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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MICROSCOPY.

a. Instruments, Accessories, &c.*

Bulloch's Lithological Microscope.—The general construction of this instrument (fig. 5), is similar to the Professional stand of Mr. W. H. Bulloch except in the following details:—

There are two stages, each is graduated to 15′ reading by a vernier to 20″, and can either be revolved by hand or by tangent screw which also acts as a slow motion. The worm cut on the periphery of the stage has 360 teeth (equal to single degrees), and the tangent screw head is graduated to 6°, so that each division reads to 1′. The tangent screw can be thrown in or out of connection as required. Each stage has stops for Maltwood finder, and also stops for the small lithological slides. The above arrangement is common to both stages. One of the stages has a plain sliding object-carrier. The second is also furnished with a sliding object-carrier, and with micrometer screws in two directions "for the direct measurement of objects without any reference to magnification." The screw threads are 0·5 mm., the heads being graduated to 250, so that each division reads to 2 μ and by vernier to tenths equal to 0·2 μ.

At the side of the limb there is a scale reading to 0·5 mm., and the slow motion screw-head is graduated to 500, each division equalling 1 μ. The polarizing prism fitting in the substage has a graduated circle, and a spring catch at each 90°. The analysing prism at the lower end of the body-tube has a revolving movement by a lever of 90° and can be removed to the side by a slide similar to the Wenham binocular prism. At the lower end of the tube is a Klein's quartz-plate, and a centering nose-piece. A goniometer eye-piece is used with crossed spider lines, a Nicol prism, and a calc-spar plate. The fitting is made adjustable, for if the calc-spar is not cut in the proper direction the cross cannot be placed in the centre of the field without slightly tilting the crystal.

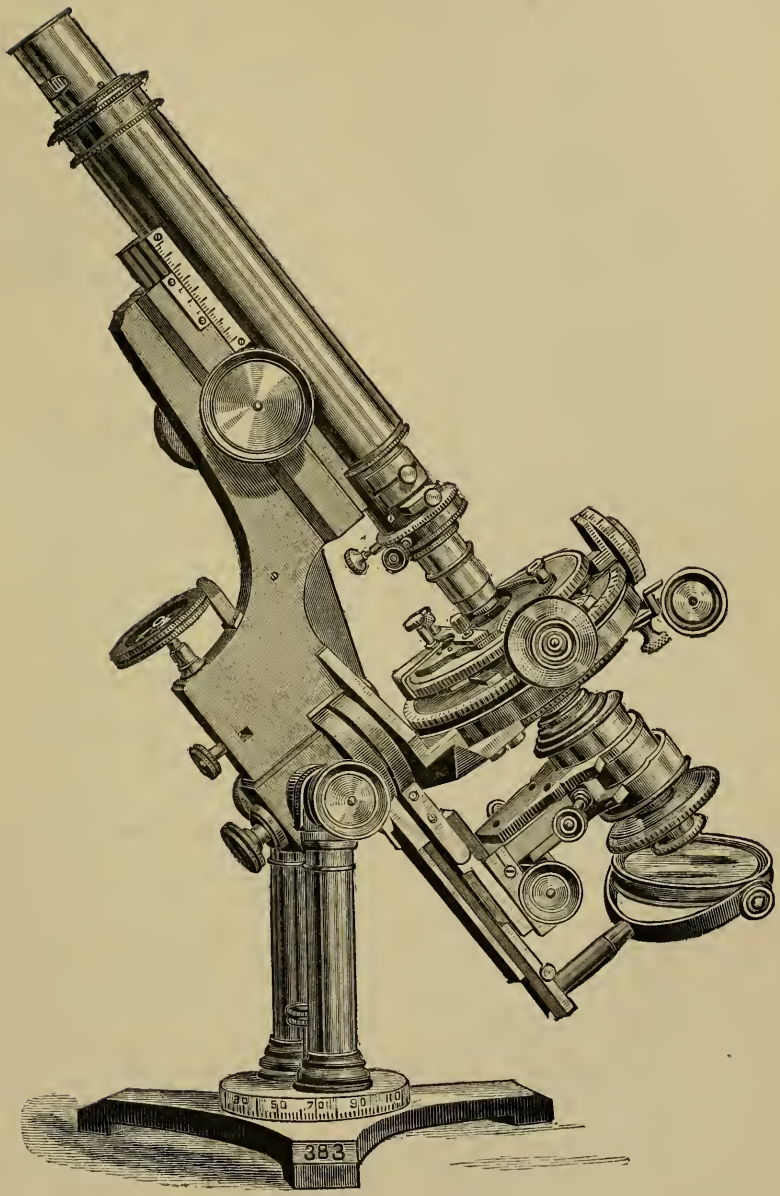
In working; to change from polarized to ordinary illumination, the prism below the stage can be turned aside, leaving the wide angle condenser in position; or the whole substage can be turned aside, a movement which is supplementary to swinging on the axis in the centre with the object on the stage. When the condenser is not required there is a supplementary substage for the lower prism, so that the prism can be used close to the object, and no light admitted, except that which has passed through the prism.

Chevalier's Portable Microscope.—An ingenious method of providing a solid and steady base for a portable Microscope was devised by M. C. Chevalier, and is shown in figs. 6 and 7.

The tripod feet of the instrument fit into three notches in the

* This subdivision is arranged in the following order:—(1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

Fig. 5.



Bulloch's Lithological Microscope.

circumference of a heavy brass disc. Over the disc fits a ring (shown separated in the fig.), which when screwed down fixes the feet

Fig. 6.

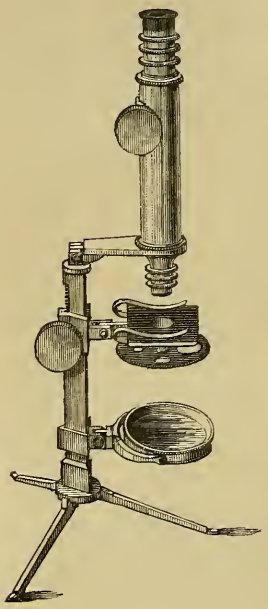
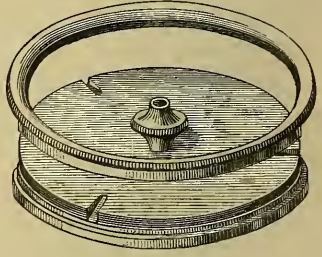


Fig. 7.



of the tripod immovably. In the centre of the disc is a support for the end of the standard to rest on.

The feet fold together, and the mirror and stage can be turned up against the standard, whilst the horizontal arm can be set vertical. When the body-tube is unscrewed, the whole instrument is reduced to very small dimensions. For a coarse adjustment the stage is moved, and for a fine adjustment the draw-tube, in which the eye-piece slides. Both movements are by rack and pinion.

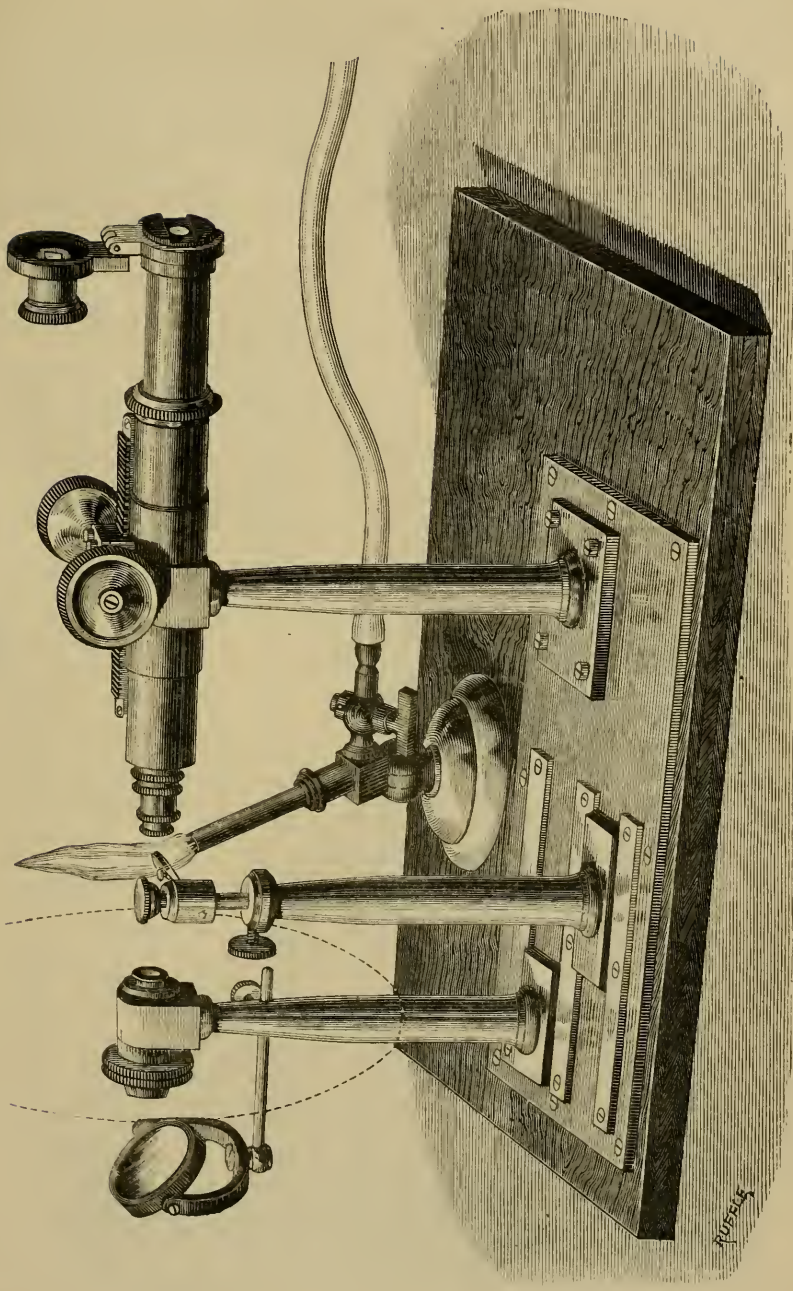
Klein's Horizontal Heating Microscope.* — This (fig. 8) was devised by Prof. C. Klein for the purpose of observing minerals with the Microscope under high temperatures.

The body-tube is mounted horizontally on a brass standard screwed to a metal plate, with which the wooden base is strengthened. Opposite to it is a second standard, which slides in grooves and carries the lower part of the Microscope—mirror, condenser of long focus, and polarizer. In another groove at the side of, and parallel to the former, is a third standard, with an extending rod, which supports a pair of forceps with platinum points to hold the mineral to be examined, which can be placed at any convenient point between the condenser and the low-power objective. An analyser is attached by a hinge-joint to the front of the eye-piece, so that it can be turned up out of the way when not required, as shown in the fig. A selenite plate can be interposed between the analyser and the eye-piece. A screen (shown by dotted lines) can be placed on the lower tube to shut off extraneous light.

Heat is applied to the object by a Bunsen burner, which is movable on a hinge, so that the flame can be quickly applied to a given point and as quickly removed again.

* Nachr. K. Gesell. Wiss. Göttingen, 1884, pp. 133–5.

Fig. 8.

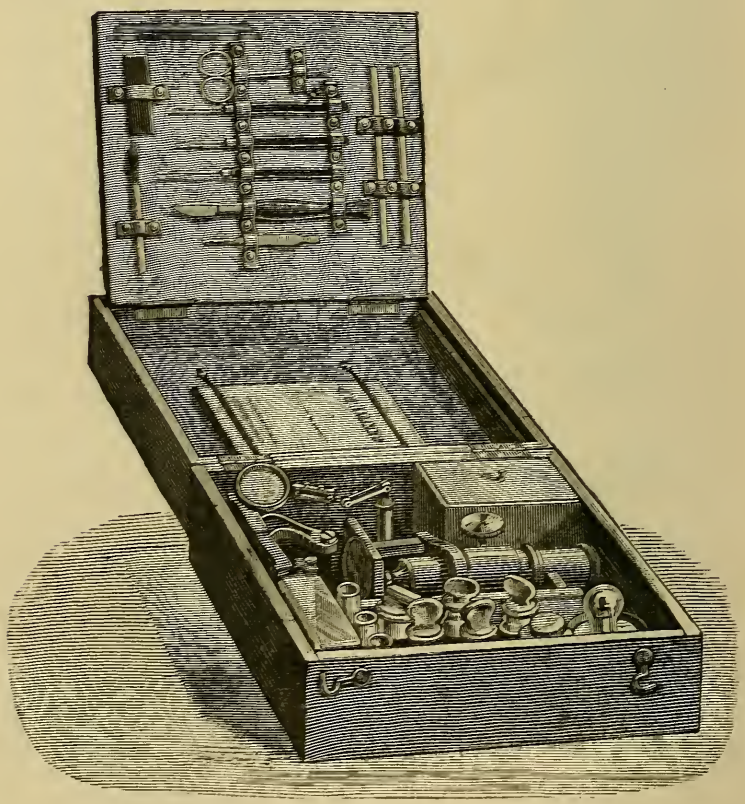


KLEIN'S HORIZONTAL HEATING MICROSCOPE.

Prof. Klein thus describes his observations on some crystals of leucite which will illustrate the application of the Microscope:—Sections parallel to the faces of the cube, octahedron, dodecahedron, and icositetrahedron (regarding the crystals as cubic for the sake of simplicity), all behaved in the same way when heated. Darkness spread over them, the characteristic twin lamellæ disappeared, and the sections remained dark between crossed Nicols until the flame was withdrawn, when they transmitted light as before (beginning with the coolest side), and the lamellæ returned. The same section could be repeatedly heated with the same results. It follows from these experiments that leucite becomes isotropic when heated, and Prof. Klein draws the conclusion that it originally crystallized at a high temperature as a cubic mineral, and became rhombic (as he shows elsewhere) on cooling.

French Dissecting Microscope.—This instrument (fig. 9), though called a "dissecting" Microscope, is in the ordinary form of a small student's compound Microscope. Its special feature is not so much the stand itself as the case in which it is packed, which has a

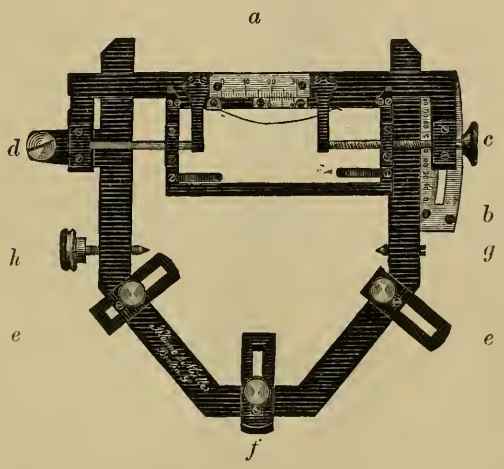
FIG. 9.



very convenient arrangement of mounting apparatus, including trays, reagents, and instruments. The knives, scissors, &c., are, as will be seen, arranged on a hinged cover to the inside of the lid, which is of extra depth.

Klönne and Müller's Pendulum Object-frame or Bacteria-finder.—Messrs. Klönne and Müller have devised this apparatus (figs. 10 and 11) for readily finding small objects. It may be fitted to any Microscope, and can be traversed over the whole of an object

Fig. 10.



by means of two graduated motions, so that the position of any point may be marked and recovered without difficulty. The frame (fig. 10) which holds the slide, is moved backwards and forwards by a swinging motion about the fixed point *d*, and from side to side by the traversing screw *c*. These motions are measured by the graduations on the circular slot at *b*, and by the millimetre scale and vernier at *a*.

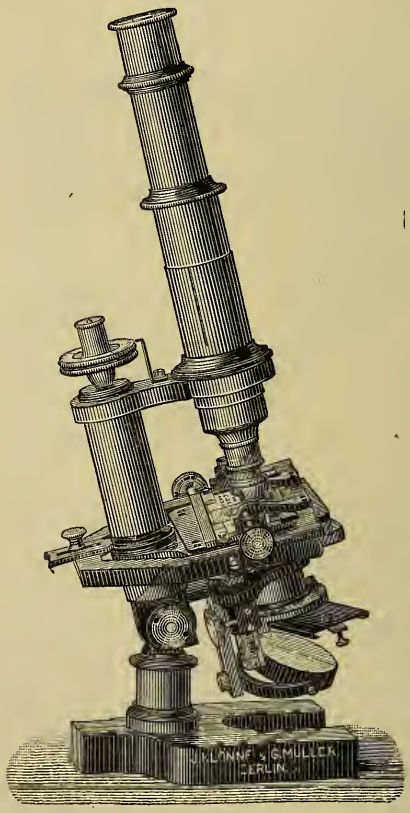
To fit the frame to the Microscope, the piece *a* is swung out of the slot *b* and brought round to the left of *d*; the framework *h f g* is pushed forward over the stage from behind until the rests *e e* lie upon the stage, and *f* upon a projection at the back of the pillar. The screw *g* presses against one side of the stage, and *h* is screwed up to the other. *f* and *g* are adjusted by the makers so that the line *d c* (*c* being near the centre of the slot) passes through the centre of the stage. The object is then inserted into the frame *a* from below; it is held in position by the spring shown at the upper side, and is pressed against the stage by the two springs below when the frame has been swung back into the position shown in the figure.

The object having been placed by means of *c* so that its edge is at one side of the field of view, is searched from top to bottom by the motion about *d*; it is then shifted by means of *c* through a distance equal to the width of the field and a second vertical strip of this width is traversed by the pendulum motion; the process is repeated

until the whole object has been searched. The exact position of any point may then be noted by the readings of *b* and *a*. If the frame is transferred from one Microscope to another, the exact points at which the screws *g* and *h* indent the sides of the stage, and the exact extent to which *g* is screwed into its bearings must be noted. To facilitate the latter adjustment, a small slit is cut across the threads of *g*.

Professor Arendt, of Leipzig, writes to express his satisfaction with the apparatus, which works extremely well in practice. The

Fig. 11.



slide can be inserted into the frame quite as easily as under the ordinary springs, and marked points in an object are rapidly recovered. He says, "For example, I have to-day searched a Bacteria-slide which I had prepared, and found in it thirty-seven points of particular interest. This was the work of about an hour. To find *all* these points again occupied me only *four minutes*, and the adjustment is so accurate that they were in every case brought back into the centre of the field."

Fig. 11 shows the apparatus in place on the Microscope.

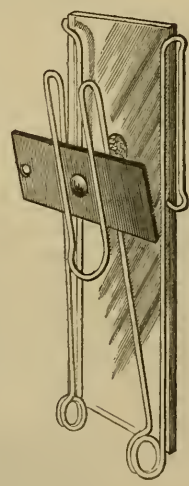
Microscopes at the Antwerp Exhibition.*—Dr. H. van Heurck reports upon the Microscopes exhibited at the recent Universal Exhibition at Antwerp. "The Microscope," he says, "is generally very imperfectly represented in universal exhibitions, and the Antwerp exhibition was no exception, only six firms being represented, Hartnack, Nachet, Prazmowski (Bezu, Hausser and Co.), Reichert, Ross, and Zeiss.

Of Hartnack's instruments Dr. van Heurck describes Bacterial, Mineralogical, and Photographic Microscopes, also his Cupro-ammonia Cell (*post*). M. Nachet's instruments are the Large Model, Petrographical, Chemical, Travelling, Demonstration, Dissecting, and Double body Microscopes. Also his "Loupe-chambre-claire" (*post*). Of Bézu's, the Mineralogical, and Large and Second Hartnack Models. In each case the objectives exhibited are also reported on, and the special fluid for homogeneous immersion used by Dr. Hartnack described (*infra*, p. 133).

Hippisley's Lens- and Slide-Holder.—Fig. 12 shows the ingeniously simple mounting adopted by Mr. J. Hippisley for the lenses made of globules of glass described Vol. V. p. 890.

The lenses are secured between two pieces of thin brass, one of which has its two ends turned up over those of the other, and hammered down. The lens thus mounted is slipped into a holder of brass wire in the manner shown in the figure, the slide being similarly held by another part of the holder. The focusing adjustment is made by pressing together the two parts of the holder which are normally kept apart by the "spring" of the wire caused by the turns which are made in it at the bottom. Mr. Hippisley describes its use thus:—

Fig. 12.



"It is intended to be held horizontally, when the focal adjustment will be found to be well under command of the thumb and finger of one hand. The spring of the wire allows ample traverse of the lens over the field; and by judicious application of the other thumb and finger the slide may be shifted longitudinally, so that any part of the field can be examined without removing the instrument from the eye. The other hand makes a convenient screen for the eye not in use.

This is only one of many variations of contrivances for utilizing these lenses. 'Thumb-screws' are an abomination for slowness of action and other inconveniences. A wedge I have found much more useful for fine adjustment, as its operation is equally fine, and it may be *suddenly* thrust in or withdrawn for the beginning (or coarse part) of the adjustment. But I do not think, unless it is wanted to

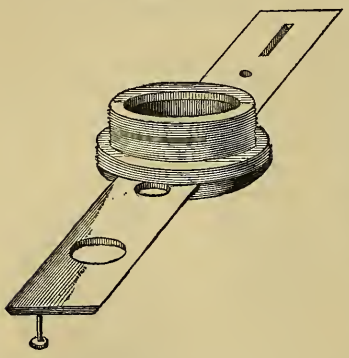
* Journ. de Microgr., ix. (1885) pp. 364–75 (6 figs.).

transfer the instrument *with focus adjustment* to the hands of some one unused to a lens, that even that provision is necessary practically, for anything not exceeding 150 or 200 diameters."

Mr. Hippisley also says that he makes "Coddington" lenses by melting pear-shaped pieces of glass until the ends in advancing towards a spherical form have approached to the right distance, which is ascertained by repeated trials. As the two ends cannot, except by chance, be exactly of the same curvature, one end has to be selected and marked, as that to which the eye is to be applied.

Griffith's Substage Diaphragm.—Mr. E. H. Griffith's substage diaphragm is intended as a substitute for the cheaper kind. The principal claims for it are that it will do the work well that is required of much more expensive ones, and as it is placed in the centre of the substage fitting, and so constructed that it may be turned in any direction, many effects may be secured by simply moving the slide. Being central it is not so much in the way as some other forms.

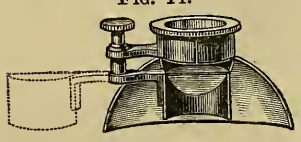
Fig. 13.



It is simply a perforated metal button fitting the Society screw of the substage. Through the head is a groove, cut with a milling-machine, which is provided with a diaphragm slide which has different sized and shaped apertures which can be placed exactly central by means of stops, or out of centre if desired. The slit can be made to be perpendicular, diagonal, or longitudinal to the slide, as desired, by turning the button.

Sorby's Direct Illuminator.—In some recent discussions on the microscopical structure of metals, Dr. H. C. Sorby has recalled attention to the illuminator devised by him many years ago for the examination of minerals. It consists (fig. 14) of the "Parabolic Reflector," in the centre of which, in a semi-cylindrical tube, open in front, is placed a small plane reflector which covers half of the objective, and throws the light directly down upon the object, and back through the other half. This allows of two kinds of illumination, oblique and direct, to be readily used, as the plane reflector is attached to an arm so that it can be swung out of the way when not required, as shown by the dotted lines in the fig.

Fig. 14.



Dr. Sorby writes:—"I may say that for the study of polished and etched sections of iron and steel, it is almost indispensable. In

examining other objects, especially if they have glass covers, the direct illumination of course causes much reflection from the glass, and makes the object look milky. The reflection from iron and steel, however, entirely overpowers this light from the cover, so that it does not interfere with the use of the illuminator." (See also *infra*, p. 175, for Dr. Sorby's paper on the preparation and illumination of iron and steel for microscopical examination.)

Equalizing the Thickness of Slips with Oil-Immersion Condensers.*—It is necessary that an oil-immersion condenser should have a fairly long focus; otherwise it would be of no use if the slip happened to be rather thick. If the slide is thin, it will be found impossible to keep the oil contact when the condenser is in focus, unless you increase the thickness of the slide, by uniting a thick cover-glass to the back by oil. It will be found very difficult to do this without oiling the stage when the Microscope is inclined. The oil between the condenser and the cover-glass is sure to unite with that between the cover-glass and slide, and then the cover-glass falls, upsetting the whole arrangement. To obviate this Mr. E. M. Nelson has found the following plan to answer admirably. A piece of glass 1 in. square, upon one side of which, close to one edge, a strip 1/8 in. broad is fastened by shellac, is oiled to the back of the slide; the ledge hooking over the edge of the slide prevents it slipping down.

Fig. 15.

Fig. 16.

Coxeter's Silico-Carbon Battery and Electric Lamp. — Messrs. Coxeter and Nehmer exhibited at the January meeting the battery and illuminator, figs. 17 and 18.

The battery has in each of the four cells two large silico-carbons, with platinum clamp connections, and one zinc rod with screw terminal. It is charged with chloride of ammonium. No chemical action takes place except when it is actually in use; and once charged it needs no further attention, but is always ready when required. There is a shunt on the lid to connect the cells consecutively, and thus illuminate the object with the varied requirements of high and low power. The current passes through a rheostat before it reaches the incandescence lamp, to prevent its being spoiled; the electrical resistance should be afterwards lessened or taken out of the circuit by moving the sliding button A, and thus the battery is economized. The lamp-holder is jointed, and can be moved into any position, either above or below the stage, or to any part of it, and the position of the light is not altered by any movement of the Microscope. The light can be turned on and off at the lamp when desired. It is

* Engl. Mech., xlii. (1885) p. 280 (3 figs.).

claimed that the lamp "is the only one with practically no heat; it gives a delightfully soft and steady light, capable of great variation

Fig. 17.

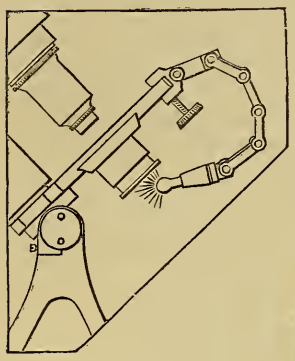
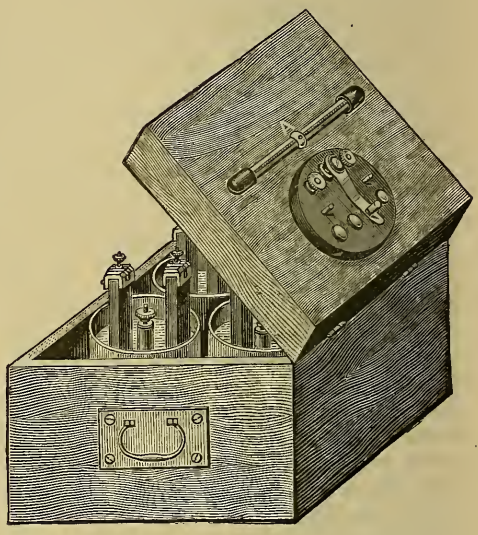


Fig. 18.



in intensity, and far less tiring to the eyes than ordinary reflected light."

The lamp can also be carried on a swinging tail-piece, after the plan introduced by Mr. E. Bausch.*

Bulloch's Cobweb Micrometer.†—A form of cobweb micrometer has been introduced by Mr. W. H. Bulloch, in which in addition to the movement of one set of lines with the micrometer screw, another screw, worked with a milled head on the other side of the instrument, moves both sets of lines together, so that it is possible to set the graduated screw-head at zero for any particular measurement. This is a very convenient as well as useful feature.

Jung's Nose-piece Adapter.—Herr R. Jung has further improved the Nachet-Thury form of adapter.‡

Fig. 19 is the adapter, and fig. 20 the ring which is screwed to each objective. The adapter consists of a fixed inner cylinder which screws into the body-tube, and a movable outer cylinder which is kept pressed up towards the lower end of the body-tube by a strong spiral spring. The bottom of the outer cylinder ends in a shoulder which is cut away for about a third of its circumference, so as to allow a ring and its objective to be slipped in when the cylinders

* Appleton's Annual Cyclopedia for 1884 (1885) p. 515 (1 fig.).
† Amer. Mon. Micr. Journ., vi. (1885) pp. 239–40.
‡ See this Journal, i. (1881) p. 661.

are separated. The spring, by drawing the outer cylinder back again, keeps the objective firmly in place. So far, the arrangement is similar to the Nachet-Thury form.

To draw down the outer cylinder against the strong spring, in order to release the objective, requires some force, and if it is allowed to slip, the fingers are apt to be nipped, apart from the injury to the fine adjustment, while if the spring is weak and so easily extended, the objective is only loosely held. To avoid these difficulties the upper margin of the outer cylinder has two notches cut in it, one of which is shown in fig. 19 (the other being opposite to it), whilst the inner cylinder has two pins with projecting heads. When a notch is opposite a pin, the outer cylinder is close home, but on rotating it, so that the pins do not fall in the notches, as shown in the fig., the outer cylinder is forced down.

Fig. 19.

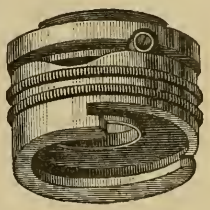
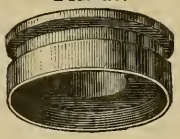


Fig. 20.



In order to release the objective, therefore, no force is required; all that is necessary being a slight rotation of the outer cylinder, so as to take the pins out of the notches. To ease the rotation, the pins have each a loose collar, which revolves as the outer cylinder is turned.

Hartnack's Fluid for Homogeneous Immersion.*—Dr. E. Hartnack supplies, in place of cedar-oil, vaseline oils—the white oil for axial illumination and the yellow oil for the oblique.

Rotary Object-carrier.†—Mr. J. M. Flint describes a device for exhibiting a series of mounted objects, without a change of slides. As described it is arranged for Foraminifera, viewed as opaque objects, with a low power. They are mounted on small brass discs furnished with a stem, by means of which they may be carried in a "Beck's disc-holder" when it is desired to make a thorough study of the specimens. Ordinarily these discs are inserted in thin wooden slides of regulation size and kept in boxes, until the series is complete. In order to protect the specimens from dust or injury, and at the same time maintain their accessibility, movable covers are constructed as follows:—A score or more of curtain rings, not flattened, are slipped upon a squared rod of wood, and brushed over freely with thick shellac. On the following day, before the shellac has become hard, the rings are slightly separated in pairs. When the pairs are firmly united, a thin glass cover is secured to the upper surface of each pair, and thus a little box cover is formed, deep enough to inclose disc and specimen. Now, by driving two small gimp-tacks into the wooden slide, at the proper distance apart, and deep enough so that the heads of the tacks will just enter the groove between the

* Journ. de Microgr., ix. (1885) p. 367.
† Amer. Mon. Micr. Journ., vi. (1885) pp. 204-5.

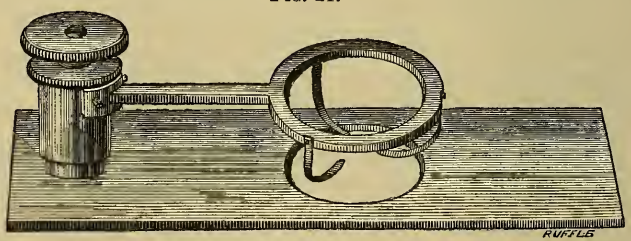
rings, a simple catch is formed, by means of which the cover may be secured, and also be removable at pleasure.

For exhibition, these discs are transferred to a thin circular plate 6 in. in diameter, made of three or four sheets of cardboard glued one upon the other. This makes a firm plate, not liable to warp, and in which holes may be readily bored for the insertion of the discs, and the tacks driven to secure the covers. By inserting the discs as near the edge of the plate as possible, a line 15 or more in. in length is obtained on which to display the objects. The circular plate bearing the specimens as above is made to rotate upon a pivot passing through its centre in such a way that the objects are brought successively into the field.

The manner of support of this pivot and its attachment to the stage must depend upon the instrument used, which, however, should have a stage with mechanical movements, and the attachment be made to the upper stage-plate, thus giving control of each object when brought into the field in the same manner as if it were mounted upon the ordinary slide. The author constructed a pivot support out of a piece of thin board (cigar-box), 2 in. wide and 3 in. long, the pivot being a common wood-screw inserted near one end, and carrying a wooden nut to steady the revolving plate, and the attachment to the stage-plate being effected by means of four small screws driven nearly home on the under side of the thin strip bearing the pivot, the heads of the screws being so arranged that they slide into grooves on the stage-plate, which ordinarily carry one of the clamps for securing the object slip. Shallow notches on the edge of the revolving plate, into which drops the curved end of a light spring, serve to inform the observer when the object is in the proper position. Transparent objects might be mounted on small squares of glass, made transferable from wooden or glass slips to the revolving plate as above, the necessary holes being made in the plate to allow the passage of light from below.

Kunckel d'Herculais' Compressor.—This (fig. 21), the design of M. Kunckel d'Herculais, is intended for the "gradual compression

Fig. 21.



of living organisms, and it has the advantage of allowing paraffin to be used for sealing the preparation." The apparatus has a micrometer screw to insure gradual compression.

Not being clear as to the mode in which the designer intended his apparatus to be used, we applied to him on the subject, but without receiving any reply. Mr. G. C. Karop has, however, kindly furnished us with the following note:—

"I do not think the use of this compressor necessarily refers to a *temporary* closure only. You have a specimen which cannot be satisfactorily examined except under pressure; the effect of pressure you may wish to keep and exhibit. A specimen is placed on a slip with, say, a drop of glycerin or other preservative; a cover-glass is placed on this, and the whole is transferred to the compressor-plate, the three curved springs being in position on the cover. The whole is then put on the stage of the Microscope, and the construction allows of the objective working down through the ring, whilst sufficient pressure is obtained by the micrometer screw to show the desired points. This being done, the apparatus is removed from the stage, any surplus glycerin, &c., wiped off, and the preparation sealed by paraffin with a hot wire, according to the well-known method. When dry it is put on a turntable and permanently sealed by a ring of Paris glue or white cement, &c."

Martius' Method of Determining the Absolute Rate of Ciliary Vibration by the Stroboscope.*—By the stroboscope, as is well known, a vibrating body is instantaneously illuminated or is viewed at successive intervals through a revolving or vibrating aperture.

A familiar instance of this is the "wheel of life" toy sold in the streets a few years ago. The wheels of a carriage, or a moving animal, seen by the light of a flash of lightning, appear perfectly stationary, the duration of the light being so brief as to admit of only an inappreciable movement of the body while illumination lasts. If a regular succession of light flashes is produced, the moving body will be seen in as many different positions as there are flashes of light. If a body rotating rapidly on a fixed axis be viewed by light flashes occurring once during each revolution of the body, only one image will be observed, and this will result from a succession of impressions upon the retina, which by the persistence of vision become blended into one continuous image. In this case no movement of the body will be apparent; but if the flashes of light succeed each other ever so little slower than the rotatory period of the revolving body, the body will appear to move slowly forward, while in reality it is moving rapidly; and should the light flashes succeed each other more rapidly than the revolutions of the revolving body, the body will appear to move slowly backward, or in a direction opposite to that in which it is really turning. These curious effects are also produced when the number of the light flashes is a multiple of the number of revolutions, or *vice versâ*.†

* Arch. f. Anat. u. Physiol. (Physiol. Abtheil.) 1884, pp. 456–60.

† The preceding paragraph is interpolated from an article by Mr. G. M. Hopkins ('Scientific American') in which he describes the method he used for applying intermittent light to a microscopical examination of ciliated organisms by an electrically rotated aperture disc, arranged to interrupt the beam of light employed in illuminating the object to be examined.

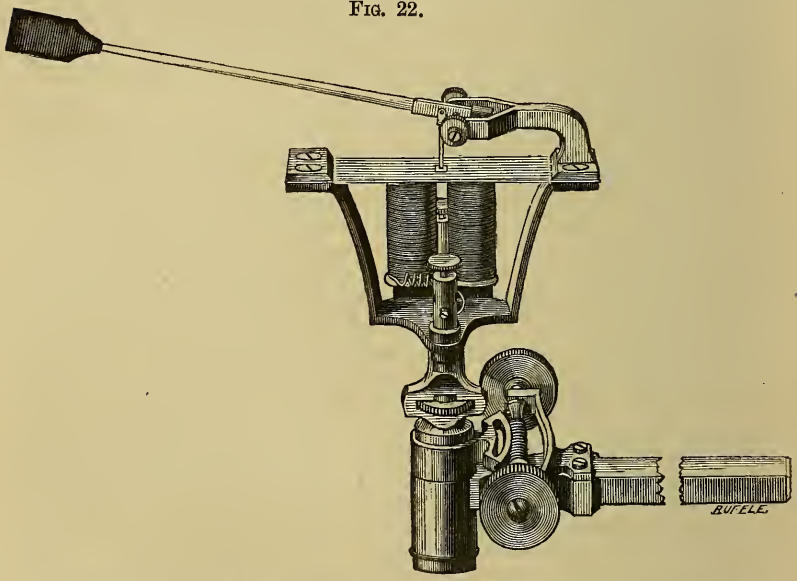
The instrument consists of a single electric motor mounted on a plate having

In the same way if a vibrating rod is viewed through a hole in a revolving disc, and the rate of revolution is varied until the period coincides with that of the rod, the latter will always be seen in the same phase and will appear stationary.

The method may be applied to the analysis of many kinds of periodic vibration, and to the examination of objects in motion. Dr. A. van Beek used a revolving screen perforated with holes, by means of which the object under the Microscope is periodically illuminated, to estimate the rate of ciliary vibration in the cells of a frog's tongue.

With such an apparatus it is not found possible to vary the rate and constancy of the revolutions with sufficient delicacy, and Herr Martius has consequently applied the electro-magnetic stroboscope, as used by Kronecker, to the same purpose. A strip of paper (fig. 22) is made to vibrate between the source of light and the

Fig. 22.



diaphragm of the Microscope so that at each vibration the object is illuminated by a flash of light. A great advantage is gained by using a plain strip in place of a perforated screen; for if the instrument is so arranged that the strip while moving in one direction

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a collar fitted to the substage. The shaft, which carries a simple bar armature, also carries upon its upper extremity a disc having two or four apertures, which coincide with the apertures of the stage and substage two or four times during the revolutions of the disc. The course of the current from the battery through the instrument is through the spring touching the commutator, through the shaft and frame of the instrument to the magnet. The speed of rotation can be varied, experiment showing that the period of darkness should be to the period of illumination about as three to one for the best effects.

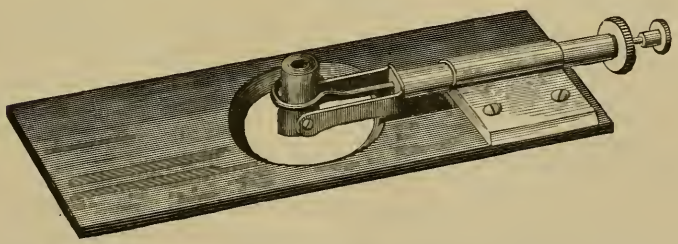
completely obscures the light, and only admits the flash when it retreats far enough in the other direction to uncover the side of the diaphragm, then a slight shifting of the whole stroboscope will lengthen the duration of the flashes without affecting their rate; while the rate can be varied by adjusting Bernstein's acoustic contact-breaker, which regulates the vibrations. Moreover, by this method the object can only be illuminated once in each complete oscillation of the strip, while with a vibrating slit it may be illuminated either once or twice. A frog's palate examined with this apparatus was found to have a period of ciliary movement varying from ten to fourteen (mostly from eleven to twelve) vibrations in a second.

A second indirect means of measurement may be used as a check upon the direct determination of the period from the phenomenon already mentioned. When the rate of the stroboscope is equal to that of the cilia, they appear as nearly as possible stationary; as the rate is increased waves of motion will be seen to run along them until a point is reached at which they appear to be in uniform motion. It will be found that at this point the rate of the instrument is exactly double that of the cilia.

Various rotifers examined by intermittent light showed the cilia perfectly stationary. The ciliary filaments of some of the Infusoria (*Vorticella* and *Stentor*), when viewed by intermittent light, not only appeared to stand still, but their length seemed much greater than with continuous light. The interrupted light brings out not only the cilia around the oral aperture, but shows to good advantage the cilia disposed along the margin of the body.*

Accessories for Microscopical Drawing.†—G. S. S. writes that it often happens to him, when wishing to draw a mounted object, that it is not placed exactly in the position in which it is wished to draw it, and to so place it, the slide requires raising at one end or side. For this purpose he devised a very simple piece of apparatus.

Fig. 23.



A piece of thin wood a little longer than an ordinary slide is cut, and a hole 3/4 in. square made in the middle. About 1/2 in. from either end, and on the lower side, cut a narrower transverse groove, and slip an india-rubber band over each end until it reaches the groove. The slide to be examined is placed on the wooden one

* Loc. cit. † Sci.-Gossip, 1886, p. 8 (2 figs.).

under the elastic rings, and then, by inserting a wedge between the wooden and other slide the object can be placed as desired.

Another very simple contrivance for placing an unmounted object in any desired position is shown in fig. 23. By turning the milled head the object can be moved in a direction transverse to the apparatus, and by moving the other in or out, the object can be moved in a longitudinal direction. The hole in the vertical tube can be fitted with a cork to hold pins; a small pair of forceps or a piece of wax can be used to hold a geological specimen.

Dunning's Zoophyte-Cell. — All who work with the ordinary zoophyte troughs know the difficulty there is in cleaning them, also the risk of breakage in doing so, more especially with the very shallow troughs. Mr. C. G. Dunning has designed the apparatus shown in figs. 24–26 to overcome this difficulty.

Fig. 24.

Fig. 25.

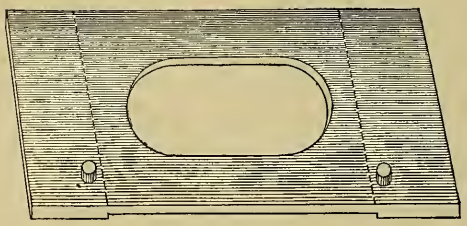
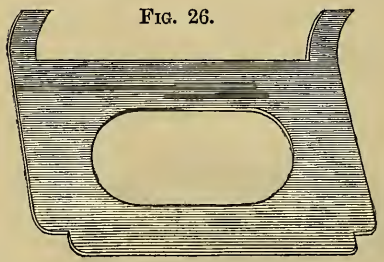


Fig. 26.



The lower plate (fig. 25) is of metal, 3 in. long, 1½ in. wide, and about 1/10 in. thick, with an oval perforation, the under side being sunk out as shown in the section (fig. 24). In this sinking is fixed, by means of Canada balsam, a piece of stout cover-glass, which forms the bottom of the cell, the sinking being sufficiently deep to prevent the thin glass from actually bearing on the stage when in use, or on a table, or when laid down. The cover (fig. 26) consists of a thinner plate of metal rather shorter than the lower plate, and having a corresponding aperture. To the under side of this plate is also fixed a piece of cover-glass.

To use the apparatus it is only necessary to lay it flat and well fill the cell with water, arranging the object if necessary; then put the cover on from the bottom edge by placing the notches over the two pins which are inserted in the bottom plate, and gradually lowering it, the superfluous water will then be got rid of, and the whole should be wiped. The capillary attraction assisted by the weight of the cover is sufficient to prevent any leakage, while the pins prevent it from sliding down when inclined. Although, of course, there is no supply of air, *Vorticellæ*, zoophytes, &c., can be kept under exhibition for more than two hours without change of water,

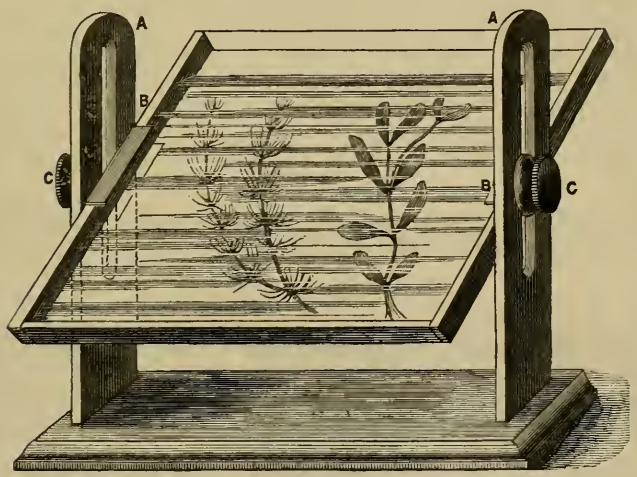
but should that be found necessary it is easily done by lifting the cover carefully by means of the projecting horns on the top edge and adding fresh water with a dipping tube. The apparatus is intended more particularly for use as a shallow cell, so that moderately high powers can be applied, yet the depth can readily be increased by means of an intermediate plate the same size as the cover and with a corresponding aperture; this plate may either be of metal or ebonite, and with this inserted between the lower plate and the cover the cell is as free from leakage as before.

The area of the cell is purposely rather large, as being more convenient for zoophytes, &c., but should it be desired to restrict the movements of a lively object, it is only necessary to select a glass ring rather thinner than the depth of the cell, place it in the middle, fill the whole cell with water and place the object within the ring and cover as before.

Hardy's Examining Tank for Pond-Life, &c.—Mr. J. D. Hardy exhibited at the last Conversazione a very convenient tank for showing aquatic organisms.

A A (fig. 27) are two uprights, each having a slot in which the

Fig. 27.



holders B B can be raised or lowered. The screw nuts C C keep the holders in place, at the same time allowing the tank to be inclined at any angle. The holders are not fastened to the tank, but clamp it so as to leave it free to be moved through them, for the purpose of bringing the tank more forward for examination with the Microscope or otherwise. A piece of cork cut to fit loosely and float on the water stops the water running out when the tank is tilted.

The stand is weighted with lead at the bottom, and the tank,

which is 6 in. square, is made of the best thin white glass in the same manner as Mr. Hardy's "flat bottle."

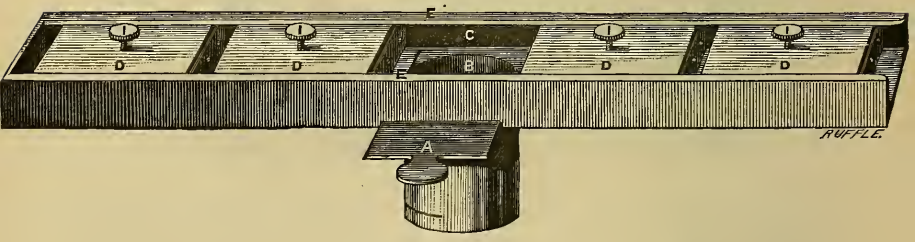
In using the Microscope, the mirror and carrier are unscrewed and placed on the opposite side of the tank from the Microscope, the light being reflected in a line with the body-tube. The objective was also screwed in the substage by an adapter and focused by the substage pinion.

Bostwick's Absorption Cell.*—Mr. A. E. Bostwick has devised a cell for obtaining the absorption spectra of liquids which have but little selective absorption, and which would therefore have to be used ordinarily in large quantities.

The cell is a rectangular box, 6 in. by 3 in. by 3 in. The bottom and the two ends are of wood, covered with shellac, and the two sides of looking-glass, cemented to the wood, so that the box is water-tight. The reflecting surface of the glass is turned inward, and at each of two diagonally opposite corners the amalgam is scraped away so as to make a vertical slit about 2 mm. in width. One of these is placed close to the spectroscope slit, and through the other a parallel beam of light is admitted. It is evident that the box may be so placed that the beam will be internally reflected in it a number of times, depending upon the angle between the two, and will finally pass through the second slit into the spectroscope. The length of its path through the cell may therefore be varied indefinitely by turning the latter, and is limited only by the decrease in intensity caused by general absorption —not only in the liquid, but also at each reflection. With mirrors of polished metal the result might be even better, since the absorption in the glass would be eliminated. In this case, however, the number of liquids which could be used in the cell would be somewhat limited.

Vérick's, Benecke's, and Moitessier's Photo-micrographic Cameras.—The first of these cameras by MM. Vérick (fig. 28) allows

Fig. 28.



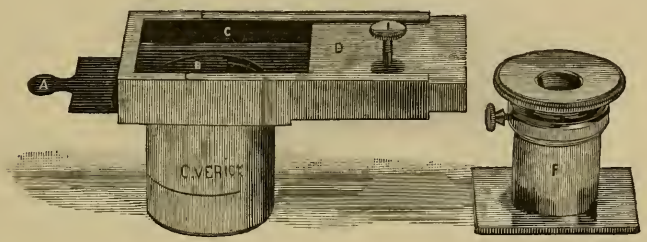
of four negatives being taken successively. It consists of a tube fitting over the body-tube after the eye-piece is removed, carrying a box C, with a central opening B, closed by a movable shutter A.

* Amer. Journ. Sci., xxx. (1885) p. 452.

In the box slide four carriers D, for the sensitive plates, and these can be placed in position over the central opening one after another and a negative taken.* The special advantage of the apparatus is that it enables different degrees of exposure to be tested, or different portions of an object to be rapidly photographed in succession.

A simpler form of camera is shown in fig. 29, on the same principle as the preceding, but for one plate only.

Fig. 29.



For focusing it is necessary first to regulate the focusing lens F, which is a single lens in an adjustable screw mounting. For this purpose a square of glass is placed in the box C, on the lower face of which some scales have been fastened. The lens is then placed so that the base-plate is applied exactly to the upper edge E of the box C. It is then focused on the scales by screwing the lens in or out, and is then clamped by the set-screw. The lens, when thus regulated, will of course only serve for the particular person to whose sight it has been adjusted.

The sensitive plate is placed in the carrier D, and its contact with the guides on the bottom of the box assured by turning the screw I gently. The image of the object is then focused by the adjustments of the Microscope, again applying the lens F upon E and using it as an eye-piece.

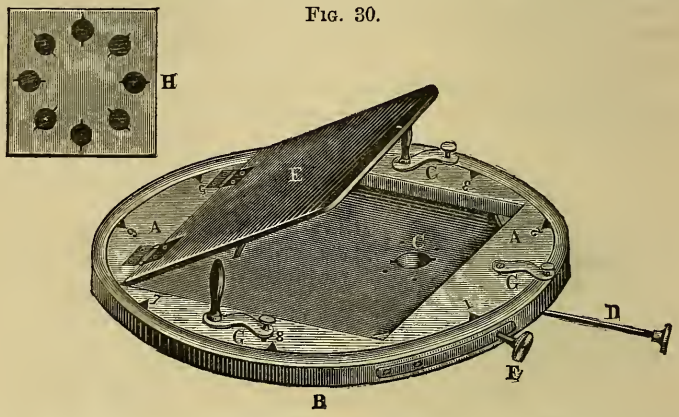
Dr. B. Benecke † devised the camera, fig. 30, for taking eight photo-micrographs. In a circular camera B, rotates a disc A having a square aperture 12 cm. wide in the centre. The bottom of the camera has an opening at C, 2 cm. in diameter, communicating with a tube which fits into the body-tube of the Microscope; it can be closed by a slider, the handle at which is at D. A plate H, for eight photographs, fits into the aperture in the disc, and can be rotated over C, a spring clip F indicating the eight equidistant positions. The shutter E of the camera is secured by the three catches G, and on the under side it has a spring which presses on the back of the plate. In order to mark the corresponding positions of the different photo-

* The drawing has been reduced in width. The box of the original apparatus is about a fifth wider so as to leave more space for the carriers.

† 'Die Photographie als Hülfsmittel Mikroskopischer Forschung,' 1868, pp. 54–6 (1 fig.).

graphs on paper copies or glass positives (which is important in the case of stereographs), the opening at C has two cuts in its margin

Fig. 30.



which show on the plate as two small black lines (see H) and so enable the image to be easily oriented.

Dr. A. Moitessier's camera,* B, fig. 31, is intended for taking six

Fig. 31.

