core of the pillar. The limb S (fig. 1) is made out of a rectangular brass or zinc plate, hollowed out for the brass-tube sleeve V, to which it is soldered. Fig. 2 shows the stage as cut out of a rectangular brass plate 4 in. by $4\frac{1}{2}$ in. by $\frac{3}{16}$ in. Fig. 3 shows the mirror-fitting, T being a bit of slotted brass tubing to fit tightly over the pillar at X. The mode of putting all these parts together is shown in fig. 4, the whole being kept rigidly in position by help of a nut L at top and at bottom (not shown) of the core. The sleeve V is lined with cloth or felt for

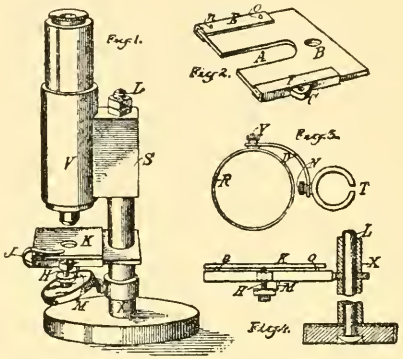

Fig. 76.

coarse adjustment of the tube. Objective and ocular should be bought from an optician. The ingenious fine-adjustment is illustrated in figs. 1 and 4. Two pieces of $\frac{3}{32}$-in. sheet-brass, 3 in. long and $2\frac{1}{4}$ in. wide, are cut and bent so as to grip tightly the sides of the stage (E, F, fig. 2). On one of the pieces near each end two brass points $\frac{1}{8}$ in. high must be soldered (*n* and *o*, E, fig. 2). To the other piece, F, solder a nut, C. This nut should be fitted with a thumbscrew $1\frac{1}{4}$ in. long (25 to 50 threads per in.), the tip of which should be conical. In a rectangular brass plate $4\frac{1}{2}$ in. by 3 in. and $\frac{1}{8}$ in. thick bore a $\frac{1}{2}$-in. hole at the centre. Shallow depressions must be punched in the plate to correspond with the points *n* and *o* and the screw H (fig. 4). A spring clip J (fig. 1) holds the plate K in close contact with the three points. A graduated drum attached to the screwhead and a pointer fastened, as shown at M (fig. 1), afford a means for estimating the amount of vertical movement of the plate. In figs. 1 and 4 the stage is shown as assembled. In a fine-adjustment of this design a certain amount of lateral movement of the image is unavoidable. However, this is partly compensated by the fact that there is absolutely no lost motion.

Gundlach Microscope, Model A H 09.* — This Microscope is primarily intended for school and college use. The coarse-adjustment

* Catalogue, Gundlach-Manhattan Optical Co., Rochester, New York.

is acquired by sliding the tube in a cloth-lined jacket, and a micrometer screw provides the fine adjustment. The stage is fitted with an iris-diaphragm, and is threaded for the addition of a substage ring to hold an Abbe condenser. The tube is nickel-plated, the other brass parts being lacquered. The height is 12 in., and the tube takes eye-pieces and objectives conforming to Society standards.

Gundlach Microscope, Model D H.*—This medal represents the latest general stand manufactured by the Gundlach firm. Economy in combination with excellence of workmanship has been kept steadily in view. The draw-tube is nickel-plated and graduated in millimeters; it slides in a cloth-lined case. The coarse-adjustment is by diagonal rack-and-pinion. The fine-adjustment is a micrometer-screw with a direct action and no reciprocating parts. The pillar is hollowed out as a handle-arm. The stage is 4 in. by $3\frac{1}{2}$ in., and the height of the whole instrument is 11 in.

Gundlach Microscope, Model D D.†—In this instrument, which is meant for general microscopical work, the pillar is bent to serve as a handle-arm, and the fine-adjustment is located under the pillar, where the operator can reach it without disturbing his elbow-rest. The stage ($3\frac{1}{2}$ in. by $3\frac{3}{4}$ in.) is provided with an iris-diaphragm, and an Abbe condenser can be added if desired.

Focostat Lens.—This lens (fig. 77) was exhibited at the February

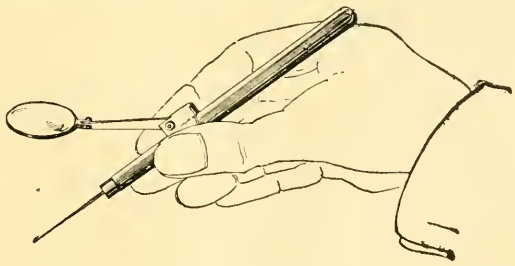

Fig. 77.

Meeting and was described by Conrad Beck (see Proceedings, pp. 231 and 232).

(2) Eye-pieces and Objectives.

Leitz' Double Demonstrating Eye-piece.‡—This eye-piece, which was exhibited by Mr. Ogilvy at the March Meeting, enables two observers to view jointly an object under the Microscope. It slips into the draw-tube of the Microscope like an ordinary eye-piece. The field of view is common to both eye-pieces and contains a pointer which either observer can direct upon any feature to which he wishes to draw attention.

* Catalogue, Gundlach-Manhattan Optical Co., Rochester, New York.
† Catalogue, Gundlach-Manhattan Optical Co., Rochester, New York.
‡ Leitz' Special Catalogue, 1912.

The arrangement of the device is shown in the subjoined figure (fig. 78).

I and II are two prisms in contact and mounted above the diaphragm between the field-lens and the eye-lens of the eye-piece. The prism I has an isosceles cross section, and its angles are 35°, 35° and 110° respectively. The prism II is rectangular, and its angles are 35°, 55° and 90°. The prisms are placed with those faces in contact which subtend the angles of 90° and 110° in such a manner as to leave between them a very thin film of air. This film is inclined at an angle of 30° to the axis of the eye-piece and partially reflects the emerging pencil of rays; about two-thirds of the rays pass through the prisms and one-third is reflected.

The image formed along the axis of the Microscope is accordingly brighter than that produced by partial reflexion. The centre line of the reflected pencil is inclined at an angle of 70° to the axis of the Microscope. III is the prism, the lower surface of which reflects the pencil upwards at a convenient angle for observation. In order that the two observers may not be in each other's way the branch-tube is fitted with

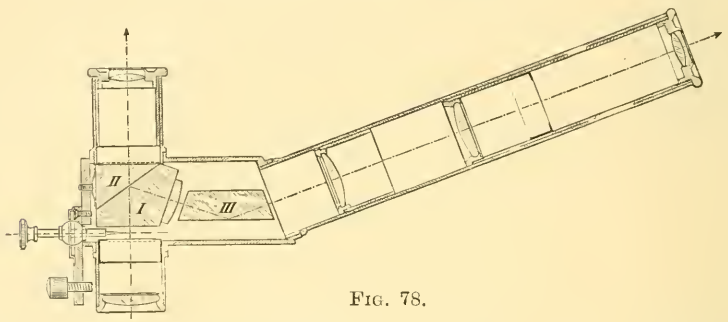

FIG. 78.

a system of lenses which resembles a terrestrial eye-piece. The image as seen in the side tube is reversed with respect to that which appears in the axial eye-piece; but this would hardly affect the observer, especially since the oblique attachment of the side eye-piece already introduces unusual conditions of working.

As a matter of fact the more expedient course is to adjust and focus the object through the principal eye-piece, as the image seen through it is brighter and easier to focus. The adjustment for one eye-piece furnishes also a clearly defined image in the subsidiary eye-piece, provided the eyes of both observers can accommodate in a similar manner. The objective in conjunction with the field lens below the double prisms of the two eye-pieces forms an image in the plane of the diaphragm below the double prism. This image and the pointer being both in the plane of the diaphragm are seen simultaneously in the principal and the subsidiary eye-piece.

The pointer can be moved backwards and forwards and turns on a pivot so that its extreme end can be set at any point in the field. The Double Demonstrating Eye-piece is made in two powers, one having a magnification of four diameters and the other of six diameters.

This eye-piece is also well adapted for the instantaneous photography of living bacteria and other moving organisms illuminated by means of

a dark-ground condenser. It enables one to watch the object through the side eye-piece and to defer the exposure until a favourable moment presents itself.

Magnifying Power of Eye-pieces.*—E. M. Nelson gives the following list of magnifying powers of some modern eye-pieces—the Powell and Lealand A eye-piece, which has an equivalent focus of 2 in., being inserted as a sort of fiducial standpoint :—

Winkel No. 2 Huyghenian	30	Winkel No. 5 complanat	90
Powell and Lealand A	32	Zeiss No. 18 compensating long tube	96
Leitz No. 4 compensating	33	Leitz No. 12 compensating	98
Winkel No. 3 complanat	45	Zeiss No. 27 compensating long tube	146
,, No. 4 complanat	60	Leitz No. 18 compensating	153
Zeiss No. 12 compensating long tube	72		
Winkel No. 6 compensating ..	88		

(3) Illuminating and other Apparatus.

Correction of Errors of Refraction for Microscope Work.†—The eye-strain which not infrequently results from prolonged use of the Microscope, especially when working with high powers and artificial light, is, says W. B. Leishman, often so great as to cause considerable discomfort and headache, and may even lead to the abandonment of microscope work, except for brief examinations. In many cases this trouble is caused by errors of refraction, more particularly by some degree of astigmatism. If this astigmatism is considerable, the microscopist is practically certain, in these days, to be aware of it, and to possess glasses which correct his particular error, but if it is small it may never be detected until advancing years lead him to consult an oculist as to his first pair of presbyopic glasses. In either case, when he attempts to work at his Microscope with spectacles or pince-nez *in situ*, he is certain to find them so uncomfortable and inconvenient that, sooner or later, he discards them, and trusts once more to his unaided vision and his powers of accommodation, with the frequent result that continuous work becomes increasingly difficult and the effects of eye-strain more conspicuous.

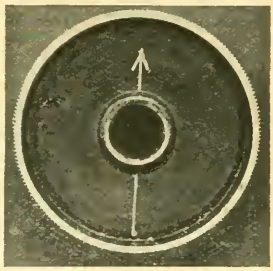

Fig. 79.

The small device here illustrated (fig. 79) has been designed with a view to correcting the error of refraction without employing spectacles. It is so obvious and simple that it is very probable that something similar may have been described and used long ere this, but, since the writer has been unable to discover that this is the case, it appears worth while, for the sake of others similarly situated, to describe the ocular cap which he has had made for his own use. The increased definition which has resulted from the use of this cap is unmistakable, and there has also been a marked lessening of the feeling of strain which used to result from long hours of high-power work.

* English Mechanic, xcv. (1912) p. 591.
† Brit. Med. Journ. (1912) i. p. 123 (1 fig.).

No lengthy description is needed, the principle being merely that the lens necessary to correct the error of refraction of the eye commonly used is fitted accurately into the centre of an aluminium carrier, so constructed as to form a cap which may be placed over the Microscope ocular. In the case of a lens with cylindrical correction for astigmatic error the vertical meridian is permanently marked on the carrier by means of an arrow, as shown in the illustration. As most workers em-

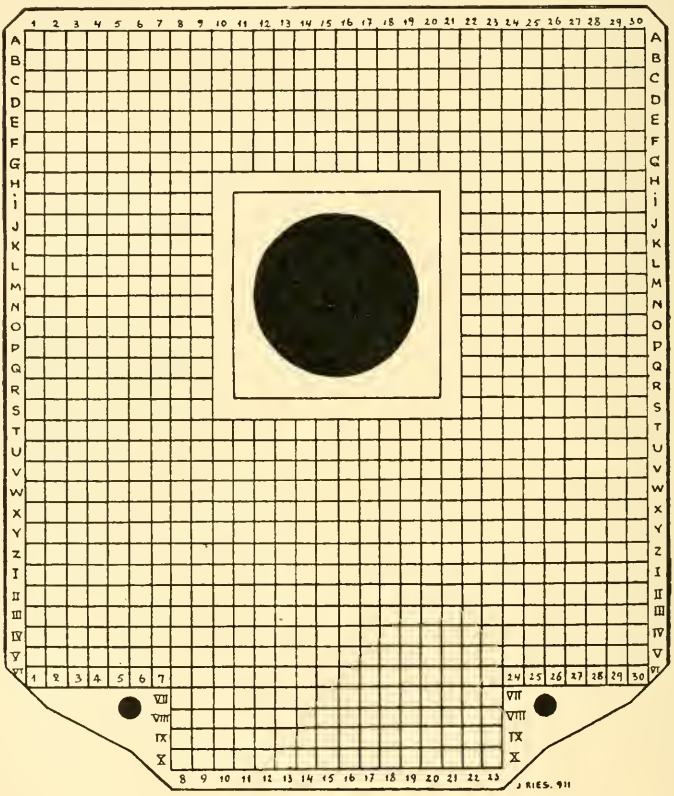

FIG. 80.

ploy oculars of the same maker, the external diameter of which is approximately the same, the cap may be made to fit them all by arranging to have the internal diameter adjusted to fit the largest ocular used.

The photograph has been taken from the cap made to the writer's design by Messrs. Cary and Co., 7 Pall Mall.

Simple Microscopic Place-finder.* — Fig. 80 illustrates a device, described by T. Ries, by means of which much tedious searching of microscopic fields may be avoided. The card may be attached to any

* Zeitschr. wiss. Mikrosk., xxviii. (1912) pp. 289–91.

Microscope stage, and the position of any desired point in the preparation may be recorded by noting the latitude and longitude, so to speak, of the two upper corners of the slide.

MAEY, E.—**Die räumliche Lagerung von Kanten im Mikroskopischen Objekt bei Dunkelfeldbeleuchtung.**
Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 48–57 (5 figs.).

SIEDENTOPF, H.—**Über ultramikroskopische Abbildung linearer Objekte.**
Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 1–47 (22 figs.).

(4) Photomicrography.

Micro-spectra Method of Colour Photography.—A method of colour photography, by purely optical means, involving but a single exposure on a single plate, and dispensing with the aid of artificial dyes or colouring matter, was suggested by Julius Rheinberg in 1904,* and has since that time been worked out and brought to a high state of perfection by the latter and his brother, Ernest Rheinberg. It forms the subject of an exhaustive paper in the Journal of the Royal Photographic Society, and elsewhere.†

The process necessitates a camera of complicated construction (fig. 81), but, given the camera, is very simple to work, the methods being those employed in ordinary black and white photography. A

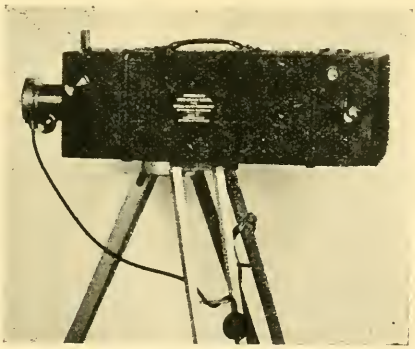

FIG. 81.—Micro-spectra camera on stand.

black and white negative is taken in the camera on a panchromatic plate; a lantern slide is made from it and placed in the camera in the position previously occupied by the negative. White light is projected through the apparatus, and the picture, after slight adjustments, flashes out in its true colours.

The general theory of the process consists in producing by optical means a surface composed of hundreds of complete but very narrow spectra, lying next to one another, the spectra being so close together as to render the individual colours indistinguishable to the unaided eye, so that the surface appears to be white. The photographic positive is

* British Journ. Photography, Jan. 1, 1904.

† Journ. Roy. Photog. Soc., April, 1912; Nature, May 23, 1912. See also British Journ. Photography, Colour Supp , May, 1912, and following months.

used as a mask to block out or weaken those colours which are not wanted, the remainder combining to form the picture.

The surface composed of these contiguous narrow spectra is produced by allowing white light to fall upon a very fine screen of nearly 400 lines per inch, in which the opaque lines are three times as wide as the clear interspaces. An enlarged image of this screen is formed by means of a lens with a prism just in front of it. The prism spreads each white line into a complete spectrum, and is so calculated that the spectra lie next to each other on the focusing screen without interspace. Thus, on the focusing screen each complete spectrum is but $\frac{1}{100}$ in. wide—hence the term micro-spectra. If, instead of white light falling upon the line screen, coloured light is caused to fall upon it, only those spectrum colours of which the line in question is composed appear on the focusing screen, the colours which are wholly or partially missing from the spectrum of white light being represented by spaces, wholly or partially dark.

In taking the photograph, the image of the coloured object is projected by means of an ordinary objective lens on to the line screen, the

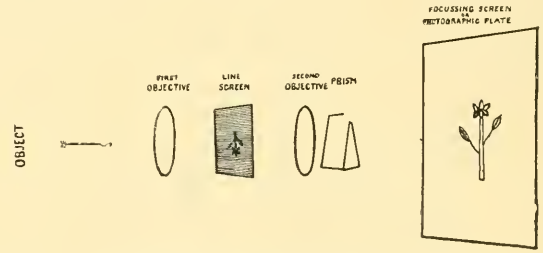

Fig. 82.—General optical arrangement shown diagrammatically.

image of which is in turn projected by the second lens with the prism in front of it on to the photographic plate placed in the position of the focusing screen.

The plate must be approximately equally sensitive to all colours, so that the resulting negative is completely darkened when acted upon by any colour in its full intensity and partially darkened where the incident colour is weakened. A lantern slide positive from this negative will, of course, show the reverse effect, being completely transparent where the colour has acted with full intensity, of partial transparency where the colour has acted less strongly, and opaque where the colours were missing—i.e. in those parts co-incident in position with the spectrum colours of white light that were not present in the object photographed. When, therefore, the positive is placed in the exact position of the negative, and white light is projected through the apparatus, it acts as the desired mask to block out those colours that are not wanted, and the picture is reproduced in the original colours.

An historical sketch shows that the general theory of the micro-spectra method was suggested independently four times, once before and twice after Rheinberg's suggestion, but the apparatus and the results obtained by others were comparatively crude, there being very great

difficulties in the way of constructing a practical apparatus and keeping the camera within portable limits. The paper deals with the nature of the various optical and other problems involved, and shows how they

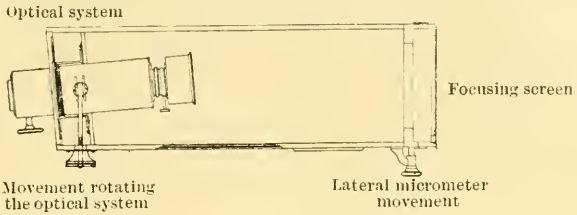

FIG. 83.—Section of micro-spectra camera.

have been solved. Figs. 83 and 84 show a sectional plan of the camera and a section of the optical system, a peculiar feature of the latter being a compound prism (which was specially computed for Rheinberg by Conrady) to produce a spectrum in which the colours are evenly dis-

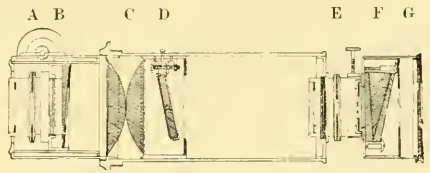

FIG. 84.—Section of optical system.

A, Zeiss 75 mm., micro-planar objective on focusing mount. B, Spectacle-prism. C, Field-lens. D, Line-screen or grating in adjustable frame. E, 75-mm. micro-planar objective. F, Compound prism. G, Cylinder spectacle-lens, 120-in. focus.

tributed as in a grating spectrum, thus obviating the crowding of the red end of the spectrum and undue extension of the blue end incidental to the usual spectra produced by prisms.

The ordinary and best way of viewing the pictures is to inspect them on the focusing screen ; for this a strong artificial illuminant is needed. Another way is to view them on the line screen by means of an eye-piece, substituted in place of the objective of the camera ; for this, daylight or any weak illuminant suffices. They may also be projected in a size of 3–4 ft. diameter on a lantern-screen. All these ways have been publicly demonstrated, and are reported to have given results absolutely faithful as regards colour rendering, together with exceptionally fine rendering of the characteristic sheen and texture of metals, silk, porcelain, etc.

The camera can be used in conjunction with the Microscope for photomicrography (fig. 85). In that case the first objective is removed, but one of the field lenses is left in position. The Microscope attachment is then screwed on in place of the objective. This attachment consists essentially of two sliding-tubes (one of which is scaled), in which the eye-piece of the Microscope can be inserted. To secure proper

illumination the distance of the eye-piece from the field or condenser lens must be adjusted so that its Ramsden circle and the other objective in the camera are in conjugate foci with respect to the field lens. The Microscope can be used with any Microscope objective. It is found convenient to place the exposure shutter and compensating filter at the end of the tube just behind the Microscope eye-piece, although other equally good positions might be found for these. So far as photomicrography is concerned, it is evident that the prismatic dispersion method, in common with all screen-plate methods of colour photography, is not suitable for work which requires the finest definition of individual elements. Its utility applies chiefly to stained objects, or to objects illuminated by Rheinberg's colour illumination: in short, to objects

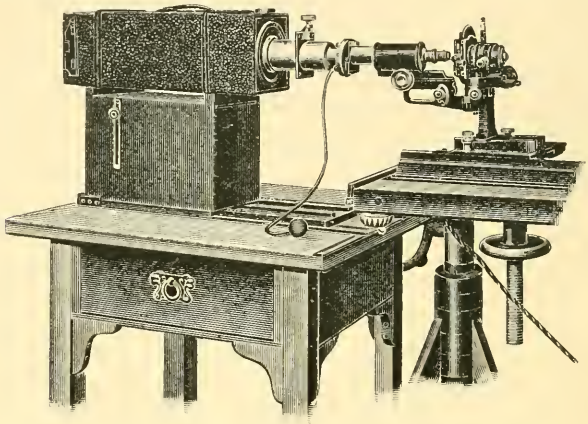

Fig. 85.—Camera as used in conjunction with the Microscope.

where colour differentiation forms one of the main features. It should also afford a striking means of reproducing polarized light effects. The authors state that that is all that can be said as yet with regard to photomicrography, a sufficient range of experiments in that direction not having yet been made.