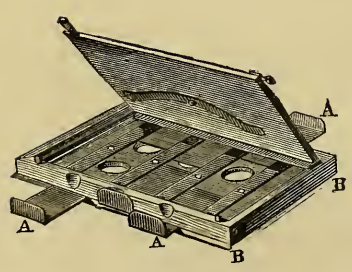
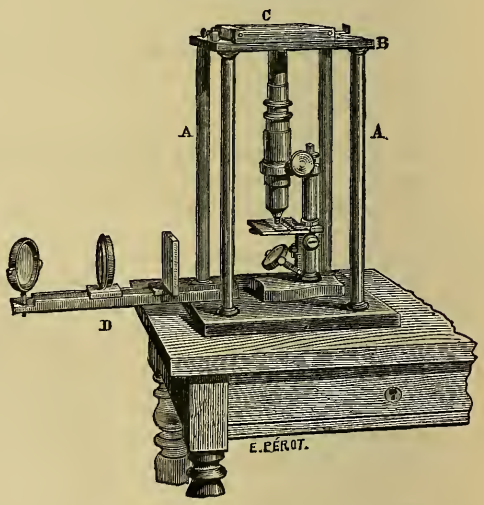


Fig. 32.



micro-photographs, each aperture having a sliding shutter A. Being too heavy to be supported on the Microscope, a special support for it is necessary, fig. 32. The camera C is placed on the wooden plate B,

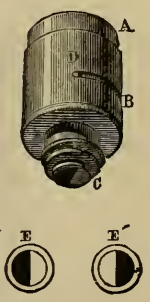
* 'La Photographie appliquée aux recherches micrographiques,' 1866, p. 121.

which is supported over the Microscope by the pillars, A. A tube inserted in an opening in B forms the connection with the Microscope, and the camera can be brought by a sliding arrangement into six different positions, corresponding with the photographic plate. D is the illuminating apparatus, consisting of mirror, condensing lens, and movable screen to shut off the light as required.

Apparatus for taking Stereoscopic Photo-Micrographs.—Stereoscopic photo-micrographs could of course be obtained by applying a camera to each end of the tubes of a binocular Microscope, and taking two photographs simultaneously, or as suggested by Babo, by slightly raising either end of the slide alternately, or again by taking a second photograph with the objective focused to a lower plane of the object than that to which it was focused when the first was taken. A combination of these two methods is said by Dr. S. T. Stein * to give excellent effects.

Dr. A. Moitessier suggested † the apparatus, fig. 33. The fixed tube A, attached to the body-tube, has a second external tube B, which rotates upon it, a pin working in a semicircular slot D stopping the rotation beyond 180°. At the end of B is attached a half-diaphragm C, and the objective is screwed over the diaphragm. On rotating the tube in opposite directions, the diaphragm takes the positions E and E′, so that opposite halves of the objective are alternately made use of and different images obtained. Photo-micrographs thus taken will give stereoscopic or pseudoscopic effect, according as they are mounted, The apparatus will only act effectively with low powers and opaque, not transparent, objects.

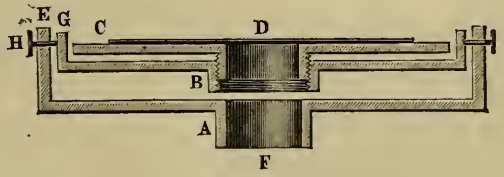
Fig. 33.



In order to alter readily the inclination of the object to the axis of the Microscope, Dr. B. Benecke ‡ devised the apparatus shown in figs. 34 and 35.

A circular plate A, fig. 34, with a central opening, is fixed by the

Fig. 34.



tube F in the aperture of the stage. The vertical pieces E support a similar plate B G, which swings on a horizontal axis passing through

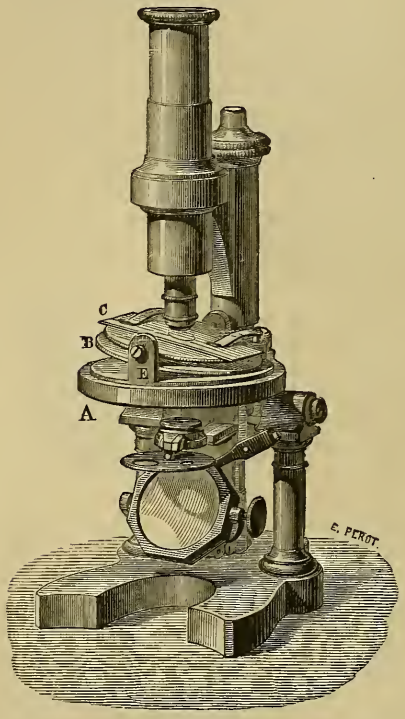
* 'Das Licht im Dienste Wiss. Forschung,' 1884, p. 197.

† 'La Photographie appliquée aux recherches micrographiques,' 1866, p. 148.

‡ 'Die Photographie als Hülfsmittel Mikroskopischer Forschung,' 1868, p. 81 (2 figs.).

H. A third disc C is supported by B and moves with it. It carries the slide D. A photograph having been taken, with the object inclined in one direction, the carrier is tilted in the opposite direction, and a second one taken. As it is indispensable that the object should be exactly in the plane of the axis of rotation, the disc C is connected with B by a piece of tubing having a thread so that it can be raised or lowered. A wedge slipped under one end of the plate B is the most convenient mode of inclining it, a spring being inserted under the other end. Screws are not so good. According to the objective used the angle of inclination for the best effects varies from 4° with high powers to 12° with low powers. The wedge can be marked at different points, so as to show the angle of inclination.

Fig. 35.



In focusing the two wedges, care must be taken that exactly the same details of the object are focused in each case, otherwise the photographs will not combine in the stereoscope.

(Fig. 35 shows the apparatus in place on the Microscope.)

Another form was devised by Prof. G. Fritsch, a description of which, for want of the woodcut illustrating it, must be deferred.

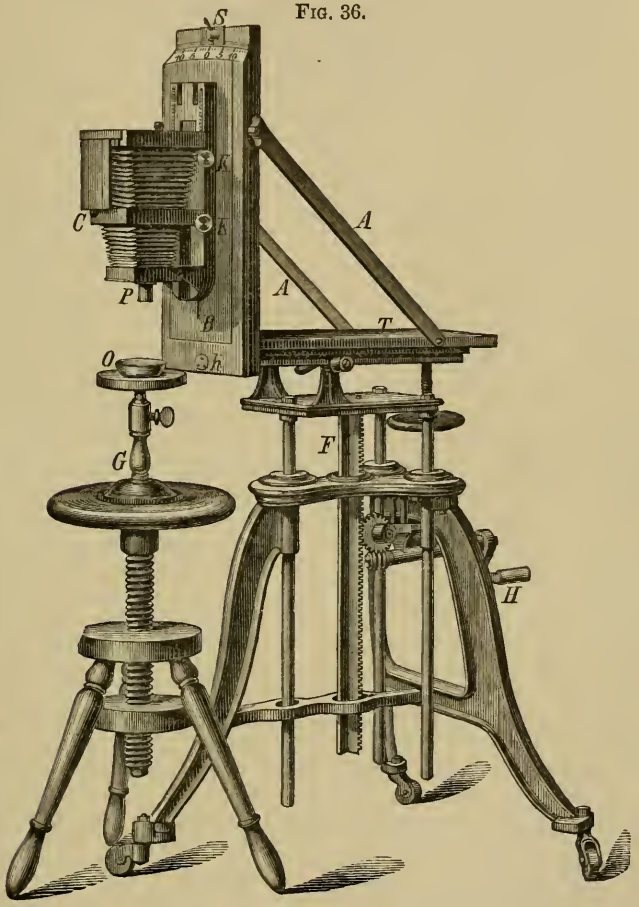
Dr. H. Fol has devised * an apparatus (fig. 36) for photographing microscopic objects under small magnifying powers. He considers that such photographs are undoubtedly of much greater value when observed under the stereoscope.

The table T carries at one end the board B and camera C P, with the supports A. The table is raised and lowered on the tripod by the rack and pinion F H, or moved horizontally by a second one on the further side. The board B turns on a pivot *k* and the extent of the motion is shown on a graduated scale at the top. It is fixed in any position by S. The camera is double, each bellows being adjustable by the milled heads K K. The object lies in a black cup O in water

* Fol, H., Lehrb. d. Vergl. Mikr. Anat., 1884, p. 79 (1 fig.).

or weak alcohol, the stand G for it being independent of the rest of the apparatus, which Dr. Fol considers to be essential to prevent the shifting of the object. The objective may be one of Steinheil's

Fig. 36.



smallest aplanatics, or a low-power objective provided with a small diaphragm.

The camera being central, the object is placed at the level of the pivot *k*, and focused. The camera is then shifted 4° or 4·5° to the right, and a photograph taken, and then to the same extent on the left and another taken.

Objectives for Photo-micrography.*—Mr. W. H. Walmsley considers that to obtain the very highest results, all powers lower than

* The Microscope, v. (1885) pp. 219-20.

1/4 in., should be supplied with special corrections to render the visual and actinic foci coincident. At the same time it may be stated as an axiom that any objective that will give a clear, well-defined image of an object under the eye-piece, will also produce a sharp and accurate reproduction of the same upon the sensitive plate. He has made most excellent negatives with a French Triplet 1/4 in., costing no more than five dollars, and magnifying 200 diameters—not equal, it is true, to the results obtained with lenses of higher grade and finer corrections, but so good that only a critical eye would discern the difference between them. We quote in full the author's succeeding remarks:—

"So let not those possessing only cheap instruments be deterred from entering upon this fascinating branch of photography on that account, as their cheap tools will turn out good work with the aid of patience and careful manipulation. Wide angular aperture is not so conducive to good results as a moderate one. Given good corrections of spherical and chromatic aberrations, good penetrating and defining powers, and the objective of moderate aperture will defeat its wide-angled rival on the photographer's field in every encounter.

"It may safely be asserted that all powers in ordinary use may be successfully employed in photographing by aid of ordinary lamp-light. I have used them all from 4 in. to 1/18 homogeneous immersion; with, and without amplifiers, and all with equally good results. If a selection has to be made by one just furnishing an outfit, I would suggest a 1 in. or 2/3; 1/2 in. or 4/10; and 1/5 or 1/6. With these and a camera of sufficient bellows capacity, a range of powers from about 25 to 250 diameters may be obtained, quite sufficient for nine-tenths of the work ever required in this direction. If a higher power be necessary, then a 1/10 immersion is recommended. None of these powers from the 1/5 upwards will require any special correction. If they define any given object under the eye-piece, clearly and distinctly, it may be accepted as certain that they will produce a correspondingly good photograph of it. But for powers less than 1/4 in., I would earnestly recommend those specially corrected for photography, else sharply defined results cannot be depended upon with any certainty. I have seen objectives of low powers, in which there was no apparent difference between the actinic and visual foci, and which gave—without any further corrections—negatives as sharp as the image seen upon the focusing screen; but such instances are rare, and cannot be counted upon. I would therefore reiterate, for all powers lower than 1/4 in., employ *only* those specially corrected for photography."

Photography and Minute Details.*—The following remarks are made by a contemporary on the discussion on this subject at the November meeting.

"It appears to us that, in these discussions, sufficient allowance is not made for the varying acuteness of vision possessed by different

* Brit. Journ. of Phot., xxxii. (1885) pp. 786-7.

persons—a subject upon which we have found most observers are particularly touchy. . . . Almost every one has eyes which are more or less astigmatic; how very different, therefore, must a set of lines in the Microscope appear to most persons, according to the relation of their direction to that of the meridian of astigmatism! Again, as to actual acuteness of vision—that is to say, power of visual perception of minute objects—that varies in individuals to a degree which could scarcely be believed by those not conversant with the subject. . . .

"The moral we would draw from these facts is that, when questions of the eye against photography in the Microscope are discussed, the conclusions arrived at are worthless unless the powers of the observer's eyes are thoroughly ascertained, both as to acuteness of vision and extent of astigmatism."

The writer has not quite appreciated that the discussion turned, not on the limit of *visibility* of minute objects, but on resolution or the limit of visible *separation*. The latter depends on the wave-lengths of the portion of the spectrum used, and hence photography will resolve lines closer together than "white light" will.

Imperfection of the Eye and Test Objects.*—Mr. L. Howe calls attention to the fact that "fine parallel lines, whether drawn artificially or existing in natural objects, do not make fair test objects for the Microscope." This is caused by an ocular imperfection which is very common—astigmatism.

In consequence of this defect, when one of Nobert's test-plates is subjected to examination, the perpendicular lines which one person can see perfectly well, cannot be seen by another who considers his vision in every way normal. The same holds for other tests of a similar nature, such as diatoms or objects marked with fine dots or lines in close juxtaposition. This, the author says, is by no means an imaginary difficulty, as it has occurred to him more than once to find this difference of opinion between persons who are accustomed to view such objects, and whose eyes and hands are trained to use the Microscope. Fortunately, however, there is a very simple method of overcoming the difficulty. This consists in revolving the object on the stage of the Microscope, in such a way that lines which at first were vertical become afterwards horizontal; for when turned through an arc of 180° they pass through every meridian in which it would be possible to see them, provided the amplification and definition be sufficient to make them at all visible.

Pygidium of the Flea as a Test Object.†—Mr. E. M. Nelson finds that the so-called hairs of the pygidium of the flea are spines which "form nothing that can be called any sort of test for a high-power objective."

Webb's Lord's Prayer.—Mr. W. Webb, well known for his microscopic writing of the Lord's Prayer (the series of which com-

* The Microscope, v. (1885) pp. 226–8.
† Journ. Quek. Micr. Club, ii. (1885) p. 197.

mences at the rate of 3,616,791 letters to the square inch and extends to 212,746,216 letters, or at the rate of more than fifty-nine Bibles written in a square inch), has added a further novelty to the series, being a photograph and a writing of the Lord's Prayer side by side on the same slide, the former being photographed on the slide and the latter engraved on the cover-glass.

We observe that at a recent meeting of the Microscopical and Natural History Section of the Manchester Literary and Philosophical Society,* a member stated, "Mr. Webb died about ten or fifteen years ago, but I cannot give the exact date." Mr. Webb is, however, still alive, and as will be seen from the above, still engaged in microscopic writing.

Leeuwenhoek Medal. — The Gold Medal established by the Royal Dutch Academy in memory of Leeuwenhoek, was last year awarded to Prof. Ferdinand Cohn, as the histologist who in the last decade had most distinguished himself in the study of microscopical beings.†

ALLISON, F. B.—**Microscopical Binoculars.**
[Explains Mr. Nelson's difficulty as to the want of stereoscopic effect in the case of objects lying "vertical," by the diminished difference of perspective. Cf. this Journal, V. (1885) p. 1076.]
Engl. Mech., XLII. (1885) p. 262.

American Society of Microscopists.
[Report of Cleveland Meeting (by Dr. S. M. Mosgrove).—Also of the Working Session (by Dr. W. P. Manton).—Personal Notes on Cleveland (Editorial).—Mr. Griffith's latest (by Dr. F. L. James, from the 'National Druggist').]
The Microscope, V. (1885) pp. 193–203, 203–204, 207–210, 232–233.

B., C. R.—**A Cheap Dissecting Microscope.** [*Post.*]
Bot. Gazette, X. (1885) pp. 427–8.

Beck's New "Star" Microscope. [Cf. Vol. V. (1885) p. 512.]
Amer. Mon. Micr. Journ., VI. (1885) p. 229 (1 fig.).

Behrens, W. J.—**Rules for the Use of the Microscope.**
[As to "keeping the metallic part clean." Focus up with high powers. Microscope, if it is to be for a long time out of use, should be put away in some closely shutting cupboard in which is placed some chlorate of lime.]
Micr. Bulletin (*Queen's*), II. (1885) p. 41,
from *The Microscope in Botany* (Transl. of the original German work).

BIGNELL, G. C.—**Photo-micrography.** [*Post.*]
Year-Book of Photography, 1886, p. 95.

BIRNBAUM, K., and J. GRIMM.—**Atlas von Photographien Mikroskopischen Präparate der reinen und gefälschten Nahrungsmittel. Abtheilg. I.: Atlas zur Mehlprüfung.** (Atlas of Photographs of Microscopic Preparations of pure and adulterated Foods. Part I. Flour testing.)
16 pp. and 16 phot. plates, fol., Stuttgart, 1886.

BOSTWICK, A. E.—**A new form of Absorption Cell.** [*Supra*, p. 140.]
Amer. Journ. Sci., XXX. (1885) p. 452.

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* Chem. News, liii. (1886) pp. 34–5.

† Cf. Versl. en Med. K. Akad. Wet. (Amsterdam), ii. (1885) pp. 105–10 (Address of Prof. Stokvis to Prof. Cohn), and pp. 111–4 (Reply of Prof. Cohn). Also pp. 88–90.

BROTHERS, A.—**Microscopic Writing.**
[Webb's Lord's Prayer, &c.—Machine for writing, purchased by Mr. Rideout at the 1862 Exhibition.
Chem. News, LIII. (1886) pp. 33–4.
„ „ **[Electric Spark under the Microscope.]**
[Produced by a carbonate of potash battery (with an induction coil) at the extremities of two lead-pencil points.]
Proc. Manchester Lit. and Phil. Soc., XXIV. (1885) p. 20.

BULLOCH, W. H.—**About Magnification.**
[Queries as to the power of 1 in. lens, formula and power of 2 in. eye-piece, and length of a 10 in. tube.]
Amer. Mon. Micr. Journ., VI. (1885) p. 240.

Bulloch's (W. H.) Cobweb Micrometer. [*Supra*, p. 132.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 239–40.

Case, Convenient Microscopical.
["There are a great many pocket cases for microscopical mounts in the market, but the most convenient article for the purpose that we have seen is a flat muslin box which does not take up much more room than a large pocket-book. It contains four trays, each of them made to hold six slides lying flat, thus exposing the label as in the large cabinets" (Queen & Co.'s).]
St. Louis National Druggist, VII. (1885) p. 230.

CASTELLARNAU Y DE LLEOPART, J. M. DE.—**Vision Microscópica.** Notas sobre las Condiciones de Verdad de la Imágen microscópica y el modo de expresarlas. (Microscopical Vision. Notes on the Conditions of resemblance in Microscopical Images and the Method of Delineation.) *In part.* [*Post.*]
Anal. Soc. Espan. Hist. Nat., XIV. (1885) pp. 257–88 (1 fig.).

COE, H. C.—See Friedlander, C.

Cole's (A. H.) Self-adjusting Frog-plate.
[No description given.]
Micr. Bulletin (*Queen's*), II. (1885) p. 41.

COX, J. D.—**[Letter accompanying Photo-micrographs of Diatoms.]**
[Also comments on Dr. Cox's views by M. W. Priuz, who considers the new photographs "lead to the same confusions and consequently merit the same criticisms" as the previous series.]
Bull. Soc. Belg. Micr., XII. (1885) pp. 7–11.

CZAPSKI, S.—**[Abbe's Optical Theories.]**
[Conclusion of review of Dippel's 'Grundzüge der Allgemeinen Mikroskopie.' Cf. Vol. V. (1885) p. 1079.]
Zeitschr. f. Instrumentenk., V. (1885) pp. 405–8.

EVANS, F. H.—**Objectives.**
[As to surprising discrepancies in his measurements of the magnifying powers of various objectives.]
Engl. Mech., XLII. (1886) p. 361.

EVERETT, J. D.—**Outlines of Natural Philosophy for Schools and general readers.**
[Microscope, pp. 188–91, 1 fig.]
335 pp. and 216 figs., 8vo, London, 1885.

EWELL, M. D.—**Prof. Rogers' Ruling Machine and Method of ruling Standard Micrometers.** [*Post.*]
The Microscope, V. (1885) pp. 221–26.

FLINT, J. M.—**Rotary Object-carrier.** [*Supra*, p. 133.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 204–5.
Engl. Mech., XLII. (1885) p. 275.

FOL, H.—**Nouveau Microscope.** (New Microscope.) [*Post.*]
Arch. Sci. Phys. et Nat., XIV. (1885) p. 575.

FREY, H.—**Das Mikroskop und die Mikroskopische Technik.** (The Microscope and Microscopical Technique.)
8th ed., vi. and 524 pp., 417 figs., 8vo, Leipzig, 1886.

Friedlander, C.—**The Use of the Microscope.** Transl. by H. C. Coe.
2nd ed., 200 pp., 8vo, New York, 1885.

GÄRTNER, G.—**Ueber das electrische Microscop.** (On the Electric Microscope.) [*Post.*]
Med. Jahrb. K. K. Gesellsch. Aerzte Wien, 1884, pp. 217–44 (1 pl. and 1 fig.).
Med. Times, II. (1885) pp. 412–5 (1 fig.).

GLAZEBROOK, R. T., and W. N. SHAW.—**Practical Physics.**
["Travelling" Microscope for measurements, pp. 64–6. Microscopes used to measure expansion, pp. 200–1. Measurement of the magnifying power of a lens or of a Microscope, pp. 283–7. Measurement of the Index of Refraction of a plate by means of a Microscope, pp. 303–5 (1 fig.).]
xxii. and 487 pp., 80 figs., 8vo, London, 1885.

GOODWIN.—**Photo-micrography for Winter Evenings.**
New York Phot. Times, XV. (1885) p. 639.

GRIMM, J.—See Birnbaum, K.

H., R. O.—**[Objectives.]**
[Explanation of F. H. Evans' difficulty, *supra*, depends on the difference between the optical tube-length and 10 in.]
Engl. Mech., XLII. (1885) p. 427.

HEURCK, H. VAN.—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Contd.*)
[Microscopes, objectives, &c., of Herr C. Reichert, *supra*, p. 129.]
Journ. de Micrographie, IX. (1885) pp. 496–504 (6 figs.).

HITCHCOCK, R.—**Photo-micrography. I., II.**
[1. General consideration of photographic methods. 2. Apparatus. (*a*) Plates. Developing apparatus (trays). Lanterns. Dark room.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 201–3, 224–7 (6 figs.).

[HITCHCOCK, R.]—**Postal Club Boxes.**
[Contents of Boxes Cy, E, Cx, D, and Cw.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 217–8.

" " **Microscopical Societies.**
[List of thirteen American societies, with brief particulars.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 237–9.

" " **Palmer Slide Co.'s Bevel-edge Slides** (and remarks by Mr. G. S. Woolman)
Amer. Mon. Micr. Journ., VI. (1885) p. 239.

HOLMES, E.—**A simple and handy Compound Selenite and Mica Stage.**
[Indicates "how a very useful stage may be made for a few pence, which will answer most, if not all, the purposes of the most expensive apparatus." A whole revolution of the films is unnecessary. A lever motion can be made to give all the alterations. Take a film of selenite and one of mica, and mount on circular pieces of wood with projecting handles. Then take five thin slips of wood a little larger than an ordinary slip, and cut circular pieces out of each. Only two of these are just large enough for the films to move in, and the other three, slightly smaller, form top and bottom and centre piece to keep films apart. Glue all these together, with the selenite and mica films in place. When dry, these have a free movement of about 60° or so, and a thin strip at back, to lodge slide against completes it.]
Engl. Mech., XLII. (1885) p. 321 (3 figs.).

HOMOIOS.—**Objectives.**
[Further as to "objectives à l'immersion of topaz, diamond, or precious stones of high refractive index."]
Engl. Mech., XLII. (1886) p. 386.

HOPKINS, G. M.—**Das Mikroskop in den mechanischen Künsten.** (The Microscope in the Mechanical Arts.) [*Post.*]
Central-Ztg. f. Optik u. Mech., VI. (1885) pp. 270–2 (10 figs.).

HOWE, L.—**An Imperfection of the Eye and Test-Objects for the Microscope.**
[*Supra*, p. 147.] *The Microscope*, V. (1885) pp. 226–228.

[JAMES, F. L.]—See American Society of Microscopists.

Jeaffreson, J. B., Death of. *Nature*, XXXII. (1885) p. 278.

KLÖNNE, J., and G. MÜLLER.—**Blendvorrichtung für Mikroskope.** (Diaphragm for Microscopes.) [*Post.*]

Title only of German Patent, Kl. 42. No. 3416.

„ „ „ **Pendel-Objecttisch für Mikroskope.** (Pendulum Stage for Microscopes. [*Supra*, p. 127.]

Title only of German Patent, Kl. 42, No. 4238.

M., W.—**The Magnifying Power of an Inch Objective.**

[Proposal to "settle the standard value of an objective which with standard length of tube and a 2 in. eye-piece shall have a certain magnifying power and be called a one-inch."]

Amer. Mon. Micr. Journ., VI. (1885) pp. 203–4.

MALASSEZ, L.—**Sur les Chambres claires en général et sur une Chambre claire à 45°.** (On Cameræ lucidæ in general, and on a 45° camera lucida.) [*Post.*]

Travaux Laborat. d'Histol. du Collège de France, 1884 (1885) pp. 166–79 (1 fig.).

MANTON, W. P.—See American Society of Microscopists.

Microscope and how to use it, with Instructions for Mounting Objects.

16 pp. and 3 figs., 8vo, London, n.d.

MOORE, A. Y.—**The Zeiss 1/18 in. Objective.**

[Results of comparison with a Spencer 1/10 in favour of the latter.]

The Microscope, V. (1885) pp. 228–29.

MOSGROVE, S. M.—See American Society of Microscopists.

MÜLLER, G.—See Klönne, J.

NELSON, E. M.—**A Method of Equalising the Thickness of Slips when using an Oil-immersion Condenser.** [*Supra*, p. 131.]

Engl. Mech., XLII. (1885) p. 280 (3 figs.).

„ „ **A New Aplanatic Pocket Lens.**

[Recommending Zeiss's No. 127. Extreme field 5/8 in., of which 7/16 in. is flat. Power 10.]

Engl. Mech., XLII. (1885) p. 283.

„ „ **Testing Objectives.**

["The art of testing object-glasses can only be acquired by long practice, and by seeing a great number of lenses, especially those by different makers."]

Engl. Mech., XLII. (1886) p. 427.

Photography and Minute Details. [*Supra*, p. 146.]

Brit. Journ. Phot., XXXII. (1885) pp. 786–87.

Photo-micrography.

[General consideration of photographic methods.]

New York Phot. Times, XV. (1885) pp. 691–2 (in part).

Presidents, Portraits of.

["The R. Micr. Soc. are adopting a plan which might be advantageously followed by all other scientific or learned societies."]

Brit. Journ. of Photography, XXXII. (1885) p. 786.

PRINZ, W.—See Cox, J. D.

Read's (H. T.) Fine Platinum Wire. [*Post.*]

St. Louis National Druggist, VII. (1885) p. 308.

ROGERS, W. A.—**The Microscope in the Workshop.**

[Paper read before Boston Meeting of Mechanical Engineers. *Post.*]

Engl. Mech., XLII. (1886) pp. 397–8.

ROSENBUSCH, H.—**Mikroskopische Physiographie** der Mineralien und Gesteine. Ein Hülfsbuch bei mikroskopischen Gesteinsstudien. Band I. Die petrographisch wichtigen Mineralien. (Microscopical Physiography of Minerals and Rocks. A guide to the microscopical study of rocks. Vol. I. The petrologically important minerals.)

[Describes the author's original polarising Microscope, and the Nachet and Klein forms, pp. 112–23 (6 figs.). Also Fuess's new stand and stage, pp. 562–4 (2 figs.). *Post.*]

2nd ed., xvi. and 664 pp., 177 figs., 26 phot. pls., and Newton scale in colours, 8vo, Stuttgart, 1885.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances, Ancient and Modern, II., III., IV.**
[Advancing angular aperture. The definition of lines, points, and spherules. Refracting spherules or molecules, black dots, test rings, and lines. *Post.*]
Engl. Mech., XLII. (1885) pp. 291–2 (2 figs.), 331–2 (14 figs.), 417–8 (6 figs.).
Cf. also *Engl. Mech.*, XLII. (1885) p. 277 (Lucernal Microscope).

S., G. S.—**Accessories for Microscopical Drawing.** [*Supra*, p. 137.]
Sci.-Gossip, 1886, p. 8 (2 figs.).

SERVUS, H.—**Die Geschichte des Fernrohrs bis auf die neueste Zeit.** (The history of the Telescope to the most recent date.)
[Contains references to the Microscope, and deals fully with achromatism.]
vi. and 135 pp., 8 figs., 8vo, Berlin, 1886.

SHAW, W. N.—See Glazebrook, R. T.

Smith's (H. L.) "Homo-tester."
[New illustration of it.]
Micr. Bulletin, II. (1885) p. 43 (1 fig.).

SORET, J. L.—**Appareil permettant l'observation microscopique des globules de vapeur.** (Apparatus for the microscopical observation of globules of vapour.) [*Post.*]
Arch. Sci. Phys. et Nat., XIV. (1885) pp. 575–6.

STOWELL, C. H.—**[Death of] Thad. S. Up de Graff.**
The Microscope, V. (1885) p. 229

[STOWELL, C. H. and L. R.]—**Is it a Micro-photograph or a Photo-micrograph?**
The Microscope, V. (1885) pp. 208–9.

" " " **Ayres' Micro-photographs.**
Ibid., p. 209.

" " " **Is it a Fraud?**
[Comment on an editorial in the 'Cincinnati Medical News,' which denounced as a fraud an offer of a Microscope and 1/2 in. and 1/6 in. objectives for 22·50 dols.]
The Microscope, V. (1885) pp. 231–2.

" " " See American Society of Microscopists.

STUBBS, E. T.—**Presidential Address to the Postal Microscopical Society.**
[How best to carry on, advance, and improve the Society.]
Journ. of Micr., V. (1886) pp. 1–9.

THOMPSON, F. C.—**An Easy Method of Making Micro-photographs.** [*Post.*]
Year-Book of Photography, 1886, pp. 49–52.

VIGNAL, W.—See Malassez, L.

WALL, O. A.—**[Pinhole Microscopes.]**
["The simplest Microscope is a piece of paper, or cardboard, which is perforated with a pin. The pinhole is brought close to the eye, and objects examined through it are considerably magnified. If the surface of the card, or paper, is first blackened with ink, the image will appear plainer and brighter. In the absence of the Coddington lens, this method may serve to examine some of the superficial characters of drugs."]
St. Louis National Druggist, VII. (1885) p. 281.

" " **On Photo-micrograph Cameras.**
[Walmsley's and Atwood's Cameras. "Buy no form of apparatus in which the focussing plate is fixed in one immovable position," as it is easier to make slight changes of focus by moving the ground glass than by moving the objective. For enlargements also a movable plate is essential.]
St. Louis National Druggist, VII. (1885) p. 320.

" " **Druggists' Microscope.**
[Statement of some of the essential features advisable in an instrument intended for actual work.]
St. Louis National Druggist, VIII. (1886) p. 7.

WALMSLEY, W. H.—**How to make Photo-micrographs.**
["Plain and practical hints"; dealing with Microscopes, (any Microscope with a joint can be employed, a monocular body is better than a binocular, a rotating stage indispensable, and a centering substage a great convenience—the eye-piece should be removed and the body-tube lined with black flock paper), Objectives (*supra*, p. 145), Illumination (with 1/4 in. and higher an achromatic condenser is necessary, otherwise a bull's-eye is sufficient), and Cameras.]
The Microscope, V. (1885) pp. 217–21 (see also p. 233), 271–4.

" " **Photo-micrography by Lamp-light.**
New York Phot. Times, XV. (1885) pp. 274 and 289.

" " **Photo-micrographs on Gelatine Plates for Lantern Projection.**
[Title only of paper read at Ann Arbor Meeting of the Amer. Assoc. Adv. Sci., 1885.]
Amer. Journ. Sci., XXX. (1885) p. 327.

Walmsley's (W. H.) Photo-micrographic Camera.
[Cf. Vol. III. (1883) p. 556 and *post*.]
New York Phot. Times, XV. (1885) pp. 703–4 (1 fig.).

WOODWARD, H.—**[Microscopic research as applied to Palæontology and Mineralogy.]**
[Reference to this Society's work.]
Geol. Mag., III. (1886) pp. 47–8.

WOOLMAN, G. S.—See [Hitchcock, R.].

β. Collecting, Mounting and Examining Objects, &c.*

Obtaining Diatoms from poor Material.†—Herr K. Müller writes that he has "discovered a new system of obtaining specimens from poor material. Take the material and dilute it well with water in a bowl, and let it stand about a quarter of an hour. The mud must be well stirred in the water so that it looks like muddy water. Let it stand and rest again. The heavy mineral particles will sink down. After a quarter of an hour the water will be clear again, but on the top all vegetable particles will float. If you have a small, fine sieve, pour the water through, and all the rough parts will remain in the sieve, while the diatoms will go through and will float on the surface of the water; let it stand about a quarter of an hour, when the diatoms will have settled on the edge of the plate, and there form a greenish-black border, which you can take off and put under the Microscope."

Dissecting Trough.—Mr. R. J. Harvey Gibson, M.A., F.R.S.E., Demonstrator of Zoology, University College, Liverpool, describes the dissecting trough which he has devised as follows :—

"As is well known to naturalists, dissection is much more easily and successfully accomplished under water, the tissues being thereby floated up and supported. At the same time it is absolutely essential

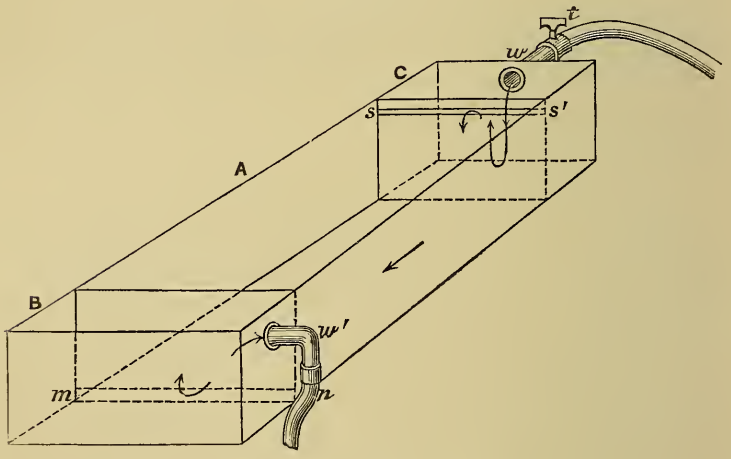
* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Amer. Mon. Micr. Journ., vi. (1885) pp. 230–1.

to have the water kept clear. Whilst engaged in the prosecution of a research into the minute anatomy and histology of *Patella vulgata*, I found that owing to the granular character of the liver and nephridia of that mollusc, it was almost impossible to keep the water pure and free from granular débris, entailing constant journeys to and from the sink, with the risk of disturbing and destroying the dissection by the pouring off and renewal of the water. I accordingly devised a form of dissecting trough which has answered its purpose very well.

It consists (fig. 37) of a long box of zinc or tin (preferably the former) divided into three compartments. The central division A is the largest; the two end divisions are of much smaller size, equal

Fig. 37.



to each other, however. The partition between A and C has a slit *s s'* about 1/2 in. from the top; that between A and B does not quite reach the bottom of the trough. Into compartment C a water pipe *w* opens with a stop-cock *t* in the position indicated; from compartment B an escape pipe *w'* passes off. The pipe *w* is in communication with a water tap by means of guttapercha tubing, *w'* by the same means with the sink. In compartment A a loaded block of paraffin is placed, the thickness of which varies with the size and depth of the dissection. The block is made so as to leave a clear space of half an inch between it and the sides of the trough. When the stop-cock *t* is turned on, the water flows in, fills chamber C, overflows into A when it has reached the level of the slit *s s'*, fills chambers A and B, escaping by the pipe *w'*. The direction of the current of water is indicated in the sketch by the arrows. The water is of course always kept at the same level by the inflow; the arrangement of the slits in the partitions, however, tends to cause the débris

of muddy water to sink to the bottom, the larger particles collecting at or near the slit *m n*. By this means the water in which the dissection is carried on is kept pure; the débris is removed, and the annoyance of having constantly to renew the water is avoided. The supply of fresh water of course is regulated in accordance with the necessity for renewal. The trough may be made of any length and shape to suit the nature of the dissections to be performed in it. It might be an advantage to have the sides sloping outwards instead of vertical. Wrist-supports might also be fitted on to the sides.

The trough was made for me by Mr. Frazer, optician, of Edinburgh, who suggested various mechanical improvements during its construction."

Differentiating Embryonic Tissues.*—It may be safely assumed that all hardening and staining fluids possess, in a higher or lower degree, the power of *developing*, in the photographer's sense, histological distinctions between embryonic cells, long before these distinctions become manifest in perceptible morphological differences. It is evident also, that this differentiating action varies in strength according to the conditions under which the reagents are applied. One of the best ways of intensifying the differential effects of hardening fluids, is to use several of them in combination or in sequence. The use of osmic acid, followed by Merkel's fluid, is an example of this kind. The advantages of this method in the study of pelagic fish eggs have already been noticed,† and Dr. C. O. Whitman now describes what the method will accomplish when applied to the eggs of *Clepsine*. The mode of procedure is as follows:—

The eggs are placed in 1/4 per cent. solution of osmic acid for ten minutes, then rinsed in clean water and transferred to Merkel's fluid (platinum chloride 1/4 per cent., and chromic acid 1/4 per cent. in equal parts), in which they are allowed to remain one and a half hours. They are next washed in flowing water for the same length of time, then treated with 50 per cent. and 70 per cent. alcohol. They need remain only a short time in the first grade of alcohol (about thirty minutes), but should be left for twelve to twenty-four hours in the second. For staining the author used Grenacher's alcoholic borax-carmine, adding to it from one-third to one-half its volume of glycerin. The glycerin intensifies the action of the dye, so that a moderately deep stain is taken in the course of twenty-four hours.

It is best to stain immediately after the eggs have remained the required time in alcohol, as receptivity for the staining fluid diminishes considerably with the lapse of time. The osmic acid has time to penetrate to all parts of the embryo, and the blackening is arrested and partially removed by the action of Merkel's fluid. The differential effects of the osmic acid are, however, sharpened under the influence of the chrom-platinum solution.

* Amer. Natural., xix. (1885) pp. 1134–5.

† Ibid., xvii. (1883) p. 1204, and Proc. Amer. Acad. Arts and Sci., xx. (1884) p. 28.

This method has enabled the author to trace out the history of the endoderm, and the precise origin of the nerve-cords, nephridia, salivary glands, larval glands, &c.

Preparing Mammalian Ovaries for Examination of Graafian Follicles.*—Dr. W. Flemming recommends a 2 per cent. solution of osmic acid, and also a mixture of chromic, osmic, and acetic acids for hardening ovaries and safranin or gentian-violet for staining the sections.

Preparation of Connective Tissues.†—Herr T. Ognew condemns most of the ordinary fixative agents, on account of their rendering connective tissue cells and their processes imperceptible. His best results were obtained from 1 per cent. solution of osmic acid. In using this, however, several precautions must be observed. The length of the embryo must be from 2–8 cm. The embryo must be still warm when placed in the hardening fluid. It must not remain in the acid longer than twenty-four hours. Preparations of connective tissue cannot be said to be properly stained unless the cells and their finest processes stand out quite clearly.

For the osmic acid preparations the best stain is a mixture of a saturated watery solution of safranin and Böhm's hæmatoxylin. Five to twenty drops of the hæmatoxylin solution are added to a medium-sized watchglassful of the safranin solution. After mixing it is necessary to remove the precipitate which arises, by filtration. Preparations stained by this method can be mounted in glycerin without detriment to their colour.

Preparing Spinal Cord.—At the December meeting of the Society a section of the spinal cord of the ox, prepared by Mr. C. Robertson, Demonstrator of Anatomy at Oxford, was exhibited by Dr. Beale, and the method of preparation is thus described by Mr. Robertson.

"Portions of the warm cord about an inch long are placed in weak spirit (10 over proof) from four or five hours, then transferred to a 6 per cent. solution of bichromate of potash for six days, care being taken during the process of hardening to remove with a razor thin sections from the ends to allow the solution to thoroughly penetrate to the interior of each piece. The process of hardening is completed by transferring to weak spirit for two days, then to strong for two or three more days, when the cord can be kept till wanted for sections. Portions of the cord are stained before sections are made by soaking for twelve hours in a solution of good picrocarmine, washed in weak spirit, and soaked for a short time in absolute alcohol, which should be used to wet the razor in cutting. The sections are cleared in oil of cloves, and mounted in dammar varnish or Canada balsam dissolved in benzole in the usual way.

I have tried most of the methods recommended in the text-books for demonstrating the structure of the spinal cord, brain, ganglia, &c., and find that none of the methods recommended bring out the

* Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1885, pp. 221-44 (2 pls.).
† Ibid., pp. 437-49 (1 pl.).

processes and cells or enable one to trace the cell process so well as the method of soaking in the picrocarmine before cutting; there is also little risk of damaging the sections after they are cut, as they can be washed off from the razor to the slide, cleared with oil of cloves and mounted in dammar varnish or balsam dissolved in benzole in the usual way.

It is very difficult to procure good picrocarmine in this country. The best thing that I have met with I obtained ready made from MM. Rousseau and Son, Paris. The only objection to the bichromate-of-ammonia method is that the solution is liable to deposit in the form of small specks amongst the nerve. Some of these specks are seen in the sections."

Preparing Teleostei for showing Development of Thyroid and Thymus Glands.*—Dr. F. Maurer studied the development of these glands chiefly in the trout. From eggs obtained recently spawned, the troutlets emerged in forty-eight to fifty-six days. Chrom-acetic acid was found to be the only satisfactory hardening agent (1/2 per cent. chromic acid, 1 per cent. acetic acid, in distilled water). During the first twenty days no deformity of the embryo need be anticipated, but from this period the amount of distortion goes on increasing. The eggs remained in the chrom-acetic from eight to twelve hours, they were next washed in water, and then, after the removal of the yolk, transferred to alcohol. Staining was always performed with alcoholic borax-carmine. In order to prepare the specimens for imbedding in paraffin, they were soaked in absolute alcohol, and afterwards in chloroform. Giessbrecht's shellac method was adopted for mounting in series.

For examination of the mature thyroid and thymus, these glands were injected with a watery solution of Berlin blue thickened with gelatine. The injection was effected by snipping off the apex of the heart and passing the canula through the ventricle into the bulbus arteriosus.

Permanent Mounting of Tracheæ of Insects.†—Mr. F. T. Hazlewood has succeeded in a very simple way in mounting permanently the tracheal system of insects.

He dissects out the soft parts and spreads them on a glass slide of the usual size; lets them dry perfectly; and then with pencil-brush gives them a good coating of collodion. After this melt a little hard, pure balsam in a test tube, and put it on the object with a cover-glass applied at once.

This method is remarkable for its results. The intestines, the ganglia, and the brain, are "perfectly magnificent." The intestine makes thus one of the most beautiful objects for dark-ground illumination. The brain shows the most abundant ramifications of the tracheæ, especially in the immense parallel branches in the rods of the eyes. The ganglia can be floated on a cover-glass, dried, and mounted in this way.

* Morphol. Jahrbuch, xi. (1885) pp. 136–8.
† The Microscope, v. (1885) p. 235.

Preparing Silkworms.*—Mr. A. C. Cole gives the following methods of preparation:—

The silkworms are to be hardened in spirit; the parts intended to be mounted are then to be cut, or dissected out, and placed in liquor potassæ for from thirty-six to forty-eight hours; then thoroughly washed and cleaned with a soft brush, then soaked in distilled water, to be once or twice changed, during three or four hours; then placed in acetic acid; next in water, to remove the acid; next in spirit, for re-hydration; next in oil of cloves; next in turpentine, and mounted in balsam.

When the tracheal tubes only (separated from the spiracle) are required for study, it is better to mount them in a cell, in glycerin jelly, and they should be placed, after the acetic-acid treatment, in a mixture of half glycerin and half water, with a slight addition of acetic acid, until all trace of air is removed.

Preparing Alimentary Canal of Crustacea.† — For *hardening* the river cray-fish, Dr. J. Frenzel recommends Kleinenberg's picro-sulphuric acid diluted with only twice its volume of water. The preparation is left fifteen minutes in the fluid, then treated with the usual grades of alcohol. Osmic acid and the various chromic solutions proved worthless. Perenyi's fluid caused a slight swelling, but was of some service in the study of the liver and the nuclei of the middle gut. Corrosive sublimate (saturated aqueous solution) proved an excellent means of isolating the epithelium of the middle gut in the lobster. In preparations hardened in this fluid the epithelium becomes loosened from the wall of the canal, so that it can be stripped off in sheets and prepared for surface-examination.

For *imbedding*, paraffin is to be preferred to celloidin. Precaution should always be taken to prevent the formation of large crystals, which not only render the paraffin brittle, but also injure the finer structure of the preparation, by immersing it in cold water and cutting soon afterwards. If the paraffin block is allowed to stand for weeks, crystallization sets in.

In *staining*, the sections are fixed on the slide with chrome mucilage, and then stained with alum carmine, alcohol carmine (Grenacher), aqueous hæmatoxylin (Böhmer), and safranin. For the epithelium of the middle gut, a double stain with acid carmine and hæmatoxylin offers some advantages.

Preservation of Medusæ.‡—Dr. W. Haacke preserves Medusæ in the following way, by which they are said to retain their shape better than by any other method known.

The Medusæ are placed in a vessel of sea-water, and killed by the addition of a few drops of concentrated solution of chromic acid; they are then placed in fresh sea-water, which is repeatedly changed

* Cole's Studies in Microscopical Science, iii. (1885) sec. 4, p. 34. "The tracheal system in our present preparation would have been thus mounted, but balsam being calculated to display the structure of the spiracle and foot to greater advantage, it was considered advisable to employ that medium."

† Amer. Natural., xix. (1885) p. 1246. From Arch. f. Mikr. Anat., xxv. (1885) pp. 141-3.

‡ Zool. Anzeig., viii. (1885) pp. 515-6.

until all trace of chromic acid is got rid of. A mixture of alcohol and glycerin is then added to the water, and the proportion of these latter is gradually increased until the Medusæ come to be in a pure solution of glycerin and alcohol, which is made of the same specific gravity as sea-water.

Mounting Diatoms in situ.*—Dr. F. L. James has found that the processes commonly in use, and recommended in the text-books for preserving diatoms, as well as other minute aquatic organisms, desmids, algæ, &c., in the natural state, are all of them more or less unsatisfactory, and he never succeeded in making a really good mount until he came across a letter from Mr. C. H. Stodder, of Boston,† giving his method of mounting *in situ*, which is briefly as follows:—

"The algæ upon which the diatoms are growing are thoroughly dried, as usual, on bibulous paper. It is presupposed that all extraneous dirt, &c., has been removed. I have provided a slide with a circle of ink marking the centre on the reverse side, clean cover-glass, a bottle of chloroform solution of Canada balsam, some chloroform, and a watch-glass. These must all be ready at hand, as the operation must be carried through quickly. I select a bit of the weed, just large enough to mount, put a few drops of chloroform in the glass, and immerse the weed in it. The chloroform seems to be as efficient as water in restoring the dried alga to its natural shape. As it evaporates quickly, a few drops should be added from time to time until the alga is thoroughly permeated and has a natural appearance. It is then transferred to the slide, covered with a drop or two of chloroform, and arranged in the position which it is to occupy. A drop of balsam is now put on, before the chloroform has entirely evaporated, and the cover-glass applied. When thus manipulated, the balsam follows the chloroform, penetrates the cells of the weed, and makes them translucent so as to show all the details of their structure admirably, and the diatoms are displayed adhering in their natural positions. The balsam must be allowed to harden slowly, as it will not do to apply heat, since there is danger of shrivelling the delicate structures by so doing.

While the specific markings of diatoms can rarely be shown in mountings of this description, what is equally important, the mode of growth, can thus be demonstrated—which cannot be with cleaned diatoms. I have before me a slide of *Ptilota*, from the Pacific, which displays finely several species of diatoms of which I had seen no trace until this method was tried. If you have a number of specimens to mount at once, it will be better to put them directly into a small bottle of chloroform instead of the watch-glass. They can thence be taken directly to the slide, well saturated with chloroform. The most important point is to add the balsam before the chloroform has evaporated."

The method of Mr. Stodder gives equally good results with fresh- or salt-water algæ.

* St. Louis National Druggist, vii. (1885) pp. 233–4.
† Amer. Journ. Micr., ii. (1877) pp. 142–3.

Another method, suggested by Mr. Atwood, of Chicago,* also gives most excellent results. It is as follows:—

"For mounting marine algæ I prepare an artificial sea-water by dissolving in rain or distilled water a sufficient amount of sea-salt, which can be procured of any druggist. The dried algæ immersed in this will, in an hour, have resumed their original state. When this has occurred I pick out and clip off such pieces as are best adapted for mounting, transfer them to a bowl of distilled water, and wash them clean. They are thence transferred into a saturated solution of salicylic acid. The slides are prepared for receiving the mounts, with cells made of bleached shellac dissolved in Cologne spirits, thoroughly dry. The specimen is removed from the salicylic solution and arranged in its place, and the cell is filled with the salicylic solution. The cover-glass, first breathed upon, is put into its place, the surplus fluid removed in the usual way, and the cell closed with a thin coating of gold size. In a day or two I lay on more size, and when it is dry finish off with zinc cement or Brunswick black.

In mounting an alga having *Isthmia* parasitic upon it, I have found it almost impossible to fill the diatoms if balsam be used, whereas the salicylic solution fills every valve and cavity. The acid sometimes, but not often, decolorizes the algæ. The immersion of marine algæ in the artificial sea-water is an important point that should not be neglected, as otherwise their full beauty cannot be brought out."

Preparing thin Sections of friable and decomposed Rocks, Sands, Clays, Oozes, and other Granulated Substances.†—Mr. F. G. Pearcey describes the method adopted in the case of some of the 'Challenger' collections, transparent sections of which were required, but which it was impossible to prepare by the ordinary method of the lapidary's wheel on account of their friability. It was therefore necessary to find some method of making them hard and compact, so that they could be subjected to this process. The principle of the method consists in the introduction of some foreign substance to cement the grains together, and make the material hard and compact. This is carried out by soaking in a solution of gum copal in ether, and then evaporating the ether, a method which is in use by naturalists for making sections of the hard parts of Echinoderms.

Preparation and Use of the Cement.—The first process consists in preparing a solution of gum copal in ether. Take one half-pound of the best gum copal and place it in a strong glass jar, sufficient to hold about one quart, with finely ground air-tight stopper; add about 20 ounces of ether B.P. (sp. gr. 0·735). This should stand for at least two days, and should be shaken frequently, or stirred with a glass rod; when all the gum copal is dissolved, it should form a clear, thin, transparent liquid, and is then ready for immediate use.

The substance to be hardened should be first well dried in a porcelain dish, upon a hot iron plate placed upon a tripod stand over

* Amer. Journ. Micr., ii. (1877) pp. 154–5.

† Proc. R. Phys. Soc. Edin., viii. (1885) pp. 295–300 (1 pl.).

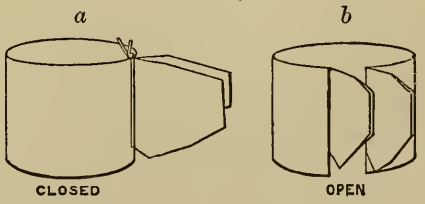
the flame of an ordinary Bunsen burner. The material is next placed in a porcelain crucible, varying in size according to the amount of substance required. About twice the volume of the solution of gum copal and ether should then be poured upon it, always taking care to press the stopper of the bottle well in afterwards.

The crucible is next placed upon the hot plate, care being taken to have a moderate heat at first, and to allow the mass to simmer till the ether has partly evaporated, when a greater heat may be applied. If the substance is a fine sand or ooze, it must be well stirred with a needle-point or small knife, otherwise it will stick to the bottom of the crucible, and not allow the gum copal to mix with it. If it is a soft, porous, or decomposed rock, it will only be necessary to turn it a few times, so that the solution may thoroughly penetrate all the pores. Great care must be taken during this part of the operation, as the cement is very inflammable, and therefore caution is essential, not only in stirring, in consequence of the gum having a tendency to stick to the sides of the crucible, but also in removing the stirring-needle to avoid contact with the flame.

After nearly all the ether has evaporated, the substance, if it is of a granular nature, should form a thin, stringy mass when stirred, and the operator can judge whether sufficient of the gum remains to cement the grains together; if too much has been applied, more of the substance and a small quantity of pure ether must be added, and the whole boiled over afresh. When there is a sufficiency of gum, the mixture should be kept boiling and well stirred till it becomes of a reddish or brown colour; sometimes it is difficult to discern the colour, as the substance interferes with it, but it can be seen in most cases. The operator, however, can easily ascertain whether it has been sufficiently boiled and has attained the necessary consistency, by taking a little out on the point of a knife, and rapidly cooling it by pressing it against some cold surface, or holding it a short time in water. If it hardens immediately, it has been boiled enough.