Making of Photomicrographs.*—J. Cockburn writes in reference to the failure of prints as regards clearness and definition, and gives his own procedure :—"Get, of course, as sharp a focus as possible, using a magnifier of low power on the focusing screen, and do not on any account try to get a large-sized negative at once. Using a rather slow plate, with as little grain as possible, and presuming that an eyepiece is used on the Microscope, get the plate at such a distance from the eyepiece that the resulting negative will be 1 in. or 1·5 in. in diameter. After developing and fixing this, and seeing that it is free from fog, take a contact transparency (positive) from it, either on a fine make of lantern plate or with transparency carbon tissue. From this positive make a negative by means of a lantern to a diameter of double

* Brit. Med. Journ. (1912) i. p. 704.

—perhaps more—also on a lantern or other grainless plate, and if this is not sufficiently large repeat the process by taking another transparency and re-enlarging. This may seem complicated and troublesome, but it is well worth the trouble. By this method I have had prints of 1024 diameters and more with very great definition and clearness. Though, of course, the exposure is longer for a slow and grainless plate, I consider that it is compensated for by the clearness for the future enlargement."

(5) Microscopical Optics and Manipulation.

General Theory of Image Formation in the Microscope.*—In the May number (1912) of the Boletin de la Real Sociedad de Historia Natural appears a review by Domingo de Orueta of a work† on the above subject compiled by J. M. de Castellarnau y Lleopart. The book is divided into three parts, the first of which discusses in seven chapters the path of the rays in the Microscope and the dioptric properties of the image. The second part deals with the genesis of the microscopic image and the laws of its correspondence with the object. The subject of the third part is the experimental demonstration of the theory of the formation of the image. The whole is preceded by a short prologue, and is followed by a group of five addenda on such special topics as dioptric demonstration of the law of sines. To a great extent the present work is an expansion of Castellarnau's Visión Microscópica, which was published in 1885, and which was very favourably noticed in our Journal.‡ Orueta incorporates into his review many interesting historical notes on the progress of the Abbe theory.

Optical Properties of Muscle.§—F. Vlés has brought together and published under the above title the results of many years' labours (1905–10). The present volume represents the study of muscle in rest or in extension, and might be briefly described as the statical optics of muscle. A second volume is to follow in due course, and will deal with the changes taking place during contraction or extension, in fact with the kinematical optics of muscle. This present work is divided into five parts, the first three of which examine successively all the fundamental optical properties of muscle and of muscular fibre, such as absorption, index of refraction, images in ultra-violet light, diffraction spectra of striæ and their ultra-microscopical structure. The fourth part deals with the reactions of muscle in polarized light and the author's criticisms, based on a long series of experiments, on Engelmann's celebrated theory as to the relations subsisting between contractility and birefringence. The author has endeavoured to show that in various contractile elements (vibratory cilia, flagellæ, etc.) it is preferable not to admit the generality of the relation enunciated by Engelmann. In the fifth part are condensed the principal results which the study of muscular optics can bring to the knowledge of muscular structure, and the author has essayed to utilize these results in attempting a theory of striation.

* Boletin de la Real Sociedad de Historia Natural (1912), pp. 289–297.

† Teoria general de la formación de la imagen en el microscopio (Madrid, 1911), 414 pp. (161 figs. and pls.).

‡ See this Journal (1886) p. 335.

§ Propriétés Optiques des Muscles. Paris: A. Hermann et Fils (1911), xviii. and 372 pp. (many figs.).

Optical Illusion observed when Blinking the Eyes. * — L. Bull points out that, if the wheels of a rapidly-moving carriage in the street are observed, the spokes ordinarily invisible owing to their swiftness are yet sometimes clearly seen, especially at the moment of blinking. The phenomenon is more easily observed with a black disk about 30 cm. in diameter on which some twenty white spokes 1 cm. wide have been painted. If the disk be turned with a speed of five or six rotations per second, and the observer is a few metres away, the sensation is that of a uniform grey. But if the spectator sharply shuts his eyes without looking off the disk, the spokes comprised in a sector of a size varying according to the individual leave a perfectly distinct impression on the retina, and appear concave in the sense of the rotation. The author describes some experiments undertaken to elucidate the cause, and comes to the conclusion that the phenomenon can only be due to a displacement of the image of the disk on the retina produced by a movement of the eye at the moment of blinking. It is possible to verify this photographically, and to establish the fact that when the eyes are closed rapidly the ocular globes are displaced. The movement takes place in a direction which depends on the orientation of the glance with regard to the position of the head, and it gives rise to the same displacement of the image on the retina as a translation of the object in the sense inverse to that of the movement.

Displacement of the Particles in the Brownian Movement. Phenomenon of the Borders.†—S. Lifchitz has continued his observations on Brownian movement by introducing particles of smoke into the ultramicroscopic condenser of Leitz. The aperture of this condenser was always covered by a plate of glass pierced at its centre by a square hole. The focus of the condenser is at the centre 1·5 mm. below the surface of its aperture, and the displacement was observed at this central spot. Now a covered condenser is a resonator of small dimensions, and therefore some acoustic phenomenon was to be expected. At the moment of sparking it was observed that the particles on the surface of the aperture of the condenser moved perpendicularly to the extremities of the borders. (This is the phenomenon of the borders.) An explosive shock —e.g. a whistle—at the same time brought about a displacement of the particles. The author concluded that in the aperture of a resonator there is produced a movement of air directed towards the centre of the aperture, and that, by employing a very small hole, one can profit by this phenomenon to construct an ultramicroscopic indicator for very short sonorous waves. The displacement of the particles due to very rapid shocks can be separated from the phenomenon of the borders by the use of holes sufficiently large.

6) Miscellaneous.

How to Use the Microscope.‡—This little work by C. A. Hall is intended as a guide for the novice, or beginners who have practically no knowledge of the Microscope, and it deals only with instruments of the

* Comptes Rendus, cliv. (1912) pp. 1251–4 (2 figs.).
† Comptes Rendus, cliv. (1912) pp. 1218–20.
‡ London: A. and C. Black (1912) 88 pp. (20 photo pls. and 25 text figs.).

cheaper kind. It contains chapters descriptive of the Simple and Compound Microscopes and how to use the Microscope. It then deals with some accessories and how to manipulate them, and afterwards describes some common objects. The last two chapters are devoted to the preparation and mounting of permanent objects and simple photomicrography. The twenty photomicrographs, which are excellent, were taken by the author, and were obtained by the method described in the concluding chapter.

Beck's Holophane Lumeter.*—The holophane lumeter is a portable instrument (fig. 86) which takes in at a glance the brightness, in candle feet, of any surface. It is a small box, on looking into which is seen an illuminated disk with an aperture in the centre. The object to be examined will be seen through the aperture. It will appear more or less brilliant than the surrounding white disk. By moving a handle the brilliance of the illuminating disk can be reduced until it is the same as the object being examined, and the brightness of the object is

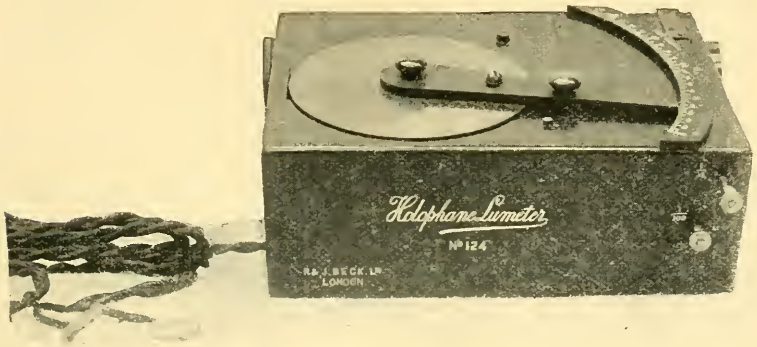

FIG. 86.

immediately read on a scale of candle feet, the range being from 1/100 candle foot to 2000 candle feet. The usual type of photometer determines the brightness of a lamp or other source of illumination, but cannot be used to ascertain the brightness of an object or surface. The complete outfit consists of the lumeter, an accumulator, a white screen, and standard candle complete in sling case.

The lumeter (fig. 87) is a hollow box measuring $6\frac{11}{16}$ in. by 5 in. and $2\frac{1}{2}$ in., within which is a circular chamber A, lined with a matt white surface, which contains a small incandescent lamp B; the box itself is black throughout, except for a matt white screen C, which has a transparent aperture D. By means of an eye-piece E, the matt-surface white screen C can be observed, a hole F at the other end of the box allowing an uninterrupted view of objects to be seen through the aperture D. The cylindrical wall of the inner chamber A has an aperture G filled with a translucent glass through which light from the electric light B illuminates the white screen C; its brilliance can be increased or reduced by moving the lever H, which revolves a tubular cover which

partially or entirely closes the aperture G, the motion of the lever H against the scale K recording the brilliance of the illumination. The apparatus is made by R. & J. Beck.

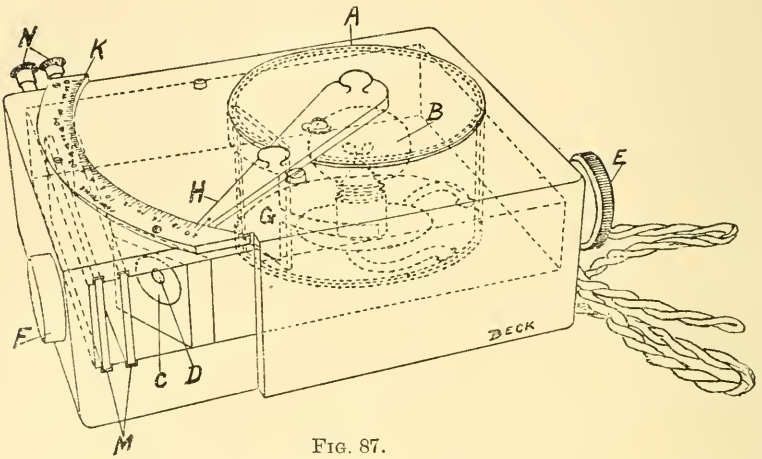

FIG. 87.

Quekett Microscopical Club.—The 482nd Ordinary Meeting was held on May 28, 1912, Dr. E. J. Spitta, Vice-President, in the Chair. Mr. E. M. Nelson wrote that he had examined a mount of Mr. Siddall's diatoms showing the so-called "pseudopodia." Structure was observed inside the filaments in two cases, one a *Coscinodiscus* and one a *Biddulphia*. Mr. R. T. Lewis, F.R.M.S., read "A Note on *Solpuga* (*ferox* ?)." About fifty species of this Arachnid are known, all African. The specimens described were from Lindley, O.R.C. Preparations were exhibited under Microscopes. Mr. A. E. Conrady, F.R.A.S., described "Some Experiments on Alternative Microscopical Theories."

The 483rd Ordinary Meeting was held on June 25, 1912. Mr. W. B. Stokes (Hon. Sec.) contributed a paper "On Resolutions obtained with Dark-ground Illumination, and their Relation to the Spectrum Theory." A number of experiments were described, of which we may select one. An objective of N.A. 0·86 and a dark-ground illuminator of N.A. 1·35 were employed. According to the Abbe theory, this should resolve 58,750 lines per inch, using light of wave-length 5080. In practice it was found that this combination would resolve the 60,000-band of a Grayson's ruling ; it was therefore suggested that we should be justified in turning for guidance to the older theory of Airy. Mr. R. W. H. Row, B.Sc., reported the occurrence in large numbers, at Malden Railway Station, Surrey, of a rare saw-fly of the genus *Phyllotoma* (possibly *P. aneris*).

DIERKS, W.—**Einführung in das Mikroskopieren Union, Deutsche Verlagsgesellschaft.** Berlin: (1912) 122 pp. (34 figs.).

HEINEMANN, P. G.—**A Laboratory Guide in Bacteriology, for the Use of Students, Teachers, and Practitioners.**
Chicago: University Press, 2nd ed. (1911) 88 pp.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Spud for Bacteriological Purposes.†—F. Schreiber describes a new instrument, which may be used for removing large masses of bacteria from the surface of solid culture media, and is therefore of service in researches upon toxins and antitoxins, and also in the preparation of vaccines. The instrument is made of German silver, and the design of it is shown in figs. 88, 89. The portion of the instrument between the handle and the spud-end is slightly flexible, and thus manipulations with plates and flasks are facilitated. It may also be adapted for use with narrow test-tubes.

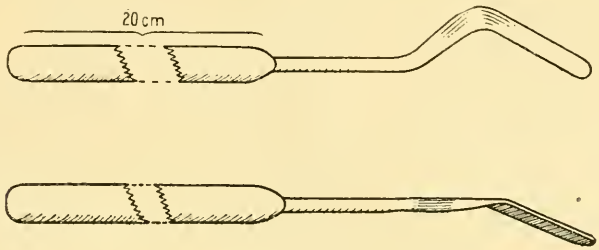

Fig. 88, 89.

Cultivation of Tubercle Bacilli.‡—R. Turro and J. Alomer make use of potato media for this purpose. Potatoes are cut up in small portions, and water containing glycerin (5 p.c.) is added. The mixture is autoclaved for 10 minutes at 125° C. It is then filtered, and a syrupy amber-coloured fluid is obtained. Surface inoculation of the fluid with suitable material causes the rapid growth of the tubercle bacilli. A solid medium is obtained by the addition of agar (2 p.c.). Cultivations upon this medium do not present quite the crusty coherent character which is a feature of growths of tubercle bacilli on ordinary media. The authors point out that certain kinds of potato, including some Spanish and Italian varieties, are not suitable for the growth of tubercle.

Medium for Cultivation of Leishmania.§—For the cultivation of *Leishmania* and allied Protozoa, R. Row has devised a modification of the Nicolle-Novy-McNeal medium, which possesses certain advantages for workers in tropical countries. The Nicolle-Novy-McNeal medium, consisting of condensation water from an agar medium, becomes rapidly concentrated by evaporation, and is only available in small quantities. Row recommends that 5–8 c.cm. of blood be aspirated under aseptic conditions from the ear-vein of a rabbit or from the human fore-arm, and defibrinated. The addition of sufficient sterile distilled water produces

* This division contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Embedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc. (6) Miscellaneous.

† Centralbl. Bakt., Abt., 1te Abt. Orig., lxiii. (1912) p. 543.

‡ C.R. Soc. Biol. Paris, lxxii. (1912) pp. 583–4.

§ Brit. Med. Journ. (1912) i. pp. 1119–20.

hæmolysis. This laky blood is then added by means of sterile pipette to sterile saline (1·2 p.c.) in test-tubes in the proportion of 1 to 2. The setting free of the hæmoglobin renders the medium most suitable for the ready growth of Protozoa.

Method for obtaining Pure Cultures from Sputum.*—It is often difficult to obtain pure cultures of lung microbes from bronchitic sputum, owing to the contamination of the material with organisms derived from the mouth. W. E. M. Armstrong removes these adventitious bacteria by placing the sputum in the wire-mesh cavity of a tea-strainer and washing under a tap. The outward salivary wrappings, with the microbes contained therein, are washed away. This is partly due to the violence of the water stream, partly to the superior solubility of the salivary portion to that of the more gelatinous bronchial part of the sputum. Cultures from the bronchial part, which remains behind, may be pure.

(3) Cutting, including Embedding and Microtomes.

Bausch and Lomb's New Model Minot Automatic Precision Microtome.†—This microtome (fig. 90) has recently been so improved as virtually to be a new model. Under proper conditions it will cut absolutely uniform sections down to one micron. The gearing between

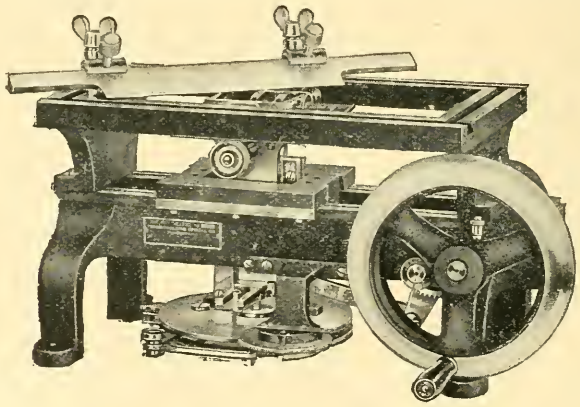

Fig. 90.

the flywheel and crank reduces the motion in a ratio of three to one; the specimen is thus prevented from moving too rapidly against the knife, and the jar upon the feeding mechanism is also avoided. It is equally suitable for paraffin and celloidin preparations. The object-clamp, supported on the vertical V-slide, is adjustable vertically upon it and also on two planes. The feeding mechanism is controlled by an adjustable cam, the impact on which is by roller, and both this and the cam are of hardened steel. A great saving of time is effected by the split nut and the releasing lever: this enables the carriage to be instantly

* Lancet (1912) i. pp. 1339–40.

† Bausch and Lomb, Special Catalogue, 1912, pp. 8 and 9.

brought to the beginning, or to any intermediate position, and then held. The knife, which is bilaterally symmetrical in section, has a straight edge, and is 315 mm. long.

Ott Rotary Microtome. — This instrument (fig. 91) was described in the June Number (see page 363).

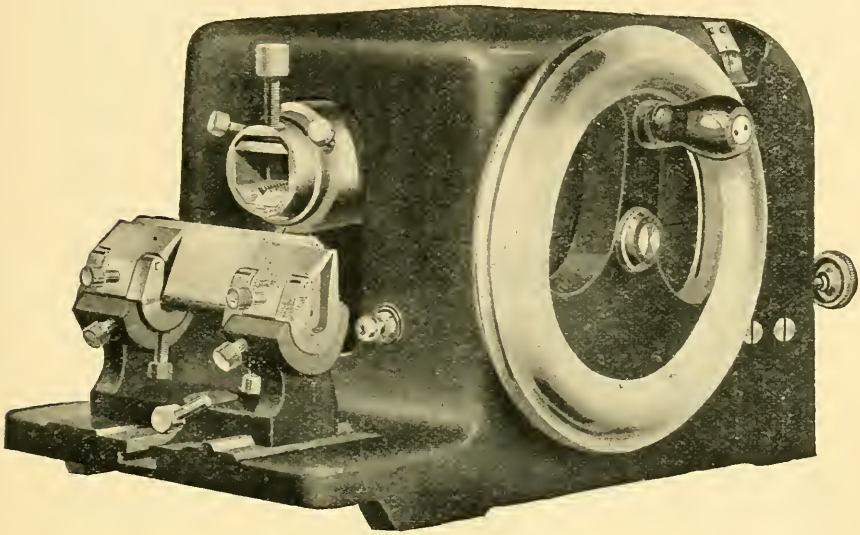

Fig. 91.

Gaskell's Method of obtaining Frozen Sections after embedding in Gelatin.*—The tissue is fixed in any formalin mixture, such as 10 p.c. formalin solution in normal saline, or formol Müller solution. The tissue, when fixed, is thoroughly washed out in running water for 12 to 24 hours, to remove all formalin. It is then embedded at 37° C. in an ordinary incubator, in gelatin previously soaked for 3 to 4 minutes in cold water, and then melted. The embedding process continues for 2 to 5 hours—longer periods are unnecessary and harmful. The tissue is then cast in paper boxes in the gelatin in which it has been soaked. The mass is then allowed to set at room temperature, and then transferred to a formalin vapour chamber to harden. It is left in this for a period of at least 3 days; it may, however, remain in the chamber almost indefinitely, and this is a convenient way of keeping the blocks till wanted.

To obtain sections, the paper is cut away with a knife, and the block pared down, and then attached to the stage of Aschoff's freezing microtome, as made by Sartorius, by a drop of gum solution, and frozen. Sections can be obtained of any tissue hitherto tried of a thickness of 10 μ, and of most tissues 5-μ sections are obtainable. They are floated on cold water, and can then be stained in any manner required. The staining of the gelatin is not found to cause much inconvenience. The

* Journ. Path. and Bacteriol., July 1912.

method has been used with success for many Invertebrates, and many mammalian and human tissues, which tend to disintegrate into fragments with the usual freezing methods.

(4) Staining and Injecting.