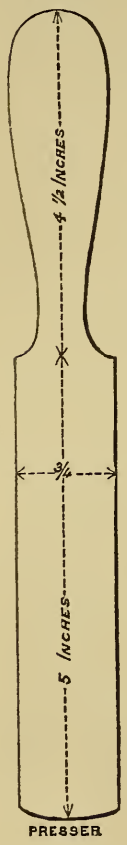
The crucible can now be taken off, and while yet warm, the substance should be scraped out with a knife, and rolled or pressed with the fingers into an oblong mass; it is then ready for moulding, or it can be laid aside and moulded at any time by gradually softening on a piece of glass or in a porcelain dish upon the hot plate. The moulds are easily made by cutting strips of ordinary tin 4 in. by 3/4 in., bent tightly over a round iron rod, a small slit being cut on one side of the tin to allow the wire connected with the mould to sink below the surface of the rim; this permits the mould to stand level and close to the glass plate; take the tin off the iron rod and bind it firmly round with fine copper wire: it is then ready for use (fig. 38 *a*).

Fig. 38.



Moulding.—This must be done while the substance is quite hot and plastic. First put a piece of common flat glass, three times the size of the cavity of the mould, upon the hot plate, with the mould on the top and the notched end downwards, so as to have it perfectly flat on the glass, and when quite hot, place the substance in the mould and press it firmly in with the presser (fig. 39), taking care to let as little as possible of the substance escape from the bottom. This may be to a great extent prevented by holding the mould down with the back of a knife with the left hand, and pressing in the substance with the right.

Fig. 39.



This done, take the whole off the plate smartly, with the glass attached, and press it on another flat slab or iron plate with the left hand, and with the right pour on a little cold water, when it will immediately set hard. Next place the whole in cold water for two or three minutes, after which the piece of glass at the bottom can be knocked or broken off; then loosen the wire which fastens the mould together, and open it a little (fig. 38, *b*); the moulded substance will then drop out in the form of a very hard mass, and is ready to be cut into sections. After a little practice, the whole operation can be done in an hour.

Preparation of the Sections.—Rub down and polish one end of the moulded substance, first upon a common hone, with a slow, equable motion, and a steady pressure, so as to produce the desired flatness of surface, and afterwards upon a Water-of-Ayr stone to give a fine polish. It must be held quite flat, so as to prevent the stones from getting worn into a hollow, when it will be impossible to get a perfectly flat surface.

The desired flatness and polish being secured, proceed to cement with Canada balsam the polished surface on an ordinary glass slide 3 × 1 in., or according to the size of the sections required. This is done in the same way as with hard rocks, but great care must at first be taken not to have the slide too hot, or the balsam will become too brittle. After having been properly mounted, it should be cemented round with a composition formed of four parts of resin and one of beeswax, melted together in a crucible on a hot plate, and put round the preparation with a glass pipette; when quite cold it may be cut with a lapidary's wheel, or ground down on a metal plate with emery powder. The slice remaining on the slide should be well cleaned and rubbed down on the hone to the required thinness. This part of the process is most difficult. The slides should be kept as flat as possible, and looked at frequently with the Microscope, so that the first indication of disruption may be detected. The proper thinness having been obtained, the sections should be at once covered

with a glass cemented with balsam; but considerable practice is required in this part of the work, as the preparation being very thin, is liable to be broken into pieces by very slight overheating. The superfluous Canada balsam around the slice should be first carefully scraped off with a sharp-pointed knife, and the slide well washed in spirit of turpentine, using a camel-hair brush to clean the section thoroughly. A little Canada balsam should then be dropped upon the centre of the section, and a clean cover-glass, heated a little, should be laid upon it while yet warm, and pressed down upon it, so as to force out the air-bubbles if any remain.

The slide on which the section still remains should not be too hot, otherwise the gum will become soft and the preparation spoiled. Several preparations may be quite easily made from one moulding, and when mounted, labelled and laid aside for future examination.

Mineral particles, no matter how small, can be cut into sections in the manner described.

Cedar-wood Oil for Paraffin Imbedding.*—Mr. A. B. Lee advocates the use of cedar-wood oil for clarifying tissues previously to imbedding them in paraffin.

The object is steeped in the oil, and then transferred to a bath of pure paraffin, or, if it be a delicate structure, first of all to a mixture of oil and paraffin. The cedar-wood oil clarifies very rapidly, and the object absorbs the paraffin quickly and thoroughly, so that it is only necessary to leave it for a very short time in the paraffin. The length of time that the object is left in the oil is of no moment, as it does not become brittle or over-hardened; treatment with this oil renders section-cutting very easy, and the method of procedure is exceedingly simple.

Apparatus for Imbedding Preparations specially adapted for the Nervous System.†—Instead of the ordinary clamp arrangement, Dr. S. v. Stein recommends a small metal case, open above, and to the bottom of which a clasp, with or without a slot, is fitted. The walls are formed by two rings. The upper ring, 30 mm. high, is pushed over the lower one, 10 mm. high. To make the imbedding mass adhere firmly, the floor of the box is fitted with three screws which project into the cavity for a distance of 4 mm.

When used, the upper ring is oiled and adjusted. The imbedding mass (one part oil and two parts wax) is then poured into the case until the screws are covered. After this has cooled down a little, the object is placed thereon, and the rest of the space filled up. The mass sets in a short time. The upper ring is then withdrawn, and there remains a wax column in which the object is firmly fixed. The sections are cut under water. This procedure is easily effected by the Leiser or Schanze microtome. The size and shape of the case (round or oval) depends on the form of the part of the nervous system (a hemisphere, &c.).

This method has the advantages—(1) that the specimen is not

* Zool. Anzeig., viii. (1885) pp. 563–4.

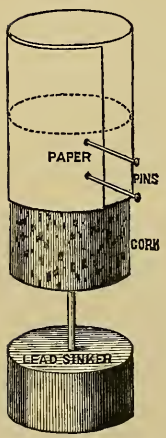
† Centralbl. f. d. Med. Wiss., 1884, pp. 120–6. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 41.

exposed to any pressure, (2) the knife does not become blunt soon, as it does not come in contact with the upper plate, as is the case with Ranvier's microtome.

Imbedding in Celloidin.*—Dr. C. S. Minot advises that after dehydration in alcohol, the object should be placed for twenty-four hours in a mixture of equal parts of absolute alcohol and pure ether before immersing in the thin solution of celloidin. In this it remains for from one to three days, according to the size of the object, and is then imbedded in a thicker solution of celloidin.

This is best done as follows: A cylindrical cork of convenient diameter is selected; a strip of glazed paper wrapped round it tightly and fastened with a couple of pins as indicated in fig. 40. In the box thus formed the object is placed and the celloidin poured carefully over it. If necessary the object can be secured in any position by pins. Bubbles will rise from the cork and interfere with the imbedding; two precautions will essentially diminish this danger: 1. Pour in so much celloidin that it covers the object half an inch deep, giving an opportunity for the bubbles to rise above the tissue; 2. Before imbedding, cover the end of the cork with a thin layer of celloidin, which is allowed to dry on completely. After the object is covered, the cork is mounted on a lead sinker, and allowed to stand until a film has formed on the upper surface. It is then immersed in alcohol of 82–85 per cent. (stronger alcohol attacks the celloidin) for one to three days. The sections have to be cut under alcohol.

Fig. 40.



For mounting sections with celloidin left on them, Dr. Minot has found none of the methods hitherto recommended satisfactory, but after trying various reagents, considers chloroform the most convenient medium of transfer from alcohol to balsam. In using it, care must be taken to place the section for half a minute in perfectly fresh alcohol, which is really 95–96 per cent.; if this is done, chloroform will clear it up almost immediately. When the section is in chloroform on the slide, the mounting must be expeditious, and the balsam added *while the chloroform is still covering the section.* The transfer, particularly of a large section, from the spatula to the slide, with chloroform, is often very difficult. To mount a single section, put it in alcohol on the slide, wash with a few drops of fresh strong alcohol; let most of the alcohol drain off, but while the section is still covered with it add chloroform, drain off the mixture, and pour over the still moist section a fresh dose of chloroform; if the washings have been really thorough, the sections will clear at once.

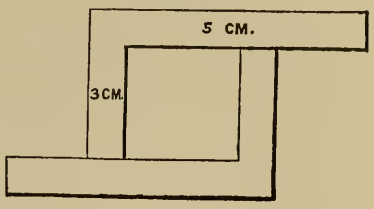
With regard to the paper-box, Dr. R. G. Hebb tells us that he has always used pill-boxes made of white board or of willow-wood.

* Amer. Natural., xix. (1885) pp. 828–9 (1 fig.).

They have all the advantages of the former, and are of all sizes and very cheap.

Imbedding-Box.*—A convenient box (fig. 41) introduced by Dr. Dimmock,† may be made of two pieces of type metal (or better of brass), each piece of metal having the form of a carpenter's square. A convenient size will be found in pieces measuring 5 cm. (long arm) by 3 cm. (short arm) and 7 mm. high. With such pieces a box may be constructed at any moment by simply placing them together on a plate of glass which has previously been wet with glycerin, and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces.

Fig. 41.



Orientation of Small Objects.‡—Orientation becomes difficult only with objects so small that their position can be controlled only by the aid of a Microscope. Spherical objects, less than 1 mm. in diameter, e. g., many ova and embryos, are the most difficult to manage. Such objects may usually be successfully oriented in the following manner, as given by Dr. C. O. Whitman:—

1. Prepare the box; for this it will be necessary to use the two triangular pieces of metal, a rectangular glass plate (2 in. by $2\frac{1}{2}$ in.). The plate should be cleaned and then smeared with glycerin, and the pieces of metal so adjusted that the arms are parallel with the edges of the plate.

2. Having warmed the box over a spirit-lamp, lift the object from the basin of paraffin by the aid of a *small*, *flat*, *thin* spatula (first starting it from the bottom by shaking the paraffin a little), and allow it to *flow* with the paraffin carried on the spatula into the box.

3. Then fill the box, 5–6 mm. deep, with the melted paraffin, and warm it a little over a spirit-lamp, just enough to keep *all* of the paraffin in a liquid condition for a few moments. Now place the box on a warm table of a dissecting Microscope, and by the aid of a hot needle proceed to place the object in the desired position. As the object is illuminated from below, it can be easily seen, turned over, and moved about at pleasure. If the paraffin sets before orientation is effected, it should be melted again as before, and the needle must be kept hot by repeatedly holding it in the flame of the lamp.

The difficulty of finding very small objects in a basin of paraffin will be very much lessened by keeping the paraffin free from dust, and the bottom of the basin (tin) scoured bright. A piece of emery cloth serves for polishing.

The necessity of re-warming the box of paraffin, which often arises

* Amer. Natural., xix. (1885) pp. 1247-8.
† Cf. this Journal, ii. (1882) p. 881.
‡ Amer. Natural., xix. (1885) p. 1248.

in the above method, may be removed by using a hot bath on the table of the Microscope. This bath should be a box of convenient size (not over 2 cm. high), with top and bottom of glass, with an opening at one end for filling with hot water, and another at the opposite end provided with a rubber tube and clamp, for drawing off the water as soon as the object has been arranged.

Prevention of Bubbles.*—After the imbedding process has been carried thus far, there is still another danger to be carefully guarded against. If the box is left to cool slowly in the air, bubbles are very likely to appear in the paraffin, which will prove a serious obstacle in cutting. Profiting by Caldwell's suggestion, to cool the box in water, one may avoid all such inconveniences. As soon as the paraffin cools around the object, so that its position is secured, the box should be held in a vessel of cold water, first at the surface (until the paraffin has set), then fully submerged. In this way the paraffin is quickly cooled sufficiently for removal from the box, which may then be used for imbedding a second object. A dozen objects may be thus imbedded in a very short time. If the box is plunged below the surface of the water before the paraffin has become rigid, holes will arise in the mass and fill with water.

Bulloch's Combination Microtome.—Since the description of this microtome was published, it has been further improved. The attachment for holding the knife consists of two discs, and when placed in position at zero, which is indicated by a spring stop, are 4/10 in. thick. Each disc is 2 in. in diameter and in the form of a wedge. The lower disc is divided into 25 parts, and by the proper position of each wedge any inclination or adjustment can be given to the knife. The periphery of the elevating wheel has a rachet with feeding attachment, but the adjustment for graduating the amount of elevation is on the block which carries the knife, and is worked by means of a sliding arm-piece, and can be gauged from one to twenty teeth, or 0·005 to 0·1 mm. By this arrangement the knife-carrier can be used on the full length of the bed at any adjustment of the feeding attachment. A ribbon carrier has also been attached.

Improved Roy Microtome.†—Figs. 42 and 43 show the Roy microtome as improved by M. C. Vérick, from suggestions by Prof. L. Malassez.

The special advantages presented by this instrument are that it cuts under water or spirit, and that the sections can be made of almost any desired thickness and in any direction. It is specially adapted for freezing, but can of course be used in the ordinary manner. In facility of management, rapidity of movement and sureness, it is claimed to be superior to all microtomes, and only yields to the Rivet microtome for extreme delicacy of sections.

The object to be cut is fixed in a metal tube fitted with a special but simple arrangement (not shown in the fig.), or if too soft to be

* Amer. Natural., xix. (1885) pp. 1248-9.

† Trav. Laborat. d'Histol. Collège de France, 1884 (1885) pp. 191–206 (3 figs.).

thus compressed, is first imbedded in carrot, pith, collodion, &c., or better still, fixed with liquid glue on a piece of wood.

Fig. 42.

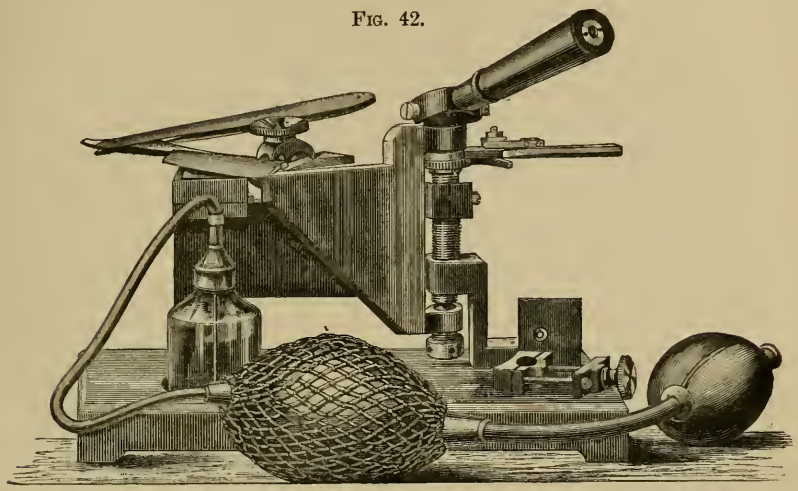
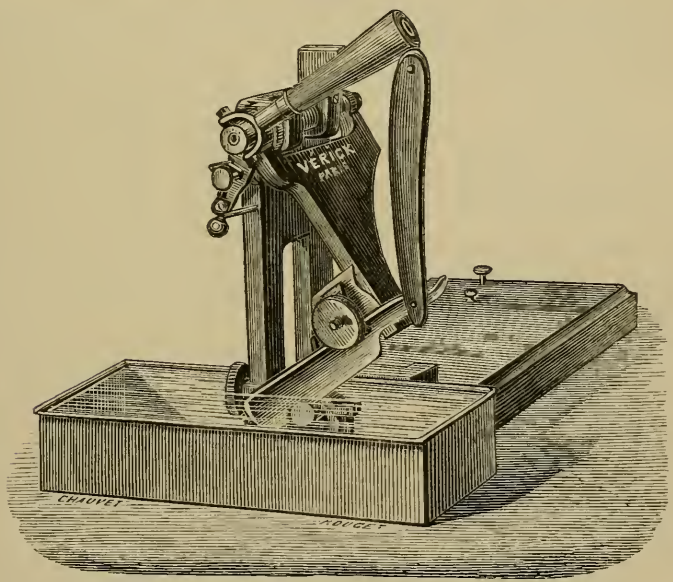


Fig. 43.



Any kind of razor may be used, and the knife may be placed in any position, and by the aid of thin metal blocks, any desired

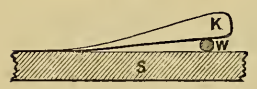
inclination may be imparted. The sections are made automatically and are of a definite thickness. By working to and fro the handle, which is in connection with the microtome screw, and having previously put the spring in action, the machine works automatically, cutting, at each complete turn, a section 1/100 of a millimetre in thickness. Thicker sections are made by stopping short just before cutting and reversing the action of the handle, &c.; thus two descents of the knife-carrier produce a section 0·02 mm. in thickness, and so on.

In cutting under water or alcohol the instrument is placed, as will be seen from fig. 43, in a position at right angles to that of fig. 42. A trough full of water or alcohol receives the object-carrier, and the sections fall off into the fluid.

When used for freezing, the object-grip or tube is replaced by a plate (fig. 42) beneath which is a reservoir for saving the superfluous ether. In place of ether Prof. Malassez advises the use of methyl chloride, which being volatile at the ordinary temperature and pressure, does not necessitate the use of a spray apparatus. A tin tube covered with caoutchouc and fitted with a stopcock is attached to the siphon which contains the methyl chloride. One jet of vapour is nearly always sufficient to freeze the object, and when this is effected it is advisable to place the machine in the vertical position and allow the sections to drop into a basin of water recently boiled or slightly alcoholized, in order to get rid of air-bubbles.

Sharpening Microtome Knives.*—Dr. C. O. Whitman considers that microtome knives can be properly sharpened only by those who understand their chief peculiarities, and who have trained themselves in this special work. The difficulties in acquiring the art are not, however, insurmountable; for with the proper means and a little perseverance they can be mastered in a short time. The first important step is to provide oneself either with a good razor-strop, or with a long and wide oilstone of the finest quality. Strops made of a leather band, unsupported by a solid base, and kept tense by the aid of a screw working in a frame, should never be employed in sharpening these knives, for they invariably give a biconvex edge, with which it is impossible to do fine work. To secure a plane bevel of the cutting edge the surface of the strop must be perfectly smooth, flat, and hard. In using the strop the knife is drawn back and forth, back foremost, without pressure, until the edge appears sharp when tested in the manner before mentioned.

Fig. 44.



In using an oil-stone it is well to cover the surface of the stone with a mixture of glycerin (two parts) and water (one part). The blade is laid flat on the stone and pushed forward, edge foremost, in such a manner that the free end of the knife finishes by resting on the more distant end of the stone. Here the blade is turned on its back and returned, edge in advance as before, to the place of starting. In drawing the blade the utmost care should be taken never to raise

* Amer. Natural., xix. (1885) pp. 831–2 (1 fig.).

in the slightest degree the back from the stone; and further the knife must not be pressed on the stone, but held lightly by the finger-tips, and the necessary friction be left to capillary adhesion. After drawing the knife fifteen to twenty times it should be tested as before.

The knives furnished with the Thoma microtome should be provided with a wire support (fig. 44 *w*) for the back of the knife during the process of sharpening.

Chrome Mucilage as a Fixative.*—Dr. J. Frenzel recommends the following process:—Make a thin solution of gum arabic in water and add to this an aqueous solution of chrome alum. An excess of the latter does no harm. A little glycerin is added to the mixture to prevent it from drying too rapidly when painted on the slide.

After painting the slide with a small brush the sections are placed in order and the slide left for a few minutes (not over fifteen minutes) in the oven of a water-bath kept at 30–45° C. The gum is thus rendered insoluble. The paraffin is next removed in the ordinary way, and the sections stained according to desire. Fuchsin and safranin are the only anilin dyes which cannot be used, as they stain the film of gum deeply, and thus injure the preparation.

Fixing Serial Sections on the Slide.†—For this purpose gutta-percha dissolved in benzol and chloroform; caoutchouc dissolved in benzol; gum arabic; gum arabic dissolved in absolute alcohol; and collodion one part with three parts oil of cloves; have been used.

Dr. H. Leboucq's modification consists in combining the last two methods. He covers a warmed slide first with gum, and then with collodion. Sections still retaining their paraffin are placed upon the slide and the latter upon a glass plate warmed by a lamp. As soon as the paraffin is melted it is removed by means of turpentine oil or benzol, and finally the sections are mounted in Canada balsam.

Treatment of Sections with Osmic Acid.‡—Herr F. Stuhlmann has devised a method of treating tissues with osmic acid after they have been cut (by the paraffin method) and placed on a slide smeared with Mayer's solution of albumen and glycerin.

A few drops of the acid are placed in a watch-glass and the slide laid across it with the sections downwards; the whole is covered with a bell-glass to avoid undue evaporation, and kept for half an hour to an hour and a half. They are then stained a pale yellow, which is sufficient, but it is sometimes useful to stain them further with a watery solution of hæmatoxylin. The method is particularly useful for nerve-tissues.

Staining Nerve-fibres of Retina.§—Dr. S. Bernheimer colours pale nerve-fibres, especially those of the retina, with hæmatoxylin in the following manner.

* Amer. Natural., xix. (1885) p. 1246. From Arch. f. Mikr. Anat., xxv. (1885) p. 52.

† Ann. Soc. Méd. Gand, 1884, pp. 167–8. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 41.

‡ Zool. Anzeig., viii. (1885) pp. 643–4.

§ SB. K. Akad. Wiss. Wien, xc. (1884) 6 pp. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 40.

The preparations previously stained by Müller's fluid are thoroughly washed for twenty-four hours in distilled water, and then steeped for twenty-four hours in a concentrated alcoholic solution of hæmatoxylin, prepared fresh every time. To the latter (the exact quantity not given) are added four to five drops of an alum solution (1–300), and five to six drops of dilute ammonia. After twenty-four hours the solution is thoroughly washed and left in distilled water for twenty-four hours, and is then placed in glycerin.

Picroborate of Carmine.*—M. G. Dutilleul describes an alcoholic reagent which has all the advantages of picrocarmine without its disadvantages. It has great penetrating force and gives a double stain (yellow and red).

Mix, warm, equal volumes of borax-carmine and a saturated solution of picric acid, and add to the mixture one volume of 95 per cent. alcohol. Filter when cold. It can be kept indefinitely without leaving any deposit.

Staining with Iodine Vapour.†—Many of the micro-fungi, when mounted permanently in Canada balsam, become so transparent as to be nearly invisible. Mr. B. Piffard finds that if previously exposed to the action of iodine vapour, they assume, when mounted, a clear yellowish-brown colour by which their structure is beautifully defined.

Cold Mass Injection for Anatomical Preparations.‡ — The materials for this mass, which has been suggested by Herr A. K. Bjeloussow, are only two, viz. borax and finely powdered gum arabic. A solution of these substances is made separately, and the two solutions afterwards mixed in the proportion of one part by weight of gum to a half-part by weight of borax. The resulting mass resembles gelatin in its physical properties, and is almost insoluble in water. The gelatinous mass is next rubbed up with ordinary water, and then forcibly strained through a piece of linen. The last two steps are repeated once more, and then a solution, miscible with water in all proportions, is obtained.

Any pigments, except cobalt or cadmium colours, may be used to stain the injection mass. Carmine is perhaps the most useful, especially for fine capillary injection. Any injection apparatus may be employed to introduce the injection mass into the blood or lymph vessels. After injection, the object is placed in spirit, and this "sets" the injection mass. Should it be necessary to remove the mass from any part, this may be effected by dropping over it a little dilute acetic acid.

Mounting in Gelatin.§—Dr. L. Gerlach dissolves 40 grm. gelatin in 200 c.cm. of a saturated solution of arsenious acid, adds 120 c.cm. glycerin, and clears with albumen. The solution is yellowish. The

* Bull. Sci. Dép. Nord, xvi. (1885) pp. 371–2.

† Sci.-Gossip, 1886, p. 17.

‡ Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1885, pp. 379–84.

§ Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 68. From Gerlach's Beitr. zur Morphologie u. Morphogenie, pp. 118–20.

specimen is placed in a watch-glass with the solution, and then covered with a circular glass plate, at the edge of which is an evenly ground ring 1 cm. broad. The aperture is hermetically sealed first with melted wax, and on the following day with amberlac. Later on they are firmly fixed with a mixture of equal parts of guttapercha and tallow.

Styrax for Mounting.*—Professor A. B. Aubert, referring to Mr. Deby's statement (Vol. V. 1885, p. 745) that styrax never dries completely, states that his experience with the styrax of commerce has been the same; but that the southern sweet gum (the exudation of *Liquidambar styraciflua*), when treated as indicated by him,† gives a chloroform solution which hardens as thoroughly as the balsam solution, and has the advantage over it of rendering fine details more visible. As far as he had heard from persons using genuine American styrax (or storax), it has been satisfactory as a mounting medium, hardening thoroughly, and giving clear and in every way excellent mounts.

Meates's Mounting Medium.—Mr. W. C. Meates writes:—"I make this medium by taking one part of powdered metallic arsenic and six parts of pure sulphur, rub them together in a mortar, and put the mixture in a small test-tube, then apply heat by means of a spirit-lamp; the ingredients soon unite, and the sulphur turns a deep red. You must go on until the mixture has boiled for a minute or so, then pour it out on to a clean piece of glass, and let it cool. I am in the habit of forming drops on the glass about the size of a large pea, and, before the mixture is cold, keeping another piece of glass upon them so as to flatten them very much, then when cold break them up into small pieces.

It is very easily used, and it is not even necessary to finish them off with a pretty border, as the sulphide gets so hard when cold. I take a clean cover and place it on a very flat brass mounting table, then place the diatoms on it, and thoroughly dry it; then put a small piece of the sulphide on the centre, make it hot with a spirit-lamp until it melts and becomes of a deep red colour and on the point of flaming, then place the cleaned side centrally upon it, and with a piece of wood or lead pencil press them well together. The sulphide will extend all round, and on cooling will turn of a canary yellow colour. You can now immediately put the slide under the Microscope.

With this medium *Amphipleura pellucida* can be resolved as easily as in Smith's medium. With a Powell oil-immersion 1/8 and oil-immersion condenser I can distinctly see the markings in squares."

Limpid Solution of Dammar.‡—Dr. F. L. James finds no difficulty in getting a perfectly limpid solution of dammar if one will only use benzol sufficient to make a solution which will readily pass through filter paper. If the solution be too thin for immediate use, the surplus benzol is easily driven off by evaporation. If the amount be sufficient

* Amer. Mon. Micr. Journ., vi. (1885) p. 219.
† See this Journal, v. (1885) p. 744-5.
‡ St. Louis National Druggist, vii. (1885) p. 245.

to warrant the trouble, it can, of course, be recovered by distillation. The same result may be obtained by shaking up a thin solution of dammar with zinc oxide. The latter should be dropped into a bottle dry, and allowed to settle spontaneously. It carries down with it the suspended particles of dust upon which the turbidity of the solution depends.

Repairing Balsam Preparations.*—When balsam preparations have been made with a very thin solution, or with a small amount of fluid, evaporation sometimes causes the balsam to be invaded by air-spaces which it is difficult to refill, even with a thin solution of balsam. Such spaces Prof. E. L. Mark finds may readily be filled with the solvent of the balsam (benzol), and then a drop of thin balsam placed at the edge of the cover-glass will gradually replace the benzol as it evaporates, without leaving air-spaces. To prevent a too rapid introduction of the benzole, it is desirable to transfer it with a glass tube drawn to capillary fineness at one end, rather than with a glass rod. If the tube is not too large—5 or 10 mm.—and is drawn out quite gradually, enough benzole may be sucked into it to serve for repairing a large number of slides without danger of loss by its running out or by evaporation when the tube is laid down. The application of the capillary end of the tube to the edge of the cover-glass induces a steady and even flow of the fluid, until the space beneath the cover-glass is completely filled.

Arranged Diatoms.†—Mr. C. Febinger, who has made some excellent arranged mounts, uses as an adhesive material to hold the diatoms when placed in position, gelatin (the best photographer's) dissolved in six times its weight of glacial acetic acid. This should be done in a porcelain capsule with a water-bath. When the solution is complete, add one part of alcohol to every fourteen parts of the solution and filter. It is spread on the slide with a glass tube or needle.

Gold-plated Diatoms.—Mr. A. Y. Moore has now gold-plated some diatoms, but we have not heard whether they show any practical advantage over the slides of silvered diatoms which he recently produced.

Test Diatoms.—Amphipleura pellucida and A. Lindheimerii.—Mr. J. Deby sends the following note:—"Don Alfredo Truan y Luard, in his very interesting and well illustrated 'Ensayo sobre la Synopsis de las Diatomeas de Asturias,' gives full instructions for collecting, selecting, and mounting diatoms, and much original matter relating to the microscopical examination and study of the Diatomaceæ. The fact to which I wish, however, particularly to draw attention is his having discovered in the north of Spain, abundantly, as he states, *Amphipleura Lindheimerii*, a species hitherto known only from South America. In a footnote, the author states that Herr Möller of Wedel has asked him for a number of these diatoms, to be mounted by him as test objects. Now *A. Lindheimerii* is larger and has very much coarser striæ, easy of resolution, yet non-specialists

* Amer. Natural., xix. (1885) p. 1137.

† St. Louis National Druggist, viii. (1885) p. 196.

would have trouble to distinguish it from the commoner European species. I do not suspect for one minute that Herr Möller himself would knowingly offer for sale test slides of the coarser diatom under the name of *A. pellucida*; but others might be found not quite so scrupulous.

Special slides, it is well known, are often kept of *A. pellucida*, of *P. angulatum*, of *F. saxonica*, of *Surirella gemma*, and others, for the best exhibition of high-power objectives; and these pet 'coarse' slides are in general not willingly parted with by their fortunate owners. My advice is, 'Make sure in future that the *A. pellucida* you resolve with ease is not one of Don Truan y Luard's *A. Lindheimerii*.'

This last diatom is figured in Grunow, 1862, pl. XI. fig. 11, and was distributed by Prof. H. L. Smith, in his 'Species Typicæ,' No. 17. A careful examination of either of these will prevent any confounding of the two species."

Bevel-edge Slips.*—The Palmer Slide Company, of Geneva, N.Y., have recently introduced slips with bevel edges. These are said to be "certainly very attractive in appearance, and well adapted for ornamental preparations." Some are plain glass, very colourless and free from defects, others are flashed with a colour on the under surface, which modifies the light, or adapts them very well for opaque mounting. Careless handling may, however, result in chipped corners.

Mr. G. S. Woolman, in further recommendation of the slips, says, "Aside from the great beauty of the finished object, making them the most elegant slide yet introduced, their bevel edge allows them to slide smoothly under spring clips on the stage of the Microscope. They are made of Chance's crystal plate and Chance's flat crown, and with ground edges, or ground and polished edges."

Adhesiveness of Cements.*—Prof. A. B. Aubert has made comparative tests of various cements, using metallic cells, and leaving the cement to harden for 103 days.

Starting with Miller's cement = 1000, the following table represents the comparative adhesiveness of the cements tested:—

Miller's caoutchouc cement	1000
Bell's cement (shellac in alcohol?)	735
Canada balsam	664
Lovett's cement (this Journal, III. 1883, p. 786)	626
American styrax	575
King's cement	532
Gold size	395
Dissolved marine glue	304
Zinc white cement	241

The gold size was not sufficiently hardened or it would have been higher in place.

Strong Cements‡.—The following formulæ are given anonymously for cementing brass cells to glass slides:—

* Amer. Mon. Micr. Journ., xi. (1885) p. 239. † Ibid., vi. (1885) pp. 227–9.
‡ Micr. Bulletin (Queen's), ii. (1885) p. 45.

1. Carbonate of lead, 1/2 oz.; red oxide of lead, 1/2 oz.: litharge, 1½ oz. Grind thoroughly together in a mortar. Stir some of this into enough gold size to make it work stiffly. If too much adheres to the work, turn it off on turntable when a little set.

2. Best quality gum arabic, dissolve in cider vinegar; add a little sugar. A very strong cement, but not tested for durability.

Test for Preservative Fluids.*—Dr. C. O. Whitman considers that one of the best objects for testing methods is found in *Phronima sedentaria*. Here the cells and nuclei are so sharply defined that they can be seen in the living animal, and so the effect of a preservative fluid can be easily studied.

Molybdic Acid Test for Protoplasm.†—If a section of some living endosperm is treated with a solution of molybdic acid in strong sulphuric acid, the cell-wall will swell up, and the threads which traverse it will soon assume a blue colour, while the main mass of protoplasm becomes intensely blue. The cell-wall itself remains uncoloured. This very delicate reaction demonstrates the protoplasmic nature of the threads.

Butter and Fats.‡—Dr. T. Taylor in a further paper on this subject, in which he repeats the results already recorded,§ says that he has examined a number of other fats, vegetable and animal, and finds thus far, that animals and vegetables of distinctly different genera and even species, yield fats which give typical fatty crystals characteristic of the animals and plants which yield them, and he is confident that this new discovery will prove highly useful to microscopists and chemists, when investigating adulterated substances used as food or in medical preparations.

Micro-organisms in Potable Water.‖—Dr. T. Leone's researches tend to show that water which contains carbonic acid is detrimental to the existence of micro-organisms. His experiments were made with a typically pure potable water (Maugfall of Munich), in order to ascertain the number of micro-organisms which could be developed in a given time.

After repeated examinations it was found that on the fifth day this water contained more than half a million of micro-organisms to every cubic centimetre. It was further demonstrated that there was no practical difference between the number of micro-organisms developed in water kept at rest, or constantly agitated for a given period of time.

When, however, carbonic acid gas was passed for a period of half an hour through flasks filled with this Maugfall water, the number of

* 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 16.

† Ibid., p. 212.

‡ The Microscope, v. (1885) pp. 212-4 (8 figs.). Cf. also Amer. Mon. Micr. Journ., vi. (1885) pp. 163-4 (8 figs.).

§ See this Journal, v. (1885) p. 918.

‖ Atti R. Accad. Lincei—Rend., i. (1885) pp. 726-32. Cf. transl. in Chem. News, lii. (1885) pp. 275-6.

micro-organisms actually diminished. After being kept fifteen days the water thus treated was found to contain only two micro-organisms to 1 c.cm. Hence the results of these experiments leave no doubt that carbonic acid is an impediment to the existence of micro-organisms in potable water. The practical importance of this of course is obvious, and needs no comment for those who are accustomed to drink waters "aerated" with carbonic acid, for according to Dr. Leone, the longer these aerated waters are kept the less chance there is of their being contaminated with bacterial impurities.

Microscopical Structure of Iron and Steel.*—Dr. H. C. Sorby has dealt with this subject in a paper read before the Iron and Steel Institute, and from which we extract the parts which refer to the preparation of the objects and their illumination.

The microscopical study of fractured surfaces is, he considers, unsatisfactory, not only on account of the optical difficulties, but because a fracture shows the line of weakness between the crystals, and not their internal structure. All his results were therefore based on the examination of flat sections. These should be finished by grinding with Water of Ayr stone, and polished so as not to alter the true structure of the extreme surface. Anything approaching to a burnished surface or polished scratches is fatal to good results. In general, after having been polished with the finest rouge and water, so as to show few or no scratches, the surface was acted on by very dilute nitric acid, and repeatedly examined in a small trough of water, until it was found that the acid had properly developed the structure. In some cases it is, however, best to polish with dry rouge on parchment, and not to use acid. Thin glass covers were afterwards mounted over the surface with Canada balsam. Some of his preparations have kept perfectly well for above twenty years, but others have deteriorated considerably.

Objects thus prepared must be examined by means of two special kinds of surface illumination, viz. first, the side parabolic reflector now common, but the author believes originally made for this purpose, which gives oblique light, and secondly, a small silver reflector, covering half the object-glass, which throws the light directly down on the object, and from this it is reflected back through the other half of the lens (see *supra* p. 130, fig. 14). With the oblique illumination, a polished surface looks black, but with the direct illumination it looks bright and metallic. A truly black substance appears black in both cases. A magnifying power of about sixty linear is most generally suitable, but the sections will bear a higher perfectly well.

In commenting on a paper on the properties of malleable iron by Dr. H. Wedding, Dr. Sorby wrote†:—"As far as I can judge the reason why his (Dr. Wedding's) conclusions differ so much from mine is that his sections were not ground down with soft stone before final polishing. It was not till I adopted this method that I was able to see the ultimate structure properly. This explains why he

* Sorby, H. C., 'On the Microscopical Structure of Iron and Steel,' 8vo, Iron and Steel Institute, 1885, 8 pp.

† Colliery Guardian, xlix. (1885) p. 908.

has not been able to detect the ultimate crystals in bar iron. My sections of these show it splendidly, as will be seen when I exhibit the microscopical photographs taken from the objects themselves. What strikes me as so strange is that he has not appreciated the total and complete difference between the intensely hard constituents of blister steel and white iron, and soft iron of a malleable bar. Possibly this may be in part due to the illuminative employed. The direct illuminative contrived by me is so indispensable, that I feel sure that no one can arrive at sound conclusions without it, and I feel almost sure he did not use it."

Microscopical Chemical Reactions.*—Herr A. Streng, from the frequent application of chemical methods in the examination of rocks, is enabled to improve and simplify the methods of microscopical chemical research. He gives microscopical reagents for potassium, sodium, lithium, calcium, strontium, barium, magnesium, aluminium, and phosphoric anhydride.

Hussak's Guide to the Determination of Rock-forming Minerals.†—The first part of this book deals with methods of research, describing Microscopes and apparatus, and giving directions for making preparations. Optical methods and chemical methods of investigation are detailed, as well as the mechanical separation of the minerals by biniodide of potassium and mercury, biniodide of barium and mercury, Klein's solution, acids, and the electro-magnet.

The second and principal part (pp. 81–191) of the book consists of well-arranged tables, in which the properties of the various minerals are placed in columns (in some cases as many as seventeen), showing at a glance the various points required to be known for their identification.

Whitman's 'Methods in Microscopic Anatomy and Embryology.'‡—Dr. C. O. Whitman, of Boston, U.S.A., is well known to the readers of this Journal as an able writer on all branches of microscopical technique, and in this book he has brought together not only the results of his own practical experience, but the principal methods in use at the present time. The result is a well-arranged and very useful work for the practical microscopist, and the more useful as it has not been limited to histological requirements only, but includes to a large extent embryological also.

The book is divided into two principal parts, (1) general methods and (2) special methods. The former includes methods of killing, hardening, preserving, bleaching, macerating, decalcifying, desilicifying, staining, and imbedding, with a description of microtomes, and chapters on fixatives for serial sections, mounting media, and the uses of collodion. The special part is subdivided into embryological methods, times and places of ovulation, nuclei, (karyokinetic figures, &c.), preparation of nervous-tissue, histological methods, and recon-

* Jahrb. f. Mineral., 1885, i. Mem. pp. 21–42.

† Hussak, E., 'Anleitung zum Bestimmen der Gesteinbildenden Mineralien,' iv. and 196 pp. and 103 figs. 8vo, Leipzig, 1885.

‡ Whitman, C. O., Methods of Research in Microscopical Anatomy and Embryology,' ix. and 255 pp. and 37 figs., 8vo, Boston, 1885.

struction from sections. An appendix describes methods of injection and museum methods, and gives formulæ for most of the important reagents, &c."

Examination of Blood. — If we did not fear to disturb the exceptional harmony which has always existed between English microscopists and their American colleagues, we should be tempted to preface the extract here given by the stereotyped formula of the newspapers, "The following is from an American source":—

"A man was found shot in his bedroom, while his wife was lying wounded in another part of the room. She said that her husband had come home in a rage, hit her on the head with the butt of his revolver while her head was on the pillow, and spattered blood over the linen; that she jumped up, and he shot her. She then rushed at him, and, snatching the revolver, shot him through the heart. He recled to the corner where he was found, and died. The prosecution did not believe her story, and set up the theory that she shot him when he was asleep, and dragged him to the corner, and then inflicted the wound upon herself. The carpet where the dead man lay was saturated with blood. According to the theory of the prosecution, the blood on the pillow was his also.

Dr. Piper put the section of the pillow with blood upon it under the Microscope, and drew the shape of the corpuscles, enlarged about 2000 diameters. He then put the blood on the carpet under the Microscope in the same way. The comparison settled the question at once. The blood-corpuscles were as different as day and night, and sustained the woman's account of the shooting. She was acquitted on that and other evidence." *

Dr. C. H. Stowell, amongst other sarcastic comments on this story, suggests † that "perhaps when a man is on a pillow his blood-corpuscles are softer and rounder than when on a hard flat carpet."

Microscopical Jurisprudence.‡—Dr. H. J. Detmers cites a case recently on trial in Illinois, where a murder was committed in an old ice-house. The murdered man was found lying on a pile of pine sawdust. A man was arrested for the murder upon whose boots and pantaloons small particles of sawdust were found clinging. He exclaimed that he had not been near the ice-house where the murder was committed, but had been sleeping in another ice-house several yards away. It was conclusively shown that all the sawdust in the house where he claimed to have been was from hard wood. There was no hard wood sawdust in the house where the murder was committed. Particles of sawdust from the prisoner's boots and clothes were placed under the Microscope by an expert, who conclusively proved that it was pine sawdust exactly like that found at the scene of the murder. The microscopist's evidence led to the conviction of the prisoner.

* The Microscope, v. (1885) pp. 234–5. From 'Scientific American.'
† Ibid, p. 230. ‡ Amer. Mon. Micr Journ., vi. (1885) p. 199.

ARTHUR, J. C.—**Some Botanical Laboratories of the United States.**
[Describes twelve laboratories, with the Microscopes, &c., used. "The number of compound Microscopes employed is above twenty on the average for each Institution, while the number of students who make use of the laboratories during the year ranges from fifty to a hundred."]
Bot. Gazette, X. (1885) pp. 395-406 (5 figs.).

" " **A Germinating Pan.**
[Found so satisfactory at the New York Agricultural Experiment Station as to supersede all others.]
Ibid., pp. 425-6 (2 figs.).

AUBERT, A. B.—**Styrax for mounting.** [*Supra*, p. 171.]
Amer. Mon. Micr. Journ., VI. (1885) p. 219.

" " **Results of Experiments upon the adhesiveness of some Microscopical Cements.** [*Supra*, p. 173.] *Ibid.*, pp. 227-9.

B. SC.—See Wood Sections.

Bausch & Lomb Microtome.
[Laboratory microtome. See this Journal, V. (1885) p. 1089.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 205-7 (1 fig.).

BECKER, A.—**Neuerung an Mikrotomen.** (Improvement in Microtomes.)
Title only of German Patent, Kl. 42, No. 6065.

BELL, J.—**[Instrument for making Cells.]**
[A home-made arrangement.] *Engl. Mech.*, XLII. (1886) p. 407 (1 fig.).

BELLONCI, G.—**Del fuso direzionale e della formazione di un globulo polare nell' ovulo ovarico di alcuni mammiferi.** (On the structure and formation of a polar globule in the ovule of some mammalia.)
[Process of preparation, *post.*] *Rend. R. Accad. Lincei*, I. (1885) pp. 285-6.

BERNHEIMER, S.—**Zur Kenntniss der Nervenfaserschicht der menschl. Retina.** (On the knowledge of the nerve-fibres of the human retina.) [*Supra*, p. 169.]
SB. K. Akad. Wiss. Wien, XC. (1884).

BIGG, J. S.—See Wood Sections.

BOOTH, C. F.—**Limpid Solution of Damar.** [Cf. *infra*, James, F. L.]
St. Louis National Druggist, VII. (1885) p. 245 and 293.

BOTTONE, S.—See Wood Sections.

BURRILL, T. J.—**Section Cutting.**
[Directions for cutting botanical specimens. "Nothing new is offered."]
Bot. Gazette, X. (1885) pp. 421-4.

" " **Starch Grains.** [*Post.*] *Ibid.*, pp. 424-5.

" " **Germination of Fungus Spores.** [*Post.*] *Ibid.*, p. 428.

" " **Exhibiting streaming of Protoplasm.** [*Post.*]
Ibid., pp. 428-9.

CAMPBELL, D. H.—**A Method of Spore Germination.** [*Post.*] *Ibid.*, p. 428.

Carmine, Preparation of.
[Madame Cenette's and other processes.]
Engl. Mech., XLII. (1885) p. 297.

CARPENTER, J.—**Foraminifera to mount in Balsam.** [*Post.*]
Journ. of Micr., V. (1886) p. 50.

Castellarnau, J. M. de.—**Procédés pour l'examen microscopique et la Conservation des Animaux à la station zoologique de Naples.** (Methods for the microscopical examination and preservation of animals at the Zoological Station of Naples.)
[Transl. by Dr. J. Pelletan of second part of the Report noted Vol. V. (1885) p. 746.]
Journ. de Microgr., IX. (1885) pp. 405-410, 482-7.
Cf. also pp. 323-4.

Cement for fixing Wood to Glass.
[Gelatin dissolved in hot acetic acid in such proportions that it solidifies on cooling.]
Journ. of Micr., V. (1885) p. 67, from *Chem. Rev.* and *Echo Forestier.*

Cements, Strong. [*Post.*] *Micr. Bulletin (Queen's)*, II. (1885) p. 45.

Cleaning Glass Slides and Covers.

[First wash well in a solution of soda or potash; if this does not suffice, use the following:—Bichromate of potash, 2 oz.; sulphuric acid, 3 fluid oz.; water, 25 oz.; and afterwards thoroughly rinse in warm and cold water.]

The Microscope, V. (1885) p. 215.

COLE, A. C.—**Studies in Microscopical Science.** Nos. 11 and 12, pp. 41–4, 45–8.

Sec. 1. (Botanical Histology.) Structure of the Sexual Organs of Reproduction in Angiosperms. No. 1. Anther of *Lilium*. Plate XI. Trans. Sect. No. 2. Ovary of *Lilium*. Plate XII. Trans. Sect. of Mature Ovary.

Sec. 2. (Animal Histology.) On the disposition of the Organs in the Invertebrata and Vertebrata. Plate XI. Earthworm (*Lumbricus terrestris*). Trans. Sect. posterior half of body. Semi-diagrammatic. Plate XII. Young Lamprey (*Petromyzon fluviatilis*). Trans. Sect. through anterior abdominal region × 30.

Sec. 3. (Pathological Histology.) Pleurisy (*concld.*). Pulmonary Carcinoma. Plate XI. Lung. Carcinoma × 38. Anthracosis (Collier's Phthisis). Plate XII. A. of Coal Miner's Lung × 6½.

Sec. 4. (Popular Studies.) Insectivorous and Carnivorous Plants (*concld.*). *Trichina spiralis*. Plate XI. Long. and Trans. Sect. × 250. The Diatom *Cestodiscus superbus*. Plate XII. × 690.

Collins' (C., jun.) "Special" Micro-Slides.

[Fish scales and skins. Heads of Insects. Parasites. The Silkworm and Moth. Anatomy of Blow-fly, Honey Bee, Great Water Beetle, and Oil Beetle. Palates in fluid and for Polariscope.]

Sci.-Gossip, 1885, p. 259.

COULTER, J. M.—**Laboratory Appliances.**

[Microscopes, microtomes, forceps, reagents, &c.]

Bot. Gazette, X. (1885) pp. 409–13.

„ „ **Cultivation of Pollen-spores.** [*Post.*] *Ibid.* 427.

CROOKSHANK, E. M.—**An Introduction to Practical Bacteriology based upon the Methods of Koch.** [*Supra*, p. 121.]

xxii. and 249 pp., 30 pls. and 42 figs. (8vo, London, 1886).

DEBES, E.—**Die Herstellung von Diatomaceen-Dauer-präparaten.** (Making permanent preparations of Diatoms.)

[Supplementary notice to his original paper on Hamilton L. Smith's Media, Vol. V. (1885) p. 1097.]

Hedwigia, XXIV. (1885) pp. 251–2.

DIMMOCK, G.—**[Separating the Layers of the Wings of Insects.]** [*Post.*]

Psyche, 1884, p. 170.

DOCTOR MEDICINÆ.—See Wood Sections.

DRAPER, E. T.—**Graphic Microscopy.** XXIV. Eggs of Parasite of Vulture.

Sci.-Gossip, 1885, p. 265 (1 pl.).

DUTILLEUL, G.—**Le Carmin Picroboraté.** (Picroborate of Carmine.) [*Supra*, p. 170.]

Bull. Sci. Dép. Nord, XVI. (1885) pp. 371–2.

ENAL.—**Microscopical Examination of Yeast.**

[Directions for examining staining, &c. Recipe for Pasteur's fluid.]

Engl. Mech., XLII. (1885) p. 325.

„ **Dry Mounting.** Zinc Cements. [*Post.*] *Ibid.*, p. 340.

ERDÖS, J.—**Eine Vorrichtung am Thoma'schen Mikrotom zum Schnellschneiden.** (A contrivance for rapid cutting with the Thoma microtome.) [*Post.*]

Internat. Monatsschr. f. Anat. u. Histol., II. (1885) pp. 343–6 (figs.).

Flemming's Method of preparing the Retractile Tentacles of Pulmonata.

Amer. Natural., XIX. (1885) pp. 1246–7, from *Arch. f. Mikr. Anat.*, V. (1870) p. 440, and *Zeitschr. f. Wiss. Zool.*, XXII. (1872) p. 366.

Frenzel's (J.) Chrome Mucilage as a Fixative. [*Supra*, p. 169.]

Amer. Natural., XIX. (1885) p. 1246, from *Arch. f. Mikr. Anat.*, XXV. (1885) p. 52.

„ „ **Method of preparing the Alimentary Canal of Crustacea.** [*Supra*, p. 158.]

Amer. Natural., XIX. (1885) p. 1246, from *Arch. f. Mikr. Anat.*, XXV. (1885) pp. 141–143.

GARBINI, A.—**Di un nuovo metodo per doppia Colorazione.** (On a new method of double staining.) [*Post.*] *Zool. Anzeig.*, IX. (1886) pp. 26–9.

GERLACH, L.—**Technische Notiz.** (Note on Technique.) [*Supra*, p. 170.] *Beitr. zur Morphol. u. Morphog.*, I. (1883) pp. 118–120.

Gierke, H.—**Staining Tissues in Microscopy. V., VI.**
[Transl. from 'Zeitschr. f. Wiss. Mikr.']
Amer. Mon. Micr. Journ., VI. (1885) pp. 210–6, 234–6.

Gottsche and Grenacher's methods of isolating the dioptric layers of the Compound Eye.
[Gottsche, from 'Müll. Arch.' 1852, pp. 488–9. Grenacher, from 'Das Sehorgan d. Thiere' (?) p. 148.] *Amer. Natural.*, XX. (1886) pp. 91–2.

Grenacher's Methods of preparing the Arthropod Eye.
[Hardening Fluids (alcohol 70–90 per cent.) Bleaching (nitric acid 20–25 per cent., or glycerin, alcohol, and hydrochloric acid.] [*Post.*]
Amer. Natural., XX. (1886) pp. 89–90.

HAZLEWOOD, F. T.—**Permanent Mounting of Tracheæ of Insects.**
[*Supra*, p. 157.] *The Microscope*, V. (1885) p. 235.

HENNING, P.—**Preserving Plants.**
[For the last three years, certain fruits, flowers, and other portions of plants have been preserved in perfect condition at the Berlin University (Botanical Museum), by means of a solution consisting of four parts of water and one part of alcohol saturated with salicylic acid.]
Bull. Torrey Bot. Club, XII. (1885) p. 121.

HICKSON, S. J.—**The Eye of Insects.**
[Summary of some of the methods in his paper, Vol. V. (1885) p. 633.]
Amer. Natural., XX. (1886) pp. 88–9.

[HITCHCOCK, R.]—**Smith's new Mounting Media.**
[The stannous chloride is not the bichloride of pharmacists, but the protochloride of tin—the 'salts of tin' of dyers. Wax rings should be used.]
Amer. Mon. Micr. Journ., VI. (1885) p. 217.

JAMES, F. L.—**White Zinc Cement.**
[*Ante*, Vol. V. (1885) p. 1101.]
St. Louis National Druggist, VII. (1885) p. 181,
Amer. Natural., XIX. (1885) pp. 1138–9.
See also p. 196 as to the difference between benzin and benzol.