New Method of Staining Diphtheria Bacilli.* — C. Ponder has found that the following procedure is extremely satisfactory for detecting *Bacillus diphtheriæ* in direct smears and in films from cultures. A film is made on a cover-glass and fixed in the usual way. It is then treated with the following stain:—Toluidin-blue 0·02 grm.; glacial acetic-acid 1 c.cm., absolute alcohol 2 c.cm., distilled water to 100 c.cm. A loopful of the fluid is dabbed on and spread over the film. The cover-slip is then turned over and mounted as a hanging drop. It is then examined by artificial light. Diphtheria bacilli are stained a pale blue, while the granules are of a deep red hue. The rings for the hanging drop are made with plasticin.

Demonstrating Unstriped Muscle Fibres in the Intima of the Human Aorta.†—A. Ollendorff alludes to the difficulty of demonstrating the presence of unstriped muscle fibres in blood vessels, especially if they be isolated or in small bundles. He adopted Benda's procedure for staining the myoglia or supporting substance of the smooth musculature. The material used was obtained from bodies 20 to 25 years of age and removed not later than 2 to 3 hours after death, fresh tissue being of the greatest importance. The material was at once placed in Zenker's fluid for 24 hours and then washed for several hours in water. The third step was to make frozen sections, which were immersed for 24 hours in 0·5 p.c. chromic acid solution. After a wash in water the sections were treated for 3 minutes with 0·25 p.c. solution of permanganate of potash. After another wash in water they were removed to Pal's mixture of sulphite of soda and oxalic acid for 5 minutes. After another wash in water the sections were placed on slides and stained with Benda's mixture (crystal violet, hydrochloric acid, alcohol and anilin water). The stain is mopped up with blotting paper and then dilute Lugol's solution poured over the section. Next, the Lugol is mopped off, the section dried, and then differentiated with a mixture of equal parts of anilin-oil and xylol. After this it is treated with xylol and mounted in balsam. The muscle fibres whose margins are not visible are seen as violet-coloured streaks, while the nuclei are quite evident.

Demonstrating the Structure of Microfilariæ.‡—G. Pittaluga finds that the best way to show the structure of filariæ is to adopt the intra-vitam method of staining. The material used was obtained from inhabitants of Spanish Guinea. A small drop of live blood from the ear or finger is placed on a slide and mixed with a similar or suitable quantity of a solution of alkalin-methylen-blue.

Simple Methods in the Bacteriological Diagnosis of Cholera.§—C. Krumwiede read a paper before the Society of American Bacterio-

* Lancet (1912) pp. 22–3.
† Anat. Anzeig. xxxviii. (1911), pp. 569–73.
‡ Bol. Instit. Nacional Higiene Alfonso XIII. viii. (1912) pp. 77–92 (3 pls.).
§ Centralbl. Bakt., 1te Abt. Ref., li. (1912) pp. 685–6.

logists in December 1911 on the diagnosis of cholera. Two points were kept in view, viz. the possibility of examining enormous numbers of cases with the minimum of equipment, and the rapid preparation of media for immediate use in emergency. In general no medium is necessary but peptone water. If the fæces contain a sufficient number of cholera vibrios, the peptone cultures after eight to twelve hours have practically a pure culture at their surface. If a drop of this and immune serum be mixed, the microscopic agglutination is so prompt and evident as to be diagnostic. In examining carriers or mild cases the first peptone tubes may show little or nothing. If, however, subcultures be made, the second surface growth becomes sufficiently pure for testing the agglutinability of the vibrios. Vibrios other than cholera can be excluded by their inability to enrich or by the absence of any influence of the agglutinating serum.

As a selective medium the following gives equally good results as defibrinated blood :—A. Whole egg and water āā ; sodium carbonate (crystallin, 12 to 13½ p.c.) ; mix in equal parts and steam for 20 minutes. B. Pepton, salt and 3 p.c. agar. Mix 30 parts of A with 70 parts of B while the agar is boiling hot ; pour medium to thick plates, and then inoculate by surface streaking. Should other fæcal bacteria grow, the cholera colonies can easily be selected. The latter have a distinctive hazy outline and appear to be deep in the agar. With longer incubation a zone of clearing appears about the colonies.

Demonstrating the Presence of Capsules in Cultures of Pneumococcus and of Pneumobacillus.*—J. Hardouin makes a film of a mixture of the culture and of indian ink after the manner initiated by Burri for demonstrating the *Spirochaeta pallida*. The film is then dried and fixed with alcohol, and afterwards stained with toluidin-blue, carbolmethylen-blue, or with carbol fuchsin. The film is then washed with water dehydrated with alcohol, cleared in xylol, and mounted. The capsules are said to stand out with perfect clearness.

Demonstrating the Presence of Chondriosomes.†—E. Grynfeltt, when examining the cells of the hypobranchial gland of *Murex trunculus*, employed the following methods :—Alizarin and crystal violet differentiated with acetic-acid (Benda), iron hæmatoxylin after fixation in formol-Müller (Regaud), fuchsin differentiated with picric-acid (Altmann). The author mentions that mitochondrial bodies or chondriosomes, which together constitute the chondriome (Meves) or mitochondrial apparatus (Duesberg), may present themselves in the form of filaments or chondriochonts (Meves), as chains of granulations, similar to streptococcus, called chondriomites (Benda), or as fine isolated granulations, the mitochondria of Benda. All of them are stained deeply by any of the three methods given above ; but it seems unwise to rely merely on these staining reactions, marked though they be. Their morphological characters must also be taken into consideration, especially as mitochondria are extremely like certain granules which, while staining exactly in the same way, are certainly not mitochondria.

* C.R. Soc. Biol., lxxii. (1912) pp. 298–9.
† Bull. Mensuel Acad. Sci. et Lettres Montpellier (1912), Nos. 1–3, pp. 12–7.

Staining Leishmania in Sections.*—L. Nattan-Larrier gives the following methods for staining Leishmania in sections:—1. Staining with carbolthionin: 30 min. in carbolthionin; wash in distilled water; dehydrate rapidly in absolute alcohol; differentiate for long time in oil of cloves, then absolute alcohol; clear in xylol. The nucleus and the centrosome are stained a deep blue. 2. Staining with nuclear black and carbolthionin: Stain for a quarter of an hour in nuclear black; wash copiously in distilled water; stain for half an hour in carbolthionin; wash in distilled water: dehydrate quickly in absolute alcohol; differentiate in oil of cloves, then alcohol until only the nuclei seem to be coloured. The nuclei and the centrosomes are stained a greenish-grey; the contour of the parasite is stained blue and stands out clearly against the grey protoplasm of the cells. Staining with alum-carmine and carbolthionin: Stain for 24 hours in alum-carmine; wash in distilled water, and then stain for half an hour in carbolthionin; differentiate in oil of cloves until a microscopical examination shows that the protoplasm of the cells is of a rose-colour; wash quickly in absolute alcohol; clear in xylol.

Intra-vitam Staining.†—E. Gollman discusses his researches in this field of vital staining, and shows how, by the injection of vital stains into living animals, valuable histological and pathological researches may be carried out. For small animals subcutaneous, for larger intraperitoneal injections are recommended. Of trypan-blue and isamin-blue, injections of 1 c.c. of a 1 p.c. solution per 20 grammes of body-weight of the animal may be used. Weekly injections of this kind may be repeated several times with safety. Both dyes allow of fixation by 10 p.c. formalin solution (best applied from the beating heart of the anæsthetized animal). Specimens fixed with formalin for 48 hours may be frozen and sections cut, counterstained, dehydrated, and mounted. As counterstain alum-carmin may be used, but for connective-tissue studies Pappenheim-Unna's pyrronin methyl-green, and for leucocytic analysis Ehrlich's triacid mixture are useful. The author discusses also the formulæ of certain new vital stains, including trypan-violet, diamin-blue BB, diamin-black BH, vital neu-rot, vital neu-orange, vital neu-gelb and dianil-blue R.

The remainder of the paper is devoted to a consideration of normal and morbid histological observations founded upon applications of this method. In another communication‡ the author details certain biochemical studies based upon the same procedures, which illustrate cellular activities in health and disease.

Staining Bacterial Capsules.§—G. Baehr and Y. Kautor, after a résumé of the methods of Welch, Hiss, Buerger, and others for the demonstration of the capsules of bacteria, criticize the methods of Welch and Hiss, in which the film is dried previous to fixation, as this has a deleterious effect upon the capsule. Buerger's method and the osmic vapour method of Weidenrich are free from this objection. Methods which leave an albuminous menstruum are objectionable, as pseudo-

* C.R. Soc. Biol., lxxii. (1912) pp. 436–8.
† Proc. Roy. Soc., Series B, lxxxv. (1912) pp. 146–56.
‡ Lancet (1912) i. pp. 1183–8.
§ Centralbl. Bakt., 1te Abt. Orig., lxiii. (1912) pp. 120–8.

capsules may be shown. Buerger's method properly applied is free from these objections. Just before the smear dries the fixing fluid (Zenker's fluid minus acetic acid) is added and heat is applied. It is then washed, treated with alcohol, iodin is applied, and after further treatment with alcohol the film is allowed to dry. It is then treated with anilin-gentian-violet, washed with 2 p.c. salt solution, and mounted in salt solution. Buerger describes a pneumococcus type, a streptococcus type, and a mucoid type of capsule, and the present authors attribute to these a high diagnostic value.

Staining Embryonic Skeletal Structures.*—H. Lundvall describes the following methods. For staining cartilage the material is placed in 0·25 p.c. solution of tolnidin-blue in 1 p.c. hydrochloric-acid-alcohol for several days at 40° C. and then decolorized in acid-alcohol. Alternatively, a rapid method with methylen-green and glacial acetic acid may be used. For contrast-staining of bony and cartilaginous structures the material is treated with alcoholic solution of alizarin and decolorized in 95 p.c. alcohol. It is then counterstained with alcoholic methylen-green to which is added a small quantity of glacial acetic acid, and washed in 70 p.c. and 95 p.c. alcohol alternately. After this decolorization is completed the bony structures appear red, the cartilage greenish-blue. For dehydrating and clearing the tissue is then treated successively with absolute alcohol, absolute alcohol and benzol two parts to one, absolute alcohol and benzol one part to two, benzol, and finally with the clearing fluid, which contains four parts of benzol saturated with peppermint-oil and one part of carbon disulphide.

Colloid Metal as Substitute for Indian Ink in Burri's Method.† P. Nitsche states that "Collargol," a silver preparation, may be usefully substituted for Indian ink in Burri's method.‡ A smear of the material to be examined is made on a slide; the material may be diluted with water. When the smear is dry the silver solution is spread over it, and this also allowed to dry. The pictures of bacteria and spirochætes are extremely sharp and larger than by Burri's method. If free acid should be present in the material—e.g. coagulated milk—this should be mixed with a few loopfuls of aqueous ammonia before allowing the smear to dry.

New Method of Spore-staining.§—Jun Hanzawa describes a procedure for staining spores, the novelty being a preliminary treatment with iodo-potassic iodide solution. The spore-bearing organism is fixed on a cover-glass, and then treated for from 1 to 3 minutes with Gram's iodin solution. It is then washed successively in alcohol and in water. It is next stained with methylen-blue (30 seconds), or with carbol-fuchsin (1 minute), or with anilin-water-fuchsin (2 minutes), or with anilin-water-gentian-violet (3 minutes). Slight heat is used for promoting the staining. If double staining be desired, this may be done by treating the preparations which have been stained with fuchsin, with methylen-blue (10 seconds, cold); while gentian-violet stained preparations are contrasted with Bismarck-brown (½ minute). After this the films are washed in water and mounted in the usual way.

* Anat. Anzeig., xl. (1912) pp. 639–46.
† Centralbl. Bakt., 1te Abt. Orig., lxiii. (1912) pp. 575–6.
‡ See this Journal, 1910, p. 118.
§ Centralbl. Bakt., 2te Abt. Orig., xxxiv. (1912) pp. 172–6 (1 pl.).

(6) Miscellaneous.

Direct Enumeration of Bacteria in Water Samples.*—After a discussion of the investigations of previous workers, and of the theoretical advantages possessed by direct enumeration methods over the ordinary procedures, which involve the counting of colonies upon agar and gelatin plates, Aumann describes his own experiences. In the author's own researches, a Thomas-Zeiss cell was used at first, but control experiments with sterile saline and distilled water showed that such a cell could not be rendered sufficiently sterile for these purposes. For the remainder of the work, the author made use of a quartz chamber, which could be sterilized. The cover-glass was also of quartz. The apparatus rested upon a holder, which ensured that a horizontal position was maintained. Comparative study of direct enumeration and of the results obtained by plating, carried out with a large number of water-samples, showed that direct methods were not reliable, and could only be applied with safety to the examination of water containing a very large number of organisms (more than 16,000).

Pseudoparasitic Modifications in Structure of Erythrocytes.† V. Schilling details the histological features presented by the normal red cell when treated and examined by modern methods. These consist, briefly, in a plate-like nucleus, in achromatic and central portions which constitute the archoplasm, in the specific hæmoglobin portion and the membranous sheath. The author then considers the various appearances found by various workers, who allege the existence of definite parasites, such as chlamydozoa, associated with diseased conditions. He submits that these are, in fact, not parasites, but pathological modifications of the various constituent elements of the cell, as above detailed. He considers, in particular, Prowazek's cell-inclusions, Guarnieri bodies, Kurloff bodies, and so on, homologating them severally to portions of the archoplasm.

Carazzi, D., & G. Levi—**Tecnica microscopica.**
Milano: Soc. editr. libr., 2nd. ed., viii and 500 pp.

Metallography, etc.

Structure of Products obtained in Manufacture of Lead.‡—G. von Komorowski describes and illustrates the microstructure of 22 specimens of matte lead of various degrees of purity, etc.

Metallographical Laboratories.§—A good description is given of the metallographical laboratories in the new Metallurgical Institute of the Technical High School, Breslau. Three types of Microscope are used—a Martens stand by Zeiss, an apparatus by Reichert on the Le Chatelier principle, and a Guertler apparatus by Leitz. The Reichert model includes the very convenient reflex camera. Krupp's laboratories and metallographical apparatus are also described.‖

* Centralbl. Bakt., 2te Abt., xxxiii. (1912) pp. 624–35.
† Centralbl. Bakt., 1te Abt. Orig., lxiii. (1912) pp. 393–400.
‡ Metallurgie, viii. (1911) pp. 741–2 (28 figs.).
§ Stahl und Eisen, xxxi (1911) pp. 1565–79 (12 figs.).
‖ Stahl und Eisen, xxxi. (1911) pp. 1624–30 (11 figs.).

Microscopic Examination of Carbon.*—G. A. Roush has applied metallographical methods to the examination of carbon electrodes, brushes, and similar electrical material. Polished sections are "etched" by heating to redness so that the more readily oxidized portions are oxidized, or by relief polishing on chamois skin or broadcloth. Petroleum coke can be recognized by a striated appearance, retort carbon by a finely pitted surface. Natural graphites can generally be recognized by the shape of the flakes, but artificial graphites are not readily identified. Photomicrographs are given.

Grinding and Polishing Machine.†—A simple and handy machine made by R. and J. Beck is described. A single horizontal brass disk is driven by a small motor. By shifting the belt a range of speeds from 300 to 1000 revolutions per minute may be obtained. The emery paper or polishing cloth is stretched over the disk and held by means of a garter made of a stiff brass spiral spring ring fitting into a groove in the edge of the disk.

A removable splash-guard is provided, and a cover for excluding dust when the machine is not in use.

Reflex Camera for Photomicrography.‡—O. Heimstädt describes a photomicrographic camera made on the reflex principle by C. Reichert. It is claimed that the effects of vibration, so troublesome in high power work, are minimized by the use of this apparatus.

Polyhedric Structure in Iron-carbon alloys.§—N. J. Wark has microscopically examined seven iron-carbon alloys, containing 0·1 to 1·7 p.c. carbon, quenched at various temperatures in the range 800–1400° C. Certain of these contained large polyhedra. A similar series of five alloys were etched with hydrochloric acid gas at high temperatures (850–1050° C.); within the solid solution field, the structures developed were always polyhedric. The polyhedric structure appears to be that of the original austenite solid solution.

Critical-point at 470° C. in Copper-zinc Alloys.‖—H. C. H. Carpenter has continued his investigation of the β constituent in the copper-zinc system. A specimen of so-called pure β, containing 52·12 p.c. copper, 47·85 p.c. zinc, enclosed in a glass tube, was heated in sulphur vapour at 445° C. for six weeks. Microscopic examination did not indicate that any appreciable progress towards coalescence of α and γ particles had taken place. An alloy consisting of β with a little α, and an alloy consisting of β with a little γ, were then annealed in a similar manner. After sufficiently lengthy annealing, it was found that the β constituent had been replaced by massive α and γ in both cases. The author concludes that below 470° C. the so-called β constituent is to be regarded as an intimate eutectoid mixture of α and γ particles; the structural stability of this complex is so great that coalescence only occurs on annealing when either α or γ is present in excess.

* Journ. Ind. Eng. Chem., iii. (1911) pp. 368–72, through Journ. Soc. Chem. Ind., xxx. (1911) pp. 811–12.
† Engineering, xcii. (1911) p. 864 (1 fig.).
‡ Metallurgie, viii. (1911) pp. 137–8 (2 figs.).
§ Metallurgie, viii. (1911) pp. 731–6 (16 figs.).
‖ Journ. Inst. Metals, vii. (1912) pp. 70–104 (24 figs.).

Influence of Tin and Lead on the Microstructure of Brass.*—F. Johnson has examined microscopically several specimens of brass to which a little tin had been added, and one to which both tin and lead had been added in small amounts. He concludes that tin is only slightly soluble in the α phase of cast 70/30 brass, but is readily soluble in the β phase of alloys of the naval brass type. The reticulations caused by the presence of tin in a brass in which the ratio of copper to zinc is 2 : 1 have no structural relations with any lead present. The lead exists in a free state. The reticulations are due to the deposition of $SnCu_4$ from the metastable β constituent, which is insufficient in quantity to retain it in solid solution.

Influence of Oxygen on Copper containing Arsenic or Antimony.†—R. H. Greaves includes with much other matter a description of the microstructure of specimens of copper, containing from 0·05 to 0·62 p.c. oxygen, together with 0·05 to 0·51 p.c. arsenic ; a similar series containing antimony instead of arsenic was also studied. The sections were etched with a 10 p.c. solution of ammonium persulphate. Copper containing oxygen with low arsenic or antimony content, shows dendrites of copper embedded in a ground mass of copper and cuprous oxide, not showing a eutectic structure but occurring in isolated globules. With more arsenic or antimony, the very distinct "cores" observed when little oxygen is present pass into a dendritic form as oxygen content rises.

Micrographical Studies.‡—Particulars of four cases in which microscopical examination has proved to be of considerable practical value are communicated by the Atelier des Essais de Métaux de la Cie. des Chemins de Fer P.L.M. Arsenic may be rapidly estimated in arsenious copper by etching a polished section with nitric acid for five or six seconds, and comparing it with photomicrographs of standard specimens similarly prepared and containing a known percentage of arsenic. Black spots are more or less abundant and voluminous according to the arsenic content. The depth of carburization produced on the edge of steel plates by cutting them with the oxy-acetylene blow-pipe is readily determined by examining a polished and etched section. The brittleness of mild-steel screws of large diameter was proved to be the result of the cold-work endured in the screw-cutting operation, and was completely removed by suitable annealing. The adulteration of wrought iron by the insertion of steel bars when piling has been readily detected, and guarded against by a suitable clause in the specification.

Utility of a Metallographic Nomenclature.§—F. Robin points out the disadvantages of systems of nomenclature based upon the use of proper names, or of names indicating properties, and makes tentative suggestions for a system of rational symbols. Thus, for example, a binary solid solution might be indicated by the symbols of the two metals separated by the letter *m*. Cu *m* Ni would signify the solid solution of nickel in copper. In the same manner, eutectics might be symbolized by *e* placed between the symbols of the constituent elements.

* Journ. Inst. Metals, vii. (1912) pp. 201–17 (12 figs.).
† Journ. Inst. Metals, vii. (1912) pp. 218–45 (14 figs.).
‡ Proc. Int. Assoc. Testing Materials, ii. (1912) No. 8, 10 pp. (18 figs.).
§ Proc. Int. Assoc. Testing Materials, ii. (1912) No. 8, 4 pp.

Alloys by Superposition.*—H. le Chatelier indicates his recent progress with this method. In an alloy obtained by superposition the crystals show in general a development along the longitudinal dimension, to a greater degree than do crystals of the same constituent in an alloy of uniform composition. The reason is, that owing to progressive variation of composition in a particular direction, solidification proceeds in the same direction, by the growth of crystals already formed rather than by the formation of fresh centres of crystallization. The same cause accounts for the absence of ordinary eutectic structures in many examples of superposition alloys. Crystals of the two phases of which the eutectic is constituted are well-formed throughout the region in which eutectic would normally occur. It is suggested that the method may be applied to the investigation of ternary systems. By bringing together three small globules of the molten metals, a preparation should be obtained containing the constituents of the three binary systems and of the ternary system also.