" " **Limpid Solution of Damar.**
[Methods of securing a limpid solution with much less trouble than that of Mr. C. F. Booth, *supra*.]
St. Louis National Druggist, VII. (1885) p. 245.

" " **Cleaning Slides.** [*Post.*]
The Microscope, V. (1885) pp. 253–4, from *St. Louis National Druggist.*

" " **Separation of Sand from Diatoms and Foraminifera.** Cleaning Diatoms. *Micr. Bulletin* (*Queen's*), II. (1885) pp. 43 and 45, from *St. Louis National Druggist.*

" " See Stowell, C. H. and L. A.

James's (Dr. F. L.) Cements. *St. Louis National Druggist*, VII. (1885), p. 307.

JENKINS, A. E.—**Methods of Study.**
[Fixing and hardening: Picro-sulphuric acid (Kleinenberg's fluid); corrosive sublimate; perchloride of iron. Hardening: Special methods: Dissociating or macerating fluids; Müller's fluid; Eau de Javelle; nitric and hydrochloric acid; chalk and baryta waters; potassium hydrate. Decalcifying: Chromo-nitric acid; picro-nitric acid. Removing silica. Iodine. Hot water. Acid alcohol. General remarks on killing fluids.]
The Microscope, V. (1885) p. 243–50.

KELLICOTT, D. S.—**[Modified Pipette.]**
["The glass tube passes completely through the ball, the end of the tube being closed with a cork or hermetically sealed; holes for suction being drilled through that portion of the tube enclosed within the ball. The advantages of this contrivance lie in the increased firmness in handling the pipette, and consequently greater suction-power."]
Science, VI. (1885). Not paged, 2nd page after p. 524.

KLÉMENT and RENARD.—**Réactions Microchimiques basées sur la formation de cristaux et leur application à l'analyse qualitative.** (Micro-chemical reactions based on the formation of crystals and their application to qualitative analysis.)

[Résumé of paper to appear in the 'Annales.']

Bull. Soc. Belg. Micr., XII. (1885) pp. 11–16, 32–5.

KRAUSE, W.—**Untersuchungsmethoden.** (Investigation methods.)

[For preserving and isolating the retinal elements, a 10 per cent. aqueous solution of chloral hydrate is recommended. It is superior in many respects to osmic acid.]

Internat. Monatsschr. f. Anat. u. Histol., I. (1884) pp. 152–7.

KÜKENTHAL, W.—**Vereinfachung der Färbetechnik.** (Simplification of Staining Technique.) [*Post.*] *Zool. Anzeig.*, ix (1886) pp. 23–5.

LACROIX, A.—**Examen optique de quelques minéraux peu connus.** (Optical examination of some little known minerals.)

["The study by the Microscope with parallel and convergent light, of thin plates of minerals, gives at the present day to their determination a degree of certainty which was wanting when it was not possible to verify the purity of the substances submitted to analysis,"—followed by descriptions of Kirwanite and four other minerals.]

Comptes Rendus, CI. (1885) pp. 1164–6.

LATHAM, V. A.—**The Microscope and how to use it.**

[V. Double-staining, &c.]

Journ. of Micr., V. (1886) pp. 36–43.

LEBOUCQ, H.—**Un mot sur la Technique des coupés en series.** (A word on the technique of series sections.) [*Supra*, p. 169.]

Ann. Soc. Méd. Gand, 1884, pp. 167–8.

LÉPINAY, MACÉ DE.—**Méthode optique pour la mesure absolue des petites longueurs.** (Optical method for the absolute measurement of minute lengths.)

Comptes Rendus, C. (1885) pp. 1377–9.

LONG.—**Test for Beeswax.**

[A few drops of solution in chloroform shows in half an hour characteristic dumbbell crystals, the balls of which consist of curved crystal bundles instead of solid masses.]

St. Louis National Druggist, VII. (1885) p. 293, from *Chem. Ztg.*

LOWNE, B. T.—**Method of Examining the Reflex in the Compound Eye of Insects.** [*Post.*]

Amer. Natural., XX. (1866) pp. 90–1, from *Trans. Linn. Soc. Lond.*

MALASSEZ, L.—**Microtome de Roy perfectionné.** (Improved Roy Microtome.) [*Supra*, p. 166.]

Travaux Laborat. d'Histol. du Collège de France, 1884 (1885) pp. 191–206 (3 figs.)

MALASSEZ, L., and W. VIGNAL.—**Sur le Micro-organisme de la Tuberculose Zooglœique.** (On the Micro-organism of Zooglœic Tuberculosis.)

[Methods, *post.*]

Ibid., pp. 18–42 (2 pls.)

MEYER, A.—**Mikrochemische Reaction zur Nachweis der reducirenden Zuckerarten.** (Microchemical Reaction for demonstrating the reducing kinds of sugar.) [*Post.*] *Ber. Deutsch. Bot. Gesell.*, III. (1885) p. 332.

MOELLER, J.—**Mikroskopie der Nahrungs- und Genussmittel aus dem Pflanzenreiche.** (Microscopy of the nourishing and useful substances of the vegetable kingdom.)

[Introduction, pp. 1–24 (Preparation, Reagents, Measuring, Drawing.)]

vi. and 394 pp., 308 figs. (8vo, Berlin, 1886).

Mounting Microscopic Objects.

[Staining Wood Sections. (Carmine or logwood, but better double stained. To fix the anilin stain, tannic acid is useful.) Orange Peel. (Gum method is preferable. After drying between glass slips, soak in turpentine and mount in balsam.) Sponge. (Cut between pieces of cork, or immerse in paraffin or mucilage.)]

The Microscope. V. (1885) pp. 238–9.

Mucilage for Slide Labels.

[As used for postage stamps. Dissolve 2 oz. dextrine in 1 oz. acetic acid diluted with 5 oz. water; when dissolved add 1 oz. alcohol.]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

Müller, K.—**Diatoms and how to collect them.** [*Supra*, p. 153.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 230–1 (*Transl.* of private letter).

Mylius, C.—See Sydow, P.

P., J. W.—**Glass-covers in the Tropics.**

[Cover-glasses should not be brought into the Tropics bedded in lime or chalk. They should be glued together by a little clove oil run in between the plates by capillary attraction.]

Sci. Gossip, 1885, p. 279.

Pearcey, F. G.—**Method of Consolidating and Preparing thin sections of friable and decomposed Rocks, Sands, Clays, Oozes, and other granulated substances.** [*Supra*, p. 160.] *Proc. R. Phys. Soc. Edin.*, VIII. (1885) pp. 295–300 (1 pl.).

Pennington, A. S.—**British Zoophytes: an introduction to the Hydroida, Actinozoa, and Polyzoa, found in Great Britain, Ireland, and the Channel Islands.**

[Zoophyte collecting and preserving, pp. 336–40.]

xvi. and 363 pp., 24 pls. (8vo, London, 1885).

Piffard, B.—**Staining with Iodine Vapour.** [*Supra*, p. 170.]

Sci.-Gossip, 1886, p. 17.

Reeves, J. E.—**Staining Urinary Sediment.**

Micr. Bulletin (*Queen's*), II. (1885) p. 48.

Renard.—See Klément.

Riggs, J. V.—**Resorcin and Antipyrine.**

["Crystallized from their alcoholic solutions upon the slide make most magnificent specimens of crystals for polarized light."]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

Sargent, F. L.—**A Spring Clip.**

[Made of a rather large hairpin with ends bent with pliers.]

Bot. Gazette, X. (1885) p. 425 (1 fig.).

Serrano y Fatigati, E.—**Precipitacion de cristales en el campo del Microscopio.** (Precipitation of crystals in the field of the Microscope.)

[*Post.* Cf. also "Fatigati, E. G.—Recherches sur les réactions chimiques dans le champ du Microscope." Title only of paper read at Stockholm Academy of Sciences, Nov. 11th. *Nature*, XXXIII. (1885) p. 216.]

Anal. Soc. Espan. Hist. Nat., XIV. (1885), *Actas*, pp. 58–60.

Slack, H. J.—**Pleasant Hours with the Microscope.**

[Sclerogen cells of pear.] *Knowledge*, IX. (1885) p. 48 (3 figs.).

Smith, H. L.—**Directions for using the Stannous Chloride medium in mounting Diatomaceæ.**

[Similar to that given Vol. V. (1885) pp. 1097–8.]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

Staining, double. *The Microscope*, V. (1885) p. 214–5.

Stein, S. v.—**Einfache Vorrichtung für das Microtom zur Einbettung der Präparate.** (Simple arrangement for the Microtome in imbedding preparations.)

[*Supra*, p. 163.] *Centralbl. f. d. Med. Wiss.*, 1884, p. 100.

Stowell, C. H. and L. R.—**White Zinc Cement.**

[Extract from letter of Dr. F. L. James, as to the necessity for all the ingredients being of the best quality.]

The Microscope, V. (1885) pp. 230–1.

Striæ of Diatoms on the Möller Probe-Platte. [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) p. 234.

Sydow, P., and C. Mylius.—**Verzeichniss der bekannteren Reagentien und Stoffe, die bei mikroskopischen Pflanzenuntersuchungen gebraucht werden. Mit kurzen Notizen über Bereitung, Anwendung, Wirkung, &c.** (List of the more ordinary reagents and substances used in microscopical researches on plants, with short notes on their preparation, use, action, &c.)

Botaniker-Kalender, 8vo, Berlin, 1886, pp. 79–89.

TAYLOR, T.—**Butter and Fats.** [*Post.*]
The Microscope, V. (1885) pp. 212–4 (8 figs.).

Threlfall's Method of Fixing arranged Diatoms and Sections.
[Cf. Vol. III. (1883) p. 600, and Vol. IV. (1884) p. 308.]
Amer. Mon. Micr. Journ., VI. (1885) p. 233.

TRELEASE, W.—**A convenient Laboratory Plant.**
[A *Mucor* of the Rhizopus section, which springs up spontaneously and can be kept growing almost indefinitely on bread.]
Bot. Gazette, X. (1885) pp. 426–7 (1 fig).

TSCHIRCH, A.—**Ueber eine Methode den grünen Farbstoff der Blätter aus . . . Rohlaugen zu entfernen.** (On a method of removing the green colouring matter from leaves.)
[*Post.*] *Bot. Centralbl.*, XXIV. (1885) pp. 314–5.

" " **Chlorophyll-präparate.** (Preparations of chlorophyll.)
[The ordinary preparations are more or less yellow-green, not emerald-green. Schütz of Vienna supplies a pure emerald-green preparation after a method of the author.]
Bot. Centralbl., XXIV. (1885) p. 315.

VIGNAL, W.—See Malassez, L.

WALL, O. A.—**The Microscopical Examination of Drugs.**
[A large number may be satisfactorily examined with a Coddington lens magnifying 10 or 12 times. Pharmacopœial requirements. Objects to be examined by low power. Value of characteristic marks. Sections by reflected light. Chemical treatment of simple sections. Objects to be examined. Importance of studying sections. Preparing drugs for examination "without making regular mounted sections."]
St. Louis Nation. Druggist, VII. (1885) pp. 257 and 269, 293 and 307.

" " **Proper Thinness of Sections.**
[Criticism of an article by Dr. E. C. Mann in 'Medical Bulletin,' that the "best test of a fine section is the ease with which it floats in a glass of water!"]
Ibid., p. 320.

WARDEN, C. J. H.—**The Biological examination of Water.**
[On examining potable water for micro-organisms. 1. Description of bacteriological apparatus. 2. Preparation of reagents. 3. Collection of samples. 4. Analytical process. 5. Inferences to be drawn from the results.]
Chem. News, LII. (1885) pp. 52–4 (9 figs.), 66–8 (3 figs.), 73–6 (2 figs.), 89, 101–4.

WEIGERT.—**Nowy Mikrotom do duzych skrawków.** (New microtome for large sections.)
Hirsch's Jahresbericht Anat. u. Physiol. (for 1884) 1885, p. 38, from *Gazeta Lekarska*, 1884, No. 51.

WHITE, T. C.—**Aids in Photo-micrography.**
[Bleaching brown chitin of insects—Braxton Hicks' bleach. Keeping Infusoria quiet—Sternberg's fluid, Vol. V. (1885) p. 912.]
Year-book of Photography, 1886, pp. 103–4.

WHITMAN, C. O.—**(1) Imbedding in Paraffin. (2) Orientation with small objects. (3) Prevention of Bubbles.**
[(1) Clarifying media. Lee, *supra*, p. 163. Holl, cf. Vol. V. (1885) p. 541. Imbedding box, *supra*, p. 165. (2) *Supra*, p. 165. (3) *Supra*, p. 166.]
Amer. Natural., XIX. (1885) pp. 1247–9 (1 fig.).

Wood Sections.
[Directions for cutting by B.Sc., J. S. Bigg, S. Bottone, and Doctor Medicinæ, and drawing of Microtome.]
Engl. Mech., XLII. (1886) pp. 391 and 411 (1 fig.).

Zeiss's New Catalogue. *Amer. Mon. Micr. Journ.*, VI. (1885) p. 218.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Fol's Travelling and Dissecting Microscope.—Prof. H. Fol's Travelling Microscope is shown in fig. 45.

As will be seen, the upper portion is similar to the large Microscope of the Geneva Society (cf. Vol. IV. 1884, p. 281), while the folding base is made on the ingenious plan of the Travelling Microscope of the same manufacturers (cf. tom. cit., p. 437).

The new points (in addition to the special stability and size of the stage, unusual in "Travelling" Microscopes) are: (1) the stage and

Fig. 45.

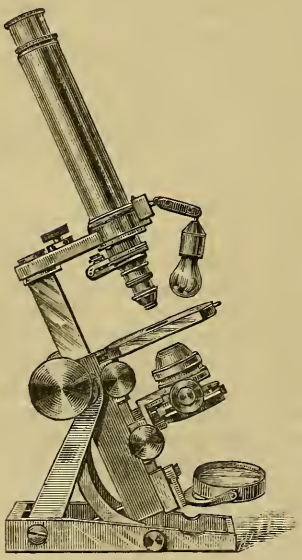
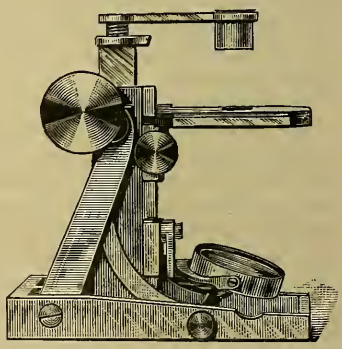


Fig. 46.



substage, both of which are movable on a single rack, and (2) the incandescent electric lamp of four candle power attached to the front of the cross arm, and worked by a bichromate battery of four elements. The lamp can also be attached beneath the stage when desired.

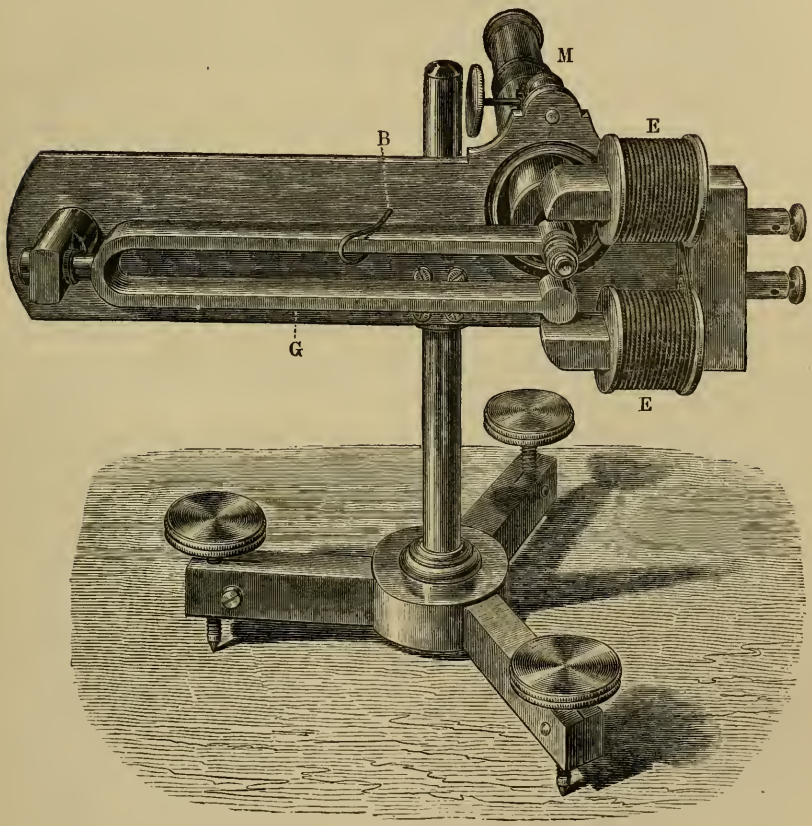
Another point is (3) that the instrument can be converted

* This subdivision is arranged in the following order:—(1) Stands; (2) Eyepieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

into a Dissecting Microscope, as shown in fig. 46. It is for this use of the instrument that the stage is made to move up and down by rack and pinion, so as to form a fine adjustment.*

Helmholtz's Vibration Microscope.†—Professor H. L. F. Helmholtz's instrument (fig. 47) is thus described by him.

Fig. 47.



"No complete mechanical theory can yet be given for the motion of strings excited by the violin bow, because the mode in which the bow affects the motion of the string is unknown. But by applying a

* The Microscope is briefly described in Arch. Sci. Phys. et Nat., xiv. (1885) p. 575, but the above figs. are taken from photographs kindly sent us by Prof. Fol.

† Helmholtz, H. L. F., 'On the Sensations of Tone as a Physiological Basis for the Theory of Music,' 2nd Eng. ed. by A. J. Ellis, London, 1885, pp. 80–2 (2 figs.). 'Die Lehre von den Tonempfindungen,' 4te Ausg., Braunschweig, 1877, pp. 137–41 (2 figs.).

peculiar method of observation, proposed in its essential features by the French physicist Lissajous, I have found it possible to observe the vibrational form of individual points in a violin string, and from this observed form, which is comparatively very simple, to calculate the whole motion of the string, and the intensity of the upper partial ones.

Look through a hand magnifying glass consisting of a strong convex lens, at any small bright object, as a grain of starch reflecting a flame, and appearing as a fine point of light. Move the lens about while the point of light remains at rest, and the point itself will appear to move. In the apparatus I have employed, which is shown in fig. 47, this lens is fastened to the end of one prong of the tuning-fork G. It is in fact a combination of two achromatic lenses, like those used for the object-glasses of Microscopes. These two lenses may be used alone as a doublet, or be combined with others. When more magnifying power is required, we can introduce behind the metal plate which carries the fork, the tube and eye-piece of a Microscope M of which the doublet then forms the object-glass. This instrument may be called a Vibration Microscope.

The end of the other prong of the fork is thickened to counterbalance the weight of the doublet. The iron loop B, which is clamped on to one prong, serves to alter the pitch of the fork slightly; we flatten the pitch by moving the loop towards the end of the prong. E is an electro-magnet by which the fork is kept in constant uniform vibration on passing intermittent electrical currents through its wire coils.

When the instrument is so arranged that a fixed luminous point may be clearly seen through it, and the fork is set in vibration, the doublet moves periodically up and down in pendular vibrations. The observer, however, appears to see the luminous point itself vibrate, and, since the separate vibrations succeed each other so rapidly that the impression on the eye cannot die away during the time of a whole vibration, the path of the luminous point appears as a fixed straight line, increasing in length with the excursions of the fork.

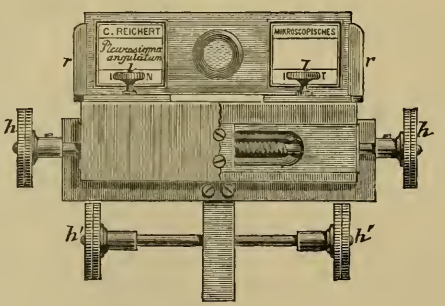
The grain of starch which reflects the light to be seen, is then fastened to the resonant body whose vibrations we intend to observe, in such a way that the grain moves backwards and forwards horizontally, while the doublet moves up and down vertically. When both motions take place at once, the observer sees the real horizontal motion of the luminous point combined with its apparent vertical motion, and the combination results in an apparent curvilinear motion. The field of vision in the Microscope then shows an apparently steady and unchangeable bright curve, when either the periodic times of the vibrations of the grain of starch and of the tuning-fork are exactly equal, or one is exactly two or three or four times as great as the other, because in this case the luminous point passes over exactly the same path every one or every two, three, or four vibrations. If these ratios of the vibrational numbers are not exactly perfect, the curves alter slowly, and the effect to the eye is as if they were drawn on the surface of a transparent cylinder which slowly revolved on its axis. This slow displacement of the apparent curves is not disadvantageous, as it allows the observer to see them in different positions. But if

the ratio of the pitch numbers of the observed body and of the fork differs too much from one expressible by small whole numbers, the motion of the curve is too rapid for the eye to follow it, and all becomes confusion.

If the Vibration Microscope has to be used for observing the motion of a violin string, the luminous point must be attached to that string. This is done by first marking the required spot on the string with ink, and, when it is dry, rubbing it over with wax, and powdering this with starch so that two or three grains remain sticking. The violin is then fixed with its strings in a vertical direction opposite the Microscope, so that the luminous reflection from one of the grains of starch can be clearly seen. The bow is drawn across the strings in a direction parallel to the prongs of the fork. Every point in the string then moves horizontally, and on setting the fork in motion at the same time the observer sees the peculiar vibrational curves already mentioned."

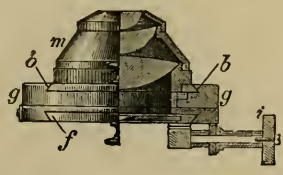
Reichert's Stand with New Stage and Iris Diaphragm.—Herr C. Reichert has adapted to this stand (fig. 50) an arrangement for moving the object in two directions, which, like that of Mr. J. Mayall jun., does not necessitate any addition to the thickness of the stage so as to interfere with the illumination.

Fig. 48.



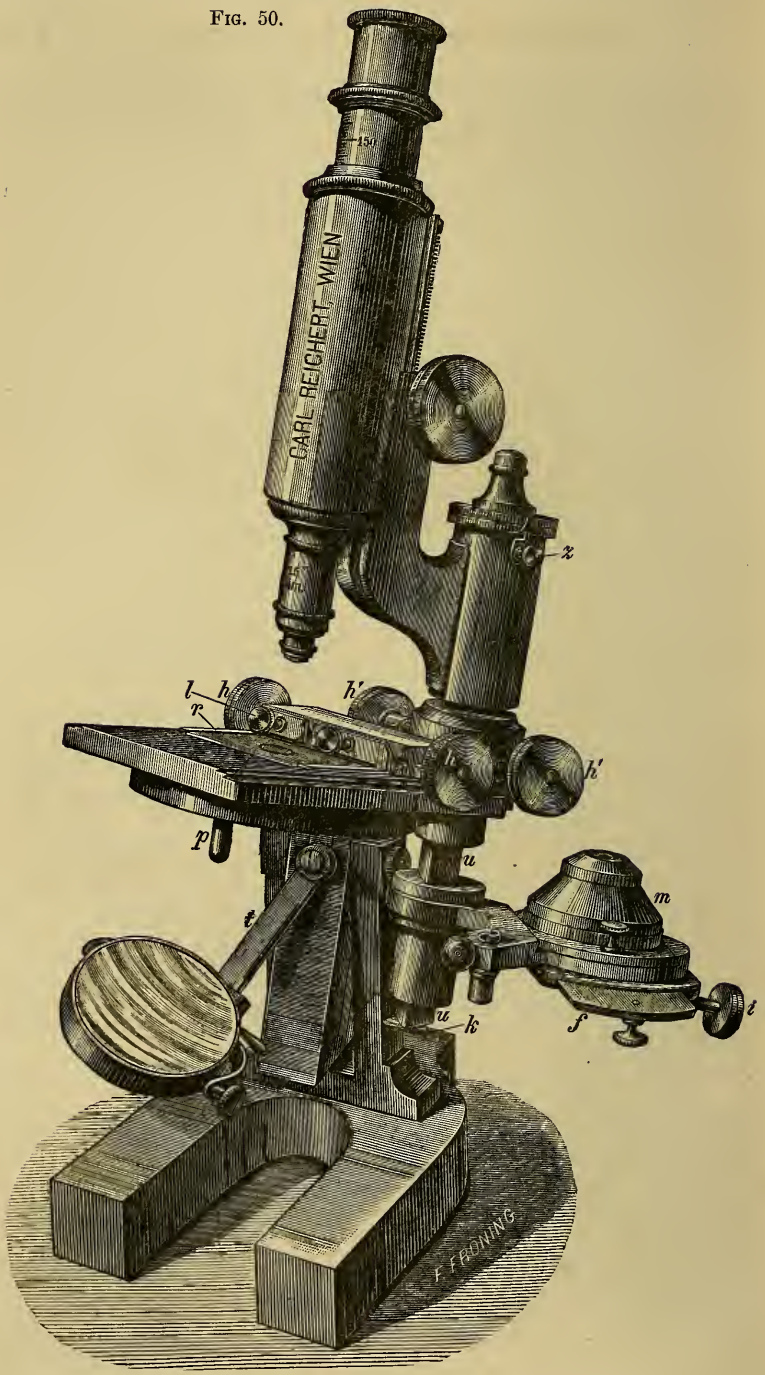
The arrangment is shown in fig. 50 *in situ*, and also separately at fig. 48. The glass slip is held between two clips *r r*. These clips are attached to a nickel-plated frame which slides on the upper surface of the stage, and is secured in place by grooves at the side. A projecting tail-piece with a rack on the under side passes through the limb of the Microscope, and the frame is moved from back to front by a pinion in the limb, which is actuated by the milled heads *h' h'*. The motion of the slide from side to side is effected by the milled heads *h h*, which by means of a screw move the piece to which the clips are attached. The clips consist of two metal plates, with a piece of indiarubber between, slightly projecting laterally, so that the metal is not in contact with the slide. By loosening the screws *l l* the clips can be brought closer together, so as to grasp the slide tightly, which is thus moved on the surface of the stage without any intermediate support.

Fig. 49.



The Abbe condenser is shown in figs. 49 and 50. It is movable by

Fig. 50.



Reichert's Stand with New Stage and Iris Diaphragm.

rack and pinion on the bar *u*. The diaphragm slide *f* can be rotated on the ring *g*, and also moved excentrically by the milled head *i*. The lenses *m* are attached to a slide *b*. A rotating stop at *k* prevents the condenser from being racked off the bar *u* unless desired. A pin *p* serves as a guide for the condenser on the other side of the stage.

A novelty in a Continental Microscope is the iris-diaphragm N (figs. 51 and 52), the first we have seen. It is made on G. Wale's

Fig. 51.

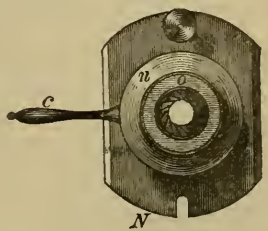


Fig. 52.

plan; the rotation of the cone *n* by *c* causes the pieces of which the iris is composed to close or open; *o* is a cap.

Thoma's Microscope for observing the Circulation of the Blood.*—This Microscope was designed by Prof. R. Thoma, to observe the circulation of the blood (and especially inflammatory disturbances of the circulation), not in frogs, but in warm-blooded animals, using for the purpose the mesentery of dogs, cats, guinea-pigs, &c. For this purpose a very large stage is of course necessary, with some kind of heating apparatus, and it is also desirable to be able to keep a stream of liquid constantly flowing over the part of the animal under observation, as previously recommended by the author (see *infra*, Thoma's frog-plate).

The instrument as now made by Herr Jung of Heidelberg, is shown in fig. 53. It consists of a stout iron stand, with a wooden top $19\frac{1}{2} \times 10$ in., which forms the base plate of the stage. The Microscope keys into the lower part of the frame by a stud pin beneath the standard, so that it can be removed as required. The mirror is attached to the front foot of the tripod of the Microscope. On the wooden base-plate is a second plate of wood of the same size as the lower one. It is unattached, and can be moved about by the hand as desired. To ease the friction, the bottom of the plate has four brass-headed nails on which it moves. To maintain an approximate equilibrium, a cord and weight are fixed to each of the front corners, the cords passing over pulleys projecting from the lower plate. The latter has a horseshoe aperture just beneath the body-tube, and the upper plate has a circular aperture, over which is fixed

* Arch. f. Pathol. Anat. u. Physiol. (Virchow), lxxiv. (1878) pp. 360–93 (1 pl.).

a "hot stage." This consists of a box $4\frac{1}{2} \times 2\frac{3}{8} \times 1$ in., through which is an aperture for illumination closed at the top and bottom by glass plates. Hot water is brought to the box by the tube on the left and passes away through the waste-pipe on the right. A third

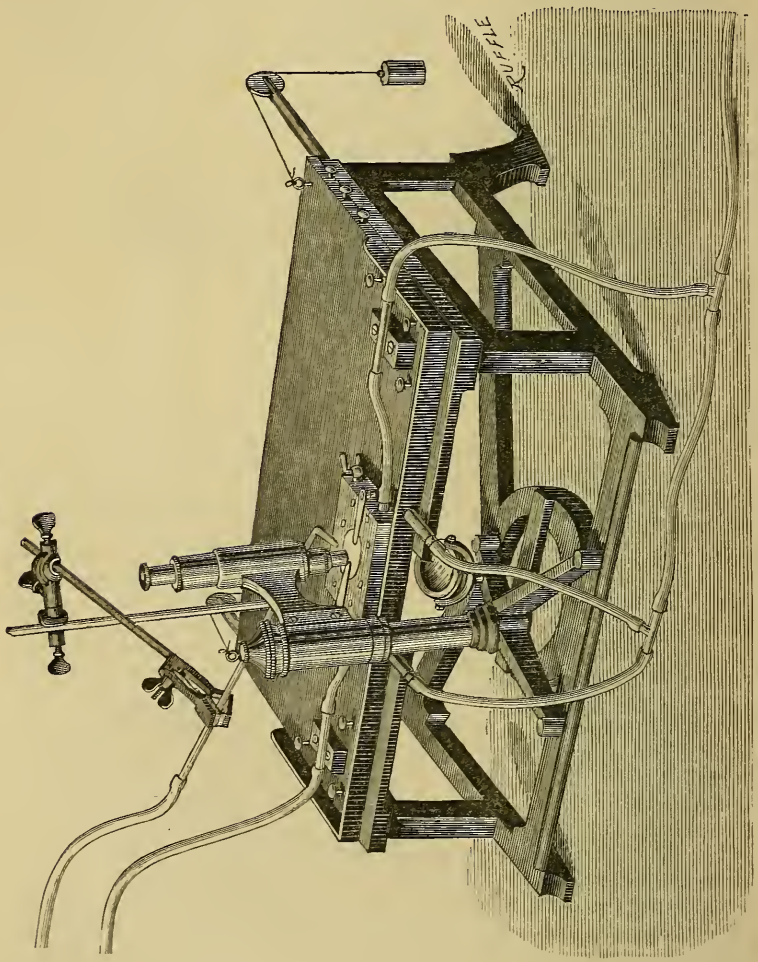


Fig. 53.

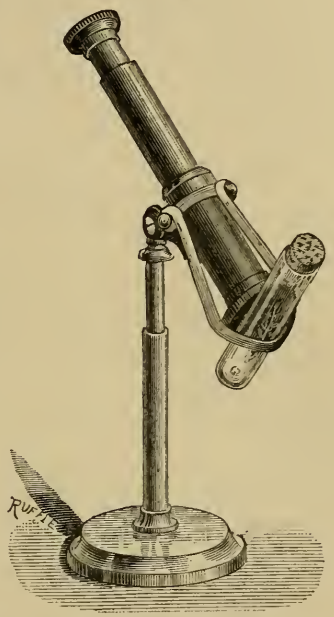
Thoma's Microscope for observing the Circulation of the Blood.

opening with a tap allows air-bubbles to be eliminated. The arrangement for irrigating the object consists of a rod and clamp for supporting a tube, through which the liquid can be directed upon the object. The stage being inclined at an angle of about 20° the liquid

flows to the side next to the Microscope, and is prevented by a raised ledge from running off, except through the two tubes on either side of the Microscope which are connected with the waste-pipe. Twelve nails in the sides and on the top of the upper plate are for the cords used in tying the animal.

The author also describes and figures the arrangement of water-bath, heating and irrigating apparatus, cork plates, &c., of which he made use, and gives directions for examining the mesentery, as well as a full description of the results of his researches.

Fig. 54.



Watson's Collectors' Pocket Microscope.—This instrument (fig. 54), made by Messrs. Watson and Sons, is a small compound Microscope with 4 in. body-tube and a 2 in. objective, mounted on an upright pillar, which screws into a round brass base-plate. There are universal motions, so that the tube may be pointed in any direction for the best illumination of the object. The body-tube slides in an outer tube or jacket for adjustment of focus, and at the object end of this is a hollow cut for a test-tube to lie across the optic axis, being held there while being examined by an elastic band. Ordinary slides (3 × 1 in.) may also be held in the same manner. The instrument, and three glass specimen tubes, pack into a flat case $5\frac{1}{2} \times 5\frac{1}{4} \times 1\frac{1}{2}$ in.

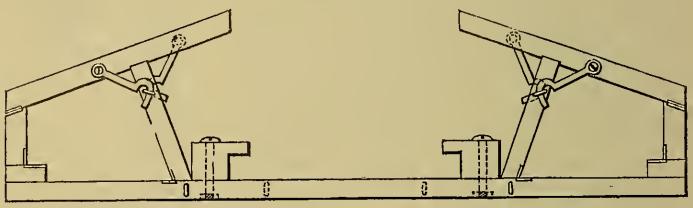
Cheap Dissecting Microscope.*—Prof. C. R. Barnes writes as follows:—"No laboratory or workers need be unsupplied with dissecting Microscopes. If even the cheapest form manufactured by the opticians is beyond the means of the school or individual, an effective stand may be made as follows:—Into any block of wood of suitable size fix upright a short piece of stiff wire or rod having a smooth surface. Bore a hole in a fine-grained cork, a little to one side of the centre, so that the cork will slide smoothly on the rod. Bend one end of the smaller wire into suitable shape to hold whatever lens is at hand, and make a hole of proper size in the cork at right angles to the first. This arrangement gives ample and smooth movements of the lens in any direction for adjustment. The plan may be elaborated to any desired extent. If the rod be fixed in a plain piece of board, dissecting may be done on a piece of glass laid flat on

* Bot. Gazette, x. (1885) pp. 427–8.

the board. Pieces of black or white paper underneath will give the backgrounds against which any object may be seen. For dissecting in liquid a deep butter-plate answers well. If it is desired to have transmitted light, the object may be dissected on the bottom of an inverted tumbler which has a *smooth* concavity. Sloping blocks may be placed at the sides for hand-rests. Still better illumination may be had by fixing two such blocks, one on each side of the upright rod, and placing between them a strip of mirror-glass inclined to an angle of 30°–40°. In fact, with a little ingenuity and mechanical skill, one may construct a stand for dissecting which will equal in efficiency any of the simple Microscopes offered for sale."

Hand-rests.*—Dr. R. H. Ward describes the hand-rests which he has been accustomed to use, and which are made of mahogany strips about 1 cm. thick, and 10 to 12 cm. wide, constructed as shown in front view in fig. 55.

Fig. 55.



The rests are attached by hinges, and are held down firmly with brass hooks, hinged strips supporting the rests at the desired height and in an inclined position. Wooden buttons, held by large screws fastened with brass nuts below, hold the base of the Microscope firmly

Fig. 56.

in position. The hinges are all so arranged that the strips can be folded together solidly, for portability, as shown in fig. 56, and held in that position by the same hooks as when open. By a slight change in size it is applicable to any dissecting Microscope. It should be made of such size that the upper ends of the rests will be nearly

* Behrens' 'Microscope in Botany' (Amer. ed. by Hervey and Ward), 8vo, Boston, 1885, pp. 108–10 (2 figs.).

continuous with, or slightly below, the stage of the Microscope. Exact approximation is not necessary. When properly adjusted, the rest is perfectly firm and steady. When portability is not required, the hinges and hooks may be dispensed with, and the wooden strips fastened together with glue and brads.

Astigmatic Eye-piece.*—Mr. E. Gundlach discusses the nature of astigmatism and its interference with the perfect use of the eye, as well as the relation of the astigmatic eye to the use of optical instruments and the injurious effects of astigmatism on microscopic observations.

As a remedy he proposes the use of an eye-piece of an asymmetric form, so as to just neutralize the asymmetry of the crystalline lens of the eye. This can best be done by making the outer surface cylindrical instead of spherical or plane. It may be made either concave or convex as the requirements of the case may demand. The eye-piece must be constructed with special regard to the purpose, so as to place the asymmetric surface in such close proximity to the eye that no perceptible secondary distortion is produced by the oblique direction of the eye towards the edge of the field, and at the same time the prismatic colours dispersed in the direction of the astigmatic distortion must be neutralized.

Mr. Gundlach intends to construct such eye-pieces, and expects to start with a 1 in. To enable the applicant, for this special purpose at least, to be his own examiner for astigmatism, he intends to furnish with the eye-piece three eye-glasses, alike in mounting but different in the degree of asymmetry, for selection; the difference being such as to practically approach both limits of common astigmatism. The one of the three lenses nearest in asymmetry to that of the eye will correct the astigmatism to an undisturbing minimum. The observer will then have to test all the lenses, beginning with the weakest, on a suitable object, slowly revolving the eye-piece until its best position is found. Mark this position, and do the same thing with the other lenses. After this, compare the action of the lenses, each in its best position, to find the one best fitted for the eye. Of course the eye-piece, or rather its asymmetric eye-lens, must then always be used in the same position to the astigmatic axis.

Dr. J. K. Stockwell considers† that while Mr. Gundlach's plan is quite feasible and very excellent in optical results, there are several serious objections that may be mentioned.

The first, and perhaps most tenable one, is the fact that while the eye-piece would perfectly suit the person for whom it was made,—one eye at least—not another one in several thousand could use it, unless it was so constructed as to admit of having the eye-lens, the asymmetric part, readily removed and replaced by a symmetrical one, and the optical results would not be commensurate with the trouble and expense involved.

Complicated combinations of spherical and cylindrical lenses,

* The Microscope, vi. (1886) pp. 1-4. † Ibid., pp. 29-32.

requiring plus and minus lenses of both kinds, ranging in focal distance from six inches in extreme to seventy or one hundred in mild cases, and skill and experience are necessary to correct astigmatism. How then can the ordinary microscopist bring order out of confusion by experimenting with three eye-glasses?

It would improve matters if the astigmatic observer were to have the formula for a lens neutralizing his asymmetry (for instance, thus:—36 cyl. axis 180°) sent to an optician, and have made a small lens, with a setting of thin brass, so constructed as to slip on the top of the eye-piece, over the eye-lens and as close to it as possible. The slight details of convenient construction readily suggest themselves to the optician.

If the microscopist uses the eye-piece of one maker, the accessory, for such it is, fits each and all of them as they are brought into use, and when not needed it may be easily removed, leaving the perfect eye-piece ready for use under the normal eye.

Many, in fact most, astigmatic persons have a different degree of defect in each eye, and therefore a better plan would be to have suitable cylindrical lenses put into *spectacle frames*, and worn only while using the Microscope. These can be placed near the eyes, the axis of each is firmly held in its proper relation to the effective medium and each eye has before it the exact correction of that eye's asymmetry. To be sure, this requires the aid of a skilled specialist, but once done, there is no further trouble or anxiety—no examination with test-lines in order to be sure that the glasses are in the best position for work.

Secondary distortion because of being a little distance from the eye-lens of the instrument is not troublesome, nor worth considering as against convenience, comfort, and the ability to instantly change eyes when working—an important desideratum.

The author also thinks that many of the disputes between microscopists as to the markings of test and other objects, notably those having lines meeting or crossing at various angles, are possibly due to the fact that they are not seen through optically similar eyes, one being practically free from astigmatism and the other having it developed to a much greater degree, thus making it utterly impossible for the observers to see alike.

Malassez's Camera Lucida.*—M. L. Malassez discusses cameræ lucidæ in general, and describes a modification which he has designed to avoid the inconveniences attendant upon the existing forms, and particularly the necessity of placing the Microscope vertical and drawing on an inclined plane in order to insure the correspondence of drawing and object. It is much preferable to be able to have the Microscope in an inclined position and the paper horizontal.

If a Doyère and Milne-Edwards or Nachet camera is placed on a Microscope inclined 15°–18°, so that the image is thrown behind the Microscope, it will be found that it is partly projected on the base.

* Laborat. d'Histol. du Collège de France. Travaux de 1884 (1885) pp. 166–79 (1 fig.).

This can be remedied by inclining the Microscope to an angle of 40°–45° and altering the position of the camera prisms as shown in

Fig. 57.

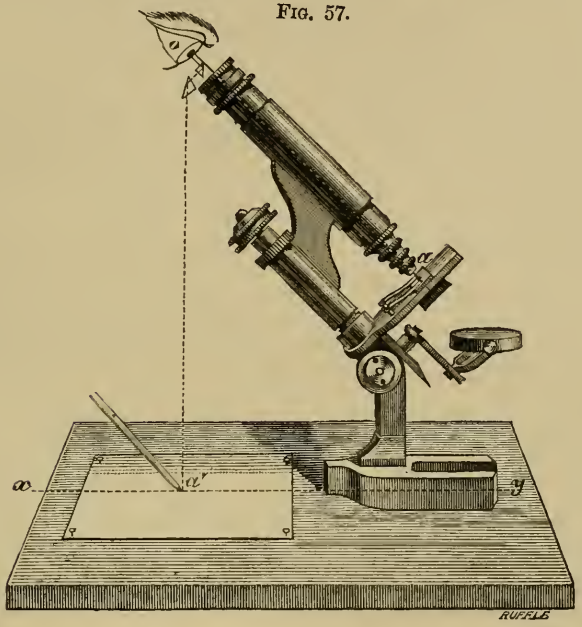


fig. 57. A drawing thus made will be undistorted if its axis (a' o) is exactly perpendicular to the surface of the table. For this, however, it is necessary that the axis should fall on the line x y, and that it should make with the axis of the Microscope an angle (a o a') equal to the angle of inclination of the Micro scope.

Fig. 58.

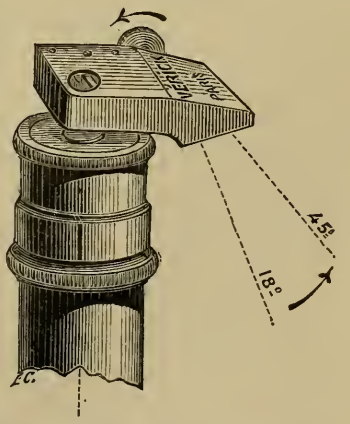


Fig. 58 shows M. Malassez's modification of a Doyère and Milne-Edwards camera to meet these conditions. One of the prisms can be rotated by a milled head and adjusted for the 45° position, or where the objects must be kept horizontal and the Microscope therefore vertical it can be set for an angle of 18°. The modification can be applied to other cameræ, but where the reflecting surfaces are not movable the original construction must be altered.

The author considers that Dr. Schröder's camera is objectionable,

on account of the rays from the Microscope having to undergo a double total reflection, whilst the necessity of drawing with the head in the same position as when using a vertical Microscope sacrifices one of the great advantages of an inclined Microscope. This would be remedied by reversing the prisms, so that the unreflected rays are those which come from the Microscope and not from the paper, the reflected rays being received from the paper.

Relative merits of Filar and Ordinary Glass Eye-piece Micrometers.*—Dr. M. D. Ewell has undertaken a series of comparisons to test Mr. H. L. Tolman's conclusion † that the cobweb micrometer does not offer sufficient advantage in point of accuracy to compensate for its additional cumbersomeness and expensiveness.

Dr. Ewell comes to the conclusion that for the comparison of lengths nearly equal and for the measurement of minute distances with low powers, the glass eye-piece micrometer is vastly inferior to the filar micrometer; and that in cases where the greatest attainable accuracy is required, as for example in the measurement of blood-corpuscles in criminal cases, nothing but the filar micrometer should be used.

The New Objectives.—For some months past it has been known that we were on the eve of an important advance in objectives, depending mainly on the elimination of the secondary spectrum, leaving only a small tertiary spectrum. We alluded to the subject at the Anniversary Meeting, by way of supplement to the remarks of the President on the great value which he had found an increase of aperture to be in his researches on very minute organisms with high powers, and we expressed the belief that the new objectives would be found to be of at least equal advantage.

Two objectives have now been received in this country, and their examination has fully borne out the expectation formed of them, and has shown that however trifling the improvement might at first sight be thought to be on theoretical grounds,‡ it is very distinctly appreciable, so that the high power work of the future will almost necessarily be done with these glasses.

The objectives in question are both 1/8 in. The special point in their construction is that they are made of new kinds of optical glass, which Prof. Abbe and Dr. Schott have been working for the last five years to perfect. The objectives are composed of ten single lenses, combined to five separate lenses, with a single front lens. Their working distance is 0·25 mm., and in order to secure this the aperture is limited to 1·40 N.A. With the length of tube

* The Microscope, vi. (1886) pp. 32–40. † See this Journal, v. (1885) p. 704.

‡ Prof. Abbe writes us on this point, "We have now made what I called in 1878 'the Microscope of the future,' i. e. objectives which admit of a more perfect concentration of all the rays from the object. If now (as I am nearly sure they will) microscopists should feel somewhat disappointed at being told that 'the Microscope of the future' is nothing more and nothing better in principle than these objectives, I must answer 'It is not *my* fault that at this time microscopical optics is such an ungrateful domain of human work, that many years' hard labour have no other result than a slight advance.'"

engraved on the setting (taken from the nose-piece to the eye-lens), the objectives have their best correction for a cover-glass of 0·16–0·18 mm. Much thinner covers require a lengthening of the tube by 10–25 mm. further. They are very sensitive in regard to length of tube, and the change in this length is the simplest, and in fact the best, means for slight corrections for different covers—the reason being that a change of that kind does not alter the proper balance of the various corrections (spherical, chromatic and sphero-chromatic), whilst an alteration in the distance of the lenses of the objective from one another, as is done by a screw-collar, does disturb that balance to the injury of the performance of the objective. It may be possible to find a formula which will be less sensitive in regard to this question of correction, but until it is found, Dr. Zeiss, by whom the objectives are made, will not supply any with correction-collars, so as to convert a good objective into a medium one for the sake of a non-essential convenience only.

A novel point in connection with the objective is that its performance is improved by the use of special eye-pieces, of which two are supplied, of 25 mm. and 15 mm. focal length. Their function is to compensate for certain aberrations *outside* the axis, which cannot be compensated for in the objective. With these eye-pieces, particularly with that of 25 mm. focal length, the field of view is surprisingly uniform.

Of the ten lenses of which the objective is composed, two only are of siliceous glass, the other eight being made of borates and phosphates. The crown and flint glass now used by opticians does not contain (as essential components) more than six chemical elements, O, Ca, K, Na, Pb and Si, whilst the new objective contains not less than fourteen elements.

The optical principle on which the objectives have been constructed is indicated in a paper by Prof. Abbe in this Journal,* "On new methods for improving spherical correction," &c. In fact, all the work of Prof. Abbe and Dr. Schott during the five years has been solely directed to finding the proper means for the realization of the desideratum there mentioned, viz. doing away with the secondary chromatic aberration, and with the chromatic difference of spherical aberration. The proper means was found in special kinds of glass, which allowed of *proportional* dispersions in different parts of the spectrum, and which at the same time exhibit different relations between the refractive indices and dispersive powers. By these means a more perfect concentration of all the rays emanating from the object is obtained. With the old kinds of crown and flint glass *two* different colours only could be collected to one focus, a secondary spectrum remaining uncorrected, whilst the new objectives collect *three* rays of different colours to one focus, leaving a small tertiary spectrum only. Moreover, spherical correction has hitherto been confined to rays of *one* colour, being made for the central part of the spectrum, the objective remaining *under*-corrected spherically for the

* See this Journal, ii. (1879) p. 42.

red rays and *over*-corrected for the blue rays. In the new objectives, however, the correction of the spherical aberration is obtained for *two* different rays of the spectrum, that is practically for all colours at the same time, and the objective shows the same degree of chromatic correction for the central as for the marginal part of the aperture. All this requires greater complication in the construction, hence the use of five lenses instead of the four hitherto employed. In addition, uniformity of amplification by the various zones of the clear aperture has been obtained in a higher degree than could hitherto be done.

The objectives will be specially useful in photo-micrography where the correction of the secondary spectrum will be found of considerable practical advantage. Not only is there no difference in the optical and chemical foci, but the image formed by the chemical rays is in itself much more perfect. This advantage is very clearly verified by experimental trials which have been made. For photo-micrography a third eye-piece magnifying $2\frac{1}{2}$ times is supplied, the lenses of which can be slightly separated for exact adjustment of the image.

Two series of objectives will be constructed, one adapted for the short Continental body-tube and the other for the long English body-tube, and there will be a corresponding "compensating" series of eye-pieces. The homogeneous-immersion lenses will have apertures of 1·40 N.A. and 1·30 N.A., and focal lengths of 3·0 mm. and 2·0 mm., the latter with much increased working distance. The water-immersion lenses will have an aperture of 1·25 N.A. and a focal length of 2·5 mm., and the dry lenses 0·95 N.A., 0·60 N.A., and 0·30 N.A., with focal lengths of 4 mm., 8 mm., and 16 mm.

We append what will we think be of interest to many of the Fellows, a brief account of what we understand to be the history of the construction of the new glass, though, as we have not been able to submit it to Prof. Abbe, he must not be understood to endorse it in any way.

The origin of the matter was Prof. Abbe's Report on the Microscopes of the South Kensington Exhibition published in 1878.* This contained at the end some general considerations as to the unfulfilled requirements of practical optics in regard to the properties of optical glass, and complaints of the unfavourable conditions then existing. Dr. O. Schott (of Witten, in Westphalia), a chemist, but long versed in practical glass-making, and who had made some remarkable researches on the physical properties of glass, read the report, and in the beginning of 1881, having communicated with Prof. Abbe, they commenced a preliminary study of the optical properties of the various chemical elements as far as they admit of "vitrificable" combinations. This was conducted at first on a very small scale, Dr. Schott working alone at Witten, and the optical part of the research being carried out at Jena. After a year it was decided to continue the experiments on a larger scale, with the object not only to determine the optical effects of various elements, but to try the production of practically useful combinations. In January 1882, Dr. Schott settled at Jena, and he and Prof. Abbe established a complete melting-laboratory with large

* See this Journal, iv. (1884) p. 291.

gas-furnaces, a gas engine for driving blowers, &c., and with the aid of two assistants for the chemical and the optical part of the work, and of several workmen, the experimental research was continued there for two years.

The general direction of the work was based on the principles indicated in the Report of 1878, and in the paper in this Journal before mentioned. According to these principles, there were *two* distinct objects:—(1) To obtain a greater variety of the optical properties of the glass in regard to the relation of the refractive to the dispersive power. The existing kinds of optical glass constituted nearly *a line*, i.e. the dispersion increasing always with the refraction, with very slight deviations only. The object was to combine glasses which, if arranged according to n and Δn, would *not* be confined to a linear series, but would embrace an *area* of a certain breadth, one value of n admitting various values of Δn, and *vice versâ*, as far as possible.

(2) The second problem was:—To procure kinds of glass of different relative dispersions, in which the dispersions should be *proportional*, as near as possible, in different parts of the spectrum (the problem of "secondary chromatism").

In regard to the general research, Prof. Abbe and Dr. Schott had a predecessor in the late Rev. W. Harcourt, who worked at the subject in conjunction with Prof. G. G. Stokes. They could not, however, use his results, as all that was published about them is very fragmentary and very indefinite, and they were obliged to begin quite anew. Nevertheless, one important fact was brought to a practical result, viz. the very peculiar property of boracic acid in regard to the second problem, the new observations being only a confirmation of Prof. Stokes's account of the glass-samples produced by the Rev. W. Harcourt (though in other essential points the results do *not* confirm the statements of Prof. Stokes).