Metallographic Hygroscope.†—C. Benedicks and R. Arpi, when attempting to etch a zinc-antimony alloy containing 9 p.c. zinc by holding the polished section over aqueous hydrochloric acid, observed that instead of attacking the surface uniformly, the acid vapours condensed upon it in separate minute drops. When these drops evaporated, thin layers displaying interference-colours remained, and the colours changed with changes in the hygroscopic state of the surrounding air. Apparently the thickness of the film of metallic chloride is a function of the surrounding hygroscopic conditions. Various other alloys of the same series, etched with alcoholic hydrochloric acid, were found to give similar effects.

Beilby, G. T.—**The Hard and Soft States in Metals.**
Journ. Inst. Metals, vi. (1911) pp. 5–43 (25 figs.).

Belaiew, N. T.—**Damaskeening.**
Metallurgie, viii. (1911) pp. 449–56, 493–7, 699–704 (17 figs.).

Fay, H.—**Some Causes of Failures in Metals.**
Proc. Amer. Soc. Testing Materials, xi. (1911) pp. 439–53 (20 figs.).

Howe, H. M.—**Life-history of Network and Ferrite Grains in Carbon Steel.**
[The author's views, previously summarized (see this Journal (1912) p. 369), are given with much detail.]
Proc. Amer. Soc. Testing Materials, xi. (1911) pp. 262–386 (74 figs.).

Louis, H.—**Failure of a Brazed Joint.**
Journ. Inst. Metals, vi. (1911) pp. 222–35 (9 figs.).

Mügge, O.—**Microstructure of Magnetite.**
Jahrb. Min. Beil., xxxii. (1911) pp. 491–534.

Rosenhain, W., & S. L. Archbutt—**Constitution of the Alloys of Aluminium and Zinc.**
[A more complete account of an investigation previously summarized (see this Journal, 1911, p. 711).]
Nat. Phys. Lab., Collected Researches, viii. (1912) pp. 41–72 (34 figs.).

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* Proc. Int. Assoc. Testing Materials, ii. (1912) No. 8, 8 pp. (7 figs.).
† Journ. Inst. Metals, vii. (1912) pp. 246–8 (2 figs.).

MICROSCOPY

A. Instruments, Accessories, etc.*

(1) Stands.

Cornell's Micro-telescope.†—To all microscopists the knowledge that their instruments may be readily converted into telescopes of high power at small cost will be extremely interesting. The principle of this invention is due to A. Cornell, of Tonbridge, Kent, and resides in the combination with an ordinary mounted Microscope of a telescopic objective and a "pin-hole." This combination produces an extremely sharp inverted image in the plane of the Microscope stage, the inversion being corrected by the Microscope element of the combination.

The attachment for converting a Microscope into the telescope shown at figs. 92 and 93, consists of a draw-tube *a* carrying suitable objective,

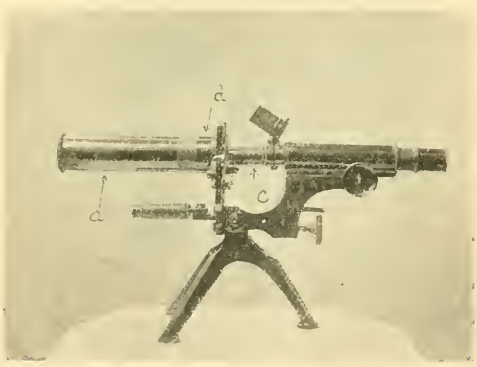


Fig. 92.

and containing a series of diaphragms for stopping down the light. These diaphragms are so proportioned that the amount of light is maintained through acute angles by concentration; as, for instance, when using an object-glass of 7-in. focal length. These graduated diaphragms provide for extremely sharp definition. Although the focal angle is

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

† Knowledge, xxxv. (1912) p. 345 (2 figs.).

extreme the flatness of field and the wide angle of same are extraordinary. With a telescopic objective of 7-in. focal length and a micro-objective of 1-in. focal length, a magnification of forty-five diameters is obtained. With such an arrangement Jupiter and four of his moons were observed with astonishing clearness during June. The best general results were, however, obtained with a 1½-in. micro-objective, which, so far, has given the brightest and most clearly defined image. With this objective the magnification was about twenty-seven diameters.

The attachment is made to fit into the diaphragm or Abbe illuminator rim or under-fitting *d* on the stage or sub-stage. By means of this combination when the telescope attachment is in place any degree of magnification from twenty to forty-eight diameters may be obtained by adjustment of the draw-tube and eye-piece to focus the micro-objective.

The only necessary alteration to the Microscope is to remove the stop

Fig. 93.

screw or bar so as to allow the eye-piece to be lowered below the horizontal to admit of observing objects at an elevation. For astronomical purposes and to facilitate observation at high angles, such as the moon or stars at or near the zenith, a reflector *b* is attached to the tube *a*. This reflector is ground optically correct for the purpose and is mounted upon a universal joint so as to be adjustable in all directions. By means of this reflector objects overhead or at high angles may be comfortably observed. When the micro-telescope is employed for terrestrial observation a tube *c* is employed to screen light from the gap between the stage and the micro-objective.

The combination forms an exceedingly compact telescope of about 15 in. in length, and the mechanical adjustments are available for focusing. To further facilitate observation, however, the tripod stand is secured to a special rotatable base mounted on a pedestal or tripod, the rotatable base being movable by means of suitable screw adjustments

about vertical and horizontal axes, or two axes perpendicular to each other but inclined to the vertical or horizontal. Provision is thus made for keeping an object in the field of the telescope when it is being employed for astronomical purposes.

Bausch and Lomb's 1912 Model B H 8.*—This instrument (fig. 94) as will be seen from the illustration, has the horse-shoe foot and the arm is of the handle type. The stage, covered with vulcanized rubber, measures 103 mm. by 101 mm. The substage consists of a mounting for the Abbe condenser and an iris diaphragm which comes into the

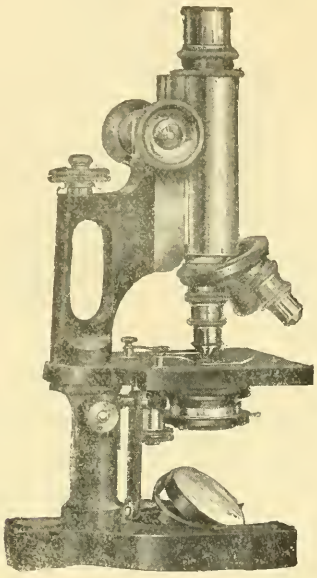


Fig. 94.

plane of the stage when the screen is turned up as far as possible, allowing the condenser to be used in immersion contact with the objective if desired. When screwed down the substage swings to the left of the optical axis. The outside diameter of the body tube is 35 mm. The fine-adjustment is of the lever type, with two-sized knurled head for slow and rapid movement.

Bausch and Lomb's Model F F.— The principal feature of this instrument (fig. 95) is the handle-arm the curve of which provides con-

* Bausch & Lomb Optical Co. Catalogue, 1912, pp. 30–31.
† Bausch & Lomb Optical Co. Catalogue, 1912, p. 34.

siderable space for manipulation. The fine-adjustment is of the lever type with two-sized knurled head for slow and rapid movement, ceasing to operate when the objective touches the slide. The stage, covered with vulcanized rubber, measures 102 mm. by 102 mm. The substage consists of a mounting for the Abbe condenser and an iris diaphragm. The condenser can be screwed up high enough so as to be used in immersion contact with the slide.

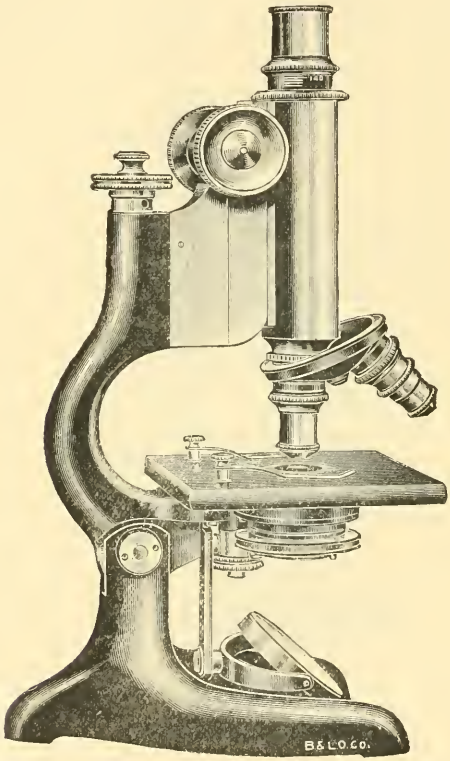


Fig. 95.

Beck's "London" Microscope.*—R. and J. Beck have just introduced a new model of the well-known "London" Microscope (fig. 96). The instrument differs from its predecessors mainly in being finished with black enamel which is unaffected by acid or spirit; also the stage is 4 in. by 4 in. In other respects this instrument differs little from previous examples, and like them is of moderate price.

* R. & J. Beck's Special Catalogue, 1912.

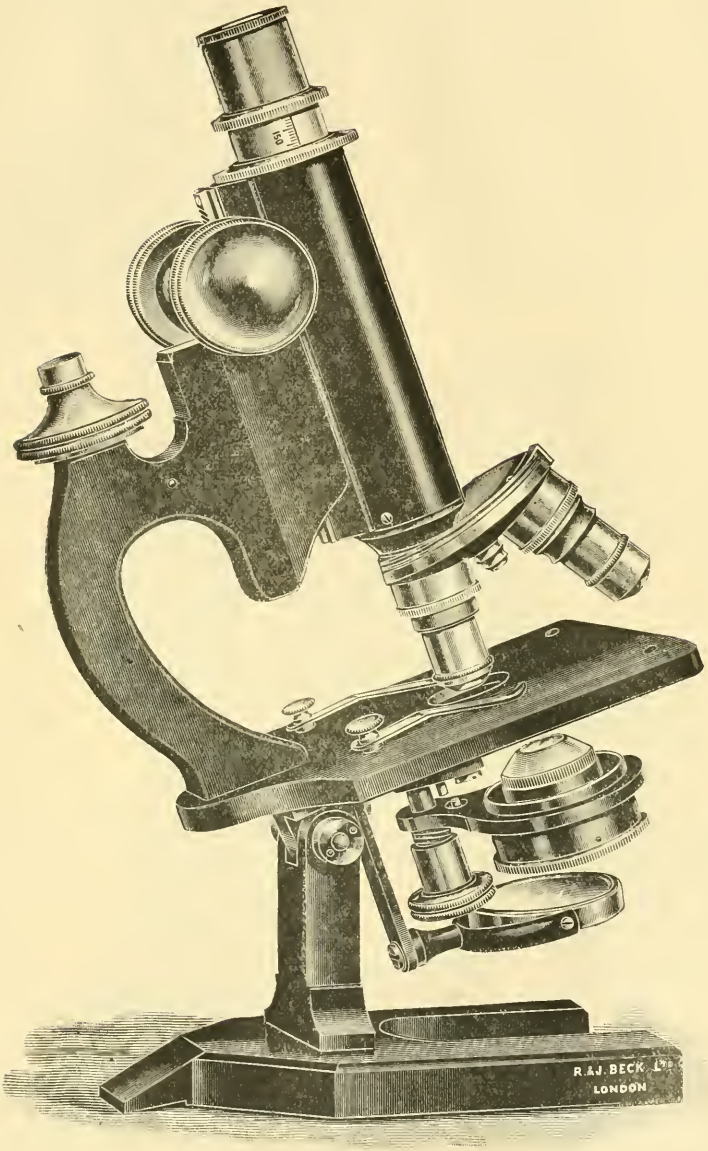


Fig. 96.

Watson's Research Microscope. * — The general design of this Microscope (fig. 97) conforms to that of others by the same manufacturers. There are, however, some changes in the details. The fine adjustment is set at the side of the limb, and operates a lever set vertically. A complete turn of the milled head imparts a movement to the fine adjustment of 0·1 m/m. It will be observed from the figure that the stage is made on the Tyrrell system, with the milled heads working through one another. The horizontal traverse given by the screw is $1\frac{3}{4}$ in. The method of attachment of its stage differs from the usual—the limb is continued beneath the stage, and projects forward so as to form a shelf to which the base of the stage is screwed ; a hollow is formed between this shelf and the lower portion of the limb by machining away a portion of the exact thickness of the stage-plate. When, therefore, the stage is mounted on the shelf previously referred

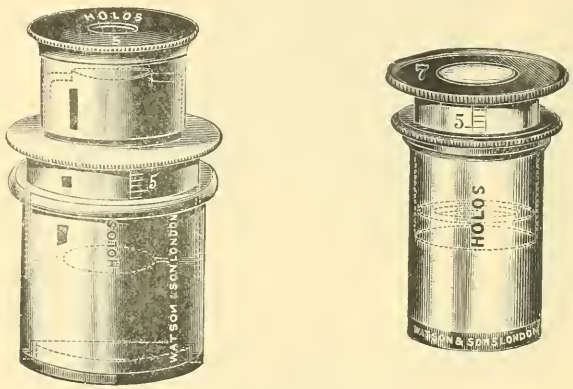


Fig. 98.

to, it is further gripped from the top by a fitting portion of the limb, and an unusually rigid attachment is secured by this means. A long range of coarse adjustment is given to the body, so that very low-power objectives can be used when occasion requires.

(2) Eye-pieces and Objectives.

New Holoscopic Eye-pieces.†—The Holoscopic Eye-pieces (fig. 98) by W. Watson and Sons, Ltd., have been re-computed, and are now made with an achromatic eye-lens whereby the eye-point is lengthened. The convenience of an adjustable fitting so that they may be used either for apochromatic or achromatic objectives is still preserved, and their construction has been so framed that they materially counteract the want of flatness of field which is inevitable in high power objectives.

* Catalogue, 1912–13, p. 51.
† Watson and Sons' Catalogue, 1912–13, p 96.

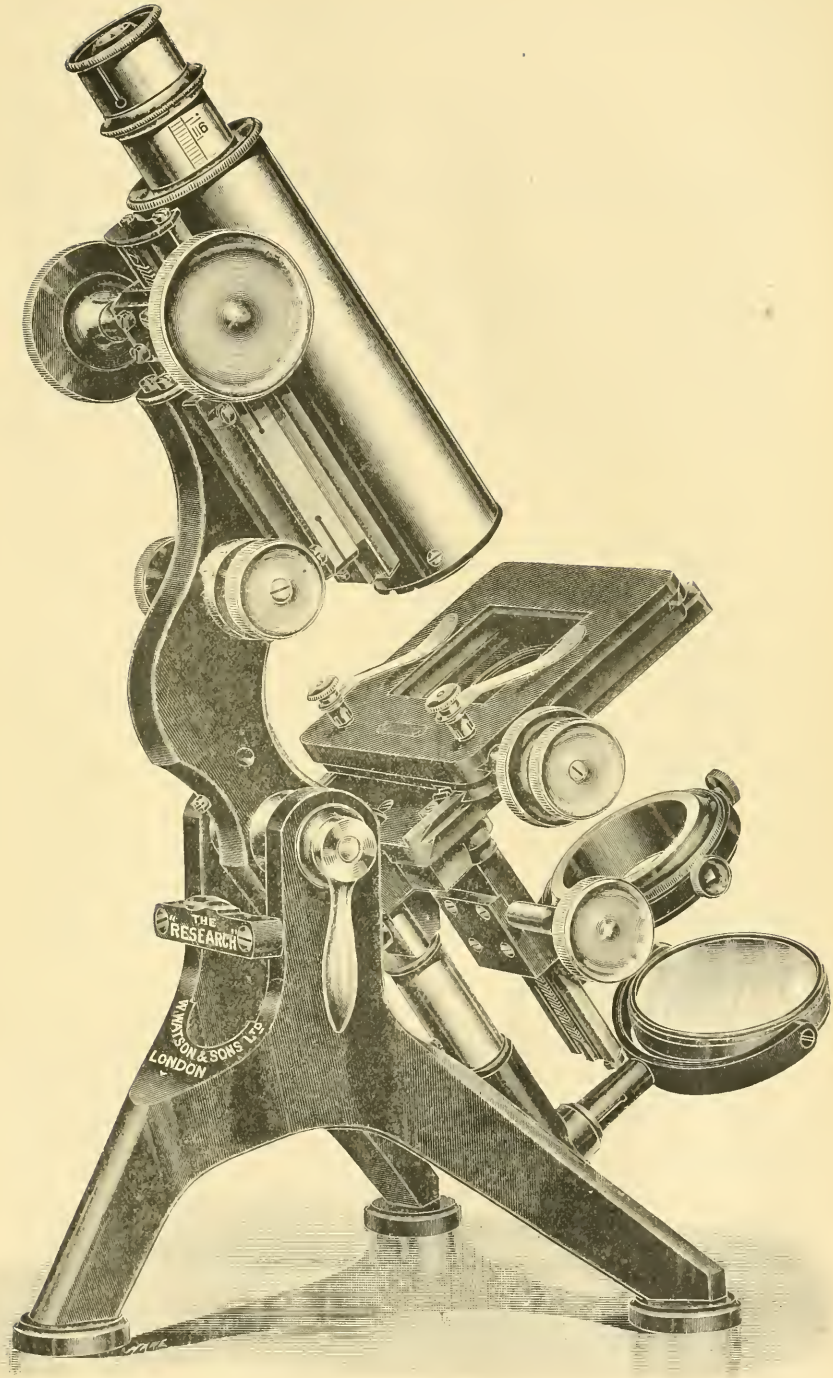


Fig. 97.

(3) Illuminating and other Apparatus.

Apparatus for Drawing in Natural Size, or with Slight Magnification or Diminution.*—This apparatus (fig. 99) is made by Messrs. Leitz, and is described by C. Metz. It is due to some suggestions made by Messrs. Brocher and Doret in the Revue Médicale de la Suisse Romande.† The apparatus will be easily understood by the figure. It resembles an Abbe drawing apparatus, but an isosceles right-angled prism is substituted for the rhomb, and its hypotenuse plane is silvered. A mirror 8 cm. by 10 cm. pushed to the end of a guide rod, attached by a jointed arrangement to a heavy foot, is kept at an angle of 45° by means of a notch. The prism leaves half of the opening free. Above this would be the observer's eye, and the plane A would be seen direct. The

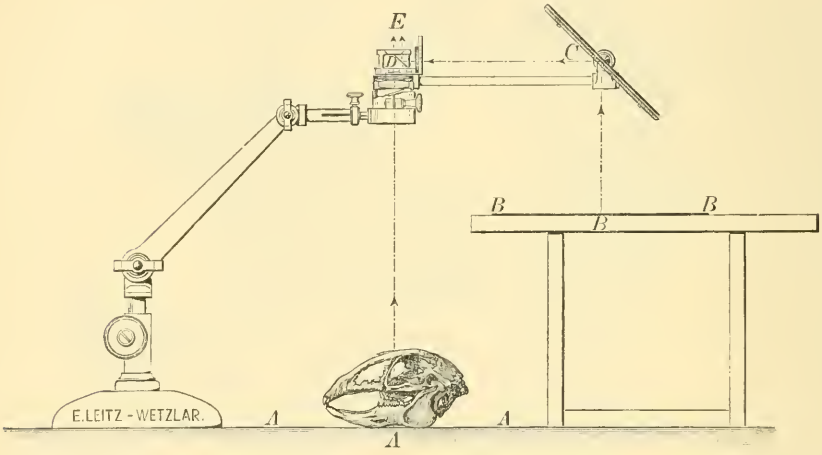


Fig. 99.

plane B is seen by rays reflected at mirror and silvered surface. It is subdued by means of smoked glasses which are inserted on the mirror side in front of the prism : two such glasses of equal intensity are provided ; they therefore give two degrees of brightness. For subduing the plane A three glasses are provided. The drawing apparatus is placed on the stand in such a way that it is at the distance of natural vision from the table. Adjustment is made by rack-and-pinion. The apparatus is fitted with four bi-convex lenses, and is capable of producing two-, three-, four-, or five-fold magnification. If enlargement is desired, the object is placed on the plane A under the lens, and the plane B becomes the

* Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 79–81 (1 fig.).
† See this Journal, April 1912, p. 244.

drawing plane. For diminution B is made the object plane and A the drawing plane. For drawing in natural size the lenses are dispensed with, and the object is placed at A 250 mm. from the eye ; the drawing plane must be at the same distance. Between the prism and the mirror is 105 mm., so that the drawing plane must lie 145 mm. from the mirror. It is also possible to arrange the apparatus for drawing objects in a vertical position.

Some Improvements in T. Tammes' Electric Microscopical Lamp.* T. Tammes has introduced several improvements into his lamp. The top of the cast-iron frame in which the incandescent lamp was originally contained is now replaced by a brass plate secured by milled heads to the sides. By relaxing these screws insertion of a new lamp is facilitated. In the centre of the top is a knob through which passes the small wire cable. This cable enters the knob horizontally, as it was found that a vertical entrance had a tendency to entangle the wire with the Microscope objective. The knob is also useful as a handle for carrying the apparatus. The back of the box is now made of blackened copper, which has the effect of destroying reflexions.