Dr. Schott had succeeded, after the first months of his melting at Witten, in obtaining fusions of very small quantities—down to 100 grammes—with a remarkable degree of homogeneity, admitting of an exact measurement of the refraction and dispersion by means of spectrometric observation. This was the very basis of advance, because it allowed of a continuous and strict co-operation of the chemical and optical research. Every change of chemical composition could be immediately controlled, in regard to the optical effect, by measurement.

The fusions were obtained by means of gas-furnaces, and with crucibles of very different kinds—a great number with platinum crucibles and tools—in quantities of from 50 grammes to 12 kilos, according to the particular object, nearly all chemical elements being submitted to trial; there is even glass containing 10 or 20 per cent. of *mercury*.

A large number of analyses had been executed by the assistants up to the end of 1883, and more than 600 prisms were ground and measured by the spectrometer. Since then this figure has reached 1000. As it would have been detrimental to the progress of the work

to depend on the weather, the spectrometer measurements were always made by means of the five *bright* lines, K_α, H_α, Na, H_β, H_γ, after the methods described in Prof. Abbe's paper, 'Neue Apparate,' &c.

There were innumerable difficulties to be overcome in order to obtain compositions which should not only show the optical properties desired, but at the same time fulfil so many other requirements for optical glass; and many repeated trials were necessary for one and the same subject before a satisfactory result could be obtained. It is due to the ingenuity and energy of Dr. Schott that these obstacles were overcome.

Towards the end of 1883, Prof. Abbe and Dr. Schott had exhausted the programme, as far as appeared possible in a laboratory-research, and were about to close the affair, and publish the results, as showing the possibility of a series of new kinds of optical glass, and thereby giving an impulse, as was hoped, to its manufacture. At this period, however, several distinguished astronomers and physicists who had taken notice of these researches, encouraged them to go one step further, and to undertake the practical utilization of the results in the way of manufacture. Through the aid of these gentlemen a subsidy was obtained from the Prussian Government (though Jena is not in Prussia) to continue the experiments, so as to establish a manufacture of optical glass, which did not exist in Germany. Messrs. Zeiss, who had already furthered the work, since the beginning, in the most liberal manner by putting all the personal and technical resources of their establishment at Prof. Abbe and Dr. Schott's disposal, united with them, and in the beginning of 1884 glass-works were set up, with a large furnace and machinery. The Prussian Government's subsidy was 3000*l.*, and given under conditions as liberal as any Government has ever granted when putting public money into the hands of private persons.

The new furnace was lighted in September 1884, and since that time Dr. Schott has been actively engaged, almost day and night, in overcoming the difficulties of the operations. The experiences of other manufacturers being inaccessible to a new competitor, everything had to be learned anew. A year later, the first part of the matter was brought to an end—the production of the ordinary siliceous glass, and this, since last autumn, is used by nearly all German opticians. In a few months, it is hoped, that the borates and the phosphates will also admit of regular production, and then the Jena manufactory will be opened for the supply of optical glass on a strictly scientific basis.

This extension of the work has had the effect of delaying the introduction of better glass into microscopical optics by more than two years. In the summer of 1883, sufficient materials had been obtained for the construction of microscope-lenses, and, in fact, the first objectives were made by Messrs. Zeiss at that period, but after it had been decided to establish a manufactory with the aid of public money, Messrs. Zeiss were obliged to abstain from using the new glass, and to wait until the latter should be accessible to other opticians also.

At present the objectives are not on sale, but it is expected that very shortly both objectives and glass can be purchased in the usual way.

Mr. E. M. Nelson, who has had our objective under examination, writes as follows:—

"The great benefit which will accrue to microscopists from the use of lenses of this construction will be due, not so much to the absence of colour as to the greater freedom from spherical aberration. In other words, these lenses will stand illuminating by axial cones of larger angle. This is evident from its performance on *Navicula rhomboides* (Cherryfield). This diatom, which under oblique light is a test for a 1/4 of 90°, becomes a pretty severe test for the widest-angled homogeneous-immersion objective under a large axial cone; in the former case only crossed striæ, or checks could be made out, but in the latter the minute grating should be clearly seen.

This minute grating I have never seen so sharply defined as with this new objective when illuminated by Powell's achromatic condenser with full aperture. It shows the following very delicate objects most distinctly: fracture through the delicate perforated membrane inside the large areolations in *Isthmia nervosa*, and the fracture through the still more minute perforations inside the hexagonal structure of *Triceratium favus*. This last object may be termed the highest test to which the 'microscopy' of the present day can be subjected. Those interested in oblique light will be glad to hear that the striæ on *A. pellucida* come out sharper than I have ever seen them before. The valve is resolved from tip to tip, showing that the lens is flat in its field. To sum up, this lens is decidedly the most brilliant objective I have ever seen. . . . After mentioning the above tests, it is almost unnecessary to say that bacteria, stained and mounted in balsam, are most clearly defined." *

Mr. Nelson subsequently wrote us that he had discovered a very minute perforation on the interior lining membrane of *Eupodiscus Argus*. This diatom consists of two separate membranes. The outer one has a brown tint with transmitted light, but appears white and sparkling, not unlike loaf sugar, with reflected light. This outer membrane has large and for the most part oval areolations all over it, the interspaces being granulated. The inner membrane, which is very transparent, has rows of comparatively large white dots radiating from the centre of the diatom. The whole of this inner membrane between these white dots is covered with very minute perforations. These perforations are often arranged in circular rows round the white dots, and are, in reality, "tertiary" markings.

There is, so far as he is aware, no record of a "tertiary" marking on a diatom having been observed before.

Liquid Lenses.*—Herr P. Lebiedzinski has described some liquid lenses prepared by a method devised by Herr K. Lochovski and himself.

* Engl. Mech., xliii. (1886) pp. 62-3.

† Medical Society of Warsaw, 1881, p. 379. Reported in Jahresber. über die Fortschritte der Anatomie und Physiologie, x. (1882) p. 6.

They are made of a glycerin mixture; and it is said that the drop of liquid adopts a form near that of a paraboloid or ellipsoid, and thus to a certain extent eliminates spherical aberration; the curvature, and with it the magnifying power, can be altered by piston- and screw-motions. Such a lens forms a cheap Microscope made on Plateau's principle, with a magnifying power of 100–200. After use the liquid can be withdrawn by means of the piston into a hollow receptacle. The lenses may be combined to the number of two or three to form a system.

Koristka's Abbe Illuminator.*—Yet another mounting for the Abbe Illuminator has been devised by Signor Koristka, of Milan, for Students' Microscopes, and is shown in figs. 59 and 60. The lenses

Fig. 59.

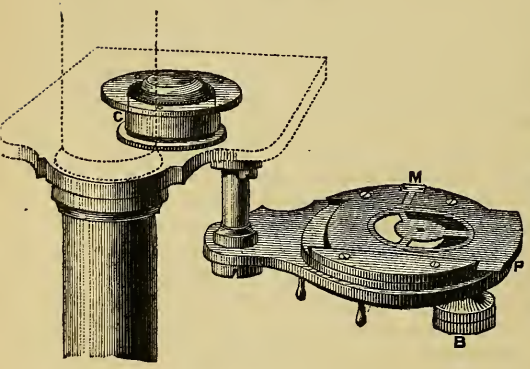
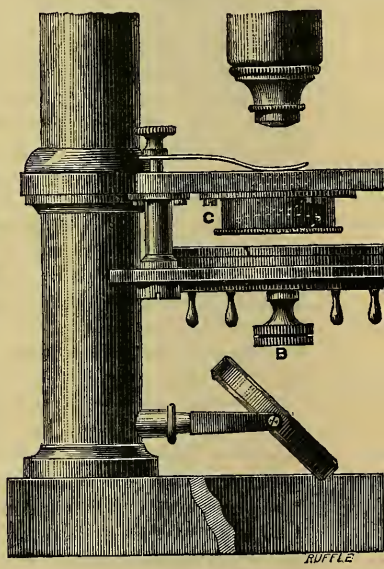


Fig. 60.



are separated from the diaphragm-holder, and slide in a tube *c* fixed to the under side of the stage, the upper lens being level with the top of the stage or below it, as may be desired. The diaphragm-holder swings on a pivot, and the diaphragms can be placed excentrically by moving the slide P by means of the milled head B. A catch at M shows when the diaphragms are central. The central plate of the holder can also be revolved by the pins underneath it.

For Microscopes which have a less space than 38 mm. between the centre of the pillar and the stage, and 80 mm. between the base and the stage, a still simpler plan is adopted, the diaphragms being carried in a ring which is movable on the under side of the stage.

Central v. Oblique Light. †—One of the familiar arts of controversialists is to conjure up an imaginary adversary who propounds the most absurd propositions which are immediately demolished by

* G. Martinotti in Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 500–2 (2 figs.).
† Engl. Mech., xlii. (1886) pp. 451-2 (3 figs.); pp. 527–8 (5 figs.).

his better informed antagonist. This device has been applied by Mr. E. M. Nelson to the question of central and oblique light.

The author first describes Mr. Stephenson's paper (*ante*, p. 37) as having for its object to discountenance the use of central illumination, and as drawing the conclusion that the central portion of the illuminating beam is "useless, harmful, and as such ought to be stopped out"! It is hardly necessary to tell any one who has read that paper that Mr. Nelson's description is as little correct as it would be to describe it as a paper having for its object the extraction of central illumination from cucumbers. The demonstration of the absurdity of the supposed view is, of course, under such circumstances, unusually complete.

Mr. Nelson next combats the view "that nothing can be known about the structure of the Diatomaceæ, because all the diffraction spectra are not admitted," which is proposed to be refuted by showing "that something can be known of the structure of *P. formosum*, because some of the diffraction spectra are admitted." In course of time we have come to know a little of the views of theoretical microscopists, but we have not yet met or heard of any one who holds or ever held the view quoted by Mr. Nelson, which we fear has only a subjective existence. We are at a loss to understand why such a misstatement should have been made in what is apparently intended for a scientific paper, and purporting to be written *au sérieux*. It seems to us, with all deference, to serve no useful purpose from any point of view.

The next point dealt with by the author is put in such a way that to be properly appreciated it must be quoted *in extenso*.

"It is curious to note how those who refuse to know anything about the structure of the Diatomaceæ, because all the diffraction spectra are not taken up, affirm that a German student, who had never seen a diatom, worked out the purely mathematical result of the interference of the six spectra of *P. angulatum*. The purely mathematical result is a very simple business. The diffraction spectra are chromatic images of the source of light arranged in a pattern similar to the pattern which causes the interference, the mathematical connection between the spectra and the pattern being in the size of the interspace and the angular divergence of the spectra from the dioptric beam. All that the German student *could* do was to say that the source of light was a disc, that the pattern causing the interference was similar to the pattern of the diffraction spectra—namely, quincunx—and that if the angular divergence of the spectra from the dioptric beam were given, the size of the interspaces could be found out. Instead of which, he drew a fantastic picture for which there was no warrant from the data given. As this picture had been drawn from purely mathematical investigation, of course the markings must be there, although no one had ever seen them. The angulatum was re-examined, but with a stop at the back of the objective, and the small secondary markings predicted by the German student were seen. The whole affair was given out as a microscopic edition of the discovery of the planet Neptune."

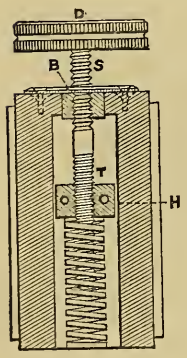
The above quotation shows that the author, at the time he wrote, had not merely not seen the paper of the German student but had not the most elementary appreciation of the manner in which hexagonal markings are derived from six spectra. The statement that the "purely mathematical result is a very simple business," &c., is as wide of the actual fact as the version of Mr. Stephenson's paper.

These are not by any means all of the mistakes into which the author has, no doubt unwittingly, fallen. It is, we venture to think, unfortunate to say the least that such crude notions should be hurried into print without any care having been previously taken to master the elements of the subject supposed to be treated of.

Illumination by aid of Air-bubbles.*—For very delicate structures, such as fur-fibres, Mr. H. L. Brevoort often purposely permits air-bubbles in the mounting material, or introduces them into it. The chances are that some of the fibres will pass through some of the air-bubbles, and when they do this in the proper position, the fibres will be found to be illuminated by the reflection of light from the upper part of the concave surface of the bubble, and the surface of the fibres may be studied with a 1/16 in. immersion lens as readily as with a 1 in. This method of illuminating he finds of great service with the highest powers, and has used it with balsam and glycerin. With the latter it works exceedingly well. The air-bubbles may best be introduced by means of a stylographic pen-filler.

Campbell's Fine Adjustment.†—Mr. E. M. Nelson describes a fine adjustment devised by the Rev. James Campbell, which he considers particularly suitable for Microscopes of the Continental type, where direct-acting screws are employed. The device consists essentially of a differential screw-adjustment, and is shown in fig. 61 as made by Messrs. J. Swift and Son.

Fig. 61.



D is the milled head of the direct-acting screw. The upper part S of the screw has 20 threads to the inch, and the lower part T 25 to the inch. B is the fixed socket forming part of the limb of the Microscope, and H is the travelling socket connected with the support of the body-tube. The revolution of D causes the screw-thread S to move up or down in B at the rate of 20 turns to the inch, whilst the screw-thread T causes the travelling socket H to move in the reverse direction at the rate of 25 turns to the inch. The combined effect, therefore, of turning D 20 revolutions, is to raise or lower T and with it the body-tube 1/5 of an inch, or 1/100 in. for each revolution. The spiral spring below H keeps the bearings in close contact.

* Journ. New York Micr. Soc., i. (1885) p. 203.
† Engl. Mech., xlii. (1886) p. 443 (1 fig.).

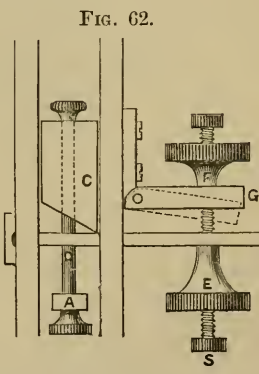
Mr. Nelson considers 25 and 20 threads upon the screw will provide a convenient fine focusing movement for students' Microscopes, though, of course, any desired speed can be obtained by proper combination of the threads. For instance, 32 and 30 would give 1/480 in. for each revolution, and 31 and 30 would give 1/960 in. He thinks the system specially commendable, from the fact that fine movements are thus obtained by the use of strong screws having coarse threads. In his opinion the difficulty with the usual fine adjustments applied to Continental Microscopes has been "that if there is a direct-acting screw with its thread fine enough to give a sufficiently slow movement, then the screw will be found too weak to stand the wear and tear. On the other hand, if it is strong enough to stand the wear and tear, the screw will have to be too quick."

It should be noted that Herr E. Gundlach applied a differential fine adjustment of this kind to the Microscope some years ago, and that at the Inventions Exhibition of last year Messrs. Ross and Co. exhibited a differential movement specially devised by Dr. H. Schröder for application to Microscopes having the "Jackson" limb.

Anderson's Double-action Fine Adjustment.—Messrs. Anderson & Sons have devised a fine adjustment by which two different rates of speed in focusing are provided, the one acting on the lever at the rate of 40 turns to the inch, and the other at 100 to the inch.

The mechanism is shown in fig. 62, where A is a stud carrying the usual tube nose-piece as applied to the "Jackson" form of fine adjustment, with a swinging pin D passing loosely through, and suspended on the top of, the metal block C, which slides freely in parallel fittings and terminates below in a knife-edge. B is a long lever acting on C. S is a screw having 40 threads to the inch at the lower part and 100 above; it is fixed in a hinged shoe-piece G, which covers a rigid bar projecting from the side of the body-tube support.

Fig. 62.



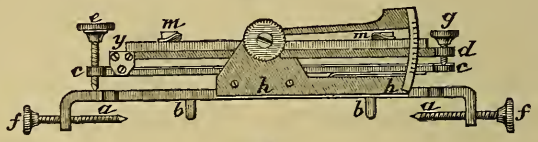
In action the rotation of the milled head E upwards raises the lever B, and consequently C, D, and A (the latter carrying the tube nose-piece), at the rate of 40 turns to the inch, and when a slower motion is required, the rotation downwards of the milled head F draws up the screw and shoe-piece G together with E, B, C, D, and A, at the rate of 100 turns to the inch, the rigid piece within G serving as the stop for this motion. A spiral spring within the body-tube acts against the upward movement of the lever B, and therefore opposes the screw movements of the milled heads E and F.

Fritsch's Stage for Stereoscopic Photo-micrographs.—Dr. G. Fritsch's apparatus, to which we referred at p. 144, is an elaboration

of that by Dr. Benecke (p. 143). It not only allows the angles of inclination of the slide to be varied to a definite extent and accurately measured, but it also enables the observer to bring the axis of inclination into exact agreement with the optic axis, a point which Dr. Fritsch considers to be of the greatest importance, as otherwise the two pictures will not be "stereo-identical." Fig. 63 is a side view, and fig. 64 a view of the apparatus from below. The base-plate consists of an outer frame *a a*, with an inner plate attached to the stage by two pins *b b*. The frame is movable laterally on the plate by the action of the screws *f f* working against the sides of the stage.

The inclining plate is at *c c*, and it can be set at different inclinations (on the axis *x*) by the screw *e* acting against the springs

Fig. 63.



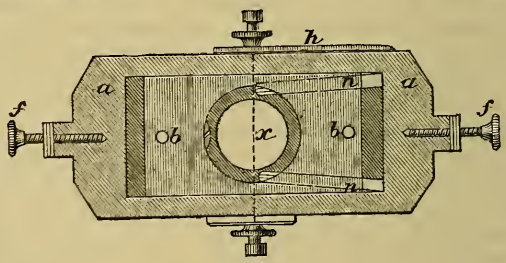


Fig. 64.

n n. The slide is not placed on this plate, but on a second plate *d*, which lies over the former, and which can be inclined (by the screw *g*), on an axis at *y*. The object of the second plate is to compensate for the thickness of the slide. At *h h* is a graduated arc for recording the inclination, and at *m m* spring clips.

The centering of the apparatus is effected by using a spider line stretched in the optic axis and a slide ruled with parallel lines. On tilting the plate *c* first to one side and then the other, any defects in the centering can be readily noticed, for if properly centred no alteration of the focus will be required for the centre ruled line, which will remain in focus at all inclinations of the plate.*

Kellicott's Moist Chamber. †—Professor D. S. Kellicott suggests a modification of Dallinger and Drysdale's moist chamber, which he thinks is an improvement. Instead of cementing the thin glass

* Festschr. zur Feier d. hundertjährigen Bestehens d. Gesell. Naturf. Freunde zu Berlin, 1873, pp. 75–95 (6 figs. and 6 stereophotographs). Cf. Stein's 'Das Licht,' 1884, pp. 201-3 (2 figs.).

† Amer. Mon. Micr. Journ., vii. (1886) pp. 267.

cover, which is the object-carrier, on the glass stage over the aperture, it is cemented on a rather deep ring, made by cutting off a glass tube of a diameter equal to that of the aperture. The ring may then be cemented to the stage, or simply made to rest in place upon it. It will be seen that the bibulous paper stage may now be made to fit close up to the ring, as the object-carrier is lifted above it into the cell or moist chamber formed by the outer glass tube and its thin rubber cover. The ring carrying the object plate and the stage perforation must be large enough to admit the substage condenser.

The author has also applied the principle of the above to the construction of a moist chamber which he has in constant use, and finds handy. An ordinary glass slip is taken; a ring with a cover-glass cemented on the top rests at its centre; then a number of layers of blotting-paper of proper size, with the centres cut out, are placed upon the slide sufficient to reach above the object; the lower paper should fit close up to the ring, and have a tongue on one side. After the object is in place, and covered or not, as the case may be, a slide is put over all, and the combination is put over a dish of water, with the tongue of bibulous paper reaching into it. The drop will not evaporate, and being surrounded by a quantity of air, the infusorian or rotifer under observation will keep in good health for a long time. A special slide and cover, 3 × 1½ in., are rather more convenient, giving a larger cell than ordinary slips.

A still better plan is to use two brass plates, 3 × 1½ in., instead of glass. The lower one is perforated at its centre, and the ring and object-carrier cemented over it; the tongued bibulous paper is then put on as before (only one layer is required to supply moisture, but an additional one with a larger hole at the centre facilitates the removal of the cover). The other plate should have a larger central perforation, over which a ring and cover-glass are cemented. When in use this one is placed over the former, covering the object with the cell, and the whole placed over a dish of water, with the tongue reaching the water. It will be seen that examination with a low power may be made at any time through the cover—the cover to be removed for the use of high powers.

Klönne and Müller's Bacteria-finder.—In the description of this apparatus (*ante*, p. 127) more stress should have been laid on the fact that the upper part of the frame is level with the top of the stage, so that the slide moves on the surface of the stage itself, thus allowing the Abbe condenser to be brought close to the under side of the slide, an advantage which is not obtainable with the earlier forms by Schmidt and Hänsch.*

Dr. W. Behrens suggests† the addition of a vernier for reading the scale on the circular slot, which it is now difficult to do on account of the end of the movable frame by which it has to be read throwing a shadow on the scale, and points out the inconvenient extent to which the apparatus projects behind the Microscope. The makers

* See this Journal, iii. (1880) p. 878.

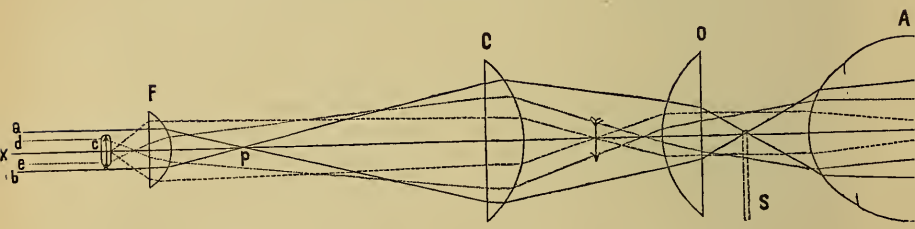
† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 502-7 (2 figs.).

propose to add rackwork for the swinging motion, to obviate the uncertainty of moving it by hand.

Exner's Micro-refractometer.*—If a card is introduced between the eye and the eye-piece of the Microscope and moved towards the axis of the instrument, a point will be reached at which the field is partially darkened, while the objects stand out in relief with sharply defined lights and shadows as in oblique illumination. A transparent object will be gradually obliterated from one side or the other as the card is inserted. If the transparent object is thicker in its centre than at the edges, then if it is also more strongly refracting than the medium by which it is surrounded, the side which is apparently opposite to the card will be the first to become dark; if, on the other hand, the object is less strongly refracting than the surrounding medium, it will be darkened first on the side from which the screen is introduced.

The matter will be better understood from fig. 65, where F is the

Fig. 65.



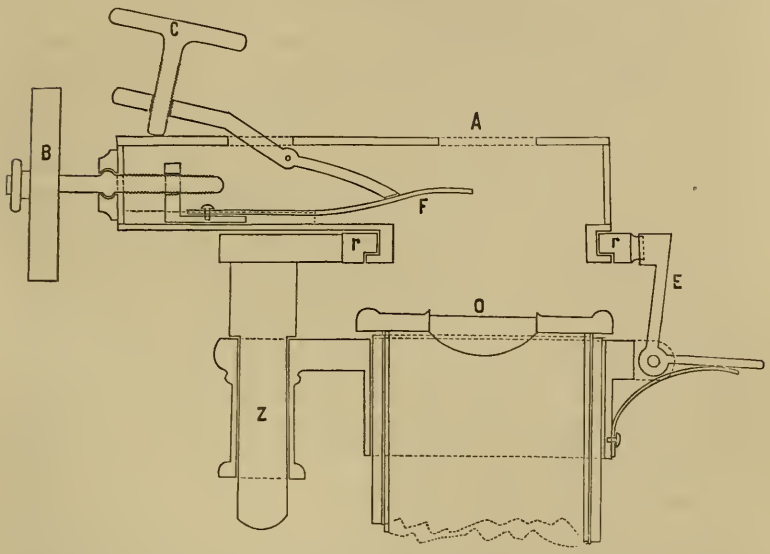
objective, C O the eye-piece, A the eye, *c* the object. The lines *a b* mark the normal course of parallel rays through a non-refracting object, while the lines *d e* represent rays passing through an object which is thicker in the centre than at the edges, and more highly refracting than the surrounding medium. In this case it will be seen that owing to its refraction towards the axis of the instrument the ray *e* is the first to be obliterated by the screen S when introduced from right to left. With a less highly refracting object, the opposite side will be first obliterated. The dotted lines which diverge from the central point of the object *c* indicate the effect of oblique illumination, produced when an opaque object is illuminated from above. S should be at the point above the eye-piece to which the rays converge.

Prof. S. Exner has devised an apparatus (figs. 66 and 67), founded on this principle, which consists of a box fitting by a spring tube above the eye-piece O, with an opening at A, and containing a screen F, with screw motions B and C, by which it can be shifted laterally and raised or depressed. The box can be rotated round the axis of the Microscope on the ring *r r*, and to allow of its being readily removed from the eye-piece, it turns on a pin *z*, and has a spring catch at E. It

* Arch. f. Mikr. Anat., xxv. (1885) pp. 97–112 (2 figs. and 1 pl.).

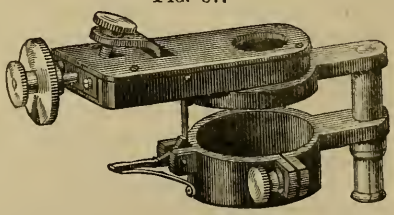
may be used for three purposes: (1) as a means of oblique illumination; (2) if the form of the object be known it will show whether the refractive power is greater or less than that of the surrounding medium; (3) if the refractive power be known it will show in which

Fig. 66.



directions the thickness of the object increases or diminishes. Prof. Exner has also used it to measure the refractive index by immersing the object in different liquids whose refractive index is known, and so finding two of very nearly the same refractive power between which it must lie. He considers that the method is so sensitive as to measure the index accurately to a few units in the fourth decimal place.

Fig. 67.



As an application of the method it is shown how the optical constants of the eye of *Hydrophilus piceus* were determined. An examination of the cornea proved that for each facet the index of refraction increases towards its centre so that the facets may be regarded as consisting of a number of cylinders inclosed within one another, the innermost having the strongest refractive power. This is just such a structure as will concentrate the greatest possible number of rays which fall upon each facet towards its axis, so that they may be utilized in the act of vision.

A plate is given showing the appearance with the apparatus of human red and white blood-corpuscles, red blood-corpuscles of a frog with two vacuoles, and a section through the cornea of *Hydrophilus*.

Apparatus for Examining the Reflex in the Compound Eye of Insects.*—Mr. B. T. Lowne has found the best method of examining the reflex to be the substitution of a reflecting ophthalmoscope for the eye-piece of the Microscope.

By this means a bright luminous spot may be observed as a real image in the tube of the instrument. A 1/4 in. objective must be used, and the mirror of the ophthalmoscope must be strongly illuminated. The Microscope is then focused so that a real image of the corneal facets is seen between the objective and the eye of the observer. By bringing the object-glass gradually nearer to the insect's eye, the reflex will come into view. The reflex appears as a disc having a fiery glow, in moths, and as a bright ruby spot in the cabbage butterfly. Sometimes six spots, surrounding a central spot, are seen in the eye of the insect; perhaps these are diffraction-images. A similar appearance is seen when the eye of this insect is observed by the naked eye, except that the spots are black. The central spot is always opposite the eye of the observer, whatever the position of the eye of the insect. The reflex seen with the micro-ophthalmoscope is green in *Tipula*, and bright yellow in the diurnal flies. Coloured diffraction-fringes are usually present around the central bright spot in both these insects; but the central image is sometimes surrounded by a perfectly black ring.

Thoma's Frog-plate.†—In addition to the Microscope described *supra*, p. 309, Professor R. Thoma previously devised and strongly recommended the following apparatus for examining the circulation of the blood in the tongue of the living frog. It is more especially intended for obviating the effects of evaporation by keeping the tongue flooded by the constant passing over it of a rapid stream of salt solution, which at the same time keeps it free from impurities which might interfere with the observations. It also allows the salt-and-water contents of the tissues to be increased or reduced, and the action of other solutions, such as indigo-sulphate of soda, to be observed.

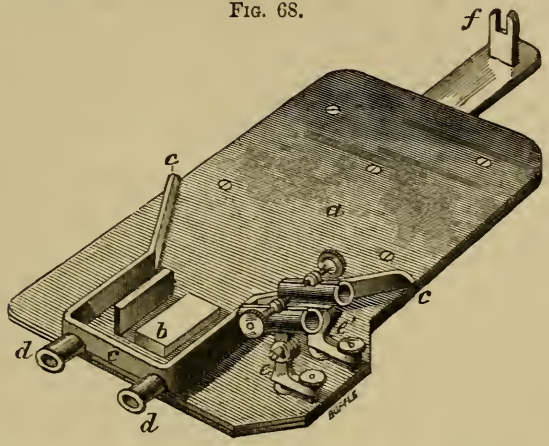
The apparatus consists of a double plate *a* of brass and vulcanite (the latter beneath) with an aperture at *b* closed by a sloping block of glass for the tongue to lie on. At *e e'* are two movable supports for the irrigation tubes. When the Microscope is inclined the fluid is retained by the ledge *c c c* which surrounds the glass block, passing away through the two tubes *d d* at the lower end. At the upper end is a support *f* for the tube used for infusing fluids into the blood, so as to prevent it being displaced if the stage-plate should be moved. Small cork plates are inserted behind the glass block to which the tongue is fixed.

* Trans. Linn. Soc. Lond.—Zool., ii. (1884) pp. 389–420 (4 pls.). Cf. Amer. Natural., xx. (1886) pp. 90–1.

† Virchow's Arch. f. Path. Anat. u. Physiol., lxv. (1875) pp. 36–47 (1 pl.).

A similar contrivance is also used for the web, mesentery, and lung of the frog.

Fig. 68.



Easy Method of Making Micro-photographs.*—The only special appliance absolutely necessary, according to Mr. F. C. Thompson, is a small dark slide to carry an ordinary 3 by 1 in. glass slip. This need be no elaborate piece of mechanism. The simplest form for use with a 1 in. objective may be constructed as follows:—Take a slip of mahogany $3\frac{3}{4} \times 1\frac{1}{2}$ in. (it may be wider if the stage of the Microscope allows of it) and 3/16 in. thick, and in its thickness make a shutter sliding longitudinally. To do this, chisel out carefully and smoothly a space $2\frac{1}{2}$ in. long, 1 in. wide, and 1/8 in. deep, so as to leave 1 in. at one end of the slip untouched, and 1/4 in. on each side. In this shallow recess cut another, the depth of the thickness of thin sheet zinc, or stout post-card. This is for the shutter to slide in; let it extend to $2\frac{1}{2}$ in. from the end of the slip, and be 3/4 in. wide. Then a piece of wood $2\frac{1}{2}$ by 1 by 1/8 in., carefully glued in the larger recess, will form a neat and light-tight groove. Before glueing in this, however, the hole should be cut in the centre of the slip, through which the picture falls on the plate. This need only be about 1/4 in. square, or the same diameter if round. Corresponding with this must be another hole in the bit of wood forming the groove. The shutter may be a piece of thin sheet zinc, or cardboard, of the thickness of an ordinary stout post-card.

On this slip thus furnished with a shutter, glue strips of wood about 1/16 in. thick, so as to leave space between them for a 3 by 1 in. slip. In the corners of this space glue small pieces of thin wood for the corners of the glass to rest upon, and keep the film from being abraded. Another slip of wood of the same dimensions as that described above, and likewise furnished with a shutter, hinged to this plate-carrying arrangement, completes the dark slide—except a

* Year-Book of Photography for 1886, pp. 49–52.

couple of fasteners, which may be made of thin sheet brass, to keep the two parts together. There is no necessity for any troublesome grooving and beading to keep out the light; the pad of blotting-paper put at the back of the plate, to soak up excess of silver nitrate, efficiently does this, and serves also for spring to keep the glass slip in place. A bellows arrangement, to go between the slide and objective, is not so good as a simple piece of black velvet, wrapped round the lens-mount, and extending to the dark slide. This is much less trouble, and more effective.

We are now prepared for the operation of focusing. It is clearly impossible to do this in the ordinary way. The picture being so small would need a second Microscope to see it, even supposing a surface sufficiently fine could be obtained on which to receive it. The principle of conjugate foci must be made use of, the property of a lens by which the object and its image are always interchangeable. In the dark slide, place face downwards, the thinnest and most distinct microscopic section available, or a micro-photograph. On each side of the centre put a pad of cotton wool or paper, to keep it in place (it is of course a convenience to provide a dark slide with a couple of springs), and close the side. Draw both shutters (which should be marked, so as to show when the hole is uncovered), and place on the stage of the Microscope, section upwards. Let the instrument have a 1 in. objective. Remove the eye-piece, and lay on the top of the tube a piece of ground glass, ground side downwards. An enlarged image will of course be produced on this; this must be focused very carefully, and in doing so it is an advantage to use a magnifier. Then, by the well-known property of lenses alluded to above, if an object be placed where the ground glass is, its image will be formed in the place occupied by the section. It is, therefore, quite unnecessary to see the small image. Turn the Microscope so that, on looking along the body-tube from below upwards, white clouds are seen, and replace the ground glass by an ordinary negative. If the operations are carried on on a bench close to a window, the window itself may keep the negative in place, otherwise a retort-stand, or some such thing, must be brought into requisition. Of course it would not entail much trouble to make a special frame, fitting on the end of the Microscope, to carry the negative, but in omitting this the aim has been to enable the worker to see some results as soon as possible.

Having thus put the instrument and negative into position, take away the dark slide, close both shutters, and insert a sensitive plate in place of the prepared slide, putting at the back a pad of blotting-paper the same size, to absorb superfluous solution, and also to act as a spring. Let the dark slide be now placed on the stage in exactly the same position as before; and around the objective, and extending from it to the dark slide, to cut off all extraneous light, wrap a piece of velvet, folded once or twice. This is extremely simple, and is done in much less time than it takes to write it. Place a card over the negative, draw the upper shutter, and all is ready for exposure, which is effected by means of the card. Experience must, as usual,

be the guide in this. A picture is not spoilt by being exposed even twenty times too long. Development is best done while looking through the plate, and as soon as the speck containing the picture distinctly appears, wash off the developer, and fix. A good magnifier will then show how much success has been obtained; if worth examining more critically, a second Microscope is a luxury, but, unless the magnifier shows a good image, it is certainly not worth while to disarrange the Microscope to examine it, if only one is in the operator's possession—especially as another plate can be exposed in two or three minutes. In fact, by having a dipper to hold half-a-dozen plates, they can be exposed, developed, and fixed in about as many minutes.

When success is fairly attained, a special negative may be taken for reduction, and a mask used to cut off all not desirable to appear in the tiny positive. It is needless to say, that this negative must be very sharp, and as clean as possible.

Instantaneous Photo-micrography.* — Mr. D. S. Holman has recently made some experiments in photo-micrography. Having succeeded in taking photo-micrographs of rapid vibrations, he determined to attempt to photograph *Amœba proteus* and other low forms of life while in motion. His method was as follows:—

Having inclosed the material in one of the Holman life-slides, and allowed it to remain until the *Amœbæ* had become accustomed to their new home and active, he cast an image of an *Amœba* on the ground glass of a camera, by means of a Holman lantern Microscope, which is illuminated with the oxy-hydrogen light. A Zentmayer 1/5 objective was used. A dry plate picture was then taken with about one-hundredth of a second exposure. Two exposures were made of one *Amœba* at intervals of three minutes, and one exposure of two *Amœbæ* in the field at one time. The photographs were a complete success, and were shown at a recent meeting of the Franklin Institute magnified 10,000 diameters, making a picture of about eight feet on the screen, so accurate that the granular appearance of the protoplasm could be distinctly seen.

"On the possibility of improvement in the Microscope."†—Dr. R. Altmann discusses the directions in which further improvements in the Microscope are likely to be made.

The absolute efficiency of an objective being $E = \frac{\lambda}{2 \sin \alpha}$, where α = semi-angle of aperture and λ = wave-length of the light employed, then in the most favourable case possible ($\alpha = 90°$) $E = \frac{\lambda}{2}$. The value actually attainable is limited, by difficulties of correction, to an angle of aperture of 120° corresponding to $E = \frac{\lambda}{2 \times 0{\cdot}866}$. The improvement theoretically possible by increase of aperture is

* Sci.-Gossip, 1886, pp. 43–4.

† Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1886, pp. 64–8 (2 figs.).

therefore about one-seventh of the maximum value, but as it is in this last seventh that the difficulties of correction increase most rapidly, it is hardly to be expected that the aperture can be much enlarged: it remains, therefore, to diminish λ by using an immersion liquid of high refractive index, and to find a form of objective which will enable the corrections to be made with the least difficulty.

If a glass hemisphere be placed with its plane surface on a printed page it will be found that the letters are magnified exactly in the ratio of the indices of glass and air. The rays which pass through the centre of the sphere suffer no aberration, so that in this case it is possible to magnify an object without spherical or chromatic aberration.

On the same principle, it will be found that using homogeneous immersion and a liquid of high index *the absolute efficiency corresponding to that index can by the alteration of a single surface be augmented without involving any essential change in the correction.*

Let B E C D, fig. 69, be the section of a hemspherical front lens, A the point of the object which lies in the axis; let a spherical surface B F C of radius A B be hollowed out, and the space between

Fig. 69.

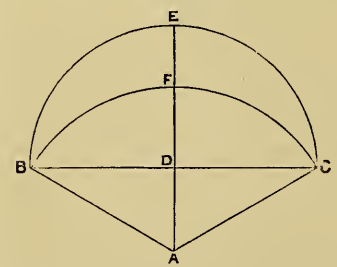
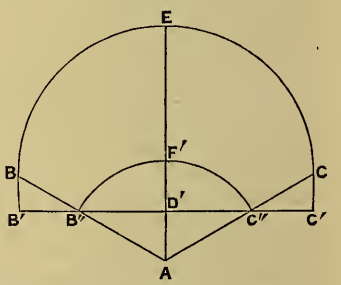


Fig. 70.



A and B F C filled with a liquid of high refractive index, then the efficiency of the objective is increased in the ratio of the indices of the crown-glass and the liquid; and if the surface B F C is accurately formed and the objective previously corrected for homogeneous immersion, the rays from A suffer no aberration; secondary aberrations only appear at some distance from A, and may be corrected by a slight alteration of the back lenses.

To strengthen the lens it is better to give it the form of fig. 70, the radius of the spherical cavity B″ F′ C″ being immaterial so long as its centre is at A. Here B′ E C′ is more than a hemisphere.

Using oil-immersion lenses of the above form, Dr. Altmann finds that without further correction the desired result is in fact attained, at least so far that with the same diameter the objective has its focal length diminished, and consequently the efficiency increased, in proportion to the index of refraction. At the same time he points out that three difficulties will be encountered in carrying out the conditions required. These are, firstly, the construction of the

cavity and the correction of the back lenses; secondly, the discovery of suitable liquids; and thirdly, the application of these liquids to histological purposes.

Imperfections in the cavity can scarcely be avoided, and will with the secondary aberrations prove a source of some trouble to opticians.

As regards the liquids to be used, methylene-iodide appears to be the best at present available; it becomes brown in the light, owing to evolution of iodine, but the colour may be removed by shaking it with aqueous potash-solution; it can be applied directly to dry diatoms, but histological preparations must be previously treated with absolute alcohol and monobromide of napthaline. More suitable liquids may yet be discovered.

With regard to the third point, the cover-glass must be dispensed with, and the immersion liquid used in contact with the object; this, however, introduces no innovation for histological preparations, and has this advantage that the principle of homogeneous immersion suffers no disturbance when the cover-glass is abolished. To get rid of difficulties arising from differences of refractive power in the tissues and the immersion-liquid it will be necessary to increase the cone of illuminating light as far as possible; with a cone of 180° this difference would theoretically be eliminated. Abbe's illuminator is not sufficient, and the best plan is to use thin plates of white glass as object-carriers, and illuminate them brilliantly from beneath.

The cavity in the front lens might be dispensed with if the crown-glass meniscus could be replaced by a flatter plano-convex lens of diamond; unfortunately it is not possible to give any considerable curvature to the diamond. If the diamond lens could be used many advantages would be gained even with oil of low refractive power, e.g. with an immersion liquid of index 1·5 it would only be necessary to correct for 60° instead of 120° as is the case at present with the most powerful objectives; and in addition to easier correction a larger aperture would be obtained.

The Aperture Question.—We were not a little surprised to receive lately an elaborate discussion on Aperture and Microscopical Vision, written in Spanish, which we should have supposed to be one of the most unlikely languages of Western Europe in which such a subject would be treated of. It is from the pen of Don Joaquin Ma. de Castellarnau y de Lleopart,* who in other papers previously published has shown himself to be much in advance of the majority of his countrymen in a knowledge and appreciation of both theoretical and practical microscopy.

The present work is extremely well put together; indeed, it is quite unique in the completeness of its treatment of the question. If there now remained in this country any microscopists who seriously questioned either the fact of an aperture in excess of 180° in air, or

* 'Vision Microscópica. Notas sobre las Condiciones de Verdad de la Imágen microscópica y el modo de expresarlas.' 96 pp., 1 pl., and 3 figs, 8vo, Madrid, 1885 (sep. repr. from Anal. de la Soc. Esp. de Hist. Nat., xiv. (1885) pp. 257–352.

the Abbe diffraction theory, a translation of the author's treatise would, we feel sure, have been of benefit to English readers. It is divided into three parts, the first dealing with diffraction, the second with aperture, and the third with the relation of aperture and power.

There are some terse passages on the aperture controversy of 1881, and the part which this Society took in finally elucidating the question, one of which we reproduce, though as we do not desire to fan into a flame again any of the slumbering embers of the old fires —if, indeed, they are not extinct—we leave the passage in its original Spanish.

"La nueva teoría—la verdadera—sobre la vision microscópica, es aún muy poco conicida. A pesar de que su orígen data de 1873, y de haberse dado cuenta de ella á la Real Sociedad de Microscopia de Lóndres en 1877, su conocimiento no se difundió más allá de un circulo muy pequeño; y apénas era conocida en Alemania, Inglaterra y los Estados-Unidos de América—países en donde la microscopia se encuentra en floreciente estado—ántes de 1881. Desde esta época, su conocimiento ha empezado á extenderse; y de la lucha entre los partidarios de las antiguas y modernas teorías, ha salido victoriosa en términos tales, que hoy nadie se atreve á disputarle el triunfo. Mr. Shadbolt, el más decidido adversario de la 'Teoría Abbe,' y el que, con más vigor le ha hecho la guerra en la Real Sociedad de Microscopia de Lóndres, ha tenido que darse por vencido, y nada en contra ha vuelto á publicar (que yo sepa á lo ménos) desde 1881."

Fine Platinum Wire and Thin Gold Leaves.—Mr. H. T. Read is said * to have made some wire so fine that it is too thin to be seen with the naked eye, though it can be felt. A platinum wire is made the core of a silver tube, and then drawn out with the silver to the thickness of the original platinum wire. This is in turn made the core of another silver tube and again rolled out, and, finally, the silver is dissolved off with nitric acid. It is intended to use this wire as a substitute for spider-webs.

Mr. A. E. Outerbridge,† by electro-plating a known weight of gold upon one side of a sheet of copper-foil of given dimensions, obtains a coating of gold upon the copper whose thickness is readily ascertainable by a simple calculation; then, by using a suitable solvent, the copper may be removed, when the leaf of gold will remain intact. After a series of careful experiments he has obtained, in this way, sheets of gold, mounted on glass plates, which are not more than 1/40,000 mm. thick; and has some specimens which he has good reason to believe are not more than 1/400,000 mm., "about the 1/200 part of a single wave-length of light."

* St. Louis National Druggist, vii. (1885) p. 308.
† Amer. Mon. Micr. Journ., vii. (1886) pp. 37–8.

ALTMANN, R.—**Ueber die Verbesserungs-fähigkeit der Mikroskope.** (On the capacity of improvement of Microscopes.)
[*Supra*, p. 333.]
Arch. f. Anat. u. Physiol. (*Anat. Abth.*), 1886, pp. 61–8.

Baldwin's (N.) Photo-micrographs.
[Of *Amphipleura* in Smith's medium, showing longitudinal (? diffraction) and transverse lines. Also of broken sections of a butterfly's wing taken with the binocular and mounted for the stereoscope.]
The Microscope, VI. (1886) p. 16.
Amer. Mon. Micr. Journ., VII. (1886) p. 18.

BEHRENS, W.—**Klönne & Müller's beweglicher Objecttisch.** (Klönne & Müller's movable stage.)
[*Ante*, p. 127, and *supra*, p. 327.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 502–7 (2 figs.).

BREVOORT, H. L.—**Illumination by aid of Air-bubbles.** [*Supra*, p. 324.]
Journ. N. York Micr. Soc., I. (1885) p. 203.

Bulloch's (W. H.) Lithological Microscope-stand. [*Ante*, p. 122.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 10–11 (1 fig.).
The Microscope, VI. (1886) pp. 12–13 (1 fig.).

CALLIANO, C.—**Un nuovo regolatore del preparato al Microscopio.**
[Mechanical stage (removable) with rectangular movements. Also acting as a finder by registering the movements on a square (of 2 cm.) divided into square millimetres.]
Giorn. R. Accad. Med. Torino, XLVI. (1883) No. 4.
Arch. Sci. Med., VII. (1883) p. 167.

Carpenter, W. B., Death of. *Journ. Quek. Micr. Club*, II. (1886) pp. 245–6.
Amer. Mon. Micr. Journ., VII. (1886) pp. 1–3.

CASTELLARNAU Y DE LLEOPART, J. M. DE—**Vision Microscópica.** (Microscopical vision.) (*Concld.*) [*Supra*, p. 335.]
Anal. Soc. Esp. Hist. Nat., XIV. (1885) pp. 289–352 (1 pl.).
Sep. repr., 96 pp., 1 pl., and 3 figs. (8vo, Madrid, 1885).

COHEN, E., and J. GRIMM.—**Sammlung von Mikrophotographien zur Veranschaulichung der mikroskopischen Structur von Mineralien und Gesteinen.** (Collection of photo-micrographs for demonstrating the microscopic structure of minerals and rocks.) 2nd ed., 80 phot. pls. (4to, Stuttgart, 1885).

Directory, Our Scientific.
[Further list of English Microscopical and other Societies.]
Sci.-Gossip, 1886, pp. 42, 65, & 88.

DU ROCHER, BOISSEAU.—**Mégaloscope.**
["A Note intended to prove that the optic system of his Megaloscope is absolutely different from Trouvé's Polyscope."]
Comptes Rendus, CII. (1886) p. 403.

EDMUNDS, J.—**"Microscopical Advances."**
[Rochon was the originator of the use of a transparent cement between the lenses of an achromatic objective, and not Chevalier as suggested by Dr. Royston-Pigott.]
Engl. Mech., XLIII. (1886) pp. 83–4.

ETERNOD, A.—**Tour horizontal pour Microscopistes.** (Horizontal lathe for microscopists.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 507–9 (3 figs.).

EWELL, M. D.—**The relative merits of Filar and Ordinary Glass Eye-piece Micrometers.** [*Supra*, p. 316.] *The Microscope*, VI. (1886) pp. 32–40.

F.R.A.S.—This Journal.
[Complaint that he has not received the title-page and index of Vol. V.]
Engl. Mech., XLII. (1886) pp. 446 and 489.

FLEISCHL, E. v.—**Das Hämometer.** (The Hæmometer.) [*Post.*]
Sep. repr. *Med. Jahrb. K.K. Gesell. Aerzte Wien*, 1885, 20 pp. (1 pl.).

GRIMM, J.—See Cohen, E.

GUNDLACH, E.—**Magnification.**
[Reply to Mr. W. H. Bulloch's queries, *ante*, p. 148.]
Amer. Mon. Micr. Journ., VII. (1886) p. 20.
The Microscope, VI. (1886) pp. 42–3.

„ „ **Astigmatism and its relation to the use of Optical Instruments.**
[*Supra*, p. 313.] *Ibid.*, pp. 1–4.
Bull. Rochester (N.Y.) Acad. Sci. (Sect. of Microscopy), 1886, pp. 4–7.

HEURCK, H. VAN—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Contd.*)
[Microscopes of Ross and Zeiss—Trouvé Battery and Helot-Trouvé and Van Heurck Photophore—Photo-micrographs.]
Journ. de Microgr., X. (1886) pp. 25–32 (7 figs.).

HITCHCOCK, R.—**Photo-micrography. III., IV.**
[2. Apparatus (*contd.*) (*b*) Microscope and accessories, Camera, &c.—Body-tube should be lined with dead-black cloth. Working with or without an eye-piece. Cameras of Scovill, Walmsley, Atwood, Stein, Aubert, and Sternberg. Amplifier. Size of plates. Focusing arrangements. 3. Illumination, with description and fig. of Kübel's Heliostat.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 5–10 (5 figs.), 48–50 (1 fig.).

HÖEGH, E. v.—**Die achromatische Wirkung der Huyghens'schen Okulare.** (The achromatic action of the Huyghenian eye-piece.)
["It will perhaps be welcome to many to understand the nature of this action, especially as in most books it is only stated, and not explained." The explanation is mathematical, and cannot be abstracted.]
Centr.-Ztg. f. Optik u. Mech., VII. (1886) pp. 37–8.

HOLMAN, D. S.—**Instantaneous Microphotography.** [*Supra*, p. 333.]
Sci.-Gossip, 1886, pp. 43–4.

INOSTRANZEFF, A. v.—**Ueber eine Vergleichungs-Kammer zur mikroskopischen Untersuchung undurchsichtiger Mineralien.** (On a comparison-chamber for the microscopical investigation of opaque minerals.)
[See Vol. V. (1885) p. 1058, and *post*.]
Neues Jahrb. f. Mineral., II. (1885) pp. 94–6 (2 figs.).

ISRAEL, O.—**Ueber eine Erwärmungsvorrichtung als Ersatz der heizbaren Objecttische.** (On a heating arrangement as a substitute for a hot stage.)
[*Post*.] *Zeitschr. f. Wiss. Mikr.*, II. (1865) pp. 459–63 (3 figs.).

JADANZA, N.—**Ueber die Fundamentalpunkte eines centrirten dioptrischen Systems und über das anallaktische Fernrohr.** (On the fundamental points of a centred dioptric system and on the anallactic Telescope.)
Centr.-Ztg. f. Optik u. Mech., VII. (1886) pp. 13–7 (8 figs.).

KELLICOTT, D. S.—**Dallinger's Moist Chamber.** [*Supra*, p. 326.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 26–7.

LAURENT, L.—**Sur l'exécution des Objectifs pour instruments de précision.** (On the execution of objectives for instruments of precision.)
[Describes his method of determining whether the defect of an objective is incorrect curvature or defective centering of the lenses.]
Comptes Rendus, CII. (1886) pp. 545–8 (2 figs.).

Lenses, the best only.
[Exhortation to the student in biology or histology to use them.]
Journ. New York Micr. Soc., I. (1885) p. 224.

LIST, J. H.—**Ueber einen Objecthalter mit Kugelgelenk.** (On an object-holder with ball-and-socket joint.)
[See this Journal, V. (1885) p. 347.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 341–2 (2 figs.).

MARTINOTTI, G.—**Di una modificazione all' Apparato di illuminazione dell' Abbe.** (On a modification of Abbe's illuminating apparatus.) [*Supra*, p. 322.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 500–2 (2 figs.).

MICHAEL, A. D.—**President's Inaugural Address.**

[Personal remarks—Future of the Club—Exhortation to younger members to communicate the results of their observations to the meetings "without fear of being laughed at."]

Journ. Quek. Micr. Club, II. (1886) pp. 215–8.

Microscope, Microscopic, Microscopical.

[Recommendation to use "Microscope" for parts of the Microscope, as Microscope-stand; "microscopic" for objects or features too minute to be appreciated by the naked eye; and "microscopical" for uses to which the term "microscopic," as above restricted, would be inappropriate.]

Journ. New York Micr. Soc., I. (1885) p. 209.