Leitz Step Micrometer with Simplified Micron Graduation.†—C. Metz describes this accessory (fig. 100) which appears to possess several advantages. The micrometer is photographed deep black and the strokes stand out so clearly as to be easily seen and yet are not so thick as to interfere with the measurement. The divisions are grouped in tens, each group being plainly distinguished from its neighbour by reason of the step-like arrangements of its units. The divisions are twice numbered—black on white and white on black—so as to be readily distinguishable in any light. The micrometer comprises fourteen groups of which only the ten middle ones serve for the finer countings, because in the centre the field is sharper, and greater freedom from error is required than at the circumference. The graduations are closer than usual, the intervals being 0·06 mm. This value is selected because with tube-lengths not greatly varying from normal the micrometer values of all objectives (achromats, fluorites, and apochromats) can be expressed in easy numbers which facilitate calculation. It is well known that the micrometer value of an objective is the number of divisions of the image covered by one division of the ocular micrometer. Thus, for example, if in the case of an ordinary ocular micrometer divided into tenths of a millimetre, this value were 0·00349 mm. = 3·49 μ (as it would be with Leitz objective No. 6 and tube-length 160 mm.),

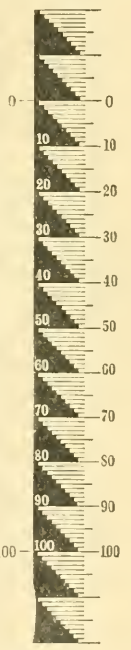


Fig. 100.

* Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 82–4 (1 fig.).
† Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 72–8 (1 fig.).

this value becomes with the new micrometer the easy quantity 2 μ. This value multiplied by the number of divisions covered (e.g. 17) would give the length of the object (i.e. 34 μ), a result easily attained. Similarly the micrometer values for Leitz objectives 1, 2, 3, 4, are respectively 30 μ, 15 μ, 10 μ, 5 μ, provided that the proper tube-lengths are used. Some of the micrometer values are still simpler, no fewer than five being unity itself. The author gives a full table of statistics referring to Leitz objectives. The fourth column of the author's table shows how many divisions of the object micrometer must be covered by 100 divisions of the step-micrometer, and, in the case of other objectives, the necessary tube-length must be determined experimentally once for all. As an illustration the author quotes the observation of a valve of *Surirella gemma* by objective No. 6 and by oil-immersion $\frac{1}{12}$. Measurements were made (1) by an ordinary travelling micrometer; (2) by a step-micrometer. The four results are practically the same (107·4 μ to 107·8 μ), but the step-micrometer has an undeniable simplicity in calculation. For the travelling micrometer the actual figures are: (objective 6) $30{\cdot}9 \times 0{\cdot}00349 = 0{\cdot}1078$ mm. $= 107{\cdot}8\,\mu$; and ($\frac{1}{12}$) $65{\cdot}5 \times 0{\cdot}00164 = 0{\cdot}1074$ mm. $= 107{\cdot}4\,\mu$. For the step-micrometer: (objective 6) $53{\cdot}8 \times 2\,\mu = 107{\cdot}6\,\mu$; and ($\frac{1}{12}$) $107{\cdot}5 \times 1\,\mu = 107{\cdot}5\,\mu$.

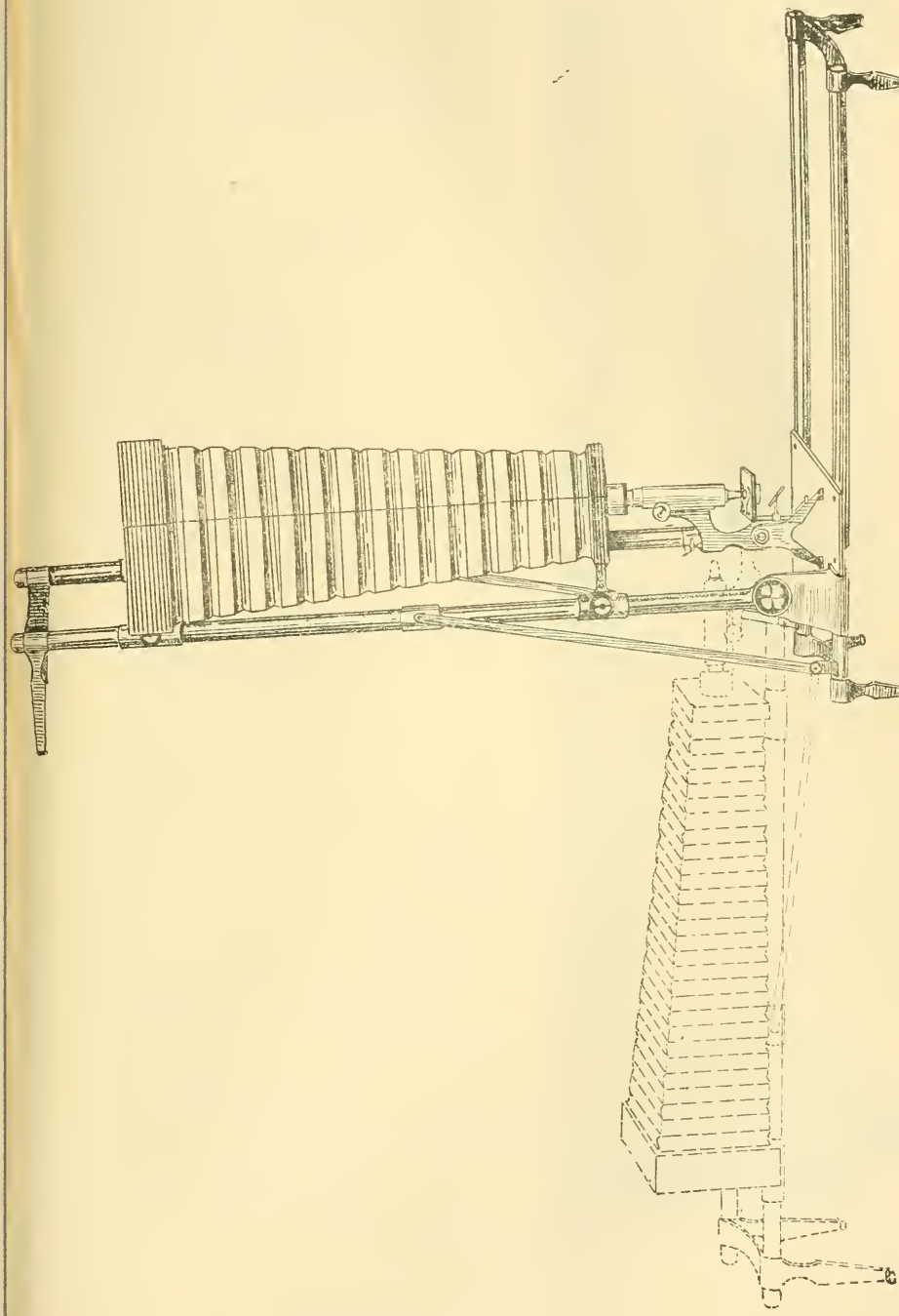
(4) Photomicrography.

Blue Screen.*—E. W. Bowell gives the following directions:—Take an unexposed process plate, fix it out in the dark with "hypo," wash well. Fix the gelatin film with formalin (say 10 p.c.), as if it were a histological preparation; this may take several hours. Wash well, and stain with aqueous solution of acid-violet (saure-violett Grübler); wash and dry. This screen will transmit only blue and half the green. The staining was made by adding water to a saturated solution of the dye-stuff in 70 p.c. alcohol.

Duplex Photo-micrographic Camera.†—This camera (fig. 101), by W. Watson and Sons, has been designed for use either vertically or horizontally, and to obviate difficulties with Microscopes of different heights and centres; the bellows are arranged for raising and lowering to suit the various axes. It is constructed principally of metal, so that it may be suitable for tropical climates.

Watson's "Laboratory" Camera.‡—This camera, by W. Watson and Sons, retains the heavy mahogany base, but has been re-modelled in certain other respects, particularly the bed and guides which carry the camera body itself; these are now made in metal, and the whole instru-

* Knowledge, xxv. (1912) p. 343.
† Photo-Microprojection Catalogue, p. 10.
‡ Photo-Microprojection Catalogue, p. 6.



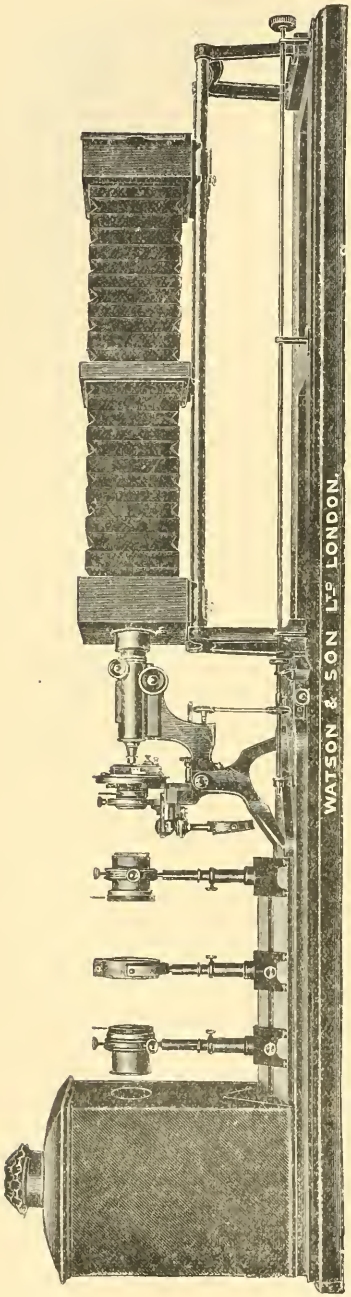


Fig. 102.

ment has been lengthened to carry a complete condenser system with electric lamp. The illustration (fig. 102) shows the Watson-Conrady Condenser system in position for use with this camera.

(5) Microscopical Optics and Manipulation.

Orueta, D. Domingo de—**Nota sobre la luz ultra-violeta y sus aplicaciones al microscopio.**

[Gives a concise account of the principles, apparatus, and applications of ultra-violet microscopy.]

Madrid (*Alemana*), 1912, 13 pp. (3 figs.).

Orueta, D. Domingo de—**Aparato para observación microscópica directa dibujo y micrografía con luz monocromática.**

[Gives a full practical account of the apparatus and methods necessary for monochromatic microscopy. Twelve beautiful plates of certain micrographic objects are given in an appendix.]

Asociación Española para el progreso de las ciencias (*Congreso de Granada*). *Madrid* (*Arias*), 1912, 44 pp. (12 pls.).

(6) Miscellaneous.

Wright, F. E.—**The Methods of Petrographic-microscopic Research: their Relative Accuracy and Range of Application.**

Washington, D.C. : Carnegie Institution of Washington, 1911, 204 pp. (11 pls. and 118 figs.).

See also *Nature*, *Aug.* 29, 1912, p. 673.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Method of demonstrating Bacillus coli in Polluted Water.†—To 100 c.cm. of double strength nutrient broth (+ 10 Eyre) there is added 1 grm. of salicylate of soda; the broth is then put into tubes (varying in size) from 25 c.cm. to 1 c.cm. in each tube, and all the tubes are sterilized in the usual way and allowed to cool; to each tube is then added a quantity of the suspected water equal in volume to the broth contained in it, and the tubes (which now contain salicylate of soda equivalent to 0·5 p.c.) are incubated for a period (24 to 48 hours) at a temperature of 42° C. If turbidity of the broth results, *Bacillus coli* may be suspected, and its identity will have to be proved by microscopical examination and by bio-chemical (e.g. sugar fermentation) tests. The only bacillus which is likely to grow along with *coli* is *subtilis*, and they can be separated from each other, if necessary, by "plating." If incubation of the tubes be carried out at a lower temperature (37° C.), which the writer, G. C. Purvis, does not recommend, then *B. proteus* is also likely to grow far more vigorously than either *subtilis* or *coli*.

B. typhosus (laboratory cultures) is completely inhibited by 0·25 p.c. of sodium salicylate and even by 0·2 p.c., and does not grow particularly well even in a 0·1 p.c. salicylate medium. As *B. coli* is considered the "indicator" of sewage contamination, its detection is of importance in the examination of suspected waters.

Method of Procuring Moulds and Torulæ from the Air Uncontaminated by Bacterial Growths.‡—This method, devised by G. C. Purvis, consists in adding salicylate of soda (in 1 p.c. strength) to the nutrient medium—e.g. agar, and "plating" in the usual way in Petri dishes, then exposing the plates (after the medium has set) to the air for such time as may be deemed necessary. Suppose 100 c.cm. of ordinary nutrient agar be taken; this will require 1 grm. of salicylate of soda, which will give 20 tubes for plating, each tube containing 5 c.cm., or 14 tubes each containing 7 c.cm. and a little to spare. It will be found on exposing the plates—or a single plate—to the air and incubating at 37° C. that no bacterial colonies will have appeared, but only moulds and torulæ. If nutrient gelatin be used for "plating," then of course the incubation will have to be carried out at a lower temperature (22° C.) which is a better temperature for moulds, but gelatin is unsuitable as a medium in the tropics, or even in sub-tropical climates.

Isolation of Spirochæts.§—This method is described by G. Proca, P. Danila, and A. Stroe. A mixed culture rich in spirochætes is in-

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Embedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservation fluids, etc.; (6) Miscellaneous.

† Lancet, 1912, ii. p. 439.

‡ Lancet, 1912, ii. p. 438.

§ C.R. Soc. Biol. Paris, lxxiii. (1912) pp. 235–6.

oculated into the upper stratum of a deep pyrogallol serum tube. The tubes are left for several days at 37° C. The top layers of serum undergo liquefaction, but the upper part of the medium which still remains solid may be rich in spirochætes. If this be so, the liquefied serum is pipetted off, and portions of the spirochæte-containing zone are inoculated into fresh tubes. Pure spirochæte cultures so obtained do not survive unless they are allowed to grow in symbiosis with typhoid bacilli or *Bacillus mesentericus*. Abundant cultures of spirochætes are obtained by means of such artificial symbiosis.

New Methods for the Culture of Bacteria.*—For the investigation of the action of nucleo-proteins and of cytoplasmic radicals upon known bacteria and parasites, and for researches upon an unknown virus which produces a specific effect upon a given organ, G. Mann recommends the use of organ extracts prepared by a special method. Brain, liver or skin, freed from blood to eliminate bactericidal principles, are passed through a sterilized mincing machine and the minced material placed in an Erlenmeyer flask of known weight. To every gram of organ, 2 c.cm. of sterile distilled water are added, and 10 c.cm. of chloroform to every 100 grammes of mixture. The flask is stoppered, and incubated for varying periods at 37° C., being shaken daily. The supernatant fluid is filtered through sterile barium sulphate filter paper, and sterile air is passed through it to remove chloroform. For certain investigations it is then necessary to add salt in sufficient quantity to restore the isotonicity of the fluid. The period for which incubation and consequent auto-digestion is allowed to proceed depends on whether the action of nucleo-proteins or of the cytoplasmic radicals is to be studied. For special researches, organs of embryos, which are devoid of acquired immunity, are specially suited.

Placental Culture Media.†—It has been shown that placental tissue is exceedingly rich in the hydrolytic products of proteins, containing large quantities of lysin, arginin, tryptophane, phenylalanine and allied bodies. C. Wellmann has therefore made use of this material for the cultivation of strictly parasitic and feebly saprophytic bacteria. Fresh human placenta is thoroughly ground up in a meat chopper, after first washing out the blood with sterile saline. To each kilo of the macerated placental tissue is added one litre of distilled water. The mixture is allowed to infuse at refrigerator temperature for 48 hours, and is then filtered through a Berkefeld N filter. The filtrate is tubed, or added to 2 p.c. melted agar and sloped. The medium is placed before using at a temperature of 40° C. for two days to inactivate the contained complement.

Portable Incubator.‡—N. S. Ferry describes an incubator (figs. 103 and 104), which is useful when travelling, by means of which material

* Centralbl. Bakt., 1te Abt. Orig., lxv. (1012) pp. 412–15 (figs.).
† Brit. Med. Journ., 1912, i. pp. 1358–9.
‡ Centralbl. Bakt., 1te Abt. Orig., lxvi. (1912) pp. 142–3.

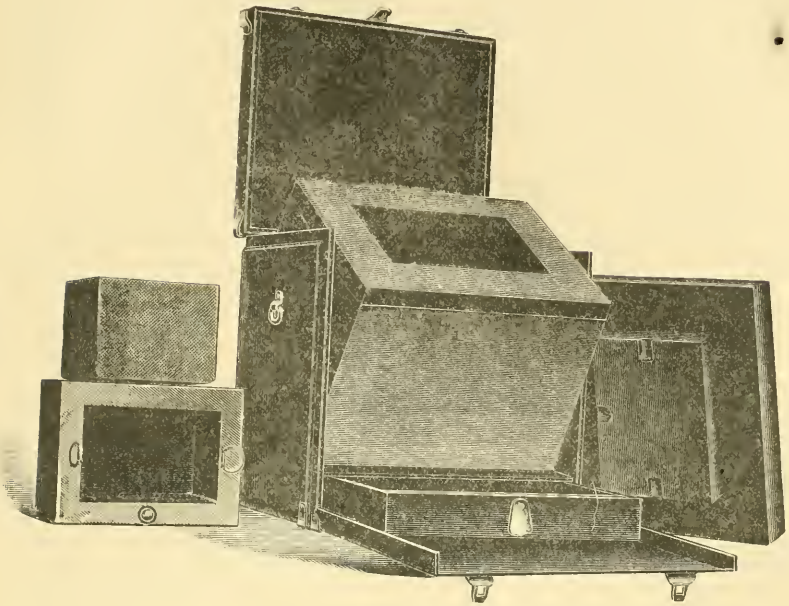


FIG. 103.

FIG. 104.

may be kept warm and at fairly constant temperature for at least 24 hours, until a base of supplies can be reached. The principle of a fireless cooker, with a few modifications, has been made use of. The insulating portion is a box composed of pressed cork, 2 in. thick. Over this is fitted a cover of the same material. The box is lined with heavy felt. Within is a copper water jacket to hold water at any desired temperature. The cultures are placed in a wire cage which just fits into the water-jacket. The whole outfit is again made to fit into a leather case, with a handle and straps. The weight is about 23 lb.

Preservation of Plate Cultures.*—E. G. Hastings describes a simple and satisfactory method for the preservation of plate cultures for museum and demonstration purposes. Some ordinary thread agar is immersed for several days in changes of tap-water to remove the materials which give turbidity to solutions of agar. By this treatment the agar is rendered so pure that a 1 p.c. solution is nearly as transparent as glass. A 2 p.c. solution of this agar is prepared by dissolving in distilled water and filtering through paper. To this is added an equal volume of glycerin. No sterilization is necessary. To preserve an ordinary plate culture it is only necessary to melt some of this glycerin agar, cool to 45° C. and pour carefully over the surface of the plate culture. The glycerin is sufficiently hygroscopic to prevent shrinking of the medium. If desired the plate cultures may first be hardened by exposure to formalin vapour. Gelatin plates so hardened are not melted by the warm glycerin vapour. Liquefying colonies on gelatin may be preserved, if the formalin treatment is continued for long enough to destroy the enzymes, though in this case satisfactory preparations are not always obtained. Plate cultures preserved by this method remained in perfect condition after eight months. It is not necessary to seal the Petri dish in any way.

(3) Cutting, including Embedding and Microtomes.

Embedding Minute Objects.†—When it is necessary to embed objects of such minuteness that they cannot be picked up with a forceps, the necessary manipulations are simplified by the use of a 1 p.c. solution of agar. H. Fischer points out that fixing processes can be performed either before or after the application of agar, but recommends that a more highly concentrated agar be used if acids are to be applied, as agar is rendered soft by acids. The objects to be dealt with may be added to the melted agar in a watch-glass, after it has cooled to 40° C. Shaking will prevent the objects sinking to the bottom of the agar. The thin layer of agar does not affect cutting or staining processes. Any stain taken up by it may easily be washed out.

Cutting Sections without Embedding.‡ — K. Peche describes methods whereby sections may be obtained of botanical specimens which

* Centralbl. Bakt., 2te Abt., xxxiv. (1912) pp. 432–4.
† Zeitschr. wiss. Mikrosk., xxix. (1912) p. 66.
‡ Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 58–62.

have not been embedded. The instrument used is Reichert's sliding microtome. For hard objects a wedge-shaped knife, for soft objects a hollow-ground razor is used. The knife and the object to be cut are kept moist with alcohol, glycerin, or water. Pieces of hard wood are boiled in water or soaked in glycerin-alcohol before cutting. Leaves are fixed in elder-pith or cork. The method is specially suitable for preparing sections of roots, barks, and seeds.

Constant Temperature Oven for Paraffin Embedding.*—This apparatus, devised by G. Y. Rusk (fig. 105) consists of a box constructed of sheet copper tinned on the inside, the dimensions of A being 17 × 15 × 12 in. In front are two sunk chambers $6\frac{1}{4} \times 11\frac{3}{4} \times 10\frac{1}{2}$ in. (D and E). On the inner walls of these are projections for shelves or for trays

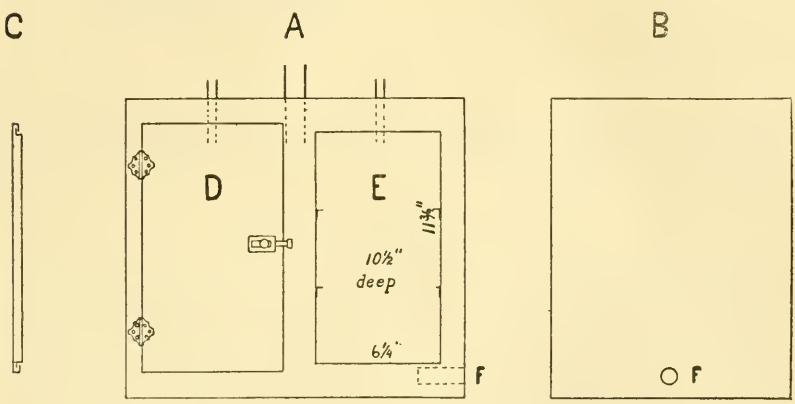


Fig. 105.

containing paraffin. D represents a closed door which is omitted on the other side to show the internal arrangements. Into the space between the outside wall and the sunken chambers, acetone is poured through the opening just below A. This opening is provided with a reflux condenser: one of the Soxhlet type answers well. Into the chambers D and E are openings for thermometers. Near the base of the side B is a cylinder F, designed to contain the heating electric cartridge. C is a cross-section of the door showing details of construction. When the apparatus is to be set up, a layer of asbestos is applied to prevent heat loss. It takes about an hour to heat the apparatus up to 56° C., and above this point it cannot go as long as acetone is present. The amount of acetone used need only be as much as will cover the heating unit. The electric cartridge is like those used in flat-irons.

* Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 85–6 (1 fig.).

New Dissecting Stand. * — The "University" Dissecting Stand (fig. 106) by W. Watson and Sons, Ltd., is mounted on a heavy square-shaped metal base, and is fitted with ball-and-socket joints of extra large size fitted with clamps, so that they can always be adjusted to any desired

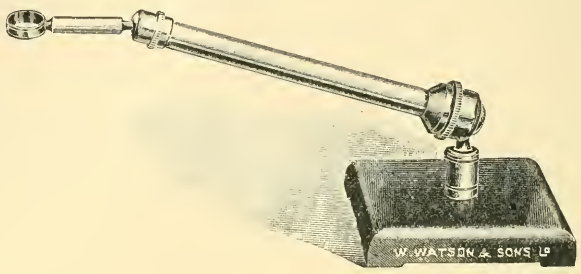


Fig. 106.

tightness. The length of the projecting arm is such as to make it suitable for use with large troughs. The magnifier is inserted in the ring provided for the purpose.

(4) Staining and Injecting.

Fat-staining with Capsicum-red. † — K. Okajima makes use of capsicum-red which has been extracted from fresh capsicum berries. The material to be stained is fixed with formalin or potassium bichromate. Sections are cut by means of the freezing microtome, and are placed in the staining solution for 5 minutes or more. Alcohol (80 p.c.), water, and glycerin are successively applied, and hæmatoxylin may be used as counterstain. Capsicum-red staining solutions, if kept in the dark, may retain their usefulness for seven months or more.

Rapid Maturation of Hæmatoxylin Solutions. ‡—By the use of hydrogen peroxide, C. Piazza has prepared hæmatoxylin solutions, which rapidly acquire the staining properties characteristic of mixtures which have been allowed to stand for a considerable period after preparation. A fresh hæmatoxylin mixture, upon the addition of hydrogen peroxide, loses its transparency and rose colour, darkens and becomes semi-opaque. This means of producing rapid maturation is of great convenience for microscopical purposes. The author sets down two or three formulæ for staining mixtures. The following is that of Boehmer :—

A.—Crystalline hæmatoxylin .	1 grm.
Alcohol (95 p.c.) . .	10 c.cm.
B.—Alum	20 grm.
Distilled water . .	200 c.cm.

* Watson and Sons' Catalogue, 1912–13, p. 72.
† Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 67–9.
‡ Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 69–71.

Mix A and B, shake and filter. Add to the filtrate 40 c.cm. of hydrogen peroxide. Shake again. The fluid undergoes the changes described above, and becomes at once ready for use.

Pikrin Method of Staining Tubercle Bacilli.*—Spengler's method consists of the following steps :—

1. Stain with warm carbol-fuchsin.
2. Pour off the stain without washing.
3. Pour on picric acid alcohol (equal parts of saturated solution of picric acid and absolute alcohol).
4. After 3 seconds wash with 60 p.c. alcohol.
5. Treat with 15 p.c. nitric acid until yellow (30 seconds).
6. Wash again with 60 p.c. alcohol.
7. Counterstain with picric acid alcohol until lemon-coloured.
8. Wash with distilled water.

H. Wilson finds this method far superior to that of Ziehl-Neelsen, especially when applied to the examination of urinary sediments.

Modern Methods of Sputum Investigation.†—G. H. K. Macalister gives a statistical analysis of the results obtained at the Lister Institute with the use of antiformin in the routine examination of samples of sputum for the presence of tubercle bacilli. Out of 2273 samples, 622 were found upon simple direct examination to be positive. The remaining 1651 specimens, which gave negative results, were incubated overnight with an equal bulk of 30 p.c. antiformin, and centrifugalized. The sediment was washed with distilled water. Examination then showed the presence of tubercle bacilli in 9 cases. So that of the sputa found negative upon direct examination, only 0·54 p.c. proved positive after antiformin treatment. This improvement percentage of 0·54 p.c. contrasted with figures ranging from 10 to 35 p.c. recorded by other observers, is explained by the fact that considerable time is devoted to the direct examination of the original sample.

A comparison of the Ziehl-Neelsen staining method with those of Herman, Much, and Gasis, shows that for sputum examination the first-named remains the most reliable and satisfactory, while the relative degrees of merit of the other procedures are shown by the order in which their names stand.

Hæmatoxylin as a Bacterial Stain.‡—A. Feeser has investigated the value of hæmatoxylin for the staining of bacteria. He has found that, in spite of statements to the contrary in text-books, this stain is under certain circumstances quite suitable for bacterial preparations. Böhmer's stain, freshly prepared, only stains bacteria after several hours' action, but if matured by three months' keeping, it stains ordinary bacteria well in an hour, faintly in 15 minutes. If heat be applied,

* Brit. Med. Journ., 1912, ii. p. 413.
† Brit. Med. Journ., 1912, ii. pp. 411–13.
‡ Centralbl. Bakt., 1te Abt. Orig., lxvi. (1912) pp. 137–42.

satisfactory preparations are obtained with 2 minutes' staining. Strong solutions containing 3 p.c. hæmatoxylin stain rapidly and well. Iodin-hæmatoxylin, containing hæmatoxylin 3 grm., absolute alcohol 20 c.cm., saturated solution of alum 60 c.cm., and 2 c.cm. of alcoholic iodin solution, is particularly suitable for staining bacteria. After staining, the preparation is washed first in 50 p.c. alcohol and then in tap-water.

Demonstrating Reissner's Fibre.*—G. E. Nicholls found that the aceto-bichromate mixture gave the most satisfactory results. Moreover, there was no risk of overhardening, and the material might be left in it for days or even weeks without detriment. The fibre was brought out especially well by staining in bulk in Grenacher's borax-carmin, followed on the slide by picro-indigo-carmine. This latter stain was prepared by mixing one part of a saturated solution of picric acid in 70 p.c. alcohol with two parts of a saturated solution of indigo-carmin in 70 p.c. alcohol. After an immersion of 5 minutes, the sections must be washed in 70 p.c. alcohol until all traces of picric acid are removed. The axis cylinders are stained red, the medullary sheaths green, and the Reissner fibre dull purple. Other stains, such as iron-brazilin, Ehrlich's hæmatoxylin, Heidenhain's iron-hæmatoxylin and others, gave good results.

Laguesse, E.—**Méthode de Coloration vitale des Chondriosomes par le vert Janus.**
[Describes the excellent results from the use of this pigment, which is Diethylsafraninazydimethylaniline.]
C.R. Soc. Biol. Paris, lxxiii. (1912) pp. 150–5.

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

Mounting Fluid for Permanent Microscopical Preparations.†—H. Fischer describes a borax-glycerin-gelatin mixture which when specially prepared remains fluid at room temperature, and is thus superior for some purposes to Kaiser's glycerin-gelatin. Five grams of borax are dissolved in 240 c.cm. of water, 25 grm. of concentrated glycerin are added and the mixture is poured over 40 grm. of fine white gelatin. This is dissolved by warming and filtered warm. On cooling this will set, but if it be kept warm for some time in a paraffin oven or water bath, it will not set when cooled, but will change into a viscid fluid of the consistence of a gum solution.

(6) Miscellaneous.

Crowe, H. W.—**How to fit up a Laboratory for £10.**
[Describes how the fittings, chemicals, apparatus, etc., may be obtained for £9 19*s.*!] *Lancet*, 1912, ii. pp. 472–4 (3 figs.).

* Quart. Journ. Micr. Sci., lviii. 1912, pp. 1–116 (5 pls. and 8 figs.).
† Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 65–6.

Metallography, etc.

Arsenic-antimony Alloys.*—N. Parravano and P. de Cesaris have ascertained, by thermal and microscopical methods, that arsenic and antimony form a continuous series of solid solutions in the range investigated, 0 to 35 p.c. arsenic. Sections were etched in the fumes from aqua regia.

Cadmium-tin System.†—A. P. Schleicher has used microscopical as well as thermal methods to determine the equilibrium diagram more accurately. The sections were etched with a solution prepared by adding a few drops of saturated aqueous solution of stannous chloride to 20 c.cm. alcohol. This preparation colours cadmium black and leaves tin unaffected. Cadmium retains only very small amounts of tin in solid solution ; γ-tin may hold up to about 10 atomic p.c. cadmium in solid solution ; β-tin much less.

W. Guertler ‡ discusses Schleicher's results, pointing out the effect of incomplete attainment of equilibrium upon micro-structure as well as upon thermal phenomena. The aggregate resulting from the decomposition of γ crystals into β-tin and cadmium, being formed at a low temperature, is ultra-microscopic in structure and resembles troostite. In discussing some theoretical points the author shows how surfusion effects may induce the formation of a purely eutectic structure in a concentration which is not that of the pure eutectic. The attraction exerted by primary crystals upon the corresponding constituent of a eutectic crystallizing around those primary crystals, causes the formation of sheaths of the other constituent.

Gold-silver Alloys.§—U. Raydt has shown by thermal methods that gold and silver form a continuous series of mixed crystals. In consequence of the smallness of the crystallization interval, the crystals are nearly homogeneous. The cored structure, when present, was found to persist after annealing. A suitable etching reagent was not found for alloys containing more than 60 p.c. gold.

Copper Alloys.‖—E. Münker has determined numerous physical properties of three series of binary alloys, copper-phosphorus, copper-manganese, and copper-tin, the amount of the element added to copper not exceeding 1·5 p.c. The influence of annealing upon the microstructure of cold worked specimens was studied, and is illustrated by photomicrographs.

Ternary System Copper-zinc-aluminium.—In the course of a determination of the equilibrium diagram of the copper-rich region of this

* Int. Zeitschr. Metallographie, ii. (1912) pp. 70–5 (4 figs.).
† Int. Zeitschr. Metallographie, ii. (1912) pp. 76–89 (9 figs.).
‡ Int. Zeitschr. Metallographie, ii. (1912) pp. 90–102, 172–7 (8 figs.).
§ Zeitschr. Anorg. Chem., lxxv. (1912) pp. 58–62 (4 figs.).
‖ Metallurgie, ix. (1912) pp. 185–98 (37 figs.).

ternary system, H. C. H. Carpenter* and C. A. Edwards have studied the microscopic characteristics of annealed and quenched specimens of alloys containing up to 60 p.c. zinc and 16 p.c. aluminium. No true ternary compound or eutectic is deposited from the liquid alloys. The inversion of β into the eutectoid $\alpha + \gamma$ is clearly illustrated by photomicrographs. The tendency of the α group of alloys to form twin crystals is very pronounced in specimens that have been annealed.

Cold-working and Annealing of Zinc.† — G. Timoféef has examined microscopically small ingots of zinc as cast and after various processes of cold-working and annealing. Re-crystallization of the severely compressed ingot proceeds very slowly at 20–25° C. ; at 65° C. a change is evident in a few minutes. The speed of re-crystallization, and the size of the resulting crystals, increase rapidly with rising temperature. Very slight deformation is sufficient to cause twinning ; the twinning lamellæ are readily removed by annealing at 200° C. The photomicrographs given clearly illustrate the changes studied. The sections were etched with dilute nitric acid to which had been added a small quantity of a 6 p.c. solution of chromic acid.

Solubility of Carbon in Nickel.‡ — By heating molten nickel in contact with carbon and quenching the melt, O. Ruff and W. Martin* have determined the temperature-solubility curve in the range 1550–2500° C., and find that at 2100° C. a maximum of solubility is reached at 6·42 p.c. carbon, corresponding to the formula Ni_3C. In no case did the combined carbon exceed 1 p.c. in the quenched specimen, the remainder being graphite. The carbide Ni_3C was identified microscopically in the quenched specimens as a brown constituent, very resistant to the numerous etching reagents used, and easily distinguished from the graphite and the nickel present in the sections. The carbide appears to form a eutectic, or eutectoid with nickel. The resemblance of the nickel-carbon system to the iron-carbon system is pointed out.

Structure of Galvanized Iron.§—W. Arthur and W. H. Walker have examined transverse sections of samples of galvanized iron manufactured by different processes. The sections were etched with a 0·5 p.c. solution of nitric acid in 95 p.c. alcohol. Four layers were distinguished in hot-galvanized iron : (1) iron ; (2) "binding alloy"—the crystals of unknown composition which first separate from a molten solution of iron in zinc ; (3) the compound $FeZn_3$; (4) zinc permeated by minute crystals of the compound $FeZn_7$. In Sherardized iron, the coating may vary from a thin layer of $FeZn_3$ with a more or less distinct layer of the "binding alloy," to a thick coating of zinc-iron alloys with a surface

* Int. Zeitschr. Metallographie, ii. (1912) pp. 209–42 (37 figs.).
† Comptes Rendus, clv. (1912) pp. 430–2 (8 figs.).
‡ Metallurgie, ix. (1912) pp. 143–8 (9 figs.).
§ Journ. Ind. Eng. Chem., iv. (1912) pp. 397–402, through Journ. Soc. Chem. Ind., xxxi. (1912) p. 644.

layer of zinc. Cracks are always present in the coating. In electro-galvanized iron, the coating may be pure zinc or zinc-iron alloys, but a very thin layer of "binding alloy" is always present.

Meteoric Iron.*—It has been shown that Neumann's lines consist of twinning lamellæ. When occurring in kamacite, such lamellæ, being in a strained condition and accordingly more readily attacked by etching reagents, are made visible when a polished surface is etched. F. Berwerth and G. Tammann have heated at different temperatures and for different lengths of time, specimens of meteoric kamacite in which Neumann's lines were highly developed, to ascertain if the lines disappeared on heating. At 727° C. four hours was insufficient to effect the transformation. At 878° C. the lines were much weakened in one minute, while at 1050° C. the transformation was complete in one second. The specimens were etched for three minutes with 3 p.c. nitric acid.

The authors have also investigated the "burnt zone" in meteorites, determining its thickness when occurring naturally, and studying its artificial production. In the Avče meteorite, Neumann lines were absent from the granular kamacite of the outer burnt zone. Below this was a transition layer, in which lines began to appear, leading to the normal internal structure showing well formed lines. Pieces of kamacite wrapped in asbestos paper were strongly heated in the oxy-hydrogen flame. The burnt zone thus produced showed three layers, oxide occurring in the outermost, while Neumann lines were still found in the inner layer.

Mechanism of the Formation of Troostite.†—D. K. Bullens has examined two steels containing 0·92 and 1·48 p.c. carbon and of great purity. A bar of each, 6 in. in length, was heated at one end to 1050° C. and quenched in water. The pieces were fractured lengthwise, polished, etched with nitric acid in alcohol, or Kourbatoff's reagent, and microscopically examined. A continuous photomicrograph, several feet in length, was obtained from each piece, and depicted the transition from austenite to the original steel. The various transition stages are described.

Nomenclature of the Microscopic Constituents of Iron and Steel.‡ H. M. Howe points out the utility of the names which have been given to the various constituents of steel, many of which are not phases, and do not find a place in the equilibrium diagram. He does not agree to the proposed abandonment of the names troostite, osmondite, sorbite, etc. None of the terms which have come into use should be omitted from a list of definitions.

Burgess, G. K.—**Metallography and Metallurgy at the Bureau of Standards.** *Met. and Chem. Engineering*, x. (1912) pp. 467–8.

Campbell, W., & H. B. Allen—**Heat-treatment of a Nickel Steel.** *School of Mines Quarterly*, xxxiii. (1911) pp. 72–83.

* Zeitschr. Anorg. Chem., lxxv. (1912) pp. 145–59 (5 figs.).
† Met. and Chem. Engineering, x. (1912) pp. 205–7 (9 figs.).
‡ Met. and Chem. Engineering, x. (1912) pp. 23–6.

Goodale, S. L.—**Metallography Sample Holder.**

[An arrangement of trays for storing a considerable number of polished sections in an ordinary desiccator is described; any specimen is easily accessible without disturbing the arrangement of the rest.]

Met. and Chem. Engineering, x. (1912) pp. 477–8 (1 fig.)

Konstantinow, N., & W. Smirnow—**Alloys of Tin and Antimony.**

Int. Zeitschr. Metallographie, ii. (1912) pp. 152–71 (11 figs.).

Lyon, D. A., & F. C. Langenberg—**A Microscopic Study of California Electric Furnace Pig-iron.**

[The microstructure of a cast iron containing 3·64 p.c. silicon, 3·58 p.c. graphitic carbon, and practically free from combined carbon, sulphur, phosphorus, and manganese, is described.]

Met. and Chem. Engineering, x. (1912) pp. 457–8 (4 figs.).

Sander, W.—**Alloys of Palladium with Antimony.**

Zeitschr. Anorg. Chem., lxxv. (1912) pp. 97–106 (10 figs.).

Sandonnini, C.—**Thermal Analysis of the System $AgCl$–Ag_2S.**

[Sections were etched with dilute nitric acid for micro-examination.]

Atti R. Accad. Lincei, xxi. (1912) i. pp. 479–82.

Vogel, R.—**Cerium-aluminium Alloys.**

[The equilibrium diagram has been determined by thermal methods, and the microstructure of the alloys is described in detail.]

Zeitschr. Anorg. Chem., lxxv. (1912) pp. 41–57 (19 figs.).

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Lieberkühn Simple (or Compass) Microscope. — This handy Microscope, presented by Mr. Alpheus Smith (fig. 119), was invented about 1738, and was intended principally for viewing opaque objects, which were illuminated by a silver speculum in the centre of which is mounted the bi-convex lens. This useful contrivance has endured to the present day and forms an essential part of the outfit of every complete Microscope. It was first figured by P. van Musschenbroek in his Essai de la Physique, published at Leyden in 1739, and was then made with various modifications by all English makers of the period until the end of the eighteenth century. Henry Baker figures and describes it in 1740 and calls it "The Single and opaque Microscope," and it is found in the works of George Adams 1747–87, Benjamin Martin 1760, and others.

The silver concave mirror for the illumination of opaque objects is

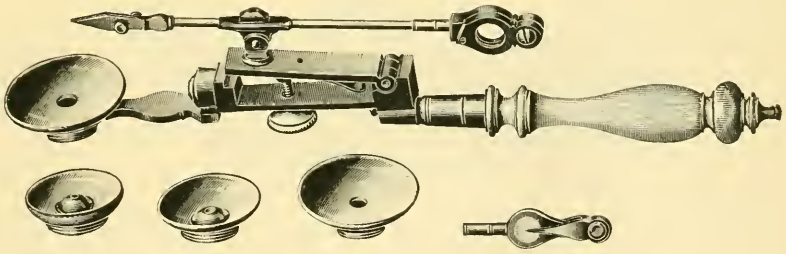


Fig. 119.

usually ascribed to Dr. N. Lieberkühn, but it must not be forgotten that Descartes in 1637 figured an appliance embodying the same principle, though it may not have been practically applied at that early date.

The present model is of superior make and in exceptionally fine condition ; the maker's name is not indicated, but by comparing various small details of parts and ornaments I have come to the conclusion that the maker was John Cuff and its date about 1745–50.

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

Old Microscope by J. Cuff.—This small portable Microscope (fig. 120) signed J. Cuff, Londini, Inv. & Fec. N° 31 was probably made by Cuff before 1750, for Cuff was declared a bankrupt in November 1750, according to the London Gazette of that date, but was still living in 1758 opposite Salisbury Court, Fleet Street, and in 1761 in Fleet Street opposite Shoe Lane. The pillar is inclinable and mounted excentrically on an oval base-plate capable of rotation, which gives greater stability to the Microscope in different positions. It has a fine adjustment of the John Marshall type for the lens-holder, and both lens-holder and the stage can be folded up for portability. Two brass holders attachable to the stage are provided for holding the ivory and brass object-sliders.