MILLER, M. N.—**Photo-micrography.**

[Reply to Editor's criticism on the author's methods that they require expensive apparatus, &c. The highest results "cannot be got without expensive appliances and special surroundings."]

Amer. Mon. Micr. Journ., VII. (1886) pp. 19–20.

Monkeying with the Microscope.

[Advice to medical readers not to purchase a Microscope to "furnish the office," nor to "mount scores of slides," which should not be done "unless for recreation or as a hobby."]

The Microscope, VI. (1886) p. 42, from *Indiana Med. Journ.*

NELSON, E. M.—**The Rev. James Campbell's Fine Adjustment.**

[*Supra*, p. 324.] *Engl. Mech.*, XLII. (1886) p. 443 (1 fig.).

" " **Central *v.* Oblique Light.** [*Supra*, p. 322.]

Ibid., pp. 451–2 (3 figs.), pp. 527–8 (5 figs.).

" " **[Magnifying Power of Lenses.]** *Ibid.*, pp. 515–6.

" " **The New Abbe-Zeiss Microscope Objective.** [*Supra*, p. 321.]

Engl. Mech., XLIII. (1886) pp. 61–2.

" " **Historic Microscopy.**

[Brief descriptions of some simple and compound Microscopes from 1590 to 1831.]

Journ. Quek. Micr. Club, II. (1886) pp. 222–9 and 247.

" " **On a method of equalizing the thickness of slips when using an oil-immersion condenser.** [*Ante*, p. 131.]

Ibid., p. 230.

ONE WHO KNOWS.—**This Journal.**

[Reply to F.R.A.S., *supra*.] *Engl. Mech.*, XLII. (1886) p. 474 and 516.

" " " **Central *v.* Oblique Light.**

[Pointing out that Mr. Nelson's letter, *supra*, in stating that the object of Mr. Stephenson's paper (*ante*, p. 37) was to "discountenance the use of central illumination," &c., was a strange mistake, as the paper "from beginning to end contains not a word or a hint on what Mr. Nelson declares to have been its object!"]

Ibid., p. 469.

OUTERBRIDGE, A. E., JUN.—**Matter, including Radiant Matter.**

[*Supra*, p. 336.] *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 37–8.

PIERSOL, J. A.—**Photo-micrography at the work-table.** [*Post.*]

Amer. Mon. Micr. Journ., VII. (1886) pp. 24–5.

President's Address. *Times*, 15th February 1886; *Sci.-Gossip*, 1886, p. 67.

Presidents, Portraits of. *Nature*, XXXIII. (1886) p. 327.

Professional Microscopy.

["There is, then, a science of microscopy. Its mastery is peculiarly difficult, requiring rare sagacity and dexterity, and a lifetime of devotion, and its study has become a profession. This fact is not known to all, it having grown too fast for any but a watchful eye to keep pace with it. 'There is no science of microscopy—the Microscope is only an instrument,' was said in our hearing a few days ago. A gun is but an instrument; yet is there not a science of gunnery? and its acquisition is an indispensible part of

the professional soldier's education. The importance of a special and systematic course of instruction in microscopy is gaining recognition in some of our best institutions of learning."]

Journ. New York Micr. Soc., I. (1885) pp. 210–1.

REINHARD, C.—**Spirituslampe mit constantem Niveau.** (Spirit-lamp with constant level.) [*Post.*]

Zeitschr. f. Analyt. Chemie, XXIII. (1884) p. 40.
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 229–30 (1 fig.).

ROGERS, W. A.—**Ruled plate for the study and measurement of blood-corpuscles.** [*Post.*] 11*th Ann. Rep. Amer. Post. Micr. Club* (Troy, N.Y.), 1886, p. 13.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances—Ancient and Modern. V. and VI.**

[V. Compensations for residuary aberrations. Mr. J. J. Lister.]

Engl. Mech., XLII. (1886) pp. 483–4.

[VI. A new era dawning for minute research. Gradual destruction of aberration.]

Ibid., XLIII. (1886) pp. 45–6.

SCHREIBER, O.—**Untersuchung von Kreistheilungen mit zwei und vier Mikroskopen.** (Investigation of circle divisions with two and four Microscopes.) [*Post.*]

Zeitschr. f. Instrumentenk., VI. (1886) pp. 1–5, pp. 47–55, 93–104.

SCHULZE, F. E.—**Lupenhalter.** (Lens-holder.)

[For passing round in a class.]

SB. Gesell. Naturf. Freunde Berlin, 1885, p. 86.

SEIFERT.—**Demonstration von Beleuchtungs-Apparaten.** (Demonstration of illuminating apparatus.)

[A.—Fritsche's albo-carbon investigation lamp. B.—Electric incandescent lamps.]

SB. Physikal-Med. Gesell. Würzburg, 1885, pp. 116–9.

STOCKWELL, J. K.—**Astigmatism practically considered in microscopic work.** [*Supra*, p. 313.] *The Microscope*, VI. (1886) pp. 29–32.

Strasburger, F.—**Manuel technique d'anatomie végétale. Guide pour l'étude de la Botanique microscopique.** (Technical handbook of vegetable anatomy.)

[Translation by J. Godfrin of 'Das Botanische Practicum.']

viii. and 405 pp., 118 figs. (8vo, Paris, 1886).

STREETER, W.—**On testing Objects, and resolution of Test Objects.**

["I tell you that which you yourselves do know, show you sweet Cæsar's wounds, poor dumb mouths, and bid them speak for me."]

Bull. Rochester (N.Y.) Acad. Sci. (Sect. of Microscopy), 1886, pp. 7–12.

Telescope and Microscope.

[Quotation of Dr. Chalmers.]

The Microscope, VI. (1886) p. 23, from *Tidings from Nature.*

TROUVÉ, G.—[**Electro-polyscopie v. Electro-mégaloscopie.**]

["M. G. Trouvé *à propos* of a recent communication of M. Boisseau du Rocher on electro-megaloscopy (Vol. V., p. 1061), recalls the results obtained by the method of electro-polyscopy, of which he is the author, and which is intended for the exploration of the cavities of the human body."]

Comptes Rendus, CII. (1886) p. 274.

VIALLANES, H.—**Microphotographie. La Photographie appliquée aux Etudes d'Anatomie microscopique.** (Photomicrography. Photography applied to micro-anatomical studies.) [*Post.*]

vi. and 66 pp., 1 pl. and 4 figs. (8vo, Paris, 1886).

WENHAM, F. H.—**Centering Glass.** [*Post.*] *Engl. Mech.*, XLII. (1886) p. 516.

β. Collecting, Mounting and Examining Objects, &c.*

Net for Catching Small Free-swimming Animals.†—Herr F. E. Schulze's modification of the ordinary gauze net, which, by reason of its sides collapsing when withdrawn from the water, damages the small animals within it, consists of a hemispherical cap of horsehair cloth. Its circular margin is fastened to a light tin ring, and the hinder part of the gauze net is sewn to the inside. Although stiff, it is perfectly elastic, returning to its original form immediately after being tilted forward, which must be done every time the net is emptied of its contents.

As thus adapted, it will be found that the imprisoned animals lie on the smooth, outstretched horsehair part of the net. As the gauze net also has its own ring of tin, the horsehair cap and ring can be pushed over it, and the two are made fast by a kind of bayonet-joint and a couple of pegs fitted to the ring.

Mud Pipette.‡—Herr F. E. Schulze employs the following apparatus on zoological excursions for obtaining small animals:—

It consists of a glass tube about as thick as the finger, and 30–40 cm. long. One end is somewhat narrowed, and the other provided with a projecting rim. An elastic tube, about as thick as a goose quill, is drawn over it, and both are fastened to an ordinary walking-stick by bending a piece of brass wire 3 mm. thick into a figure of 8 shape. The eyes are about 10 mm. in diameter, and are bent towards each other at a right angle. Through one eye another brass wire ring, 8 mm. in diameter, is drawn, and this is fastened to the stick by means of a caoutchouc ring 12 mm. in diameter and 8 mm. broad. The figure of 8 thus hangs down free, the lower limb projecting outwards. The elastic pipe is then drawn first through the lower horizontal eye, and then through the upper vertical eye. The glass pipette depends just beneath the former. The tube is held in the left hand, the stick in the right, and the tube having been compressed, the pipette is sunk into the water. Pressure is now relaxed, the water rises, and the animal having been caught, pressure is again applied, and the stick removed.

Method of Spore Germination.§—In view of the difficulty experienced in growing the spores of those Pteridophytes whose prothallia are destitute of chlorophyll, the following experiments by Mr. D. H. Campbell, though incomplete, may perhaps be of service for further investigations:—

The spores were sown upon the surface of fine earth, in shallow earthen saucers, and covered with small frames constructed as follows:

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† SB. Gesell. Naturf. Freunde, Berlin, 1885, pp. 178–9.

‡ Ibid., pp. 179–80.

§ Bot. Gazette, x. (1885) p. 428.

A shallow box, or rather frame, about four inches across, was made from four narrow strips of wood, the bottom being constructed of fine wire gauze, thus forming a sort of small sieve. This was filled with fine earth pressed firmly down, so as to allow as little air as possible to get in between the bottom of the box and the surface upon which the spores were sown. The spores were thus practically underground, and yet could be readily examined by simply lifting the frame. By this process a number of spores of *Botrychium ternatum* were made to germinate, and small prothallia were obtained. In this case germination did not occur until nine months after sowing the spores.

Germinating Fungus-spores and Pollen-grains.*—Mr. T. J. Burrill says that fungus-spores, as a rule, germinate best when sown *upon* a drop of water in which there is dissolved a small proportion of gum. If the aqueous drop is put on a slide, the spores dusted on the slightly viscid fluid, and the whole kept in a moist chamber for twenty-four hours, at the ordinary temperature of the laboratory, an examination will often be rewarded by an instructive exhibition of germinal tubes.

The same may be said of pollen-grains, though the addition of a little nectar or sugar to the fluid in this case is useful.

Cultivation of Pollen-grains.†—In the cultivation of pollen-grains, those of monocotyledons are most responsive, and of all that have been tried, those of *Tradescantia* are the most serviceable. The pollen-tube begins to develope in a very few minutes, and within an hour becomes many times longer than the grains, and has received the contents. An ordinary moist chamber can be used, constructed of blotting-paper or cardboard, as suggested by Bower and Vines in their 'Practical Botany,' p. 16, and by Goodale in his 'Physiological Botany,' p. 430. The points which experience with this special plant suggests are, according to Prof. J. M. Coulter :—

1. The culture drop, for a quick response, should be a saturated solution of cane sugar.

2. The pollen-grain should be first placed upon the cover-glass, and then the culture drop added. If the pollen is sown on the culture drop, it will remain too far removed from the objective, and the tubes will mostly grow towards the objective, and so be seen in optical section instead of in profile.

3. Pollen should be obtained from flowers that have been open for some time.

"*Tradescantia* is so common, the moist chambers are so simple, and the response so immediate, that it would seem a pity for any student to fail seeing the extine ruptured, and the intine developing into a pollen-tube."

Silver treatment of Medullated Peripheral Nerves.‡—Dr. C. Mondino gives detailed instructions as to his modification of Golgi's silver treatment of peripheral nerves.

This simpler procedure consists in first moistening the nerves *in*

* Bot. Gazette, x. (1885) p. 428.
† Ibid., p. 427.
‡ Arch. per le Sci. Med., viii. (1885) p. 45.

situ with a 2 per cent. solution of bichromate of potassium or ammonia, or with Müller's fluid. The pieces of the nerve are then hardened for twenty-four to forty-eight hours in the same solution, and are next placed in 1/2 per cent. solution of silver nitrate. Less permanent preparations may be obtained somewhat more quickly by adding to 10 parts of the first solution 1 part osmic acid. This is dropped on *in situ*, and after ten or fifteen minutes, the nerve (sciatic of dog) having been cut out, is divided into pieces 1 cm. long and placed in the solution. The after treatment is as before. Examination must be made every day for the first week to see if the time for silver treatment have arrived; a longer action of the silver than twenty-four hours is of advantage. The rest of the procedure consists in teasing out under alcohol and mounting in creosote-dammar.

Preparing Nasal Mucous Membrane.* — Dr. E. Paulsen has obtained very satisfactory results in his study of the glands of the nasal mucous membrane by the use of Flemming's osmium mixture and 1 per cent. osmic acid, or Heidenhain's alcohol-hardening method,† and of de la Field's hæmatoxylin solution for staining. Not only the nuclei but the protoplasmic network were beautifully stained, while the homogeneous intermediate substance remained clear. He distinguishes three kinds of glandular epithelium, (*a*) a portion exhibiting all the characteristics of secreting mucous cells, (*b*) a second portion resembling the cells of the albumen-glands, and (*c*) a third uniting the characteristics of both.

Chloral Hydrate for Preserving Lower Animals.‡ — Dr. A. Föttinger has tried chloral hydrate for the preservation of lower animals. Complete results were obtained with *Alcyonella stagnarum;* when all the polyps in a vessel containing 100 cc. of water were fully expanded, some crystals of chloral hydrate were dropped into the vessel; these dissolved rapidly, and the substance was gradually diffused through the water; after ten minutes a little more chloral was added, and at the end of three-quarters of an hour the whole colony had become insensible. When irritation results in no retraction, the whole colony may be placed in alcohol without any of the crowns of tentacles contracting or losing their normal form. Dr. Föttinger is of opinion that the chloral has nothing but a narcotic action, for they can recover from it, and their tissues are not affected by it. The same result was obtained with the common star-fish, with *Doris stellata*, and with other Polyzoa. Care must be taken that the crystals do not come into direct contact with the object. The drug succeeds very well with Nemertean worms.

Collodion for Fixing on the Glass Objects to be preserved in Alcohol.§—Dr. A. Föttinger also describes his method of using collodion to fix on to glass objects which it is intended to preserve in alcohol. The animal, hardened by alcohol, is withdrawn from the

* Arch. f. Mikr. Anat., xxvi. (1885) pp. 307–21 (2 pls.).
† See this Journal, v. (1885) p. 158.
‡ Arch. de Biol., vi. (1885) pp. 115–25. § Ibid.

liquid and placed on blotting-paper, so as to withdraw much of the alcohol. A drop of collodion having been put on a glass plate, it is placed in it; and the plate is laid horizontally into a flat vessel, which is slowly filled with spirit; after a few minutes the animal adheres sufficiently well to allow of the glass being set vertically. When large objects, such as star-fishes, are being set up, it is sufficient to put drops of collodion at various points on the glass. One great advantage of this method is that the collodion remains transparent in spirit.

Purifying and Hardening Commercial Paraffin.*—A method for purifying and hardening commercial paraffin is recommended by Dr. A. Föttinger. The paraffin is heated in a sand-bath with distilled water to which a small quantity of solid caustic potash has been added. When the paraffin has melted and the potash is entirely dissolved, the mixture is well stirred. After a certain time there is an abundant precipitate; this is allowed to settle, and the paraffin is then poured off, thoroughly washed with distilled water, and then heated afresh; but this time the temperature must be considerably raised, and kept high for several hours. If the paraffin turns yellow it must be washed with a warm weak solution of caustic potash. This method gives a white, very hard, and quite homogeneous paraffin, in which there is no solution of continuity.

Bleaching the Arthropod Eye.—Prof. Grenacher, according to Prof. J. Carrière,† employed the following mixture (as well as one with nitric acid):—Glycerin, 1 part; alcohol (80 per cent.), 2 parts; and hydrochloric acid, 2–3 per cent. The preparation remains in this mixture until the pigment changes colour and becomes diffuse.‡

Separating the Layers of the Wings of Insects.§—Mr. G. Dimmock separates the two layers of the wing of *Attacus cecropia* by the following process:—The wing from a specimen that has never been dried is put first in 70 per cent. alcohol, then into absolute alcohol, and from the latter, after a few days' immersion, into turpentine. After remaining a day or two in turpentine, the specimen is plunged suddenly into hot water, when the conversion of the turpentine into vapour between the two layers of the wings so far separates these layers that they can be easily parted and mounted in the usual way, as microscopical preparations on a slide.

Method of Bleaching Wings of Lepidoptera to Facilitate the Study of their Venation.‖—In the common method of destroying the scales on the wings of Lepidoptera, for the purpose of studying their venation, by means of caustic alkaline solutions, there is danger of not arresting the action at the proper moment, and consequently of destroying not only the portions which it is desirable to remove, but also the scale-supporting membrane, and even the delicate veins themselves. An application of a modification of the chlorine bleaching

* Arch. de Biol., vi. (1885) pp. 115–25.
† Carrière, J., 'Die Sehorgane der Thiere,' 1885, p. 205.
‡ Amer. Natural., xx. (1886) pp. 89–90.
§ Ibid., p. 92, from Psyche, 1884, p. 170. ‖ Ibid., pp. 204–5.

process, commonly used in cotton bleacheries, suggested by Mr. G. Dimmock, obviates the necessity of removing the scales, and leaves the wing perfect.

The most convenient method for applying the chlorine is as follows:—The wings must first be soaked a few moments in pure alcohol, in order to dissolve out the oily matter in them. If this is not done, the surface of the wings acts as a repellent, and will not be moistened by an aqueous solution. When the wings have become thoroughly soaked by the alcohol, they are ready to be removed to a solution of common bleaching powder. This bleaching powder is sold by druggists as "chloride of lime," but it is really a mixture of calcic hypochlorite, calcic chloride, and calcic hydrate. Ten parts of water dissolve the first two compounds, leaving nearly all the third suspended in the solution. The solution should be made with cold water, filtered, and kept in a tightly corked bottle until required for use. When the wings are transferred to this solution the bleaching commences, and in an hour or two the wings are devoid of markings, although the veins retain a light-brown colour. This is due to the fact that chlorine cannot quite decolorize animal matter, or any substance containing nitrogen, as it does vegetable tissue.

After the colour has sufficiently disappeared from the wings they should be transferred to a wash composed of one part of strong hydrochloric acid to ten parts of water. And here it may be added that in case the bleaching does not readily commence upon immersion in the bleaching solution, the action may be hastened by a previous dipping in the dilute hydrochloric acid. In the bleaching solution a crust of calcic carbonate, formed by the union of the calcic hydrate of the solution and the carbonic dioxide of the air, is deposited on the wings, and this calcic carbonate the final wash in dilute acid will remove. As soon as the calcic carbonate has disappeared, and all bubbling, consequent upon its decomposition by the hydrochloric acid, has ceased, the wings should be well soaked in pure water. They may then be secured on cards with a mucilage of gum tragacanth, or upon glass by the proper transfers, through alcohol and chloroform, to Canada balsam.

A solution of sodic hydrochlorite, known as "Eau de Labarraque," or a solution of potassic hydrochlorite, known as "Eau de Javelle," when used in place of the solution of bleaching powder, do not leave a deposit of calcic carbonate on the wings, and thus dispense with the wash of dilute acid. A solution of zinc hypochlorite acts more delicately than a solution of sodic hypochlorite, and may be used in place of the latter, as may also solutions of aluminic hypochlorite, or magnesic hypochlorite.

Modification of Ehrlich's Method for Tubercle Bacilli.*—Dr. G. Fütterer proceeds as follows:—1. Stain sections after Ehrlich's method. 2. Decolorize, in alcohol acidulated with nitric acid (3 drops to a watch-glassful of absolute alcohol), down to a light rose-colour. 3. Immerse for one minute in a well-filtered solution of palladium

* Virchow's Arch. f. Path. Anat., ci. (1885) p. 198.

chloride (1 : 500). 4. Wash in water. 5. Then for some minutes in acidulated alcohol. 6. Cedar oil. 7. Canada balsam.

The advantages of this method are said to be more rapid and more perfect decolorization ; greater resistance of the bacillar stain to the action of alcohol, ether, chloroform, and turpentine oil; and greater distinctness of the tissue structure.

Method for Determining the Acids in Plants when combined with Bases. *—Dr. H. de Vries proposes a modification of the alcohol method for determining the amount of free and combined organic acids in plants. The sap is, when necessary, first freed from albuminoids by heating in a closed flask and filtering. In one portion the acidity is then tested in the ordinary way by curcuma-paper. To the other portion 10 to 20 times the volume of alcohol of 90 per cent. is added, treated with 1/10 normal potash-ley, and with phenolphthalein. The deduction of one of the numbers so obtained from the other gives the portion of acids combined with organic bases and with ammonia.

By this means it can be determined that in rapidly growing organs there is a much larger quantity of organic acids combined with organic bases than free, while in mature organs the latter portion may be as large as the former. Thus, in the sap of mature apices of the stem of *Impatiens Roylii* there was 1·1 per cent. of free acid, 2·6 per cent. combined with bases; in mature leaf-stalks of *Rheum officinale*, 8·2 per cent. of free acid, 9·7 per cent. combined with bases.

Separation of Chlorophyll.†—Herr A. Tschirch proposes a method for separating chlorophyll from the other ingredients of plants which are soluble in alcohol, ether, carbon bisulphide, &c. The alcoholic extract is treated, at the temperature of the water-bath, with baryta-hydrate, by which a deep green barium cyanophyllate is obtained, insoluble in alcohol. The xanthophyll can be separated by saponification. The barium precipitate is also insoluble in water. If dried with an excess of baryta, or at a temperature of 100 degrees, it is also insoluble in ether and benzin. Dried at a lower temperature, it forms black plates soluble in ether.

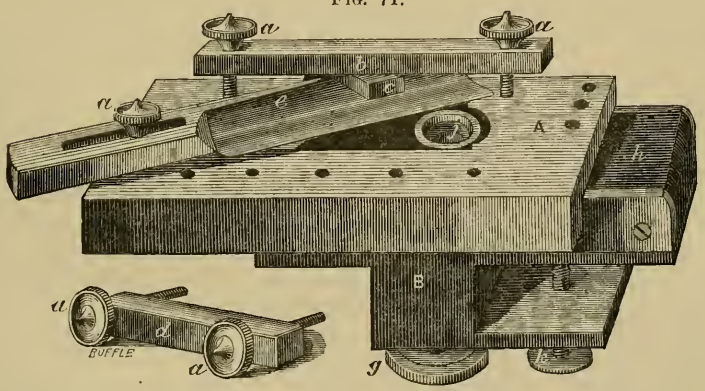
Preparing Starch-grains in Potato.‡—Prof. T. J. Burrill gives the following directions:—Starch-grains in the cells of potato can be beautifully shown by first partially drying the part from which sections are to be made, thereby aiding materially the process of cutting. Remove from a fresh tuber a prism 1/4 in. to 1/2 in. in diameter, and 1 in. or more in length. Expose for a few minutes to moderate heat (hot air from a register is excellent) until the surfaces are quite free from moisture, then allow to remain in the ordinary air of the laboratory for twenty-four hours. The consistence will now be excellent for cutting, and clean cells without ragged remains of ruptured ones may be seen beautifully filled with starch-like baskets of fruit. Mount in water. Stain, if desired, with iodine.

* Maandbl. voor Natuurwet.,1884, No. 9. See Bot. Centralbl., xxiv. (1885) p. 249.
† Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 314.
‡ Bot. Gazette, x. (1885) pp. 424–5.

Deceptive Results produced by Hardening Solutions.* — For the diagnosis of keratin in animal tissues, Dr. H. Steinbrügge has applied Ewald and Kühne's method to the investigation of the tissues of the ear of mammalia for the presence of keratin as a normal constituent, which was a probability to be inferred from the morphological relationship of the tissues to the ectoderm of the ovum. The sections were digested in a trypsin solution prepared in the usual way from pancreas. Very divergent results were obtained in regard to the degree of resistance to the action of this solution, which was the criterion adopted by Ewald and Kühne for the presence of keratin. Investigation showed that these divergencies corresponded with the degree of action of the hardening solutions employed in preparing the tissues for cutting, and that the criterion in question is worthless.

Providence Microtome. †—The original form of this microtome was designed by Mr. N. N. Mason of Providence, R.I., U.S.A., and was perfected by Rev. J. D. King. In its present form (fig. 71), it

Fig. 71.



is described by the Rev. A. B. Hervey as "perhaps equalled by no microtome made, for extreme precision of movement and consequent accuracy of performance in cutting sections. With a good knife in good order, sections of 10 μ to 25 μ thick can be made without difficulty, and all alike."

It consists of a heavy iron bed B, a knife-carrier A, and the usual apparatus for holding and moving the object to be cut, *g j*. The iron bed which furnishes the clamp *k*, and a solid support for the knife-carrier and object-holder, is 13·8 cm. long, 5·7 cm. wide, and 6·8 cm. deep. Cemented to its top is a brass plate *h*, 6·5 mm. thick. Rising through and above this is the cylindrical tube or object-holder *j*, 29 mm. in diameter. It projects 10 mm. above the

* Zeitschr. f. Biol., xxi. (1885) pp. 631–5.

† Behrens' 'Microscope in Botany' (Amer. ed. by Hervey and Ward), 8vo, Boston, 1885, pp. 188–90 (1 fig.).

surface of the brass plate and to within 0·5 mm. of the upper surface of the knife-carrier. It has an inner cylindrical piston 15 mm. in diameter and a sleeve around this which may be used with the piston, when it is desired to have a larger well, having a diameter of 19 mm. On each side of the brass plate and rising 1 mm. above its upper surface is an iron bar, 7 mm. thick, running the whole length of the bed and screwed fast to it. These are the ways or tracks upon which the knife-carrier slides. The knife-carrier consists of a solid plate of brass, 13 cm. long, 8·6 cm. broad, and 8 mm. thick, with projections along both sides, 6 mm. thick and 13 mm. deep, which fit down over the outside of the iron ways. The inside of these projections and the adjoining under surfaces of the brass plate are planed and polished so as exactly to fit over and upon the smooth iron tracks in such a way that the carrier moves freely, but with the utmost precision, back and forth upon them.

The brass plate A has an oblong opening cut in its middle, 9·6 cm. long and 3·3 cm. wide, through which, when in place, the cylindrical object-holder projects, very nearly to the upper surface of the plate. The plate is provided along its sides and ends with a series of screw-holes, to receive the milled head screws *a* of the clamps *b d*, by means of which the knife *e* is made fast to the carrier, and may be set at any desired obliquity to the line of motion of the carrier. The knife has a heavy strong plano-concave blade with a straight edge, and is laid flat upon the carrier and securely clamped down at heel and point. It, therefore, will not spring in the least and may be depended on to do work of very great precision. It is used for cutting all kinds of wood sections, and such other tissues as can be cut by simply packing in elder pith or imbedding in paraffin.

Fig. 72.

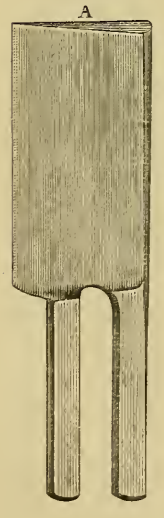


Fig. 73.

Fig. 74.

Henking's Simple Microtome Knife.*—Dr. H. Henking's knife (figs. 72–74) has a short blade with a bifid handle of the same length A. The measurements of the blade are: length about 5 cm., breadth about 28 mm., thickness of back about 7 mm. Though the back of the blade and the handle are in one and the same straight line, yet the handle diverges from the plane of the blade so that the cutting edge is $2\frac{1}{2}$ mm. lower than the back B. The knife is supported by

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 509–11 (1 fig.).

a brass plate C with a notch to receive the binding screw, and also with a cavity for the admission of the knife blade.

The principal merit of the knife is that owing to the shortness of its blade, it may be easily sharpened by the owner. In order to do this a wooden grip must be fitted to the handle.

Ordinary v. Serial Sections.*—A writer in 'Nature' notices with regret a tendency "in certain histological schools to neglect almost entirely the older and simpler methods of cutting sections. Serial section cutting is now such an important item in all morphological work, that it is apt to be used to the exclusion of the older methods which give in many cases undoubtedly better histological results."

Serial Sections of Celloidin Preparations of Central Nervous System.†—Prof. C. Weigert gives an account of a method devised by him for obtaining a succession of sections, specially adapted for the nervous system. The course of procedure is, he says, so very convenient that he can recommend it even when a series of sections is not required.

The process is completed in six steps, of which the first consists in preparing the glass plates. These of course may be of various sizes; for large preparations, Koch's culture plates may be used, while for spinal cord a plate 4 cm. broad and 15 cm. long suffices. After being cleaned, the plate is covered with a thin layer of celloidin, exactly as a photographer makes a moist plate. It is then set on end and dried.

The second step is to make the sections and arrange them ribandwise on strips of transparent porous paper. In order to withstand stretching when damp, tenacity is a necessary quality of the paper. The width of the strips should be about double that of the sections. The sections are then disposed in a suitable position along the strips by carefully removing them with a brush from the knife. It is important to keep the strips, when covered with sections, moist while their successors are being cut and arranged. This is accomplished by laying them on blotting paper placed in a dish containing some spirit.

The third step is to transfer the sections to the celloidin plate. The strips, section side downwards, are laid upon the celloidin surface just sufficiently moistened, the paper surface is softly pressed and then peeled off. Any superfluous fluid is removed with blotting-paper, but anything like dryness of the sections must be avoided as it is injurious to the after steps of the process, which must be immediately proceeded with. Not more than one or two strips should be transferred to the same plate.

The fourth step consists in covering the sections with a thin and even layer of celloidin. When dry the celloidin may be marked (for recognition of series) with a brush dipped in methyl-blue.

Staining is the next step: immersed in hæmatoxylin, the celloidin

* Nature, xxxiii. (1886) p. 243.

† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 490–5.

mass separates off from the glass plate, thus setting free the two celloidin layers with their inclosed sections, the whole forming a flexible but tough plate, which may be handled like a rag. Staining and washing are carried out in the usual manner, and after differentiating in the ferrocyanide of potassium, the series are again immersed in water, frequently changed, for at least one hour.

The celloidin section-plate may be now cut up under water into as many pieces as there are sections. These are then dehydrated in 90–96 per cent. alcohol and cleared up in creosote or xylol. Such sections must remain in alcohol much longer than ordinary ones, as the celloidin layers are slow in dehydrating. From the preparation of the plates to the immersion in hæmatoxylin it takes about one hour to produce 100 sections.

The author has recently discovered a medium to replace creosote (which is dear and malodorous), in a mixture of benzine and alcohol. He hopes to be able to publish his results very shortly.

Preparation of Picro-carmine.*—Prof. G. Bizzozero prepares an excellent picro-carmine in the following manner:—

A solution of 0·5 grms. carmine, 3 cc. ammonia, and 50 cc. distilled water, is made in a mortar. In another mortar is made a solution of 0·5 grm. picric acid in 50 cc. water. The picric acid solution is then poured slowly into the carmine solution. The combined solutions are then heated in a water-bath until every trace of ammonia has disappeared. By this time the bulk of the fluid is reduced to half its previous quantity. It is then allowed to cool, and one-fifth of its volume of absolute alcohol is added. The fluid must be kept in a carefully corked bottle. It is not necessary to filter before using.

Picro-chromic Acid.†—This is recommended by Prof. H. Fol as an excellent hardening agent for very small pieces of tissue. It acts slowly, having little power of penetration. It is made as follows:—Picric acid (saturated aqueous solution), 10 parts; chromic acid (1 per cent.), 25 parts; water, 65 parts. A little osmic acid (·005), added shortly before using, is said to strengthen its action much.

The staining capacity of objects is not impaired by this mixture. The objects should be washed in water. The extraction of the acid is more complete and rapid if nearly boiling-hot water is used.

Minot's Picric-acid Carmine.‡—Dr. C. S. Minot's carmine is made as follows:—

Boil 1 grm. best powdered carmine with 200 c.cm. of water, plus an excess of picric acid for half an hour; allow it to stand and cool; decant the clear fluid, add fresh water, and, if necessary, picric acid; boil, cool, and decant; repeat this operation until all the carmine is dissolved. Place the decanted fluid in an evaporating dish, add

* Zeitschr. f. Wiss. Mikr., ii. (1885) p. 539, from Bordoni-Uffredduzzi, 'I Microparassiti,' Torino, 1885, p. 97.

† Fol's Lehrb. d. Vergl. Mikr. Anat., 1885, p. 100.

‡ Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 42.

about 1 grm. thymol, and stand in a warm place until the volume is reduced to 25 c.cm.; let the solution cool, filter, wash out the residue, which should be on the filter, with 25 c.cm. water; dilute the filtrate with 50 c.cm. water. By this means a solution ready for use, which will keep indefinitely, and contains carmine and picric acid in good proportions, can be prepared with certainty.

It gives a stronger differential colouring than Ranvier's picro-carmine; but over-staining must be carefully avoided. For staining sections, two to five minutes are sufficient. The fluid stains connective tissue (fibrous) deep red; striped muscle, deep dull red; smooth muscle, blood, and horny tissue, bright yellow; glands, reddish yellow. With the kidney it gives a differentiation of the different portions of the tubules; for the central nervous system it seems to be of little value. If rightly used, it gives a sharp nuclear colouring.

If the aqueous solution is evaporated to dryness, the residue may be redissolved in alcohol, giving an alcoholic carmine dye, which has not yet been tested sufficiently. Apparently the alcoholic solution will keep only a few months. The alcoholic solubility of the dye offers the advantage that sections stained in the watery solution can be washed in alcohol directly.

Differential Action of Safranin and Methyl-green.*—In studying the sexual characteristics of the oyster Mr. J. A. Ryder found that a mixture of these two dyes enabled him to distinguish both ova and spermatozoa in the same follicle, the nuclei of the ova being stained red by the safranin, and the heads of the spermatozoa bluish-green by the methyl-green. The method of preparation is as follows:—

1. After removing the shell the oyster is hardened in chromic acid (1 to 2 per cent.) for several days.

2. Washed in water two days, and then further hardened in alcohol.

3. Soaked for twenty-four hours in water, to remove the alcohol; then imbedded in gum arabic and cut with free hand.

4. Sections freed from imbedding mass by washing in water; then stained in a mixture in equal parts of safranin (saturated alcohol solution), methyl-green (ditto), diluted with eight times its volume of water, two to three hours.

5. Decoloured in 95 per cent. alcohol until clouds of colour no longer appear (five to fifteen minutes).

6. Clarified in clove-oil and mounted in balsam of dammar.

Staining Spermatogems.†—Herr Benda, in his studies on the spermatogenesis of mammals, made use of a modification of Weigert's hæmatoxylin method. Sections preserved in Flemming's solution were fixed to a cover-glass and placed for twenty-four hours in a strong solution of oxide of copper. After careful washing in water, repeated several times, they were placed in 1 per cent. watery solution

* Bull. U.S. Fish Commission, 1883. Cf. Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 52.

† Arch. f. Anat. u. Physiol. (Physiol. Abth.), 1886, p. 186.

of hæmatoxylin, until they became intensely coloured, which happened in about five minutes. The sections were then washed in a 1/300 solution of nitric acid, which gave a yellow colour to the preparation; it is possible by stopping the action of the acid when one pleases to have the nuclei alone coloured, or to have also fine shades of colour in the cell-body, ground substance, and so on; the action of the acid is best stopped by replacing the preparations in the copper solution, where they again take on a violet-grey shade.

Picro-nigrosin as a Stain for Nerve-centres.*—Dr. G. Martinotti prepares this staining fluid by mixing crystals of picric acid and nigrosin with rectified spirit in a test-tube and shaking frequently. The supernatant fluid, which is of a deep olive colour, is decanted off, and if any undissolved crystals remain more rectified spirit is added, and so on. Sections obtained in the usual manner are then immersed in the decanted fluid, where they may remain for from two to forty-eight hours. When removed from the staining bath the sections are of a blue colour, and it is impossible with the naked eye to distinguish between grey and white matter. At this stage they may or not be washed with rectified spirit to remove the superficial colouring matter. The sections are next placed in a mixture of two parts alcohol and one part formic acid. When by this treatment the difference between the white and grey matter is sufficiently marked, they are treated with rectified spirit, after this with absolute alcohol, and having been cleared up in bergamot oil, are mounted in Canada balsam dissolved in xylol.

On microscopical examination it will be found that the axis cylinders and the nerve-cells are stained a deep blue colour, and that the processes of the latter may be followed with great ease. The walls of blood-vessels are of a dark-blue colour, while connective tissue and neuroglia appear of a somewhat lighter hue. Leucocytes and neuroglia nuclei are but slightly stained. The myeline sheaths receive a deep greenish-yellow stain. Hence in transverse sections the blue axes stand out surrounded by yellow areas, and when viewed longitudinally the axis cylinder lies between two parallel lines of yellow.

For sclerosis of the spinal cord this method has the great merit of showing up the affected parts most conspicuously, owing to the contrast between the deep blue of the connective tissue and the yellow sheaths of the unaffected nerves. Hence the amount of the degeneration is easily recognized. The author has compared this method against the anilin-blue stain recommended by Schiefferdecker, and has no hesitation in saying that the latter method is inferior to his own.

A special advantage of this picro-nigrosin method is its behaviour towards celloidin, for it is possible to stain sections without removing the celloidin with which they have been impregnated. Now certain stains, and especially some of the anilins, dye celloidin so deeply that it is necessary to remove it from the sections, thus surrendering

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 478–84.

one of the principal advantages of celloidin, while the colour from picro-nigrosin completely disappears under the action of the alcohol and formic acid.

Staining Mucous Glands and Goblet-cells.*—Dr. E. Paulsen has succeeded in staining deeply the network of mucous glands (lingual and submaxillary of calf) with Delafield's hæmatoxylin after fixing in 1 per cent. osmic acid or in Flemming's osmium mixture and hardening afterwards in alcohol for some days. Alcohol preparations were treated after Heidenhain's method. The osmic acid mixture is preferable to the osmium mixture. Good stainings were obtained in a dilute solution after immersion for twelve to fifteen hours; in the undilute solution the same effect was attained in about half an hour. By this the reticulum of the epithelium of mucous gland was sharply stained, while the intervening substance remained clear and uncoloured. The receptivity for colour is unequal, some cells staining more than others, while some are altogether unaffected by the stain.

The author has also with 1 per cent. osmic acid and hæmatoxylin staining after Heidenhain's method, been able to show in Bowman's glands of many mammals that the epithelium unites in itself the characteristic properties of both kinds of lingual glands, both kinds, and even a third with a central mucous zone, occurring within the gland-sheath.

Goblet-cells, which appear in large numbers in nasal mucous membrane, are by the same treatment stained blue or blue-violet.

Staining Capsule Micrococci.†—Dr. C. Friedländer recommends the following for cover-glass preparations:—Pass thrice through the flame; immerse in a 1 per cent. solution of acetic acid for one or two minutes; then blow off the acetic acid with a pipette, and dry in the air. Stain for some seconds in the solution of anilin-water and gentian-violet. Wash again, and examine. The ground-substance is colourless, hence the stained parts, e. g. the capsules, stand out very distinctly.

For demonstrating capsule cocci in sections Friedländer gives the following method:—Stain for twenty-four hours in acid solution of gentian-violet (concentrated solution of gentian-violet in alcohol 50; aq. destil. 100; acid acetic 10). Then decolorize in 1 per cent. acetic acid for 1–2 minutes, dehydrate in alcohol, and clear up in oil of cloves. Some practice is required to hit off the requisite degree of decolorization.

Staining Spirilla in Blood-preparations.‡—Dr. C. Günther recommends that the cover-glass preparations of blood containing spirilla, made in the usual manner and fixed over a flame (or better by five minutes in a thermostat at 75° C.), should be washed for ten seconds in a 5 per cent. solution of acetic acid before being stained. This drives out the hæmoglobin from the blood-discs, which are no longer coloured by the stains, so that when the staining of the preparations is completed the most highly coloured spirilla no longer

* Zeitsch. f. Wiss. Mikr., ii. (1885) pp. 520–1.
† Fortschr. d. Med., iii. (1885) p. 757. ‡ Ibid., p. 755.

meet the eye covered up partly by blue-stained blood-discs, partly by the granular opacity of the ground stain. The acetic acid must be carefully removed before the staining is undertaken. The greater part of the acid is blown off, and after drying in the air the cover-glass is held over an open bottle of strong ammonia, in order to eliminate the last traces of the acid. The excess of fluid is washed off with water and the preparation mounted in Canada balsam.

Staining Bacillus of Syphilis.*—Herrn Doutrelepont and Schütz have, by a special method of staining, demonstrated bacilli in syphilitic indurations, condylomata, papillæ, and gummata. In form, size, and arrangement they perfectly resemble the bacilli described by Lustgarten.

The method is as follows:—The material hardened in alcohol is softened in water for about 10 minutes before cutting. Very thin sections made with freezing microtomes are then placed in a 1/2 per cent. salt solution, and next are carefully spread out in absolute alcohol until all the air bubbles have disappeared. They are next stained in a 1 per cent. watery solution of gentian-violet for 24 to 48 hours.

Decolorization is effected by waving each section for some seconds about in weak nitric acid (1–15 water), and then immersing in 60 per cent. alcohol for 5 to 10 minutes. When of a pale violet-blue colour, the sections are transferred to a weak watery solution of safranin, where they remain for some minutes; next to a 60 per cent. solution of alcohol for a few seconds, then, having been dehydrated in absolute alcohol, are cleared up in cedar oil, and mounted in Canada balsam.

Giacomini's Process for Preserving Microscopical Preparations.†—Prof. C. Giacomini's process consists in imbedding the stained sections (which may be coloured by any reagent whatever) in a layer of gelatin, backed upon either side by a layer of collodion. As many glass plates are required as there are sections. They should slightly exceed the size of the sections. They must be most carefully cleaned in the ordinary manner (with acids, alcohol, ether), then dusted over with talc powder, which is briskly rubbed in with a piece of chamois leather, and finally removed with a soft brush. The glass plates are then coated with a thin layer of collodion (the author uses commercial collodion, and if it be too thick, thins it down with a mixture of equal parts of alcohol and ether). They are then dried in a horizontal position, and when sufficiently firm to bear the imprint of the finger-nail, they are coated over with gelatin. This 8 to 10 per cent. watery solution of gelatin must be already prepared before the collodion process is begun. The whole of the gelatin is placed in half the distilled water for an hour; it is then warmed to a temperature of 50° to 55° C. in a water-bath, and the other half of the water added until a perfect solution is obtained. This is

* Deutsche Med. Wochenschr., 1885, p. 320.

† Gazzetta delle Cliniche, xxii. (1885) November. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 531–5.

filtered while hot through a suitable apparatus. It is not advisable to add any antiseptic. The collodionized plate is now immersed in the vessel containing the hot gelatin, and when the collodion and gelatin have united (the disappearance of all streaks from the collodion surface shows this), the section, previously kept in distilled water, is placed thereon by means of a fine brush. The plate is then removed from the bath, and laid carefully in a horizontal position. If the gelatin layer and the section both be thin, 12 to 18 hours are sufficient to dry them. Should any part of the section remain uncovered, a fresh layer of gelatin solution, at a temperature of 50°, may be poured over the plate, held in a sloping position.

Drying may be considered completed when the preparation is quite transparent, and the gelatin surface so firm that it no longer receives the indent of the finger-nail. The gelatin layer may now be marked, if need be, with ordinary ink. Finally, a second collodion layer is run over the gelatin. Endeavour should be made to keep the second layer about as thick as the first. After drying again, the gelatin-collodion layers are stripped off the glass plate by cutting first along the edge, and then raising the collodion-gelatin layers with a scalpel. If the glass plate have been properly cleaned, this is quite easily done. As the collodion-gelatin layers tend to curl up, it is advisable to submit them to a certain pressure. This is best done by placing them between the leaves of a pretty thick book.

With care, 200 sections of the pons varolii may be mounted in one collodion-gelatin layer. The author's researches were chiefly devoted to the central nervous system. He found that preparations treated with Müller's fluid, and afterwards with perchloride of mercury, gave better results than when nervous tissue had been hardened in alcohol, and especially if kept for any length of time. The chief advantages of this method consist in the transparency of the sections and the ease with which they are preserved. Low powers are quite sufficient to enable the course and distribution of the nervous fibres to be followed with ease. The only inconvenience complained of by the author is the impurities which commercial gelatin contains. These, however, are no bar to microscopical investigation.

White Rosin as a Mounting Medium.*—Mr. H. L. Brevoort reports the results of his experiments in mounting with white rosin to be very satisfactory. The method is the following:—On the centre of a clean glass slide, laid on the heating table, put a small piece of rosin of the purest quality. Heat is gently applied until the rosin becomes as liquid as it can be made without burning it. To remove air-bubbles, with a pointed glass rod add to the liquefied rosin and stir in with it, a half-drop of turpentine. A moment or two after the object to be mounted has been placed in the medium, and the cover-glass has been dropped upon it, the slide must be removed from the hot table, and a spring clip applied. In five minutes the mount will be ready for finishing and labelling. For such objects

* Journ. New York Micr. Soc., i. (1885) pp. 202-3.

as hairs and fur-fibres in particular rosin is preferable to balsam as a medium for mounting.

Smith's Newer Mounting Medium of High Refractive Index.*—Prof. Hamilton L. Smith has recently discovered a mounting medium which he regards as superior to any hitherto described. It is even superior to the preparations described last year.† These consisted of stannous chloride in glycerin jelly, giving a refractive index of 1·7, and of realgar in arsenic bromide, with a refractive index of 2·4. The new medium, which has a refractive index considerably above that of the stannous chloride medium, is prepared in the following manner:—

Dissolve $1\frac{1}{3}$ oz. of antimony bromide in two fluid drachms of a 50 per cent. solution of boro-glyceride. This, when cold, makes a very viscid medium, like old stiff balsam, of a dark, sherry wine colour. Mounts made with it in the extremely thin film required are as colourless as with old balsam, and when laid upon white paper, the colour of the medium is scarcely perceptible, if it has not been injured by overheating—certainly less than most mounts in styrax. It is used precisely like Canada balsam. It works easily at a moderate heat, and boils very rapidly. The heat must be continued until the boiling is nearly over, but care must be observed not to overheat, as the glycerin is likely to burn. When entirely cooled, the cover will be firmly attached, as with balsam, and the slide may be cleaned with moist tissue paper, without fear of disturbing the cover.

A finishing ring may now be applied, but Prof. Smith advises that a bit of paraffin should be placed on the slide, melted, and caused to flow around the mount, by tilting the preparation. A vigorous rubbing with a cloth will remove all excess of paraffin, leaving a sloping or bevelled ring round the mount. This operation has preserved mounts for two months already, with no indication of change. Any finishing cement may then be applied.

The medium is only slightly deliquescent, but is decomposed by water, and injured by contact with immersion fluids—hence some protection is necessary.

We now quote from Prof. Smith's letter as follows:—

"The boro-glyceride which I have used was prepared for me by Mr. C. F. Booth, of Tarrant & Co., manufacturing chemists, New York. This substance is a hard, brittle, and glassy compound of glycerin and boracid acid, and will no doubt serve an excellent purpose as a mounting material from its antiseptic properties. I use a 50 per cent. of this in glycerin.

I wish to say here that recently, in looking over some of my earliest mounts in the chloride of tin and glycerin medium that I had thrown aside because of leakage (as this material, before I used gelatin, always remained more or less soft, and so made it difficult to

* Amer. Mon. Micr. Journ., vii. (1886) pp. 3-4.

† See this Journ., v. (1885) p. 1097.

clean off the cover before ringing), I was surprised to find that not only had the leakage stopped, but that the drop outside was indurated, and when removed the whole seemed perfectly sealed, and showed no tendency to the smearing when wiped hard, that had caused me at first to suppose these mounts were spoiled, and they remain up to the present moment now apparently good. The boro-glyceride 50 per cent. solution will not permit as much chloride of tin to be dissolved as I mentioned in the directions for the gelatin preparation. A 25 or 30 per cent. solution will be better here, and this medium still answers admirably for ordinary diatoms.

The gelatin and tin compound is more hygroscopic than the compound of boro-glyceride and antimony; still, if properly made and used will answer admirably and remain unchanged, I believe, for any length of time."

Meates' New Medium of High Refractive Index.—Mr. W. C. Meates describes a still newer medium:—In a clean dry test-tube put 10 grains of bromine, and 30 grains of sulphur. Boil gently until the sulphur is dissolved; then add 13 grains of powered arsenic (metallic); again boil gently until the whole of the arsenic is dissolved. The result is a medium of a light yellow colour with a high refractive index (2·4), and easily melted at a low degree of heat. It does not crystallize. When it is boiling, fumes of bromide of arsenic are given off, which are deposited on and forced up the sides of the test-tube; therefore, when these fumes nearly reach the top of the tube, the boiling should be discontinued for a few seconds and the mixture agitated, in order that the bromide may be again absorbed. Then boil again, and so on until the arsenic is dissolved, when the mixture will be ready for use.

There is no occasion for making more than the quantity indicated, as a small drop, when warmed, no bigger than a small pin's head, taken up on a finely drawn out piece of small tubing, is quite sufficient for a slide. When the slide is warmed it spreads into a very thin layer.

Morris's Mounting Medium.*—Dr. W. Morris suggests another mounting medium, of high refractive index. The method of preparation is said to be exceedingly simple, and the whole process need not take more than two minutes. To equal parts of sulphur and disulphide of arsenic 1/20 part of biniodide of mercury is added; the whole is fused on a piece of mica, then sublimed on to the cover-glass, finally remelted on the cover-glass and mounted in Canada balsam. The very thinnest cover-glass may be used. American slides recently received have a cover-glass with the thickness of 0·009; Dr. Morris's cover-glasses are only 0·004.

Seaman's Mounting Media of High Refractive Index.†—Prof. W. H. Seaman has tried oil of cassia (the refractive index of which is nearly equal to that of carbon bisulphide) making a saturated solution of phosphorus in the oil. This mixture is easier to use because less inflammable than carbon bisulphide, but contains less

* Australasian Med. Gaz., v. (1886) p. 100.
† Amer. Mon. Micr. Journ. vii. (1886) pp. 21-4.

phosphorus, as the latter is not perfectly soluble in oil of cassia as in carbon bisulphide. A ring of liquid glue should be made on the slide, and allowed to dry, drying the diatoms on the cover, adding the solution, and quickly inverting the cover in its place, then removing the surplus squeezed out by blotting-paper, carefully pressing down on the glue ring, and then sealing with balsam. The solution smokes on exposure to the air, but in these preparations there is no evidence of acid flakes.

On endeavouring to make a good solution of sulphur in carbon bisulphide, it did not appear that sufficient dissolved to get the full benefit of the high index of sulphur. He therefore sought a better solvent, and found it in anilin. On making a test mount of mixed diatomaceous material he was surprised at the brilliancy and sharpness of definition, in which it excels any other medium yet tried. The diatoms used were in alcohol. He first placed the required quantity on the inverted cover, dried them, added sufficient medium to cover them, heated the cover to drive the air out of the cavities of the diatoms and cause the fluid to enter, added, if necessary, a little more, inverted in place on the slide on a turn-table, and removing any surplus by a blotter, put a ring of balsam or shellac cement round, thus finishing at one operation. The anilin is not very volatile, and the adhesion of the cover very slight, but with care, using a long-bristled brush and thin balsam, a coat can be got quite sufficient to seal and fix the cover in place, and additional coats may be given when convenient.

Anilin, according to Storer, dissolves its own weight of sulphur; if heat is used it will become supersaturated, and crystals will form on the slide, which are very pretty of themselves, but of course are not desirable with other objects. As Gladstone and others have indicated that high refractive power accompanies complex molecular constitution, it is probable the best solvents for this purpose will be found among the carbon compounds like anilin, chinolin, &c.

Black Ground for Opaque Mounts.*—Mr. W. C. Brittan thinks that the following receipt for a paint that will give a dead black surface as required for the inside tubes of optical instruments, &c., should be in the hands of all who work with the Microscope:—Take two grains of lampblack, and add three drops of gold-size, mix thoroughly, and add 24 drops of turpentine, when again thoroughly mixed it is ready for use. Apply it thin with a camel's hair brush. When dry, the articles will have as fine a dead black as when they came from the optician's hands. This paint will also be found just the thing where a dead black ground is required for opaque mounts.