Fig. 120.

In 1898 E. M. Nelson* described a very similar old Microscope with a compound body. The present model differs from Nelson's instrument in the following points: the stage has no lateral movement; it has no clip to clamp the slide to the stage; it has no compound body.

In the Micrographia Illustrata, 1771, George Adams figures and describes "The Single and Double Aquatic Microscope," which is very similar to the present model with some slight differences.

It appears probable also that the present model is the parent of Ellis's Aquatic Microscope, for in the Introduction to Ellis's Essay on the Corallines, 1755, p. viii. We find the author saying "Here we had the opportunity of seeing these . . . . Corallines alive in sea-water by

* See this Journal, 1898, p. 675.

the help of a very commodious Microscope of Cuff's, the optician in Fleet Street, *which I had altered* for the purpose."

Ellis's Aquatic Microscope is also figured in George Adams' Micrographia Illustrata 1771, and is of a simple type for use with low powers.

Old Microscope by Watkins and Smith.*—In November 1907 E. M. Nelson described before this Society an old Microscope (date between 1765–1775) made entirely in solid silver by François Watkins, an Anglo-Frenchman, of Charing Cross, London, who published a small book in French entitled L'Exercice du Microscope, London, 1754–5, a copy of which is in our library.

Through the investigations of T. H. Court, who has searched Kent's London Directories of the latter half of the eighteenth century, we now know that François Watkins in 1754 was "Optician to their Royal Highnesses Prince and Princess of Wales at Sir Isaack Newton's Head, Charing Cross." In 1765 the name of the firm appears to have been changed into that of Watkins and Smith, and can be traced through the Directories until 1774. In or about 1775 Smith appears to have died or retired, and the firm was again carried on by F. Watkins alone, as indicated by the Directory of 1776 and subsequent years. Watkins seems to have died, or else retired, about 1790. In 1796 the firms' style was T. and W. Watkins, and in 1806 Watkins and Hill.

The old Microscope (fig. 121) here exhibited by the kindness of T. H. Court is signed Watkins and Smith, and was therefore made between the years 1765–1775. It has much resemblance with the silver Microscope described by Nelson, but is more substantially made in every way, and the folding tripod-foot is strong enough to prevent vibration, thus correcting most of Nelson's adverse criticism of the silver Microscope. The screw fine-adjustment at the base of the limb of the latter has been removed, and replaced by a very good and strong sprung-rack coarse-adjustment which moves the stage, thus changing the model from a body-focuser to a stage-focuser. As Nelson has stated, Watkins' earlier Microscope has introduced some improvements of first-rate importance, such as the inclinable limb to carry the body, stage and mirror, and in the present specimen an excellent rack-and-pinion movement to the stage, with the rack cut in the back of the limb. The stage can be removed by pressing a lever. The seven powers are mounted on a wheel between two brass plates, and can be used as simple Microscopes or with a body and eyepiece as a compound (or double) Microscope. The limb is marked with a double set of numbers S and D, indicating the position of the stage corresponding with the focus of the power in use, both for the simple and double Microscope. The limb is made inclinable by a compass-joint and can be fixed in any position by means of a thumb-screw. The mirror is double, plane and concave. The compound body unfortunately is lost.

In the same box with the Microscope is a solar projection apparatus, identical with that described by Nelson for the silver model.

Old Culpeper and Scarlet Microscope by George Adams. — The old Microscope depicted in fig. 75, p. 445, is a large specimen of the Culpeper and Scarlet type of "double reflecting" Microscope made by

* See this Journal, 1908, pp. 137–45.

George Adams in 1736. The date is presumably indicated by a letter found in the drawer of the box containing the apparatus, addressed to the Rev. Mr. Talbot and signed by George Adams, and dated January 7, 1735/6

The large wooden body is covered in its lower part with green

Fig. 121.

sheepskin, and this part slides in a tube of cardboard covered with shagreen. The body is supported on three brass legs rising from the brass triangular stage, and the stage in turn is supported by three straight brass legs standing on a black circular wooden base. The base is fixed on to a square wooden box containing the apparatus.

The optical parts consist of an eyepiece with bi-convex eye lens, and a plano-convex field lens, the plane surface turned towards the object. The object glasses, of which there were five originally, consist of single bi-convex lenses in brass mounts. A concave mirror, moving in a gimbal, is placed below the stage fixed to the base of the stand.

The apparatus in the box consists of object glasses, spring stage, stage forceps, frog plate, black and white disk, conic light modifier, brass forceps, glass cells, and four ivory sliders.

The whole Microscope is enclosed in a pyramidal oaken cabinet.

This interesting old Microscope was lent for exhibition and description by Mr. Alfred Hodgson.

Leitz New Model Microscopes.*—The illustration (fig. 122) shows a new pattern Microscope stand D E, which has been designed with a view to incorporating the most important features of the English and Continental models.

The tripod base is well spread and is exceptionally rigid in the horizontal as well as in the vertical position, and allows of free access to the

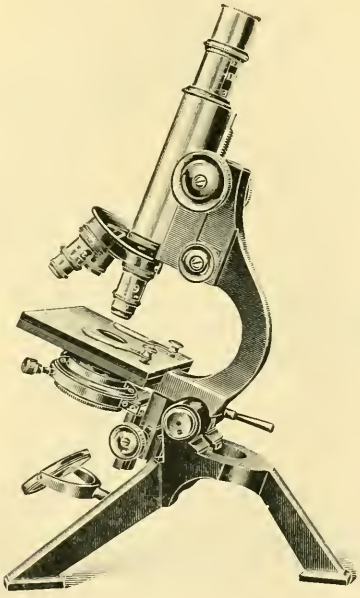


Fig. 122.

substage. The substage is of the compound type, consisting of rack-and-pinion focusing adjustment, with centring screws controlling condenser sleeve, which is of the Royal Microscopical Society standard gauge.

* Leitz Special Catalogue, 1912.

The stage is of the square fixed type, and may be provided with a detachable mechanical stage. The curved limb allows of additional working space on the stage and incidentally forms a convenient angle for lifting the Microscope. The fine-adjustment consists of the cam and worm

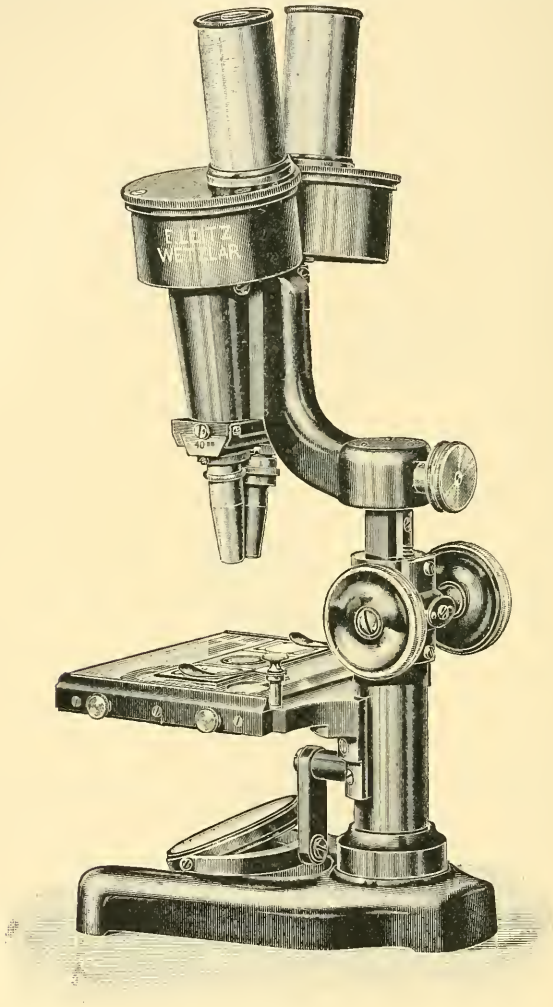


Fig. 123.

screw continuous motion, originally introduced in the Leitz Continental Microscopes, coarse-adjustment being by diagonal rack-and-pinion, and draw-tube with millimetre scale. This is also fitted with an English-pattern mechanical stage, which forms an integral part of the instrument.

The stage, which is controlled by two milled heads on one spindle, is provided with millimetre scales and verniers reading to $\frac{1}{10}$ mm. ($\frac{1}{250}$ in.).

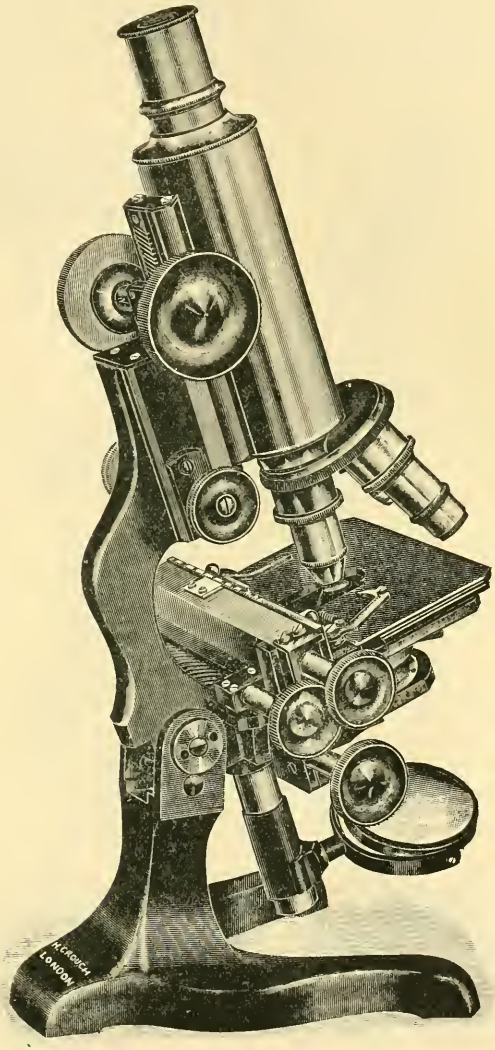


Fig. 124.

Greenough's Stereoscopic Binocular Microscope.*—The firm of E. Leitz have improved this instrument in the direction of stronger construction, giving greater rigidity. The stand is provided with rack-and-

* Leitz Catalogue 44A, pp. 82–3.

pinion adjustment, and if desired an inclination joint is provided. The other features are well known (fig. 123).

Crouch's "Opsonist" Microscope.*—This instrument is shown in fig. 124. The lateral position of the fine-adjustment is a special feature, and has been designed to meet the wishes of those microscopists who prefer the fine-adjustment at the side rather than at the back. The fine-

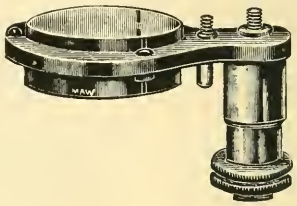


Fig. 126

Fig. 125.

adjustment itself is on the cam and screw principle, and is executed by a new micrometer movement with drum reading to 0·001 mm. The coarse-adjustment is by means of a diagonal rack-and-pinion. The stage has vertical and cross-traversing mechanical adjustments of 1 in. and 2½ in. respectively, and is made removable, so that a cultivation on a plate or

* Catalogue, Crouch's Microscopes and Accessories, S. Maw, Son & Sons, London.

Petri dish, or a large section, can be examined without difficulty. The mirrors are plane and concave. The foot is of solid brass, and admits of any angle of inclination with perfect stability. When the Miscroscope is used vertically the mirror and substage are conveniently adjustable. The substage is perfectly centred to the objectives supplied with it, and

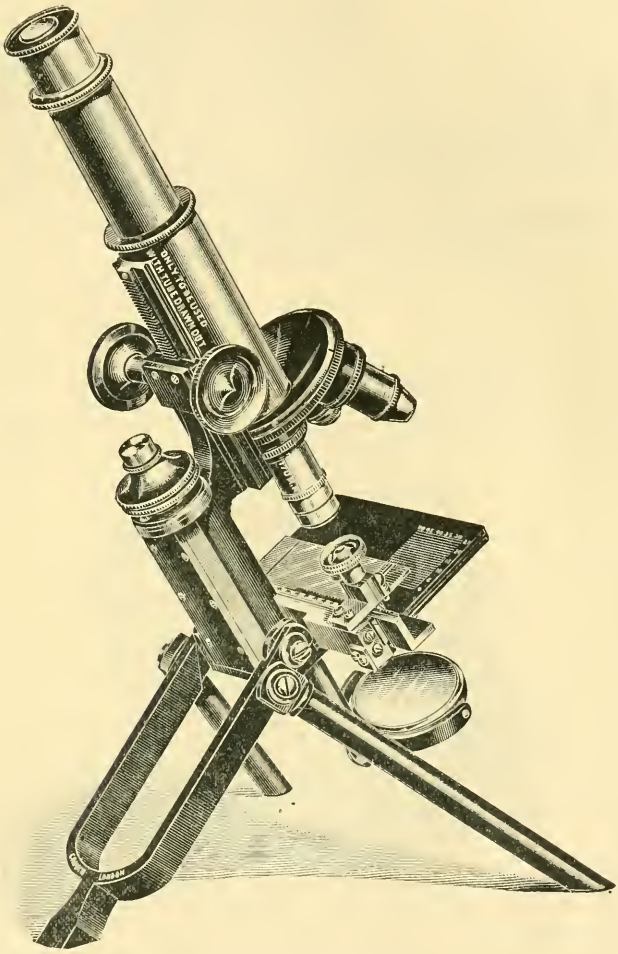


Fig. 127.—Ready for Use.

has a focusing adjustment by diagonal rack-and-pinion ; it has a swing-out movement for changing the accessory apparatus. The instrument represented in the figure has a horse-shoe foot. It can, however, be supplied with a tripod foot, and is then listed as the " Oxford " model.

Crouch's "Histologist" Microscope, Model B.*—This instrument is shown in fig. 125, p. 656, and has been recently designed with a view to meeting the demand of students engaged in elementary work at the hospitals. It has coarse- and fine-adjustments, plane and concave

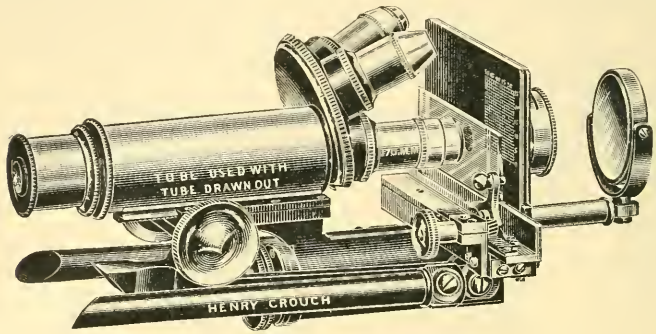


Fig. 128.—Ready for Packing.

mirrors, and is fitted with large stage. The limb can be inclined at any angle. The rack substage is shown in fig. 126, p. 656.

Crouch's Portable Travelling Microscopes.†—This is shown in figs. 127, 128, 129, pp. 657, 658, in the three conditions, ready for use,

Fig. 129.—Packed.

ready for packing, and packed. Its stability is said to be equal to that of any of the non-portable models. It is provided with rack-and-pinion and fine focusing adjustments. It has a large stage with cross-travelling

* Catalogue: Crouch's Microscopes and Accessories. S. Maw, Son, and Sons, London.

† Catalogue: Crouch's Microscopes and Accessories. S. Maw, Son, and Sons, London.

movement of 2 in. gradated to millimetres, vernier reading to 0·1 mm. It is fitted with an Abbe stage condenser with iris diaphragm, and a high power dark-ground illuminator. The entire apparatus can be folded up into an exceedingly small space, and is packed in a leather case measuring 11 by 4½ by 5 in.

(2) Eye-pieces and Objectives.

Double Fluorite Objective.*—The firm of E. Leitz has recently introduced a double fluorite objective, a dry 1/8 (3 mm. focal length). Numerical aperture = 0·95.

(3) Illuminating and other Apparatus.

"Rystos" Microscope Platform.†—This platform (fig. 130), made for use with science lanterns, is adjustable so that any ordinary Microscope without the draw-tube can be used for projection work; it can be

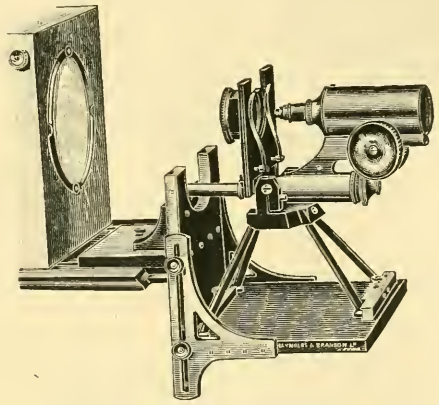


Fig. 130.

raised or lowered in order that the optical centre of the Microscope may coincide with that of the lantern.

C. Baker's Miniature Arc Lamp.—This lamp (fig. 131), made at the suggestion of Mr. J. E. Barnard, differs somewhat in design from any other of this type. The hand-feed mechanism is carried on an open frame so that the lamp keeps much cooler when burning than those which are closed in. The carbons are held in V-shape blocks, and are controlled by one milled head made of non-conducting fibre which actuates two screws attached to these blocks. By suitable gear wheels the speed at which the carbons are fed is so arranged that the difference in consumption of each carbon is compensated for.

The lamp is primarily intended for a current of 4 to 5 amperes, but owing to the construction mentioned it may be used for heavier currents up to 8 or 9 amperes.

* Leitz Catalogue 44A, p. 19.
† Reynolds and Branson Catalogue, 1912.

A gallery is fixed to the lamp upon which a chimney is placed. The chimney is provided with a bullseye condenser which is placed in alignment with the positive carbon. At right angles to this and also supported in the chimney is a pin-hole camera. This will be found most useful in enabling the user to see an image of the arc when the carbons require feeding as if thrown on a ground-glass screen, and it can at once be seen what the length of the arc actually is.

The carbons used are 8 mm. cored placed in a horizontal position,

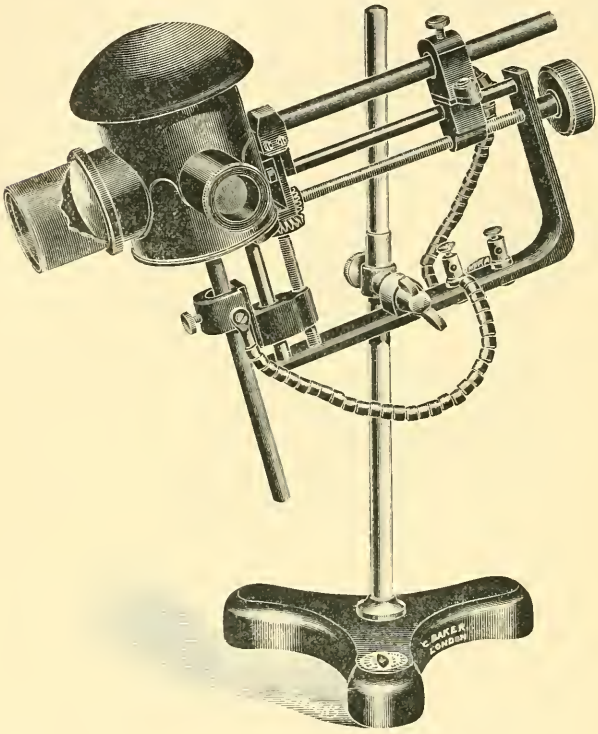


Fig. 131.

and 6 mm. solid for the vertical, when the current does not exceed 5 amperes.

There is a clamping arrangement which holds the lamp at any position on the upright of stand, and another which permits the whole lamp to be tilted to any angle required.

This arc lamp can be used for the projection lantern without the chimney, but the latter is needed when employed for microscopic or spectroscopic work.

An inexpensive yet efficient resistance suitable for use on a 100 or 200 volt current is supplied for use with this arc lamp.

(4) Photomicrography.

Observations and Contributions to the Practice of Scientific Photomicrography and Macrophotography inclusive of Colour Photography with Autochrome Plates.*—M. Wolff has compiled a thorough and complete treatise on the above subject, with especial reference to the requirements of the scientific investigator. The treatise is divided into thirteen sections, and contains numerous statistical tables of such important matters as time exposures and solutions.

(6) Miscellaneous.

Observations on the Brownian Movement, with special reference to the Anthrax Spore.†—E. Emrys-Roberts and S. B. Walsh, having made the observation that anthrax spores suspended in tap-water exhibit practically no Brownian movement, have endeavoured to investigate the phenomena and incidentally to attempt to elucidate some points in connexion with Brownian movement. In their investigations they made use of *Staphylococcus aureus* and Indian ink granules as controls, on account of their approximate size to anthrax spores, and also because the one could be taken as typical of dead particles and the other of living particles, both exhibiting well-marked Brownian movement. A number of exhaustive experiments showed the practical immobility of anthrax spores under all circumstances, and also that this property was to a certain extent shared by other spores. The experiments did not favour the theory that Brownian movement is an indication of the molecular movement of the suspensory fluid; but rather that it is due to unequal differences in surface tension between the particles and the suspensory fluid. A reasonable supposition to account for the comparative immobility of the anthrax spores is to postulate their possession of an envelope so nearly perfectly uniform that no unequal differences of surface tension exist, and hence no conversion of potential into actual energy. To put this theory to the test, the spores were treated with antiformin and other liquids likely to attack cellular material, and the spores were then found to exhibit marked Brownian movement. It would seem that the treatment had so altered the surface of the spores as to bring into action the forces leading to the production of Brownian movement, and this result would appear to strengthen the theory that the movement is due to unequal differences of surface tension between the particles in question and the suspensory fluid.