Exhibiting the Streaming of Protoplasm.†—The streaming motion of protoplasm can be exhibited very satisfactorily, according to Mr. T. J. Burrill, in the thin membrane (upper epidermis of scale-leaf) found between the scales of the bulb of the common onion. All that is necessary to do is to transfer a piece of the fresh membrane,

* The Microscope, vi. (1886) p. 41. † Bot. Gazette, x. (1885) pp. 428–9.

snipped off by a pair of scissors, to a drop of water on a slide, cover, and examine with a power of four hundred or so times. The temperature of a comfortable room is about right; with less heat the movement is very slow. Success is more certain if the bulb has started to grow, as they often do in a cellar. Care should be taken in removing the membrane, for the cell-walls are very delicate, and easily wrinkle, forming unsightly and annoying irregular lines, over what should be the clear open cell.

The material commends itself for its accessibility at any time, and especially in winter when other things may not be readily obtained, and for the extreme ease of preparation.

Examining Embryo-growth in Birds' Eggs.*—Dr. L. Gerlach describes a successful method which he has devised for watching the embryo-growth in birds' eggs through a small glass "window" made at the smaller end. After detaching the end with a bent pair of scissors, a little albumen is taken out, so that the germinal disc of the yolk turns upwards; the liquid is then put back. Gum-arabic solution is spread on the opening, and wadding put round it, then a small watch-glass is fixed on it with gum; collodion and amber-lac being afterwards added. The eggs must lie horizontally in the incubator; development then goes on normally, and may be observed till the fifth day (thus comprising the time most interesting to the embryologist), the egg being taken out, and the window-end turned up.

Examining Iron and Steel.†—Mr. F. L. Garrison considers it is at present difficult to say what will be eventually the practical value of the Microscope in the sciences of engineering. The *rôle* which it seems most likely to play is that of an adjunct to the testing-machine, and not (as some have supposed) a rival to the chemical laboratory. That it will be a most valuable accessory seems, to say the least, highly probable.

As regards preparing the material for examination, the author points out that Mr. J. C. Bayles ‡ has "described the process in such a plain and comprehensive manner, that if his instructions are carefully followed, one need not encounter any serious obstacles after a little experience and the expenditure of a considerable amount of time and patience. Patience and cleanliness are the two most important attributes to be acquired by a student, if he desire success in a work of this characrer. A deficiency in either will be sure to spoil his work, and in the end he will give it up in disgust, wondering what has been the cause of his failures. In grinding the specimens, it is quite unnecessary that they should be ground to an extreme thinness and mounted in Canada balsam, as microscopical objects are usually preserved. This entails a vast amount of labour, to no end whatever. A good and accurate photograph, once obtained, is usually sufficient for any reference that might be desired in the future; besides, with a little care the etched surfaces of the objects can be

* Nature, 1886, p. 497. See this Journal, v. (1885) p. 784.
† Journ. Franklin Institute, cxx. (1885) pp. 300–6 (5 pls.).
‡ See this Journal, iii. (1883) p. 605.

preserved from rust by simply rubbing a few drops of kerosene oil over them with a soft chamois-skin, and then placing them in a tightly corked phial.

The size of the objects to be examined under the Microscope may vary considerably; but the sizes found most convenient range from 1/4 in. down to about 1/16 in. in thickness, and from 1 in. to 1/5 in. in sectional area. If the specimens are extremely thin, there is often much difficulty in mounting them properly on a slide, and in getting the etched surface perfectly parallel to the object-glass. After the surface has been sufficiently treated with acid, and shows under the Microscope no further traces of scratches made in the grinding, it should be carefully dried and cemented to a glass slide with wax or cement, great care being taken to have it in the proper plane parallel to the object-glass: otherwise, it will be impossible to make a satisfactory photograph.

The great difficulty encountered in pursuing the study of the structure of materials is that of making accurate and satisfactory records of what is seen under the Microscope. To effect this, the only accurate and quick means is to photograph. Hence the student must not only be a good microscopist, but also understand the theory and practice of photography, an accomplishment which every engineer will find it useful to acquire."

Some hints are given for photographing and for selecting a Microscope. The use of a condensing lens depends, it is said, upon the ability of the etched surface to reflect light. Thus hard steel reflects light so well that a condenser is not necessary, while in the case of pig, cast, or wrought iron its use is absolutely essential. Ten photographs are given of various kinds of iron and steel, with a description of the characteristic features of the specimens.

Draper's Graphic Microscopy.—Mr. E. T. Draper proposes to continue in a separate form the coloured illustrations which were a special feature of 'Science-Gossip' in 1884 and 1885. The first part has been issued with two plates and accompanying description. Mr. Draper is well known as one of the most expert artists in drawing microscopical objects that we have, and we shall be very glad to hear that his new venture turns out a remunerative one. For this it is necessary that microscopists—who cannot but appreciate such work—should give it more than moral support.

BANTI, G.—**Manuale di Technica Batteriologica.** (Manual of Bacteriological Technique.) From *Lo Sperimentale*, May, 1885.

BAREGGI.—**Modificazione all' allestimento dei preparati Microscopici tinti con colori di anilina allo scopo di renderne più perfetta e durevole la conservazione.** (Modification in preparing microscopical objects stained with anilin colours in order to make them more durable.) [*Post.*]
Gazzetta degli Ospitali, 1884, p. 645.

BELLONCI, J.—**La terminaison centrale du nerf optique chez les mammifères.** (The central termination of the optic nerve in mammals.) [Methods, *post.*] *Arch. Ital. de Biol.*, VI. (1885) pp. 405.

BELVOR.—**On staining in toto the Central Nervous System with Weigert's Hæmatoxylin.** [*Post.*] *Brain*, 1885, July.

Benda.—**Ueber die Spermatogenese der Säugethiere.** (On spermatogenesis in the Mammalia.)
[Methods, *supra*, p. 351.]
Arch. f. Anat. u. Physiol. (*Physiol. Abtheil.*), 1886, pp. 186–7.

Bertrand, E.—**Sur l'examen des Minéraux en lumière polarisée convergente.** (On the examination of minerals in polarized convergent light.)
Bull. Soc. Minéral. France, VIII. (1885) p. 29.

Bizzozero.—**Ueber die Mikrophyten der normalen Oberhaut des Menschen.** (On the microphytes of the normal skin of man.)
[Methods, *post.*]
Virchow's Arch. f. Path. Anat. u. Physiol., XCVIII. (1885) p. 441.

„ „ **Preparazione del picrocarmino.** (Preparation of picrocarmine.)
[*Supra*, p. 350.]
Cf. Bordoni-Uffredduzzi, 'I Microparassiti,' 8vo, Torino, 1885, p. 97.

Born, G.—**Biologische Untersuchungen. I. Ueber den Einfluss der Schwere auf das Froschei.** (Biological researches. I. On the influence of gravity on the frog's egg.)
[Methods, *post.*] *Arch. f. Mikr. Anat.*, XXIV. (1884) p. 475.

Brass, A.—**Mittheilungen zur mikroskopischen Technik.** (Communications on microscopical technique.)
[1. Die Einbettungsmethode mit Benzol und das Schneiden leicht zerbrechlicher Objecte. (Imbedding methods with benzol, and cutting very friable objects.)
2. Bemerkungen über die Mikrotommesser und ihre Behandlung. (Observations on microtome knives and their use.
3. Die Anfertigung von zusammenhängenden Serienschnitten. (Making adhering series of sections.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 300–7 (3 figs.).

Brevoort, H. L.—**White Rosin as a Mounting Medium.** [*Supra*, p. 355.]
Journ. N. York Micr. Soc., I. (1885) pp. 202–3.

Breyer.—**Mikromembranfilter.** (Micromembrane filter.) [*Post.*]
Naturforscher, XIX. (1886) pp. 123–4,
from *SB. Vereins zur Förderung des Gewerbfleisses*, 1886, p. 15.

Brittan, W. C.—**A Black Ground for Opaque Mounts.** [*Supra*, p. 358.]
The Microscope, VI. (1886) p. 41,
Amer. Mon. Micr. Journ., VII. (1886) p. 37.
from *The Locomotive.*

Bulloch's (W. H.) Combination Microtome. [*Ante*, p. 166.]
The Microscope, VI. (1886) p. 14.

Buysmann's Medicinal Plants.
[Dried plants, with the floral and fruit parts dissected and separately mounted. Those parts which would be injured by pressure are placed in alcohol in small flat-sided bottles, so that they can be readily examined with a lens. Small parts of flowers are also mounted in the same way, and where they require a higher power than an ordinary lens they are mounted on glass slides for use with the Microscope."]
Journ. of Botany, XXIV. (1886) p. 96.

Cox, C. F.—See Leggett, F. W.

Deans, J.—**Notes on Mounting.**
[Never use asphalt. Directions for making gold-size cells for fluid mounts.]
Scientific Enquirer, I. (1886), pp. 5–6.

Dimmock, G.—**A Method of bleaching Wings of Lepidoptera to facilitate the study of their venation.** [*Supra*, p. 344.]
Amer. Natural., XX. (1886) pp. 204–5.

Doutrelepont and Schütz.—**Ueber Bacillen bei Syphilis.** (Staining bacillus of syphilis.) [*Supra*, p. 354.]
Deutsche Med. Wochenschr., 1885, p. 320.

Engelmann, T. W.—**Zur Technik und Kritik der Bakterien-methode.** (On the technique and criticism of bacteria methods.) [*Post.*]
Bot. Ztg., XLIV. (1886) pp. 43–52, 61–9.

Enock's (F.) Entomological Slides.

[A series of slides, showing the mouth-organs of British Hymenoptera, especially bees, accompanied by explanatory drawings, so that a person can see at a glance the name of each part. The specimens are mounted naturally, and the heads are specially prepared for a paraboloid.]

Sci.-Gossip, 1886, p. 44.

ETERNOD, A.—**Armoire à préparations microscopiques.** (Cabinet for microscopic preparations.) [*Post.*]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 511–3 (3 figs.).

F.—Ueber Sammeln von Tieren. (On collecting animals.)

[Brief directions for preserving—principally insects.]

Naturforscher, XIX. (1886) pp. 70–1.

FARHALL, M.—**A simple Cell for Fluid Mounts.**

[Cardboard rings saturated in patent knotting. Fasten to slip with gold size and cover the ring with a mixture of gold size and oxide of zinc.]

Scientific Enquirer, I. (1886) pp. 4–5.

FENNESSEY, E. B.—**A new Microscope Slide.**

[Those who delight in looking at the coursing of the blood through the web of a frog's foot, or the motion of the sap as seen in *Vallisneria*, &c., "will be pleased with the spectacle of the flow of oil towards the flame of a burning lamp. To see this interesting phenomenon it is only necessary to raise the burner partly out of the lamp, then hold it steadily, close enough to the Microscope, which ought to be turned horizontally, and use a 1 in. or lesser power objective, when the current of fluid will be observed writhing and struggling amongst and through the interstices of the cotton wick. The oil may be coloured if thought desirable."]

Engl. Mech., XLIII. (1886) p. 12.

FERRAN, J.—**Ueber die Morphologie des Komma-Bacillus.** (On the morphology of the comma bacillus.) [Methods, *post.*]

Zeitschr. f. Klin. Med., IX. (1885) p. 361.

FLEMMING, W.—**Notizen zur Färbetechnik.** (Notes on staining technique.) [*Post.*]

[*Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 517–9.

FLEISCHL, E. v.—**Ein mikrostroboskopischer Reizversuch.** (A microstroboscopic irritation experiment.) [*Post.*]

Arch. f. Anat. u. Physiol. (*Physiol. Abth.*), 1886, pp. 67–71.

FLESCH, M.—**Zur Kenntniss der Nerven-endigung im quergestreiften Muskel des Menschen.** (On the nerve-endings in striated human muscle.) [Methods, *post.*]

MT. Naturf. Gesell. Bern, 1885, p. 1.

„ „ **Zur Anwendung der Merkel'schen Doppelfärbung mit Indigo und Carmin.** (On the use of Merkel's double staining with indigo and carmine.) [*Post.*]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 349–52.

„ „ **Notiz zur Watney's Doppelfärbung mit Hämatoxylin.** (Note on Watney's double-staining with hæmatoxylin.) [*Post.*]

Ibid., p. 353.

„ „ **Bemerkungen zur Kritik der Tinctions-Präparate.** (Remarks on staining reagents.) [*Post.*]

Ibid., pp. 464–77 (2 figs.).

FRANCOTTE, F.—**Réactifs colorants.** (Staining reagents.)

[Arcangeli's four formulæ, *ante*, V. (1885) p. 1094, with modifications, *post.*]

Bull. Soc. Belg. Micr., XII. (1886) pp. 48–51.

FRIEDLÄNDER, C.—**Microscopische Technik zum Gebrauch bei medicinischen und pathologisch-anatomischen Untersuchungen.** (Microscopical technique in medical and pathologico-anatomical investigations.)

[3rd ed., viii. and 128 pp., 1 pl. (8vo, Berlin, 1886).

„ „ **Notiz, die Färbung der Kapselmikrokokken betreffend.** (Note on the staining of capsule micrococci.) [*Supra*, p. 353.]

Bot. Centralbl., XXV. (1886) pp. 380–1, from *Fortschr. d. Medicin*, III. (1885) p. 757.

Friedländer, C.—**Microscopical Technology.** *Transl.* by S. Y. Howell. x. and 250 pp., 1 pl. (8vo, New York, 1885).

FRIEDLÄNDER, C., and G. MARTINOTTI.—**La technica microscopica applicata alla clinica ed all' anatomia patologica.** (Microscopical technique applied to clinical work and pathological anatomy.) (Ital. transl. from the last German ed.) 296 pp., 1 pl., and 66 figs. (8vo, Torino, 1885).

FÜTTERER, G.—**Ueber eine Modification der Ehrlich'schen Färbemethode für Tuberkelbacillen im Gewebe.** (On a modification of Ehrlich's staining methods for tubercle bacilli in tissues.) [*Supra*, p. 345.]
Virchow's Arch. f. Path. Anat. u. Physiol., CI. (1885) p. 198.

GARBINI, A.—**Guida alla Bacteriologia.** (Guide to Bacteriology.)
xv. and 145 pp., 34 figs. (8vo, Verona, 1886).

GELPKE, T.—**Notiz zur Anwendung der Weigert'schen Modificirten Hämatoxylin-Färbung auf das periphere Nervensystem.** (Note on the use of Weigert's modified hæmatoxylin stain for the peripheral nerve-system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 484–9.

GERLACH, L.—**[Examining Embryo-growth in Birds' Eggs.]** [*Supra*, p. 359.]
Nature, XXXIII. (1886) p. 497.

GIACOMI, DE.—**Neue Färbungsmethode der Syphilisbacillen.** (New staining methods for bacilli of syphilis.) [*Post.*]
Corresponzbl. d. Schweizer Aerzte, 1885, No. 12.

GIACOMINI.—**Nuovo processo di conservazione delle sezioni microscopiche.** (New process for preserving microscopic sections.) [*Supra*, p. 354.]
Gazzetta delle Cliniche, XXII. (1885).

Gierke, H.—**Staining Tissues in Microscopy. VII., VIII., IX.**
Amer. Mon. Micr. Journ., VII. (1886) pp. 13–5, 31–5, 53–4.

GOLGI, C.—**Sur l'Anatomie microscopique des organes centraux du système nerveux.** (On the microscopical anatomy of the central organs of the nervous system.)
[Methods, pp. 15–41. *Post.*]
Arch. Ital. de Biol., IV. (1883) pp. 92–123, VII. (1886) pp. 15–47.

GOTTSTEIN, A.—**Ueber Entfärbung gefärbter Zellkerne und Mikroorganismen durch Salzlösungen.** (On decolouring stained nuclei and micro-organisms by saline solutions.) [*Post.*]
Fortschr. d. Med., III. (1885) p. 627.

GÜNTHER, K.—**Ucber die Färbung der Recurrens-Spirillen im Blutpräparaten.** (On the staining of recurrens *Spirilla* in blood-preparations.) [*Supra*, p. 353.]
Bot. Centralbl., XXV. (1886) pp. 379–80.
Fortschr. d. Medicin, III. (1885) p. 755.

GUTTMANN, P.—**Ueber Leprabacillen.** (On leprosy bacilli.)
[Methods, *post.*]
Berlin Klin. Wochenschr., 1885, No. 6.

HANSEN, E. C.—**Einige kritische Bemerkungen über Dr. Hueppe's Buch, 'Die Methoden der Bacterien-Forschung.'** (Some critical remarks on Dr. Hueppe's book, 'The Methods of Bacteria-research.')
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 355–8.

HARRACH, A.—**Der Käfersammler.** (The Insect-collector.)
[Contains directions for preparing microscopical slides of insects.]
308 pp. (8vo, Weimar, 1884).

HAUSER, G.—**Ueber Fäulnissbacterien und deren Beziehung zur Septicämie. Ein Beitrag zur Morphologie der Spaltpilze.** (On pathogenic bacteria and their relation to septicæmia.) [*Post.*] 15 pls. (8vo, Leipzig, 1885).

„ „ **Ueber das Vorkommen von Mikro-organismen im lebenden Gewebe gesunder Thiere.** (On the occurrence of micro-organisms in living tissues of healthy animals.) [*Post.*]
Arch. f. Exper. Pathol. u. Pharmakol., XX. (1885) p. 162.

HAUSHOFER, K.—**Beiträge zur mikroskopischen Analyse.** (Contributions to microscopical analysis.)
[1. On the use of concentrated sulphuric acid. 2. A microscopical reaction for copper.]
SB. K. Bayer. Akad. Wiss., XV. (1885) p. 403.

HENKING, H.—**Ein einfaches Mikrotommesser.** (A simple microtome knife.) [*Supra*, p. 348.]
Zeitschr. f. Wiss. Mikr., II. (1885), pp. 509–11 (1 fig.).

HEYDENREICH, L.—**Ueber den besten Deckglaskitt.** (On the best cover-glass cement.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885), pp. 333–8.

HILDEBRAND, H. E.—**Ein vereinfachtes Mikrotom von grosser Leistungsfähigkeit.** (A simplified Microtome of great working capacity.) [*Post.*] *Ibid.*, pp. 343–5 (1 fig.).

[HITCHCOCK, R.]—**Preserving Urinary Casts.**

[Dilute carbolic acid. Shellac as the cement.]

Amer. Mon. Micr. Journ., VII. (1886) p. 18.

„ „ **Liquid Preservative.**

["It is frequently desirable to have a liquid preservative of the same specific gravity as water. Probably the nearest approach to such a medium is the one recommended to be used with Deane's gelatin medium, having the following composition:—rectified spirit 1½ oz., water 1½ oz., glycerin 5 fl. dr.]

Ibid., p. 38.

Howell, S. T.—See Friedländer, C.

HUEPPE, F.—**Ueber die Dauerformen der sogenannten Commabacillen.** (On the permanent forms of the so-called Comma Bacillus.)

[Methods, *post.*]

Fortschr. d. Med., III. (1885) p. 619.

HUNTER, W.—**Recent Histological Methods.**

[*Hardening.*—(1) Weigert's rapid method in Müller's fluid, which is kept at a temperature of 30°–40° C. accelerating the process from 6 weeks to 14 days. It is specially applicable to brain and spinal cord. (2) Gaule's, placing the fresh tissue for 20–30 minutes in a saturated solution of corrosive sublimate and then in alcohol. *Imbedding in celloidin. Cutting.*—In cutting, the so-called dry method must be employed to obtain the full advantages of this method. Staining in the ordinary way. *Imbedding in Paraffin*, cutting and staining (alum carmine). For general purposes celloidin will be found more generally useful than paraffin, especially for nervous tissues. For fine histological or embryological purposes, paraffin is by far the best, and can in no way be equalled by any other known method.]

Journ. of Anat. and Physiol., XX. (1886) pp. 307–16.

IMHOF, O. E.—**[Turntable.]**

[Description of a simple form devised by the author.]

SB. K. Akad. Wiss. Wien, XCI. (1885) pp. 207–8 (1 fig.)

JENKINS, A. E.—**Methods of Study. IV.**

[Staining Methods and Formulæ. Cochineal (Mayer's and Alum). Carmine (Borax, Bermann's, Beale's, Alum-, Acetic Acid-, Acid Borax-, Alcohol-). Double Stains (Carmine and Indigo-Carmine, Picrocarmine, Picro-lithia-carmine, Palladium chloride and Carmine).]

The Microscope, VI. (1886) p. 5–11.

KALKOWSKY, [E.—**Ueber die Polarisationsverhältnisse von senkrecht gegen eine optische Axe geschnittenen zweiaxigen Krystallplatten.**—(On the polarization relations of biaxial crystal plates cut at right angles to an optic axis.)

[*Post.*] *Zeitschr. f. Krystallog. u. Mineral.*, IX. (1884) pp. 486–97 (1 pl.).

KLEMENT and RENARD.—**Réactions microchimiques à cristaux.** (Microchemical crystal reactions.) [*Post.*]

Bull. Soc. Belg. Micr., XII. (1886) pp. 55–6.

KOGANEÏ, J.—**Untersuchungen über den Bau der Iris des Menschen und der Wirbelthiere.** (Researches on the structure of the Iris of man and vertebrates.)

[Methods, *post.*] *Arch. f. Mikr. Anat.*, XXV. (1885) pp. 1–48 (1 pl.).

KOROTNEFF, A.—**Zur Histologie der Siphonophoren.** (On the histology of the Siphonophora.)

[Methods, *post.*] *MT. Zool. Stat. Neapel*, V. (1884) pp. 229–88 (6 pls.).

KRAUSE, W.—**Die Retina.** (The retina.)

[Methods, *post.*]

Internat. Monatsschr. f. Anat. u. Histol., I. (1884) p. 225.

L., V. A.—**Cleaning Slides.**

[Bichromate of potash 2 oz., sulphuric acid 3 oz., water 25 oz.]

Scientific Enquirer, I. (1886), p. 3.

LAKER, K.—**Die ersten Gerinnungserscheinungen des Säugethierblutes unter dem Mikroskope.** (The first coagulation appearances of mammalian blood under the Microscope.) [*Post.*]
SB. K. Akad. Wiss. Wien, XC. (1884) pp. 147–58.

LATHAM, V. A.—**On mounting Pathological Specimens.**
[(1) Examination of fresh Tissues. (2) Hardening. (3) Cutting. (4) Staining.]
Sci.-Gossip, 1885, pp. 25–6.

LAVDOWSKY, M.—**Mikroskopische Untersuchungen einiger Lebensvorgänge des Blutes.** (Microscopical researches on some vital processes of the Blood.)
[Methods, *post.*]
Arch. f. Pathol. Anat. (*Virchow*), LXXXVI. (1885) pp. 60–100 (3 pls.).

LEE, A. B.—**Notiz, das Schällibaum'sche Collodium betreffend.** (Note on Schällibaum's collodion.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885) p. 522.

LEGGETT, F. W.—**Silicate of Soda as a mounting medium.**
[Finds it to be a good mounting medium, transparent, and the mount is quickly made. Mr. C. F. Cox, on the contrary, found the soda was deposited in crystals.]
Journ. New York Micr. Soc., I. (1885) p. 213.

LIST, J. H.—**Mittheilungen technischen Inhaltes.** (Technical notes.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 514–6.

LOCKWOOD, S.—**Preparing Feather Crystals of Uric Acid from a Caterpillar.** [*Post.*] *Journ. New York Micr. Soc.*, I. (1885) pp. 217–8.

MARMÉ, W.—**Lehrbuch der Pharmakognosie des Pflanzen- und Thierreiches.** (Handbook of animal and vegetable pharmacology.)
[Contains brief directions for the preparation of each drug for microscopical examination.]
Part I., 272 pp. (8vo, Leipzig, 1885).

MARTINOTTI, G.—**La picronigrosina nello studio delle alterazioni dei centri nervosi.** (Picronigrosine in the study of the alterations of the nervous centres.) [*Supra*, p. 352.] *Zeitschr, f. Wiss. Mikr.*, II. (1885) pp. 478–84.

MATTIROLO, O.—**Skatol e Carbazol, due nuovi reagenti per le membrane lignificate.** (Two new reagents for lignified membrane.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 354–5.

MAYER, S.—**Ueber die blutleeren Gefässe im Schwanze der Batrachier-larven.** (On the bloodless vessels in the tail of Batrachian larvæ.)
[Methods, *post.*] *SB. K. Akad. Wiss. Wien*, XCI. (1885) p. 1.

MAYS, R.—**Histophysiologische Untersuchungen über die Verbreitung der Nerven in den Muskeln.** (Histophysiological researches on the extension of the nerves in the muscles.)
[Methods, *post.*] *Zeitschr. f. Biol.*, XX. (1885) p. 449.

MELTZER, S. J., and W. H. WELCH.—**Zur Histophysik der rothen Blutkörperchen.** (On the histophysics of the red blood-corpuscles.)
[Methods, *post.*] *Centralbl. f. d. Med. Wiss.*, 1884, p. 721.

MIRFIELD, E. H.—**Turn-table.**
[Lever for holding brush and raising or lowering it.]
Engl. Mech., XLII. (1886) p. 451 (2 figs.).

MOLISCH, H.—**Berichtigung.** (Correction.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) p. 359.

MONDINO, C.—**Sulla struttura delle fibre nervose midollate periphericheo.** (On the structure of the medullated peripheral nerve-fibres.)
[*Supra*, p. 342.] *Arch. per le Sci. Med.*, VIII. p. 45.

MORRIS, W.—**[New Mounting Medium.]** [*Supra*, p. 357.]
Australasian Med. Gazette, V. (1886) p. 100.

New Slides.
[Hinton's *Trichina*—Piffard's botanical—Collins's *Eozoon.*]
Sci.-Gossip, 1886, p. 67.

NISSL.—**Untersuchungsmethoden der Grosshirnrinde.** (Methods of investigation for the brain cortex.)
[Methods, *post.*] *Ber. Naturf.-Versamml. Strassburg*, 1885, pp. 506 and 135.

Ost, J.—**Ueber die Leistungsfähigkeit der Mikrometerschraube.** (On the performance of the micrometer-screw [of microtomes].) [*Post.*]
Zeitschr. f. Wiss Mikr., II. (1885) pp. 295–300.

Paulsen, E.—**Färbung von Schleimdrüsen und Becherzellen.** (Staining of mucous glands and goblet cells.) [*Supra*, p. 353.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 520–1.

Pengra, C. P.—**Preserving Urinary Casts.**
["There is no better medium than the mother liquid.]
Amer. Mon. Micr. Journ., VII. (1886) p. 39.

Prudden, J. M.—**Delafield's Hæmatoxylin Solution.**
[Reply to query as to the discoverer (Prof. J. Delafield) and original directions for making.]
Zeitschr. f. Wiss. Mikr., II. (1885) p. 288.

Renard.—See Klement.

Ribbert.—**Zur Färbung der Pneumoniekokken.** (On staining pneumonia cocci.) [*Post.*]
Deutsche Med. Wochenschr., 1885, p. 136.

Rohrbeck, H.—**Neuerungen an bacteriologischen Apparaten.** (Improvements in bacteriological apparatus.)
Gaea, XXI. (1885) No. 6.

Rössler, R.—**Die Bildung der Radula bei den cephalophoren Mollusken.** (The formation of the radula in the cephalophorous Mollusca.)
[Methods, *post.*]
Zeitschr. f. Wiss. Zool., XLI. (1885) pp. 447–82 (2 pls. and 1 fig.).

Sandmann, G.—**Ueber die Vertheilung der motorischen Nervenendapparate in den quergestreiften Muskeln der Wirbelthiere.** (On the distribution of the motor nerve-end-apparatus in striated vertebrate muscle.)
[Methods, *post.*]
Arch. f. Anat. u. Physiol.—Physiol. Abtheil., 1885, p. 240.

Schulze, F. E.—**Entwässerungsapparat.** (Dehydrating apparatus.) [*Post.*]
S.B. Gesell. Naturf. Freunde Berlin, 1885, pp. 175–7.
Arch. f. Mikr. Anat., XXVI. (1886) pp. 539–42 (2 figs.)

„ „ **Neues Netz zum Fangen kleiner frei-schwimmender Thiere.** (New net for catching small free-swimming animals.) [*Supra*, p. 341.]
SB. Gesell. Naturf. Freunde Berlin, 1885, pp. 178–9 (1 fig.).

„ „ **Schlammsauger.** (Mud-pipette.) [*Supra*, p. 341.]
Ibid., pp. 179–80.

Schütz.—See Doutrelepont.

Seaman, W. H.—**Mounting Mediums with high Refractive Indices.**
[*Supra*, p. 357.] *Amer. Mon. Micr. Journ.*, VII. (1886) p. 21–4.

[Sections, Ordinary v. Serial.] [*Supra*, p. 349.] *Nature*, XXXIII. (1886) p. 243.

Seeds of Orthocarpus purpurascens.
[The fully ripe seed has become a favourite object for exhibition under the Microscope. Its chief interest centres in the white net-like sac in which the kernel is encased.]
Journ. New York Micr. Soc., I. (1885) p. 224.

Serrano y Fatigati, E.—**Nota sobre la cristalizacion en el campo del microscopio del acetato potásico.** (Note on the crystallization of acetate of potash in the field of the Microscope.)
Anal. Soc. Españ. Hist. Nat., XIV. (1885) *Actas*, pp. 79–80.

Slack, H. J.—**Pleasant Hours with the Microscope.**
[Rotifers.] *Knowledge*, IX. (1886) pp. 144–5 (5 figs.).

Smith's (H. L.) New Mounting Medium of high refractive Index.
[*Supra*, p. 356,]
Amer. Mon. Micr. Journ., VII. (1886) pp. 3–4.

Spengel, J. W.—**August Becker's Schlittenmikrotom.** (A. Becker's Slide-Microtome.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 453–9 (2 figs.).

Stein, S. v.—**Einfache Vorrichtung für das Mikrotom zur Einbettung der Präparate.** (Simple contrivance for the microtome for imbedding). [*Post.*]
Centralbl. f. d. Med. Wiss., 1884, p. 100.

STEIN, S. v.—**Eine neue Methode, Hämoglobin-Krystalle zu erhalten.** (A new method of obtaining hæmoglobin crystals.)
[Methods, *post.*] *Centralbl. f. d. Med. Wiss.*, 1884, p. 404.

STELZNER, A.—**Die Entwicklung der petrographischen Untersuchungsmethoden in den letzten 50 Jahren.** (The development of petrological methods in the last 50 years.)
Festschr. Gesell. Isis, 1885, p. 25.

STOWELL, C. H.—**How to examine Epithelium.**
[Directions for preparing and examining columnar, ciliated, and pavement epithelium.]
The Microscope, VI. (1886) pp. 25–8 (6 figs.).

STRENG, A.—**Ueber einige Mikroskopisch-chemische Reactionen.** (On some microchemical reactions.)
[Tests for silver, arsenic, antimony, barium, tartaric acid, and sulphuric acid.]
Ber. Oberhess. Gesell. f. Natur- u. Heilk. Giessen, XXIV. (1885) pp. 54–5.
[Phosphoric acid, potassium, sodium, lithium, calcium and strontium. barium, magnesium, aluminium.]
Neues Jahrbuch f. Mineral., I. (1885) pp. 21–42.

TOISON, J.—**Sur le numération des éléments du Sang.** (On counting the elements of the blood.)
[Methods, *post.*] *Journ. Sci. Méd. Lille*, 1885, 4 pp.

UFFREDUZZI, G. B.—**I Microparassiti nelle Malattie da Infezione. Manuale technico.** (The micro-parasites of infectious diseases. Technical manual.)
322 pp., 2 pls. and figs. (8vo, Torino, 1885).

UNNA, P. G.—**Zur Färbung der Leprabacillen.** (On staining the leprosy bacillus.) [*Post.*]
Monatsch. f. Prakt. Dermat. Ergänzungsh., 1885, p. 47.

VINASSA, E.—**Beiträge zur pharmakognostischen Mikroskopie.** (Contributions to pharmacological microscopy.) [*Post.*]
Zeitschr. f. Wiss. Micr., II. (1885) pp. 309–25 (4 figs.).

VIRCHOW, H.—**Ueber Zellen des Glaskörpers.** (On cells of the vitreous body.)
[Methods, *post.*] *Arch. f. Mikr. Anat.*, XXIV. (1884) pp. 99–109.

VRIES, H. DE.—**Over eene methode om im plantensappen gebonden zuren te bepalen.** (On a method of determining the acids in plants when combined with bases.) [*Supra*, p. 346.]
Maandblad voor Natuurwetenschappen, 1884, No. 9.

WALL, O. A.—**Glass Slides for Mounting.**
St. Louis Nation. Druggist, VIII. (1886) pp. 24 and 39.
" " **Protect Slides against Frost.**
["It is advisable to take it for granted that frost may injure the slides, and to act accordingly by keeping them in a moderately warm room."]
Ibid., p. 39.

WARLOMONT, R.—**Le Bacille de la tuberculose.** (*Bacillus tuberculosis.*)
[Methods, *post.*]
Bull. Soc. Belg. Micr., XII. (1886) pp. 44–8, from *Rev. Médicale*, Louvain.

WEIGERT, C.—**Eine Verbesserung der Hämatoxylin-Blutlaugensalzmethode für das Centralnervensystem.)** An improvement in the hæmatoxylin ferrocyanide of potash method for the central nervous system.) [*Post.*]
Fortschr. d. Med., III. (1885) p. 236.
" " **Ein neues Tauchmikrotom besonders für grosse Schnitte.** (A new immersion microtome, especially suited for large sections.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 326–33 (2 figs.).
" " **Ueber Schnittserien von Celloidinpräparaten des Centralnervensystems zum Zwecke der Markscheidenfärbung.** (On series-sections of celloidin preparations of the central nervous system for staining nerve-sheaths.)
[*Post.*] *Ibid.*, pp. 490–5.

WELCH, W. H.—See Meltzer, S. J.

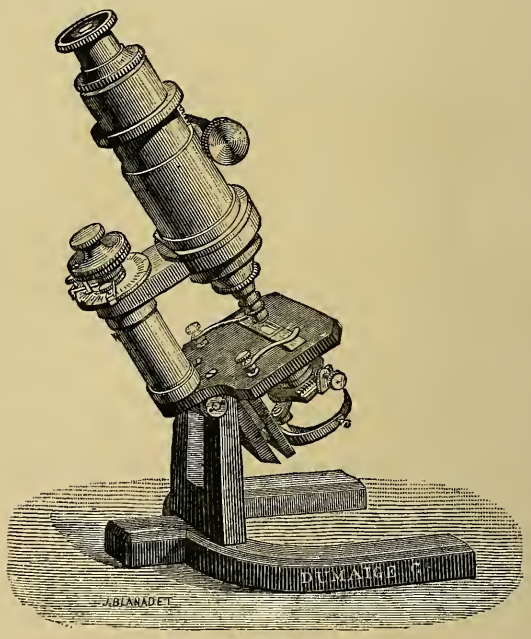
WHITMAN, C. O.—**Osmic Acid and Merkel's Fluid as a means of developing nascent histological distinctions.** [*Post.*]
Amer. Natural., XX. (1886) pp. 200–3.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Viallanes' Photographic Microscope—Compound Images by the Method of Successive Exposures.†—At the outset of an inquiry into the best methods and conditions of micro-photography, Dr. H. Viallanes premises that those instruments, in which the dark chamber is fixed directly to the tube of the instrument are subject to a serious defect, both because the weight of the chamber must affect the micro-

Fig. 82.



metric screw, and also because the tremors caused by inserting and removing the negative are communicated to the instrument, and may displace the object and with it the photographic image. It is a

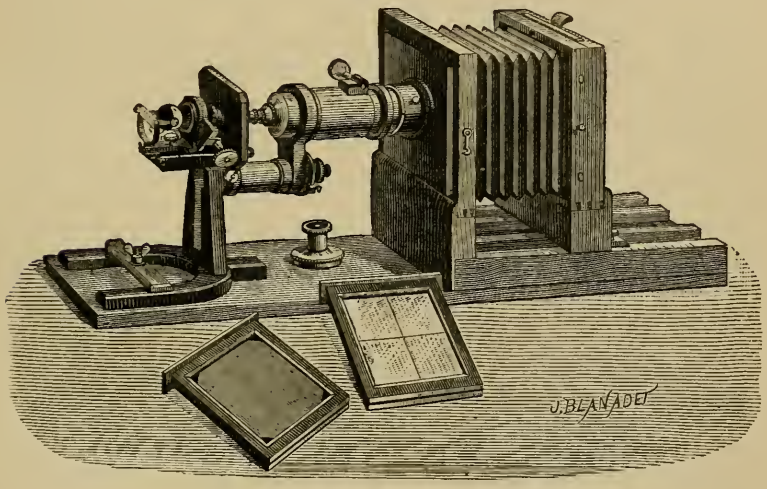
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

† Viallanes, H., 'La Photographie appliquée aux Études d'Anatomie Microscopique,' 63 pp. and 4 figs. (8vo, Paris, 1886).

primary necessity that the camera and the Microscope should not be in direct contact but united only by a cloth connection. The Microscope-tube may be either vertical or horizontal, but the latter is the position which insures the greatest stability and facilitates manipulation; it is true that this involves some difficulty in photographing an uncovered preparation which is liable to slip when the Microscope is horizontal, but in practice it is generally easy to fix the section to the object-carrier with a few drops of paraffin.

The Microscope and camera adopted by M. Viallanes are shown in figs. 82 and 83. The latter is a sliding collapsible camera similar to that used by photographers. In the front of the camera is a large hole to receive the eye-piece end of the Microscope, while at the

Fig. 83.



back are the usual arrangements for receiving in succession the ground glass for focusing, and the sensitive plate. The Microscope is fixed upon the base which carries the camera slide, and in such a position that the eye-piece end of the tube enters the circular hole in the front of the camera, the connection being made by a metallic washer faced on the inside with velvet to prevent the entrance of any external light. A stop insures the tube being brought into a strictly horizontal position.

On the means of obtaining as large a field as possible, the author says, "The modification required in the Microscope in order that as large an image as possible may be projected upon the sensitive plate, is easily effected; it is only necessary to increase the diameter of the tube, and this has been done in our photographic Microscope. The instrument with the tube thus enlarged can be employed just as well

as any other for ordinary observations, and for this purpose we have added an adapting piece by means of which the usual eye-pieces may be used. It is not difficult to understand the motives which have led the makers to construct narrow tubes in Microscopes designed for ordinary work; the dimensions of the tube are determined by those of the eye-piece, which, in order that the observer may not be fatigued, should only receive so much of the image as may be conveniently comprehended by the eye."

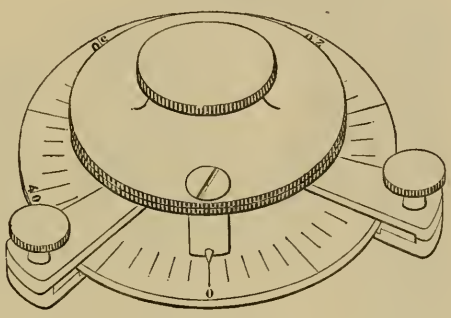
With regard to the special difficulties presented by objects which are not flat, the author writes, "We have already stated that to obtain a photograph well defined in every part, the object should be as nearly as possible a plane. Unfortunately, even in the case of sections, this condition is not always realized, while with certain objects, e. g. insects and Foraminifera, it can never be so. It is possible, however, by certain methods to obtain perfectly clear photographs of objects which lie in different planes. When such a case presents itself, it is well to use the weakest possible objective which will bring out the details that are to be reproduced. By employing a weak objective with long focus, many more planes can be simultaneously brought to a focus than with a more powerful one. The desired result may also be obtained by stopping the objective with a diaphragm; the smaller the diaphragm the greater will be the depth of focus, but at the same time the definition of the lens will be proportionately diminished. A happy mean must be preserved in the choice of a diaphragm.

If the above means are not sufficient, we must have recourse to the *method of successive exposures.* This method is based upon the fact that the same sensitive plate may receive two or more images without confusion; this may be shown as follows:—Place on the stage a micrometer, bring its divisions to a focus on the ground glass, then insert the sensitive plate and expose for say two minutes. Intercept the light, rotate the micrometer through an angle, and expose again for two minutes. The plate when developed will show two crossed images of the micrometer which are perfectly clear even at the point where they intersect. In this way, three or even four superposed images may be obtained upon the same plate. From the observation of these facts, I was led to use the method of successive exposures in the case of objects which could not be simultaneously focused in all their parts. If the same plate receives in succession the images of the different planes of an object, these will be superposed without confusion, and a compound image will be produced which is far more complete than that obtained by photographing a single plane.

In employing this method, the head of the micrometer screw should be provided with an index which moves upon a graduated circle (fig. 84). The lowest part of the object being first brought to a focus upon the ground glass, the division at which the index stands is noted, then the highest part of the object is focused and a second reading is made on the circle. These readings determine the limits between which the index must move if all the successive planes of the

object are to be photographed. The sensitive plate is now introduced and exposed three or four times, the index being set at different points between the limits; in this way three or four images are superposed and form a complete picture. To obviate the reading of angles, the circle is provided with two movable stops which can be fixed at the limiting positions by means of screw clamps, so as to limit the angular space through which the index can be turned, without

Fig. 84.



the necessity of any reading. In practice it is best not to attempt to obtain more than two or three successive impressions, since with a greater number the figure becomes confused. It must be added that the photographs are never so fine as those got from an object which can be completely photographed by a single exposure."

Beck's Demonstration Microscope.—The instrument shown in fig. 85 was devised by the late Mr. R. Beck for the purpose of securing delicate objects against injury at soirées and similar exhibitions.

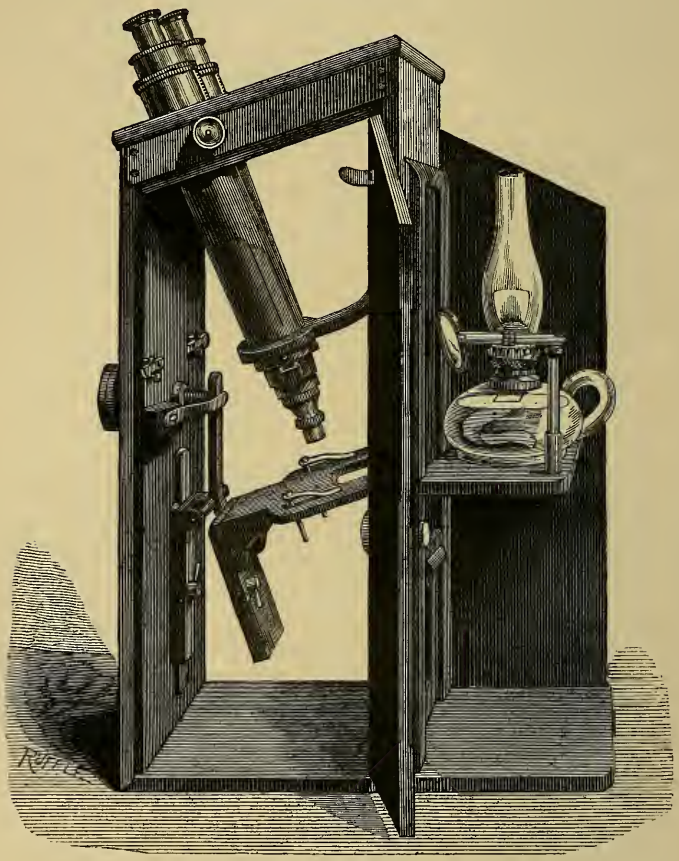
The special point consists in inclosing the Microscope in a box 7 in. $\times 6\frac{1}{2}$ in. $\times 19$ in., into which it is locked, there being doors on either side. The binocular body is fixed to the front of the box by a bar, and also to the top, and the draw-tubes can be extended by the milled head at the side.

At the back of the box is a horizontal pivot on which turns a lever-piece with two equal arms. The stage slides on the lower arm, to which it can be clamped. This enables the object to be placed approximately in focus. For a fine adjustment the top of the upper arm can be pressed forward against a spring by the milled head at the back, the stage being then slightly tilted. The pivot on which the lever-piece turns can also be raised or lowered and clamped. This we presume was intended to provide for a more extended motion of the stage than could be obtained by sliding it on the lower arm of the lever.

The lamp is placed on a bracket in front, which is attached to a vertical sliding piece having a circular aperture which admits the light

to the inside of the box. The bracket, lamp, and sliding piece can be raised or lowered according as it is desired to illuminate opaque or transparent objects. A bull's-eye is attached to the bracket.

Fig. 85.



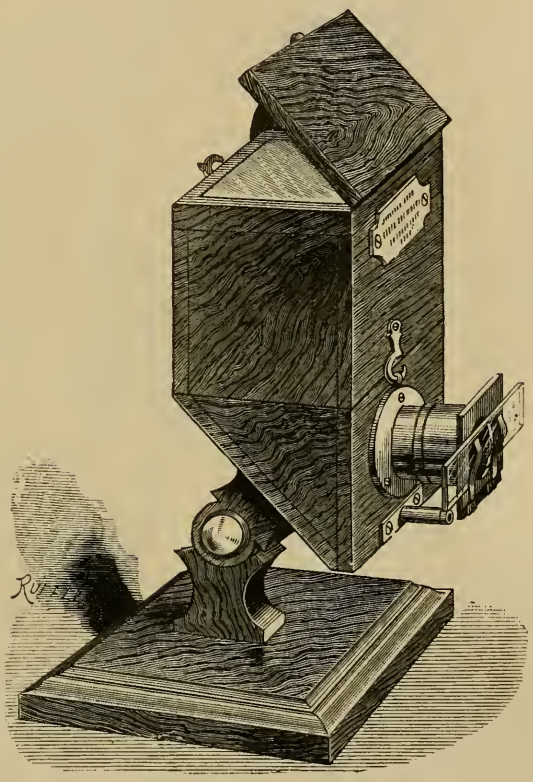
Projection Microscopes.—The exhibition of Messrs. Watson's Microscope (*ante*, Vol. V. p. 1064) has brought forward a somewhat large number of similar instruments, from which we select the following:—

Chevalier's Projection Microscope.—M. V. Chevalier designed the instrument shown in fig. 86 for the purpose of showing microscopic objects to a limited number of students.

The wooden box (which can be inclined on a hinge-joint and clamped) incloses a large right-angled prism by which the image from the objective is reflected upwards to a ground-glass plate (2½ in. square)

which can be shaded by a rising lid. The stage is attached to a piece of tubing fitting over the objective, and the objects can be illuminated either by direct light or by a mirror sliding in the socket below the stage. A lieberkühn fits over the objective for opaque objects.

Fig. 86.

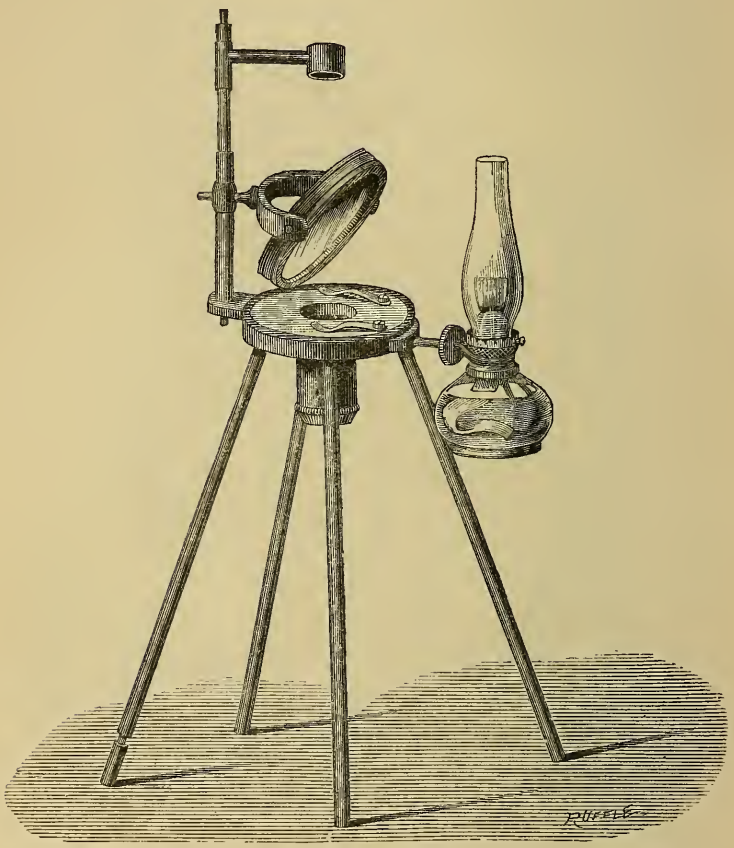


Cooke's Projection Microscope.—The disadvantage of the preceding instrument is the small size of the image, an objection which is remedied in the form devised by Mr. C. Cooke and shown in fig. 87.

Here the stage is raised on four legs to a height of 18 in. above the table. One of the legs has an arrangement for lengthening or shortening it, by screwing in or out a separate piece at the foot. The objective is screwed to an adapter which slides in a tube-fitting beneath the stage. A mirror is attached to a gimbal sliding on a vertical rod above the stage, on which is also a socket for other apparatus. The rod is connected with a ring which rotates on the outer margin of the stage, carrying with it a clip with a lamp. The clip is made to grasp

the lamp by a sliding nut. The legs at their base form a square of 16 in., thus allowing room for a large image, which can be better seen if a piece of black cloth is thrown round three of the sides.

Fig. 87.



*Plössl's Electric Projection Microscope.**— Dr. G. Gärtner describes the Microscope made by Plössl and Co., which is used for demonstration purposes at the Institute of General and Experimental Pathology in Vienna by Prof. Stricker.

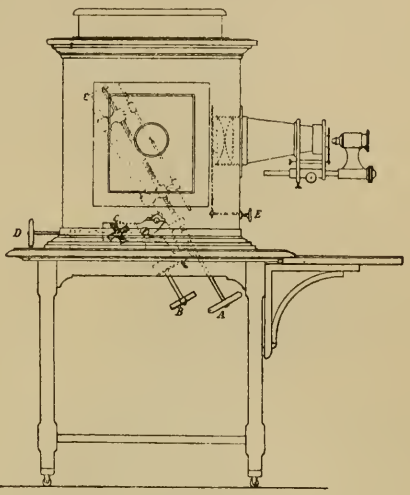
The source of light is an electric arc lamp, supplied by a dynamo driven by a 6 horse-power gas engine. The maximum illuminating power amounts to 2500 candles. An assistant regulates it by hand,

* Med. Jahrb. K.K. Gesell. Aerzte Wien, 1884, pp. 217–44 (1 pl. and 1 fig.).

as flickering cannot be avoided when an automatic regulator is used.

The general arrangement of the instrument is shown in fig. 88. It stands on a table 96 cm. high, running on wheels, so as to be readily movable. The case (with wooden sides) inclosing the carbons is 90 cm. high by 74 cm. deep by 45 cm. wide. It is purposely made large, to prevent the sides getting too hot, and to allow of the carbons being some distance from the lenses. The wooden parts are also lined with asbestos.

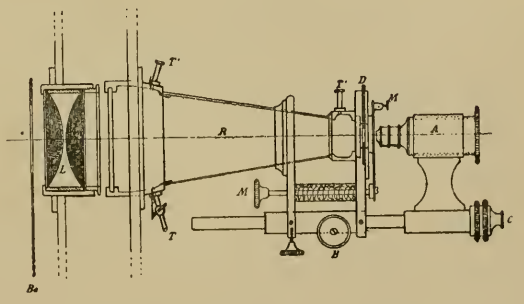
Fig. 88.



The carbons can be inclined and also moved in three directions by the three milled heads at B, C, and D; B raising or lowering them, C moving them from right to left, and D backwards or forwards. The regulator is at A, turning a rod with differential screws, so that the upper carbon moves twice the distance of the lower to compensate for the difference in the rate of consumption.

The special feature of the optical part (fig. 89) is that between the two plano-convex condensing lenses L and the stage D is interposed

Fig. 89.

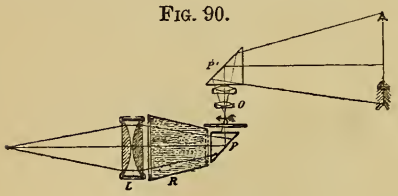


a conical reservoir R, 30 cm. long, filled with water, to cool the rays from the lamp. It is filled by the tube at T, those at T′ T′ allowing the air to escape. Experiments proved that practically nothing was

gained by using an alum solution instead of water. The objective is shown at A, the coarse and fine adjustments at B and C, the clamp for the objects M, the stage diaphragms at D, and a second diaphragm at the back of the condensers at B *e*. The latter is actuated by the screw E in fig. 88.