Experiments in Scientific Microscopy.‡—Under the above title H. Siedentopf has published the first part of what seems intended to be a complete practical guide to the most recent developments in advanced microscopy. This first part embraces sixteen pages and is copiously illustrated. The experiments dealt with are:—1. Observation by light-ground illumination. 2. Observation of the same preparation by dark-

* Zeitschr. wiss. Mikrosk., xxix. (1912) pp. 145–81.

† Brit. Med. Journ., 1912, ii. pp. 1305–6.

‡ Übungen zur wiss. Mikrosk., Heft i., Dunkelfeldbeleuchtung. Zusammengestelte von H. Siedentopf mit 20 Figuren; published by S. Hirzel (Leipzig), 1912.

ground illumination. 3. Dependence of resolution of linear objects on the azimuth of the dark-ground illumination. Observation of the spherical aberration of Microscope objectives with the Abbe testplate by means of dark-ground illumination. 5. Distinction between dry-condenser and immersion-condenser. 6. Observation of living bacteria with the paraboloid condenser. 7. Comparison between a paraboloid condenser and a centrally stopped-off immersion-condenser.

Quekett Microscopical Club.—The 484th Ordinary Meeting of the Club was held at 20 Hanover Square on October 22, the President, Prof. A. Dendy, F.R.S., in the Chair.

A paper by Mr. J. Rheinberg, F.R.M.S., "On Resolutions obtained with Dark-Ground Illumination, and their Relation to the Abbe Theory," in the absence of the author, was taken as read.

Messrs. Heron-Allen, F.R.M.S., and A. Earland, F.R.M.S., gave a lecture on "The Foraminifera in their role as World Builders." The earliest geological records of the group were quoted, and the development of the Foraminifera up to their "golden age" in Eocene times was traced. Here they reached their maximum development both as regards size and abundance, and left their remains in great beds, often of enormous thickness and extending across whole continents. With the passing of the Eocene period, the Foraminifera rose to their all-important position as rock-builders, although at the present day the area of the *Globigerina* ooze, estimated by Murray and Renard at 49½ million miles, exceeds in extent even the Nummulitic limestones of Southern Europe, Western Asia, and the Himalayas. Of the thickness of the *Globigerina* ooze we can, of course, form no idea, but as the great oceans in which it is being laid down are practically permanent, it must be very great, because we know from deep-sea deposits which have been elevated in Malta, Barbados, Australasia, and elsewhere, that similar deposits have been forming in the deep-sea ever since at least Miocene times.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Medium for Cholera.† — E. Morelli recommends the following medium for cultivating the cholera vibrio: Pancreatina (pepsina or papaina) 2, sodium chloride 0·5, water 100. The pancreatine prepared by Parke, Davis and Co. gave very good results.

Cultivation of the Cholera Vibrio in Coloured Media.‡ — E. Signorelli advocates the use of coloured media for cultivating cholera. The medium used is composed of the ordinary agar to which 1 p.c. of the pigment solution is added in the proportion of 1 c.cm. to 5 c.cm. of the agar. The pigments which gave positive results were erythrosin, safranin, orcein, and dahlia. While other vibrios were affected by the first three, dahlia gave the specific reaction, viz. the decolorizing of the

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

† Rend. R. Ist. Lombardo, xlv. (1912) pp. 671–5.

‡ Centralbl. Bakt., 1te Abt., Orig., lxvi. (1912) pp. 469–80.

medium and the staining of the colonies. The stained colonies lose their virulence in 48 hours. There are two coloured illustrations, but they are not described.

Direct Cultivation of Tubercle Bacilli. * — J. Cruickshank finds that there is a marked superiority of egg and animal tissues over other media for the growth of tubercle bacilli. In the case of sputum, urine, or other fluid, a 15–20 p.c. antiformin (equal parts of liquid sodæ chlorinatæ B.P., and 15 p.c. NaHO) is allowed to act until the coarse material is dissolved. In the case of solid particles, trituration is necessary. The solution is centrifuged, and the deposit washed with distilled water or saline two or three times. The washed sediment is then inoculated on egg, glycerin egg, or animal tissue media. The egg medium is prepared by mixing the whites and yolks of three eggs, straining them through gauze, and adding one part of 0·85 NaCl to every three parts of egg. A few drops of alcoholic basic fuchsin are added just to give a distinct colour to the medium ; this renders the growth more visible. Slopes are then made and sterilized in test tubes (3–5 minutes). The tubes are further sterilized at 105° C. on two successive days. To prevent drying of the medium, glycerin bouillon may be added, and a small amount should be allowed to remain in each tube at the time of inoculation.

Animal tissue media is prepared from fresh rabbit lung or other tissue. This is soaked for an hour in 0·85 p.c. NaCl solution containing 6 p.c. glycerin : it is then sterilized at 120° C. for 30–45 minutes, and is then supported over the surface of 6 p.c. glycerin bouillon, so that the tissue surface is kept moist by capillary attraction and by condensation. On glycerin-egg medium growth appears in from 12–24 days ; on animal tissue medium, in from 7–14 days.

Isolation of Bacillus Acne. † — E. M. Stanton makes use of the following procedure. The comedone is macerated in a few drops of sterile bouillon ; from this 2 p.c. glucose-agar slants are inoculated. The cottonwool plug is pushed down the tube until the lower end is a little above the medium. The space above the plug is filled with pyrogallic acid crystals, and a few drops of 5 p.c. sodium or potassium hydroxide added ; a rubber plug is at once inserted, and the paraffin applied to the plug and neck of the tube. Care must be taken not to use too much alkali, lest the liquid be forced through the cottonwool plug and the culture killed. Examination after three days' incubation shows small cream-coloured colonies on the surface of the milk-white *Staphylococcus albus* growth. The acne colonies are also found below or to the side of the *Staphylococcus* growth. As they are non-adherent, they are easily picked off, and anaerobic subcultures made. The author also gives the culture and morphological characteristics of *B. acne*.

Culture of Spinal Ganglia. ‡—G. Marinesco and J. Minea record their attempts to cultivate the spinal ganglia of mammals. They claim that their researches show that the nerve-cell removed alive from the

* Brit. Med. Journ., 1912, ii. pp. 1293-1300.
† Centralbl. Bakt., 1te Abt. Orig., lxvi. (1912) pp. 386–9 (3 figs.).
‡ Anat. Anzeig., xlii. (1912) pp. 161–76 (8 figs.).

animal body is capable of producing nerve-fibres in the artificial medium. They give illustrations which support their view.

Omission of Peptone in ordinary Cultivation Media.*—O. Nicolle strenuously advocates the omission of peptone from ordinary cultivation media, declaring that its presence is not only useless, but deceitful. In regard to cultures intended for inoculation purposes, he asks: "What is the use of infecting with the organism a substance which is in itself toxic?"

Diagnosis of Bacillus diphtheriæ, Klebs-Loeffler, and Hoffmann's Bacillus.†—E. Cathoire recommends Rothe's medium, agar or ox-serum, which have been saccharated and tinted with litmus. Two sugars, dextrose and saccharose, suffice for differentiation. Hoffmann's bacillus vel pseudodiphtheria bacillus ferments neither, while the Klebs-Loeffler alters the colour of the litmus-glucose medium very distinctly, and but little affects the saccharose medium. The author points out that Hoffmann's bacillus may often be found in the throats of healthy persons; it is rarely found in the course of diphtheria, though during convalescence it is frequently present. This explains why some observers advocate a morphological and physiological transformation. These two species retain their cultural characters when subcultivated every week for a year, even after passages in collodion sacs inserted in the peritoneal cavity of guinea-pigs.

(4) Staining and Injecting.

Demonstrating the Nucleus of Bacteria.‡—J. R. Douglas and A. Distaso point out that in order to demonstrate the presence of the bacterial nucleus, very young cultures must be used. In the case of a spore-forming organism, such as anthrax, they start by taking an old culture rich in spores and make a suspension of this in saline. By centrifuging this an emulsion is obtained consisting only of spores. 20 c.cm. of this emulsion with 2 c.cm. bouillon are placed in very strong tubes, and after incubation periods of $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 12 hours, and so on, the tubes are centrifuged until all the bacteria are sedimented. The supernatant fluid is then pipetted off and the deposit is mixed with an equal bulk of sterilized serum. From this, presumably, films are made; anyway the material is fixed in 2 p.c. osmic acid, to which a few drops of glacial acetic acid have been added. After an exposure to the vapour of the fixative for two or three minutes, the preparations are air-dried. They are then stained with Giemsa (1–2 drops to the cubic centimetre of water) for from 4–24 hours or longer. Differentiation, which must be watched under the Microscope, is carried out with 10–20 p.c. alcohol. In successful preparations the cytoplasm is blue and the nucleus red. With organisms which do not form spores good results are difficult to obtain, but the following method is successful. An emulsion, e.g. cholera or typhoid, is made with an equal bulk of human fresh serum, and then incubated for five or six hours. By centrifuging this a small number of bacteria is obtained. An emulsion is then made with a small

* C.R. Soc. Biol. Paris, lxxiii. (1912) p. 403.
† C.R. Soc. Biol. Paris, lxxiii. (1912) pp. 405–7.
‡ Centralbl. Bakt., 1te Abt. Orig., lxvi. (1912) pp. 321–7.

quantity of serum and bouillon, after which the procedure is apparently as in the former example.

The author's paper is illustrated by thirty-six coloured figures showing the cytoplasm and nucleus in anthrax, Friedlaender, typhoid, cholera, diphtheria, pseudodiphtheria, and in *Pneumococcus*.

New Method of Staining Lignified Tissue.*—E. F. Galiano first treats the sections with caustic potash, or with sodium hypochlorite, followed by washing in water. The sections are then stained in an aqueous 1 : 1000 solution of thionin for 2–5 minutes. After washing freely in water, the sections are passed through upgraded alcohols, and when dehydrated mounted in balsam.

Another procedure consists in treating the sections, stained as above, with strong hydrochloric acid, and after washing very freely in water, dehydrating in upgraded alcohols and mounting in balsam.

For contrast staining, the sections may be treated with hæmatoxylin, with thionin and orsellina BB, or with thionin and alum-carmin.

(6) Miscellaneous.

New Method of finding Ova of Worms.†—S. Yaoita mixes a fresh sample of fæces with equal parts of ether and of 25 p.c. antiformin, and shakes vigorously. The mixture is filtered through ganze and centrifuged. The lowermost layer of the deposit contains the eggs of the parasitic worms.

If the deposit becomes copious it is further diluted with antiformin, filtered and centrifuged; the deposit from this is then treated with dilute hydrochloric acid and a small quantity only of ether added; this mixture is vigorously shaken and again centrifuged. This procedure removes the salts and other debris, and facilitates the finding of ova when scarce.

Metallography, etc.

Cobalt-carbon System.‡—G. Boecker found that the maximum carbon content obtainable by melting cobalt in contact with sugar charcoal was 3·9 p.c. Alloys prepared by melting this alloy with more cobalt were examined thermally and microscopically. The microstructure was revealed by polishing: etching was unnecessary. A specimen of pure cobalt was etched successively with ferric chloride and picric acid solutions. No indication of the existence of a carbide of cobalt was found. In the slowly cooled alloys the carbon was present as graphite. At the eutectic temperature, 1300° C., the cobalt held 0·82 p.c. carbon in solid solution; the eutectic contained 2·9 p.c. carbon.

Electrical Disintegration of Metals.§—C. Benedicks has attempted to apply the electrical disintegration of metals, as used by Svedberg in the synthesis of colloids, as a metallographic method of investigation,

* Bol. R. Soc. Española Hist. Nat., xii. (1912) pp. 340-5.

† Deutsche Med. Wochenschr., 1912, p. 1541; through Centralbl. Bakt., 1te Abt. Ref., liv. (1912) p. 635.

‡ Metallurgie, ix. (1912) pp. 296-303 (8 figs.).

§ Proc. Int. Assoc. Testing Materials, ii., No. 10 (1912) 18 pp. (12 figs.).

but the results were mainly negative. The particles thrown off into the surrounding liquid by the spark discharges were found to be very regular minute spheres ; diameters measured ranged from 5 μ down to 0·2 μ.

Progress of Metallography 1909–1912.*—E. Heyn summarizes critically the more important researches of the last three years, and adds bibliographical references to 540 metallographical papers. The iron-carbon system is considered at some length.

Crystallization and Structure of slowly-cooled Steels.†—N. T. Belaiew describes the processes of crystallization occurring in steel from the beginning of solidification down to the lower limit of the critical ranges, and shows how the resulting structures are produced. The author's views are based chiefly upon an examination of nine ingots containing 0·45–2·30 p.c. carbon, made by melting pure iron with carbon in crucibles, maintaining the melts in a fluid state for two hours and allowing the crucibles and their contents to cool very slowly in the furnace. "Damaskeened" steel is made by a similar process. Solidification in steel proceeds by the formation of dendrites, and at the end of the solidification range the ingot may be regarded as a mass of interlaced dendrites. The axes of the skeleton crystals, being the lines of primary solidification, tend to contain less carbon than the later solidifying portions. For this reason, traces of the dendritic structure may persist throughout subsequent treatments of the steel, and may be revealed by long-continued etching with dilute acids. After complete solidification, neighbouring particles tend to assume a uniform crystalline orientation, and the mass becomes an aggregate of approximately equiaxed crystalline grains of the solid solution. In the next stage of crystallization, ferrite, or cementite, according to the carbon content of the steel, separates from the solid solution. This separation of "pro-eutectoid" takes place wholly at the boundaries of the crystalline grains, if these are not too large and the cooling is slow. The well known cellular or network structure is thus produced. With more rapid separation the pro-eutectoid forms plates parallel to the faces of the octahedra, of which the crystals of solid solution are composed : the resulting formation is the Widmanstätten structure.

A third structure occurring in isolated crystals and occasionally in castings is described.

Formation of Osmondite in hypo-eutectoid Steels.‡—J. Calian has examined four steels containing 0·42, 0·65, 0·80, and 1·02 p.c. carbon. A number of specimens of each were quenched from 900° C. and reheated respectively to 100°, 200°, 300°, 400°, 500°, and 600° C. From a microscopical study and a determination of solubility in dilute sulphuric acid, the author concludes that the transition constituent, osmondite, is not formed only at one definite temperature, but may be formed within the range 300° to 500° C.

* Proc. Int. Assoc. Testing Materials, ii., No. 11 (1912) 58 pp. (8 figs.). Official report to the Sixth Congress, New York, 1912.

† Rev. Métallurgie, ix. (1912) pp. 321–42 (14 figs.).

‡ Rev. Métallurgie, ix. (1912) pp. 187–94 (22 figs.).

Widmanstatten Structure in Forged Steels.* — A. Portevin and V. Bernard point out that the conditions favourable for the production of the Widmanstätten structure in steel, long heating in the γ iron or solid solution range, followed by a sufficiently rapid separation of the ferrite during cooling, often occur in the manufacture of forged pieces of steel. A considerable number of forgings examined by the authors to ascertain the cause of their failure in service have been found to possess this structure. Mechanical tests also indicated decided brittleness, and the authors conclude that the Widmanstätten structure is commonly accompanied by brittleness.

Life-history of Pro-eutectoid Cementite.†—H. M. Howe and A. G. Levy have microscopically examined two steels containing respectively 1·14 and 1·45 p.c. carbon, after different heat treatments. Small specimens were heated to about 1200° C., cooled slowly to determined temperatures, and quenched. Others were heated to 1000° C., quickly cooled to 800° C., and quenched after being held at that temperature for a determined length of time. The form and amount of cementite observed in the specimens led to the following conclusions. In cooling, the coalescence of the pro-eutectoid cementite into readily visible masses is very slow, but is less slow as the carbon content of the steel is greater. The internal pro-eutectoid cementite coalesces more slowly than the network cementite. Internal cementite may be transferred to the network, probably by solution and reprecipitation.

Crystalline Growth of Ferrite.‡—A. Sauveur subjected a specimen of steel containing 0·05 p.c. carbon, previously slowly cooled from 1000° C., to a high load in the Brinell ball test, and then annealed the specimen for seven hours at 650° C. A vertical section through the bottom of the cavity showed a very coarsely crystalline layer some distance below the bottom of the cavity, while the structure both above and below this layer was comparatively fine. Numerous other experiments on the same material confirm the existence of a critical stress (either tension or compression) producing a critically strained condition, which on annealing at temperatures below the thermal critical range develops an excessively coarse crystalline structure. If the strain is greater or less than this critical value, subsequent annealing does not develop a coarse crystallization. The tensile stress required to produce the critical strain in the material investigated was about 22 tons per square inch.

Slag Enclosures.§—W. Rosenhain, in the official report on this subject, summarizes and discusses the investigations of the last three years. Further work appears to be desirable upon the equilibrium of the system Fe–Mn–S. upon the solubility of oxides of iron, and of silicates and sulphides, in iron at various temperatures and also in each other, and upon the mechanical effects of enclosures.

* Rev. Métallurgie, ix. (1912) pp. 544–50 (8 figs.).
† Proc. Int. Assoc. Testing Materials, ii., No. 13 (1912) 14 pp. (34 figs.).
‡ Proc. Int. Assoc. Testing Materials, ii., No. 11 (1912) 12 pp. (14 figs.).
§ Proc. Int. Assoc. Testing Materials, ii., No. 10 (1912) 22 pp. (4 figs.).

Effect of Silicon in Mild Steel.*—P. Paglianti has determined numerous properties of ten specimens of mild steel containing 0·1–0·15 p.c. carbon, the silicon increasing from 0·24 to 5·26 p.c. The structures of the specimens as rolled, or annealed, were pearlitic in all cases. The etched sections of the rolled bars had a decidedly streaky appearance, due to the arrangement of the pearlite and ferrite in alternate bands. Increase in silicon content up to 2·35 p.c. had little effect upon grain size, but with 3 p.c. silicon the ferrite crystals were three or four times as large; they increased greatly in size with further increase in silicon content. Elongated inclusions were conspicuous in the specimens containing 3 p.c. silicon or more. The streaky structure can be removed by long heating at 1100° C.

Nomenclature of Constituents of Steel.†—H. M. Howe and A. Sauveur present the report of the committee on the nomenclature of the microscopic substances and structures of steel and cast iron. Working definitions for all names in use are given, with some reference to the theories involved. The report does not lend itself to abstracting.

Effect of Superheated Steam on Cast Iron.‡—W. Campbell and J. Glassford have studied the changes occurring in the microstructure of cast iron, etc., when exposed to superheated steam, with a view to explaining the failure in use of cast-iron fittings under similar conditions. With white cast iron, steel, and malleable cast iron, surface oxidation alone took place. In some grey cast irons, particularly those containing much silicon, the oxidation penetrated through the mass, envelopes of oxide being formed around the graphite plates. The penetration of oxidation increased with increase of silicon content.

BARTH, O.—**Methods of Increasing the Resistance of Technical Alloys to Corrosion.**
[The author includes a description of the microstructure of cobalt-tin and aluminium-cerium alloys.] *Métallurgie*, ix. (1912) pp. 261–76 (21 figs.).

BAUCKE, H.—**Action of Electrolytes on Metals under Stress.**
Proc. Int. Assoc. Testing Materials, ii., No. 13 (1912) 10 pp. (19 figs.).

CHARPY, G., & S. BONNEROT—**Cementation of Iron by Solid Carbon.**
[A more detailed account of an investigation previously abstracted, see this Journal, 1912, p. 255.)
Rev. Métallurgie, ix. (1912) pp. 305–20 (9 figs.).

HEIKE, W.—**System Lead-sulphide—Tin-sulphide.**
[Photomicrographs of alloys of the two sulphides, PbS, SnS, are given.]
Métallurgie, ix. (1912) pp. 313–19 (9 figs.).

HIBBARD, H. D.—**Solid Non-metallic Impurities in Steel, "Sonims."**
Proc. Int. Assoc. Testing Materials, ii., No. 13 (1912) 15 pp.

STEINBERG, S.—**Influence of Annealing on the Microstructure of Forged Steel.**
Rev. Métallurgie, ix. (1912) Extraits, pp. 227–9 (12 figs.).
Journ. Soc. Met. Russ. (1911) p. 299.

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* Metallurgie, ix. (1912) pp. 217–30 (37 figs.).
† Proc. Int. Assoc. Testing Materials, ii., No. 13 (1912) 18 pp. (1 fig.).
‡ Proc. Int. Assoc. Testing Materials, ii., No. 13 (1912) 16 pp. (18 figs.).