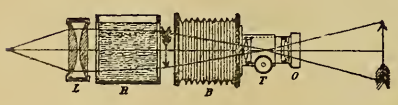
With objects which must remain horizontal, the contrivance shown in fig. 90 is used, with smaller condensers L and a shorter cone R, the rays being deflected by two prisms P and P′, above and below the stage and objective (O). It is only suitable for low powers, and has been used more especially for showing living chicken embryos.

Fig. 90.



A second subsidiary apparatus or "Sciopticon" (fig. 91) is used for small amplifications of very large objects, such as large brain sections. The water vessel R in front of the condensers L is rectangular, and the objective O is composed of photographic lenses. An extensible camera B is interposed between the object and the objective, and the focal adjustments are made either by compressing or extending the camera, or by moving the objective alone by the milled head T. At 4½ m. distance from the screen amplifications of 18 to 25 times are obtained.

Fig. 91.



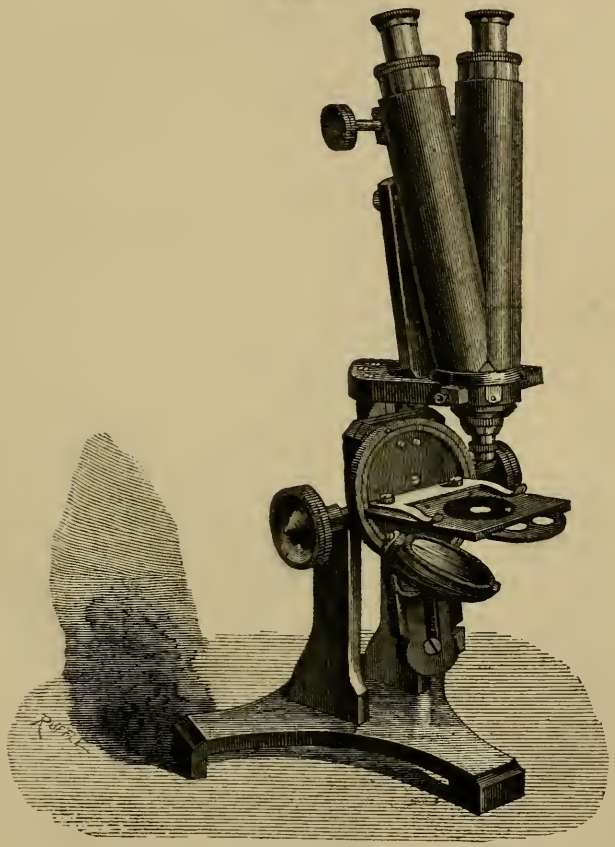
A table is given showing the amplifications, with the various objectives, from 370 to 8000; the highest powers used being Seibert's Nos. VIII. and X. water-immersion (3800 and 8000 respectively).

As a screen for the reception of the images, a plate made of the finest gypsum, 1·5 m. in diameter, is used, placed 4·5 m. from the objective. Upon this a human red blood-corpuscle appears, with a Seibert X objective, as a disc of 6 cm. in diameter. The amœboid movements of white blood-corpuscles are perfectly visible to a class of 300 persons (the more distant ones provided with opera-glasses). In order to make the white blood-corpuscles quite distinct, Professor Stricker passes through the fresh blood a solution of fuchsin in water, containing 0·6 per cent. of common salt. The living cells absorb the pigment very slowly, whereas the fluid in which they are contained takes a distinct red colour. The white blood-corpuscles, therefore, appear as bright, white spots on a coloured ground, and do not lose anything of their mobility.

In preparing sections for use with an electric Microscope they require to be somewhat deeply stained, and stains should be chosen which show the histological elements in strongly contrasted colours, such as carmine, gold, or silver staining.

Holmes' Microscope with Swinging Radial Mirror. *—This Microscope (fig. 92) was made by Mr. S. Holmes in 1872, and is an anticipation of the principle subsequently adopted in the Tolles-Blackham and similar Microscopes. The stage is attached to a disc mounted on a slide which is raised or lowered by rack and

FIG. 92.



pinion (forming the only adjustment for focus). At the periphery of this disc is a ring which is free to rotate between guides and to which is attached the mirror. The latter can thus be rotated completely round a line drawn through the centre of the stage, thus giving radial illumination above and below the stage.

* The stand is Holmes' Isophotal Binocular. There is a spiral pinion and diagonal rackwork to the stage-movement.

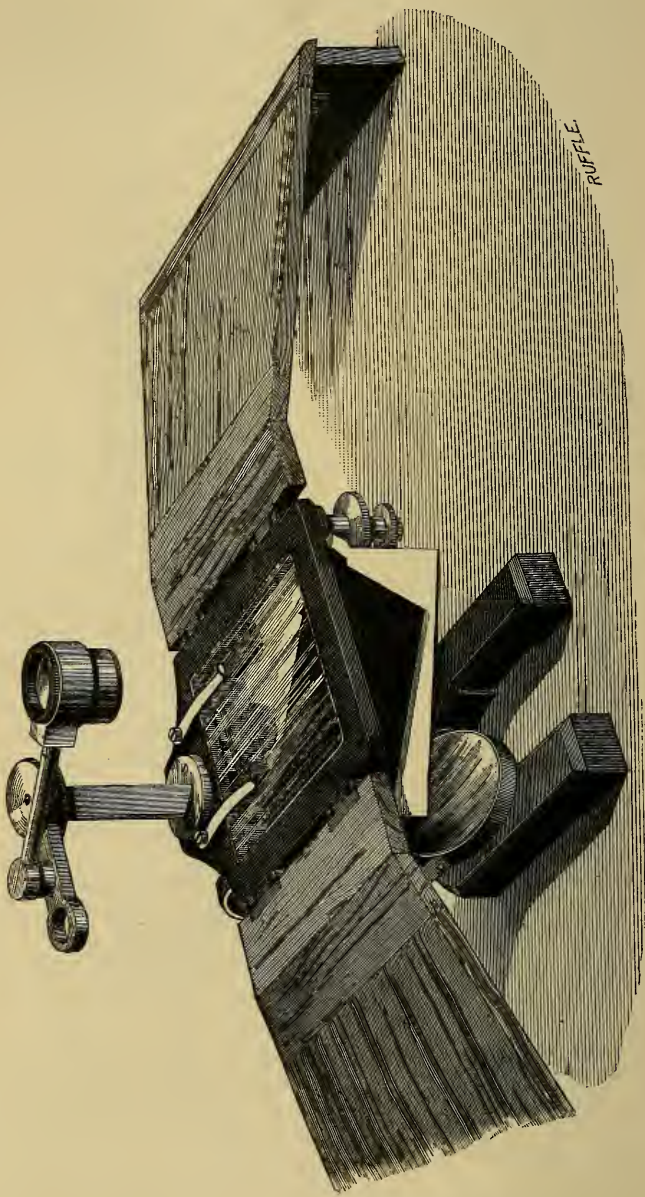


Fig. 93.

Mayer's Dissecting Microscope.

Mayer's Dissecting Microscope.—This (fig. 93) is one of the most convenient dissecting Microscopes which we have yet seen.

The stage consists of a large metal frame, 10 cm. square, to which are attached folding wooden supports for the hands. For minute objects a metal plate is dropped into the frame, in which is a small central opening, which can be closed by either a black or white disc as desired. For larger objects, especially living aquatic animals, the metal plate is replaced by glass, and white or black plates can be brought beneath it, according to the background required. These plates are turned away from the stage by the milled heads shown in front of the stage on the right.

There are three arms for lenses. The lower one shown in the fig. is for high powers (the upper being removed), while the upper is for Zeiss's aplanatic lenses (× 6 and 10). By the combination of the movements of the two arms the lenses can be made to traverse all parts of the stage. An extra holder is also supplied for the high powers, which can be moved in the same way over the whole stage.

Magic Lantern v. Microscope.*—Mr. T. King considers that for purposes of general teaching the magic lantern possesses the advantage over the Microscope of lessening both labour and expense. By means of micro-photography, the magnified image of minute objects, such as sections of vegetable tissues, diatoms, &c., can be photographed in a form available for use as a lantern-slide. With the aid of such slides, the teacher can at once explain to the whole class what can only with the Microscope be explained individually.

Inostranzeff's Comparison Chamber for the Microscopical Study of Opaque Minerals and other objects.†—M. A. Inostranzeff writes as follows:—

"The great importance of the Microscope in the study of rocks cannot be denied. To the Microscope we owe the modern classification of rocks, our knowledge of the structure of the rocks themselves, of the minerals which compose them, and of their inclusions, as well as of many modifications and metamorphoses to which rocks and minerals are subject. Up to the present time, however, scarcely any progress has been made to a rational method of investigating the opaque minerals which enter into the composition of rocks. Ten years ago I published ‡ a note on the study of opaque minerals, in which I proposed to employ the colour and lustre of these minerals to distinguish between them. By means of brilliant illumination from above, little differing from ordinary daylight, the lustre and colour may be made evident. In this way I succeeded in determining eight opaque minerals in the rocks of the district of Olonez, and in showing, in several cases, their genetic relations. But the determination of colour and lustre being liable to subjective errors, I have

* Proc. and Trans. Nat. Hist. Soc. Glasgow, i. (1886) p. xxx.

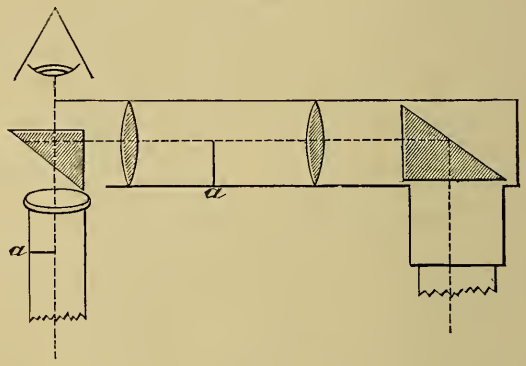
† Comptes Rendus, c. (1885) pp. 1396–8. Neues Jahrb. f. Mineral., ii. (1885) pp. 94–6 (2 figs.).

‡ Abh. d. Moskauer Naturforschergesellschaft, vi., Part 1.

been endeavouring for some time to devise a method of comparing unknown opaque minerals with others which have been already determined. For ten years no progress was made in this direction.

My first attempt was made by means of the camera lucida, which transmits perfectly both the colour and the lustre of opaque minerals; with the help of this instrument I transfer the image from one Microscope into a second, on the stage of which is a known mineral, and so am able to compare the two. But to prevent the image of the first Microscope from covering that of the second the following precautions must be taken. Into a Hartnack's camera lucida (fig. 94) I

Fig. 94.

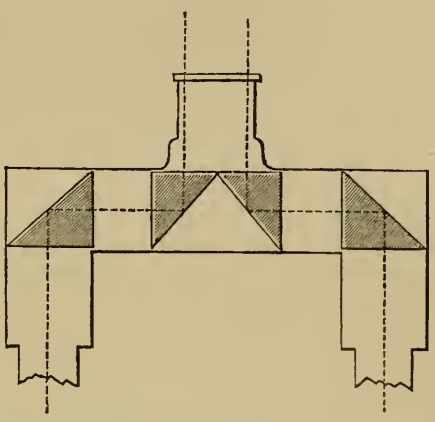


introduce a diaphragm *a*, which is placed in the lower part of the tube, so as to cover half the field of view; a similar diaphragm *a*, that is, one which also covers half the field, is introduced into the second Microscope, which contains the known mineral. By means of this arrangement of the diaphragms I see in the second Microscope on one side (the left) the image of the mineral to be determined, and on the other side (the right) that of the known mineral. The apparatus, as described above, has always one great fault, that is, that the comparison is made, so to say, between an object and a shadow, for the camera lucida always slightly increases the image which it transmits, and consequently diminishes its brightness. I have now, however, found a method of comparing minerals under identical conditions, and I have only mentioned the camera lucida and my first attempt because every one possesses this instrument, and can easily test the method.

To secure a complete identity between the image of the mineral to be determined and that with which it is compared, I have had a new apparatus constructed, which may be called the *Comparison Chamber* or *Microscopic Comparer* (fig. 95), which enables us, as it were, to elongate two Microscopes, and bend them at right angles. At the outer corners of the apparatus are placed totally reflecting prisms or small mirrors, which receive the rays that emerge from the Microscopes and reflect them at right angles. Below the opening, in

the centre of the top of the apparatus, are placed two other prisms, which reflect upwards the rays which they receive from the first pair of prisms. This comparison-chamber is fixed on two Microscopes without eye-pieces, and an eye-piece is placed above the central prisms. By these means I obtain a circular field of view composed of two halves, divided by a fine line; one half belonging to the image from the first Microscope, the other to that from the second. If now two minerals absolutely identical in colour and lustre are placed under the two Microscopes there will appear in the eye-piece of the chamber a completely uniform image, so that the line of division disappears. The slightest change in the tint of one of the objects causes the sudden reappearance of this line, the image being again divided into two distinct parts.

Fig. 95.



I think I am justified in supposing that my comparer may be applied not only to the study of minerals and rocks, but equally to all microscopic researches in which comparison is employed.

To bring out better the colour and lustre of the minerals, I illuminate them by means of small mirrors placed on the stage of the Microscope. For an account of the construction of these, and of the scale of comparison, I must refer to a detailed account which will shortly be published. I may add that in my scale I replace the natural opaque minerals, which would themselves be too expensive, by artificial colours prepared from the powder of these minerals. Under the Microscope the effect is precisely the same."

Astigmatic Eye-piece.*—Mr. E. Gundlach criticizes Dr. J. K. Stockwell's criticism† of his proposed astigmatic eye-pieces, and considers that the latter's suggestion of cylindrical lenses in spectacle-frames is objectionable on the ground that spectacles should never be used with any optical instrument, as they are always injurious to its proper performance, and, therefore, the wearer of spectacles should always remove them before using the Microscope or telescope.

That spectacles are injurious is attributable mainly to the following reasons: In the first place they prevent the eye reaching its proper place, in proximity, to the eye-piece. Secondly, the generally very eccentric and oblique position of the spectacle-glass to the optical axis of the eye, and, consequently, also of the instru-

* The Microscope, vi. (1886) pp. 63–5. † See this Journal, *ante*, p. 313.

ment, greatly injures the proper performance of the latter. The third objection is that spectacle-glasses add two light refracting and reflecting surfaces to those already existing. It is almost impossible for the observer wearing spectacles to even roughly place the optic axis of the spectacle lens, if worn in the ordinary manner, in line with that of the instrument.

On the other hand, Mr. J. Martin finds* that "in every case where test objects could be seen both with and without the spectacles, the definition was better when they were used."

Immersion Objectives.†—Mr. E. Gundlach has a wonderful paper under this title, which carries one back to the dark ages of microscopy. The following is quoted verbatim:—

"The refractive power of water being much lower than that of glass or homogeneous oil, it will, if put in place of those substances, exert a correspondingly smaller influence in correcting the aberrations. But, on the other hand, while the use of the homogeneous medium permits the preservation of the full working distance without any loss in correction, this loss, if water be employed, can, in a great degree, be regained if so much of the working distance as can be spared is sacrificed and the space filled with glass. This can best be done by adding to the thickness of the front lens so much that only just enough of the working distance is left as is practicable, and then fill the comparatively small immersion-space with water. Indeed, by a skilful balancing of the interfering conditions, the difference between the adaptation of water and homogeneous oil can be reduced to a minimum, and yet the working distance be as long as is practically required.

"The high optical superiority of the modern homogeneous immersion objectives over the old water-immersion may seem to disprove this theory. But I do not hesitate to claim right here that the wonderful performance of these objectives is due in a comparatively small degree only to the homogeneous immersion; it is due in a far greater degree, to the increase of the number of lenses and, consequently, the number of refracting surfaces. We remember that at the same time as the homogeneous immersion the four-system principle was introduced. Probably a more important advantage of the homogeneous over the water-immersion, than that of the higher corrective power, may be found in the fact that adjustment for cover-thickness is unnecessary. But even this merit is doubted by many first-class authorities on the manipulation of the Microscope, and the demand for adjustable homogeneous objectives is on the increase.

"Under such circumstances, weighing its merits and its faults, it must be admitted that the practical advantages of the homogeneous immersion principle are at least doubtful. This cannot be said of the four-system principle. It is unnecessary to enter into a thorough theoretical investigation of this matter. It may suffice to call to mind the fact that the aberrations of higher order are inversely pro-

* The Microscope, vi. (1886) pp. 79–80.

† Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 51–3.

portional to the number of refracting surfaces. The objection that there is also a corresponding loss of light, although practically true, is of no consequence whatever, as is sufficiently demonstrated by the extensive experience in the use of this class of objectives.

"Summing up, we come to the conclusion that the future high-power objectives will be the four-system water-immersion. Or, the immersion will be done away with altogether as an incurable inconvenience, and the four-system dry-working objective will be used."

Has not Mr. Gundlach heard of such an important property of objectives as aperture, and does he not know that the limit of aperture of a "dry-working objective" is 1·0 N.A., while a homogeneous-immersion objective may approach 1·52 N.A.?

The microscopist of the future who "does away with immersion altogether as an incurable inconvenience" must, to be consistent, refuse to ride by railway or to send or receive communications by telegraph or telephone. He will probably not carry his consistency so far as to insist upon walking the streets in a state of nature and without the "incurable inconvenience" of clothing, only because he will have just sense enough left to appreciate the fact that his so doing would land him in a prison or an asylum—in the latter he ought at least to be.

Application of Very High Powers to the Study of the Microscopical Structure of Steel.*—Dr. H. C. Sorby writes as follows:—

"Though I had studied the microscopical structure of iron and steel for many years, it was not until last autumn that I employed what may be called 'high powers.' This was partly because I did not see how this could be satisfactorily done, and partly because it seemed to me unnecessary. I had found that in almost every case a power of 50 linear showed on a smaller scale as much as one of 200, and this led me to conclude that I had seen the ultimate structure. Now that the result is known it is easy to see that my reasoning was false, since a power of 650 linear enables us to see a structure of an almost entirely new order, and of such a character that, if it had been on a scale of a quarter or a half the actual magnitude, it would probably never have been recognized, on account of being beyond the resolving power of the Microscope for fine parallel lines. . . . With this arrangement [the Vertical Illuminator] high powers give as good, or even better, illumination than low. Speaking generally, a power of 650 linear is about ten times that previously employed, which is, of course, enough to open out a new field for research.

This great increase has, however, shown little or nothing more in the case of malleable iron containing little or no carbon, or in the case of the intensely hard constituent of spiegel iron, of white refined iron, and of blister steel. It has also shown but little more in the case of inclosed slags, or of the graphite in cast iron; but it has enabled me to see to great perfection crystals which are probably silicon, and has thrown a flood of light on the nature and character

* Paper read at the Iron and Steel Institute on May 14, 1886. Cf. the Ironmonger, 1886, p. 905.

of that constituent of steel which in my lecture at the last annual meeting I described as the pearly compound. High powers show that it really has a structure closely resembling that of pearl, the surface being marked by fine straight or curved parallel lines, due to the presence of alternating very thin plates of varying hardness. After only a few hours of observation I felt almost certain that these thin plates were iron free from carbon, and the intensely hard substance seen so well in blister steel; but the facts were so extraordinary and so unlike anything I had ever seen or heard of in any mineral substance, that it was not until after several months devoted to the careful study of all the chief kinds of iron and steel that I felt confidence in the results.

The chief facts are best seen in the case of an ingot of steel of medium temper. On fracture comparatively large crystals are visible, radiating from the surface to the interior. When a properly prepared microscopical section is viewed with a moderate power, it is easy to see that, after having crystallized out from fusion at a high temperature, these large crystals break up on further cooling into much smaller, as described in my lecture. What is now seen with very high powers is that these smaller crystals finally split up into alternating very thin plates. Taking all the facts into consideration, it appears as though a stable compound of iron with a small amount of carbon exists at a high temperature, which at a lower breaks up into iron combined with a larger amount of carbon, and into iron free from it. If these two products had not differed so much in hardness, or if the alternating plates had been considerably thinner, or if definite plates had not been formed, such a compound structure would never have been suspected. It has probably never been specially looked for in other substances, and might exist without being visible, even with the highest and best magnifying powers. In those cases where no subsequent segregation has occurred, these alternating plates are often remarkably regular and uniform in thickness; and as far as I am able to judge, the softer plates are about double the thickness of the harder. If so, we may say that the thickness of the softer plates is about 1/40,000 in., and of the thinner 1/80,000, thus giving well-marked striæ 1/60,000 in. apart. To define even these requires very careful adjustment of the object-glass; and, considering all the circumstances of the case, it could not be expected that the two bounding edges of the thinner hard plates could always be defined so as to show a flat intermediate surface. We are, in fact, brought face to face with an optical difficulty, depending on the considerable length of waves of light compared with the objects under examination, and are obliged to infer the nature of the very fine structure from what is seen when it is somewhat coarser. In some cases it is easy to trace the gradual passage from these extremely thin plates up to those which are sufficiently thick to show clearly that the structure is due to thin plates of the hard substance between soft iron. No mere cleavage would explain all the facts, though it is extremely probable that the direction of the alternating plates was determined by the previous crystalline structure. In some cases the plates are less well marked, and the structure is more granular.

To give a good idea of the size of the plates, I would refer to what is seen in a longitudinal section of medium steel forged from an ingot 3 in. in diameter down to a bar 1 in. square. When broken it shows a very fine grain, and when a prepared section is examined with a moderate power this grain is seen to be due to crystals often about 1/1000 in. in diameter, which are not drawn out or distorted, as they would have been if they had existed previously to final cooling after hammering, and as they are distorted if the steel be hammered at a lower temperature. Examined with a power of 650 linear, these crystals only 1/1000 in. diameter are seen to contain something like sixty of the alternating plates, and even this extremely delicate structure shows little or no trace of distortion. Of course it is impossible to separate and analyse such thin plates, and we must rely on induction to furnish us with a knowledge of their nature....

It will thus be seen that the use of very high magnifying powers opens out a wide field for research, and has already placed a number of important questions in a new light. As far as I am able to judge, all the facts seen in the various kinds of iron and steel hitherto examined may be explained in accordance with the views here described; but the time spent in studying the fundamental questions prevented me from finishing a comprehensive illustrated memoir which was already in large part written before using very high powers."

Use of the Microscope with Convergent Polarized Light.*—Dr. A. Wichmann considers that the methods proposed some years ago, almost at the same time by Bertrand, Klein, and Lasaulx, for converting the Microscope into a polarizing instrument for convergent light, in spite of their utility in the microscopic analysis of rocks, have not as yet fully answered the expectations which were formed of them. The obstacle to their success is the want of intensity in the interference figures when the sections are very thin, which makes it difficult to observe them with certainty. Where, however, this objection does not apply, the method, as is shown by a paper by Herr F. Becke, gives good results.†

Experiments with the Electric Incandescent and Arc Lights.‡—Dr. M. Flesch has made experiments with the arc light of a Duboscq lamp, with two Edison incandescent lamps of 16 and 8 candle power respectively, and a Swan lamp of 2½ candle power. Tests were applied for the discrimination of colours, and for resolving power by the electric light as compared with daylight. For colour was used a histological preparation injected with Berlin blue, and stained with carmine and iodine green; for resolution the test-objects employed were *Surirella gemma* and *Nitzschia sigmcidea* of Möller's test-slides. The arc light was used at a distance of 1 metre, and the incandescent lamps at a distance of 30–40 cm. from the mirror; the same results were obtained from both, namely, very good distinction of colours, considerably better than by daylight, and improved resolv-

* Zeitschr. f. Wiss. Mikr., i. (1884) p. 139.
† Tschermak's Mineralog. und Petrogr. Mitth., v. (1883) p. 527.
‡ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 561–3.

ing power; the latter was also increased by interposing a blue-green glass, but diminished by the use of red and orange-yellow glasses.

Dr. Flesch concludes, as the result of his experiments, that the incandescent light excels every other artificial light for clearness and brightness of field and for steadiness. He is opposed to any plan of fixing the lamp to the stand of the instrument, better results being obtained when the lamp is placed immediately below the condenser than when the light is reflected by a mirror.

Mayer's Black-ground Illuminator.*—This is a simple form of black-ground illuminator, devised by Prof. A. M. Mayer, for the study of aquatic life with low-powers of aperture up to 60°, showing aquatic organisms as brilliant objects on a black ground, so that they are instantly detected among the more opaque particles of ooze. The interior structure of rhizopods, infusoria, rotifers, worms, &c., is also brought out in a manner which is said to be very striking. With dark-ground illuminators which give large angles to the emergent pencils, the interior structure of translucent bodies is not so well seen.

The optical combination consists of three plano-convex lenses in contact with one another, which the author denotes as A, B, and C, in their order from below upward. A is a plano-convex lens with its plane side facing the mirror; the radius of its curvature being $2\frac{1}{4}$ in. and its thickness 0·175 in. B and C are plano-convex lenses with their convex sides down; radius 1 in. and thickness 0·4 in. On B is cemented a stop, formed of a piece of paper blackened with lamp-black in shellac. The diameter of the central stop is 0·71 in., and the width of the annular opening round the stop 0·1 in.

Each of the lenses in the experimental form of the illuminator exhibited had a diameter of $1\frac{1}{2}$ in. It is evident that this diameter may be lessened in the lenses B and C, so that the combination when mounted will have the form of the frustum of a cone. With this form, the combination could enter the aperture of the majority of stages, and its upper lens be brought even in contact with the under side of the slide.

The mean angle of the emergent rays at the upper lens C is $69\frac{1}{2}°$. The mean diameter of the annular opening of the stop is calculated in reference to the curvatures of the lenses, so that the central rays issuing from this stop fall normally on the convex surface of the lens C, and thus traverse it without refraction. This also tends to correct the chromatic dispersion of the pencil of rays emerging from B, whose boundaries of red and blue fall in directions inclined towards the normal of the lens C, on opposite sides of this normal.

The plane mirrors, as generally made, of nearly all Microscopes, except those of the large models, are too small in the front and rear diameter to illuminate the lower lens of dark-ground illuminators; and the author obviates this defect by cutting an ellipse out of a piece of plane mirror, and attaching this to the frame of the ordinary mirror. The ellipse has a mirror axis a little larger than the diameter of the lower lens of the illuminator, and the major axis is so long that

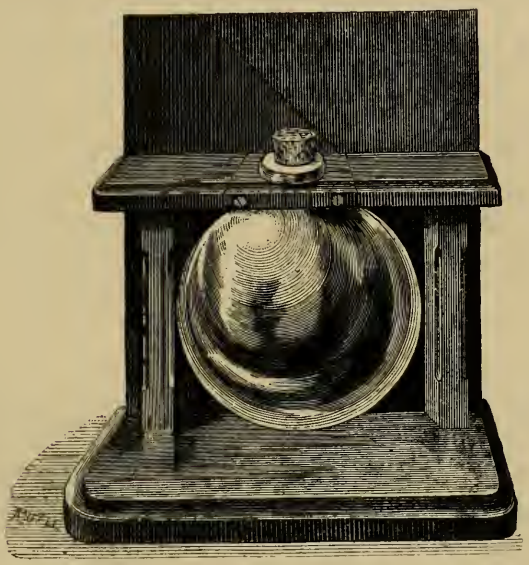
* Journ. New York Micr. Soc., ii. (1886) pp. 28–30.

when the mirror is inclined as much as it will ever need to be to the axis of the Microscope, the whole of the surface of the lower lens of the illuminator is covered by reflected light.

Zeiss's Monochromatic Illuminator.—Dr. Zeiss supplies the apparatus shown in fig. 96 for obtaining monochromatic light for photo-micrography, or ordinary microscopic work.

A glass globe 7 in. in diameter is held by the neck in a wooden frame consisting of a base-plate, two uprights, and a cross piece.

Fig. 96.



The globe is filled with ammonio-copper solution, and placed in front of the lamp, so that monochromatic light can be received by the mirror or condenser. The space between the globe and the uprights is closed by a thin wood screen, which also extends 5 in. upwards, and 3/4 in. on each side of the uprights, shutting off extraneous light more completely.

The lamp intended to be used with the globe is a Siemens gas-burner, and should be placed about 6 in. behind the globe, while the mirror should be at the same distance in front of the globe. The concentrated part of the rays should fall exactly on the mirror. It will be remembered that Hooke * made use of a glass globe filled with water as a bull's-eye condenser, and that Mr. Kitton, in 1881,† also suggested the use of a globe filled with water as well as with a dilute solution of sulphate of copper.

* 'Micrographia,' 1665.

† See this Journal, i. (1881) p. 112.

Theory of the Camera Lucida.*—The first ten pages of Dr. E. Giltay's paper deal with the theory of lenses, nodal points, &c., the constitution of the eye (with a diagram of the cornea, lens, and retina), and contain a discussion of how the image is formed in the eye, whilst the last six pages are devoted to a consideration of the use of lenses between the pencil and the eye (previously published by the author, and noted in this Journal, III. 1883, p. 278). In the rest of the paper the author discusses the best conditions for illuminating the field of view and the drawing paper.

Take first the case of a white chalk pencil on a black slate. Let fig. 97 represent the image on the retina of the field of view with illumination ω and the object with illumination δ, so that ω is great in comparison with δ; let fig. 98 represent the image of the slate with

Fig. 97.

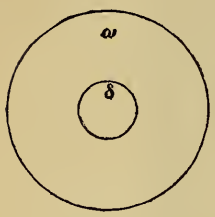


Fig. 98.

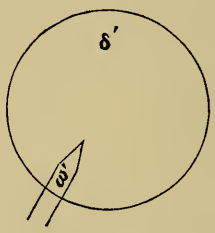
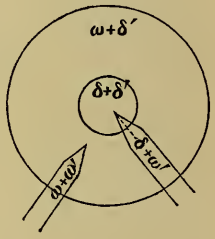


Fig. 99.



illumination δ' and the chalk pencil with illumination ω'. When the two are superposed fig. 99 is the result. The pencil with illumination $\delta + \omega'$ will always be clearly seen upon a faintly illuminated object of which the brightness is $\delta + \delta'$; whether it is also clearly visible upon the background will depend (since δ' is small) upon the relation between ω and ω'; it will be if ω is small in comparison with ω'. If ω is too great in comparison with ω' it must be diminished.

Fig. 100.

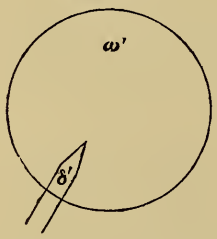
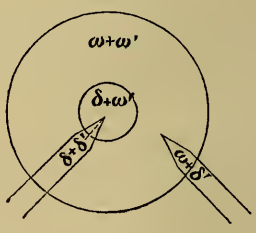


Fig. 101.



The case of a dark pencil upon white paper is represented in figs. 100 and 101, where ω' is now the illumination of the paper and δ' of the pencil. As before, whether the pencil will be easily visible

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 1–23 (10 figs.).

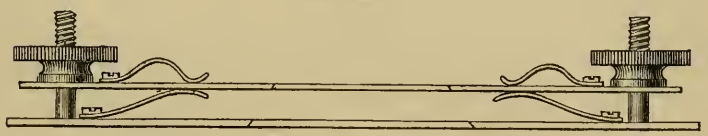
depends upon the relation between ω and ω'. If ω is too great in relation to ω' it must be reduced.

It is generally assumed that to ensure the best conditions the paper and the field of view must be equally illuminated, i. e. $\omega = \omega'$; whilst in fact ω' should be greater than ω. This may be proved by obscuring half the field of view by a semicircular piece of cardboard placed upon the diaphragm of the eye-piece. Using a weak objective, and having diminished the illumination until it is most convenient for drawing the object with the camera, shift the drawing paper until it occupies only the obscured half of the field; it will then be seen at once that the field is much darker than the paper, i. e. ω is less than ω'.

On the other hand, the brightness of the paper must not be too great in comparison with that of the field, or the object will not be clearly visible. In the use of high powers, therefore, the illumination of the paper must be reduced by interposing glass of different tints between the camera and the paper. These should, however, be sparingly used, and only when the illumination of the paper is such as to obscure the object.

Vorce's Combined Focusing and Safety Stage for use in Micrometry with High Powers.*—Mr. C. M. Vorce's device (fig. 102) consists of two perforated brass plates, the upper bearing two spring

Fig. 102.



clips to hold the slide, and the lower having springs lifting the upper plate, and also a micrometer screw at each end passing up freely through the upper plate, which is depressed by milled nuts on the micrometer screws, opposed by the lifting-springs of the lower plate. "The object of the device is to move the slide instead of the objective in focusing, in order that when making measurements by projecting the image on a screen the distance of the screen from the focal point of the objective may remain absolutely unchanged, which is necessary to avoid the objection that the power has been changed by changing this distance. In micrometry it is essential to avoid, so far as possible, every theoretical as well as every practical source of error, even if it should be too minute to effect, appreciably, the result. And especially is this true of micrometry applied to determine, judicially, important questions. In micrometry there are, with all the ordinary appliances, some theoretical sources of error, which, although in most cases so minute as to be, in their effect upon the accuracy of the result, practically *nil*, are sufficient to afford pretexts for objection on the part

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 115-9 (3 figs.).

of those who seek to magnify every defect to be found in the work of others whose results are not agreeable to the views or wishes of those who so object. The identity of results by different methods, and correlation of tests, may often show a given method to be practically exact, yet, if any theoretical objection can be raised against it, it may often be so treated as to completely discredit results that are in point of fact accurate and reliable, and, unfortunately, the less scrupulous the party who thus seeks to discredit such results, the greater the success likely to attend his efforts."

The foregoing, with other considerations, induced Mr. Vorce to adopt the following method of micrometry for high powers:—Instead of using extremely high-power objectives to gain great magnification, tube length, as advocated by Dr. Beale, is employed, and the image is viewed direct, i. e. without magnification by eye-piece, the method having been suggested in part by former experience in the micrometry of blood, and in part by experience in photo-micrography. A base-board is provided, some four or five feet long, at one end of which the lamp is placed enclosed in a light-tight box. A magic lantern answers admirably for illumination, connecting its condenser tube with the stage of the Microscope by means of a light-tight sleeve. The Microscope is placed horizontally with the amplifier in place and the tube as short as possible, and internally blackened to avoid reflection. A movable vertical screen, faced with white cardboard or glass, is adjusted on the base-board at such distance from the Microscope as is found suitable, but need not ordinarily exceed two feet, and is clamped in place when adjusted. The focusing stage is adjusted on the Microscope stage, clamped in place, and a micrometer is put in place and focused, the image being observed on the screen. When the desired power is gained by moving the screen along the base-board it is clamped in place, and the lines of the micrometer, as seen on the screen, are traced by means of a ruler and pen on the face of the screen, and by the use of dividers the spaces may be further subdivided. In the measurements to be made the Microscope and screen are not moved in the least, nor even touched, except to turn the screws of the mechanical stage. The micrometer is removed by pressing down the top plate of the focusing stage, the slide containing the objects to be measured is substituted, and the plate, on being released, brings the slide into focus, if it is of the same thickness as the micrometer, if not, it is brought into focus by the focusing screws of the focusing stage. When focused, the image on the screen is viewed and the measurement read off and noted as the slide is passed along by the movement of the mechanical stage. If, owing to uneven thickness or curvature of the slide or cover, the object begins to pass out of focus, it is focused by means of the screws of the focusing stage. The operator sits, ordinarily, near the screen, working the stage with the left hand and noting the measurements with the right; the milled nuts of the focusing stage are easily reached, and the work proceeds rapidly; although two operators, one to note down the measurements as called off by the other, and occasionally changing places, facilitate the work.

It is obvious that with this device the power employed is always the same, when once adjusted, and enlargement up to 5000 diameters may be obtained. The micrometer eye-piece, where the body is moved by the fine adjustment, is also practically unchanging in power, but cannot easily afford the same amount of magnification, unless with unusually high-power objectives whose short working distance usually precludes their use with tube lengths sufficient to give so great amplification.

A very convenient method of using the focusing stage in micrometry is to so adjust the screen that 0·001 in. of the stage micrometer exactly equals 1 in. of the paper scales used by architects and divided into hundredths of inches; by pasting one of these scales across the screen and bringing the micrometer lines (of 0·001 in.) to coincide with the inch lines of the scales, and clamping the screen in that position, a scale upon the screen is obtained reading to $\frac{1}{10000}$ in., which is far finer than can ordinarily be utilized, although by sunlight the striæ of some diatoms, such as *F. saxonica* and *A. pellucida*, will puzzle the eyesight in attempting to count their striation by means of the scale.

An incidental feature of this focusing stage is that it will not allow the slide or cover to be broken in focusing, and is therefore a safety stage as well.

In making measurements by this method the same spaces of the scale should be used for every measurement, and, preferably, the central ones, thus removing any question as to the variation of power or aberrations in the extreme edges of the field. Thus, if the objects measured are about $1\frac{1}{2}$ or 2 divisions of the scale, and two are in the field at once, do not read the dimensions and record them as they stand, but bring first one of the objects to the central line and read from that, and note the measurement; then bring the other object to the *same side* of the central line, read and record as before; both are then measured by the same part of the scale to the extent of the smaller.

Logan's Life-Slide.*—Mr. J. H. Logan's slide (fig. 103) consists of a glass slip of the usual size, but 1/4 in. thick. An annular channel

Fig. 103.

as deep as the thickness of the slide allows is ground out for an air-space, and outside of this a much narrower and quite shallow channel is cut. This last is for holding beeswax or wax and oil, to cement down the cover and prevent evaporation of the enclosed fluid. A drop of water placed in the centre of the slide and flattened down to a stratum as thin as the objects under examination will permit, is in a very favourable condition for examination. Infusoria, thus confined,

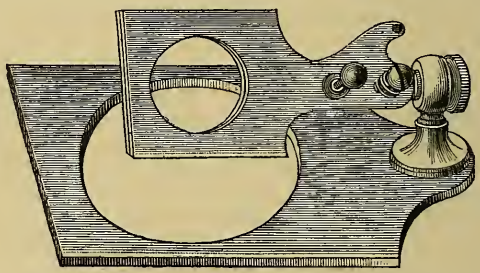
* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 110–1 (1 fig.).

can move freely in every direction except the vertical, and are always in focus. The air channel also serves to hold any excess in the amount of fluid, above that required to fill the area of the circular field. Infusoria may also be isolated and sealed up, when they may be kept alive and in good condition for a week or more. In some temporary slides, where the air-space was much too small, there being no channel, rotifers, *amœbæ* and other forms, were alive and active for nearly a week.

Beeswax alone seems the best cement for sealing. If put in a syringe having a very small nozzle, and warmed, the wax may be forced out as a long, thin thread. This can be wound on a spool and kept ready for use when a slide is to be sealed up. A piece long enough to fill the outer channel is placed therein. A glass slip placed over the cover-glass, and pressed down securely, seals the cell, and, as the wax is soft, the stratum of fluid can be made as thin as desired.

Watson's Reversible Compressor.—Mr. G. Watson's apparatus (fig. 104) consists of a base-plate carrying a compressor which can be

Fig. 104.



completely rotated on its horizontal axis—so as to exhibit the object on both sides or even in an intermediate position—as well as on the vertical pin which fits into the socket of the base-plate. The two plates of the compressor are separated by a screw acting against a spiral spring, while the upper one pivots over the lower to allow the object to be inserted.

Ruled Plate for Measurement of Blood-corpuscles.*—Prof. W. A. Rogers describes a plate ruled in 1,300,000 squares which when not in use is covered in order to protect the filling of the lines. Whenever it is to be used, it is uncovered and the lines filled with graphite by rubbing the surface diagonally with a camel's-hair brush pressed upon the glass with the fingers. A very slight amount of powder upon the brush will be sufficient. After the lines are filled, the blood placed directly upon the slide will not interfere with their visibility. When the examination is completed, the surface of the glass should be cleaned with cotton.

* 11th Ann. Rep. Amer. Postal Micr. Club, 1886, p. 13.

Beautiful slides have been prepared upon small circles of speculum metal, in which the lines are protected by nickel plating. The lines are very sharp under the nickel. With a vertical illuminator and very high powers this form is recommended.

Yeast Counting Apparatus.— Herren Klönne and Müller supply an apparatus for use by brewers in counting the number of cells in yeast and thus judging of its quality. It is practically identical with the blood-corpuscle counters, and consists of a slide with a cell of definite capacity, a reticular micrometer, and a pipette.

Metal Micrometers.*—Mr. M. D. Ewell calls attention to the fact of the very great superiority of metal micrometers over glass. To say nothing of their greater durability, in point of clearness and sharpness of outline there is no comparison whatever between the two. With a high power the edges of lines ruled upon glass appear rough and uneven; but the author has never yet been able to find a power high enough to produce an effect upon a speculum metal centimetre ruled to 1/100 mm., though he has examined it with a Zeiss 1/18, Bausch and Lomb amplifier, and 1/2 in. solid eye-piece, with the draw-tube drawn out to its greatest length.

Circulation Plate for Frogs, &c.†—Prof. S. H. Gage says that an excellent circulation board for *Necturus* and frogs may be prepared by boring a hole about 2 cm. in diameter in a pine board 8×30 cm. and 15 mm. thick. The hole should be about 5 cm. from one end and near one side. A perforated cork or hollow cylinder of wood should be fitted to this hole. Over the top of the perforated cork should be placed a very thick cover-glass or a piece of thin glass slide, and sealed with sealing-wax; finally the whole board should be covered with woollen cloth or cotton flannel. The perforated cork should be capable of being moved so that it will stand a centimetre above the surface of the board if desired.

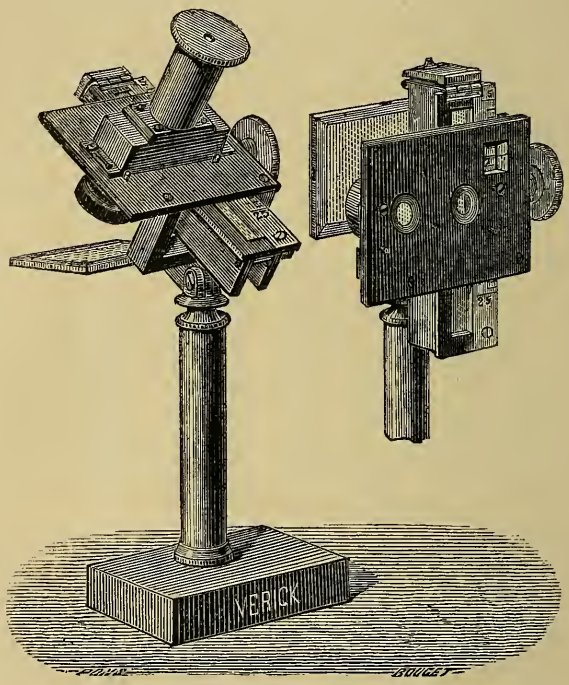
Malassez's Hæmochromometer.‡—Dr. L. Malassez's instrument serves to estimate the intensity of the colour of blood by placing in a wedge-shaped trough a solution of the blood to be examined and then determining at what point of the wedge the solution reproduces the tint of a fixed standard. This point will, of course, be so much the nearer to the apex of the wedge as the blood examined is richer in hæmoglobin. Dr. Malassez's apparatus is therefore the inverse of the old one.

A small metal plate (fig. 105) forms a screen having in its centre two circular holes. Behind one of these is placed the coloured standard and behind the other the vessel for the solution of blood. The coloured standard is formed by a small glass trough inclosing a solution of picrocarmine, which reproduces exactly the colour of a solution of 1 in 100 of blood containing 5 per cent. of hæmoglobin. The trough is mounted in a brass box, and fixed in a metal ring. The

* The Microscope, vi. (1886) p. 63.
† Notes on Histological Methods, 1885-6, p. 10.
‡ Arch. de Physiol., 1882.

trough is in the form of a very elongated wedge. The lateral walls are of metal which hold firmly between them the glasses which form the oblique walls of the trough. This trough is fixed to a carrier which can be moved up or down by a milled head. To the right near the top of the screen is a square orifice through which the scale engraved on the carrier can be seen. Behind the screen and the trough is placed either a piece of ground glass, or a mirror with ground surface, according as the examination is conducted by direct or reflected light.

Fig. 105.



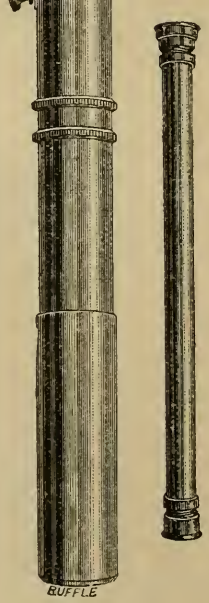
To the anterior face of the screen and in front of the two central orifices a small apparatus can be applied, consisting of two total double-reflection prisms, a very narrow diaphragm, and a lens. The screen is attached to a vertical support, which obviates the necessity of holding it in the hand, and it can be placed vertically or inclined as desired.

The accessories comprise (1) a guarded lancet, (2) a "mélangeur" (identical in construction with the "Mélangeur Potain," see this Journal, II. (1882) p. 561, fig. 107, but differently graduated) for making the solutions of blood, and (3) a small vessel to receive them temporarily.

The method of using the instrument is briefly as follows:—A solution of blood (1 in 50, 1 in 100, or 1 in 200) is made by the mélangeur and put in the trough; the latter is then placed in its carrier and moved up or down by means of the milled head till the precise point is reached at which the tint of the solution seen through the central aperture exactly matches that of the coloured standard. The figure is then read off by the index, and if the solution is 1 in 100 it will indicate direct the quantity of hæmoglobin contained in 100 parts of blood; but if the solution is 1 in 200 this figure must be doubled, or if 1 in 50 halved.

Thierry's Hæma-Spectroscope.*—M. M. de Thierry designed this apparatus for the detection of infinitesimal quantities of blood in any fluid (water, urine, humours) or in spots on linen, wood, metals, &c. The principle of the apparatus is based on the optical properties of oxyhæmoglobin and reduced hæmoglobin, one of which gives two absorption-bands between the lines D and E of the spectrum and the other a single band between the others.

Fig. 106.



It consists of a brass tube, in which slides another tube of much smaller diameter, the latter having a spectroscopic apparatus of new design, furnished with a prism of great dispersive power and having a slit the width of which can be regulated symmetrically on both sides of the median line. Into the apparatus can be introduced at will three glass tubes with their ends closed by small glass discs. The tubes are 1, 3, and 5 dm. long and 1 cmq. in section. They hold the fluid to be investigated, and according to its richness in colouring matter one or other of the tubes is taken. It can be adapted either for a separate stand with a concave mirror or more simply for an ordinary Microscope.

In use the mirror is adjusted so as to illuminate the tube strongly, and the opening of the slit is regulated and focused so that the spectrum is very clearly seen. The urine or fluid in which the linen, paper, &c., supposed to be spotted with blood has been previously macerated, is placed in one of the tubes. If the fluid is colourless or the colour is very faint the 5 dm. tube is used; if it is highly coloured it is diluted with water, until it is of a bright rose colour when seen through a pretty considerable thickness and placed in the 1 dm. or 3 dm. tube. If the solution is too highly coloured it will completely absorb the light, and consequently the two characteristic bands will not be visible.

* Comptes Rendus, c. (1885) pp. 1244–6.

Owing to the thick stratum of fluid traversed by the light, the absorption-bands appear, even with a solution only containing 1/100,000 of hæmoglobin. A drop of blood the size of a grain of wheat, on a piece of linen exposed three months in the open air, showed very distinctly after maceration in fluid enough to fill the 5 dm. tube the absorption-bands of hæmoglobin, and the author has found the absorption-bands still perfectly visible in a fluid which under ordinary circumstances presented no colour, and which only contained 1 c.cm. of blood in 30 lit. of water. With urine the results are almost as satisfactory.

The tubes being entirely of glass, the fluids can be submitted to the chemical actions which allow the oxyhæmoglobin to be reduced, and its presence verified by the appearance of the characteristic black band.

This apparatus can of course be used in all cases where the process of spectroscopy by absorption admits of application, as in the determination of the presence of chlorophyll. The author has, moreover, applied it to the detection of very small quantities of ergot in wheat-flour, by means of the distinctive absorption-spectrum which the colouring matter of ergot presents.

Apparatus for Microscopical Observation of Vapour-drops.*— Prof. J. L. Soret describes an apparatus by which drops of vapour

Fig. 107.

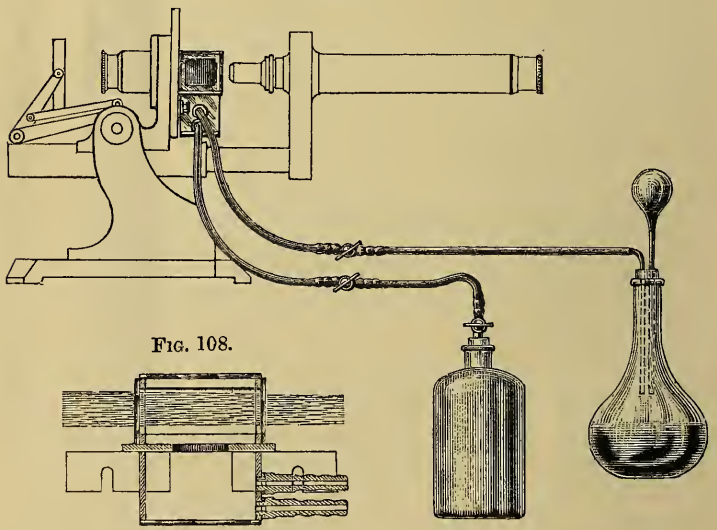


Fig. 108.

can be examined microscopically. It depends upon the principle that when moist air is rarefied by an air-pump a precipitation of vesicular

* Arch. Sci. Phys. et Nat., xiv. (1885) pp. 575-6.

vapour is formed, which disappears in a few minutes. When the exhaustion is feeble the vapour is scarcely visible in diffused light, but becomes very apparent when a beam of solar or electric light is directed on it.

A small box with glass walls, shown in position in fig. 107 and in section in fig. 108, is placed on the stage of the Microscope, and to it are attached two tubes fitted with stop-cocks. One of them communicates with a vessel partly filled with water for obtaining moist air, the other with the receiver of an air-pump. The air in the glass box can alternately be rarefied, and moist air allowed to enter at each dilatation. By means of sunlight or electric light, the globules of vapour formed can be examined; but the author has not yet arrived at any conclusion as to their constitution.

ABBE, E.—**Changing Eye-pieces without altering focus, &c.**
[Letter written in 1881 pointing out that to do this it is the anterior principal focus of the eye-piece that must keep the same place in the Microscope-tube.]
Micr. Bulletin (*Queen's*), III. (1886) pp. 9–10 (1 fig.).

American Society of Microscopists.—Working Session.
["Schedule of Demonstrations," &c.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 203–7.

BULLOCH, W. H.—**Magnification.**
[Answers to his questions, *ante*, p. 149.]
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

BURRILL, T. J.—See Stratton, S. W.

C[AMPBELL], J. A.—**Fine Adjustment.**
[1. Criticism of Mr. Mayall and Mr. Swift's views of his adjustment, *ante*, p. 375. 2. Criticism of Anderson's fine adjustment, *ante*, p. 325.]
Engl. Mech., XLIII. (1886) p. 148.

COLE, A. H.—**A new self-adjusting Frog-plate.** [*Post.*]
Micr. Bulletin (*Queen's*), III. (1886) p. 11 (1 fig.).

Connor's (R.) Pen-and-ink drawings of objects viewed with the Microscope.
[Vol. V. p. 1077.] *Nature*, XXXII. (1885) p. 633.

COX, J. D.—**The Actinic and Visual Focus in Micro-photography with High Powers.**
[See Vol. V. (1885) p. 1070.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 29–32 (1 heliotype), and pp. 229–30.

CRAMER, C.—**Ein neuer beweglicher Objecttisch.** (A new movable stage.)
[*Post.*] *Zeitschr. f. Wiss. Mikr.*, III. (1886) pp. 5–14 (2 figs.).

CZAPSKI, S.—**Ueber ein Mikrorefractometer.** (On a Micro-refractometer.)
[Description of Exner's, *ante*, p. 328, with critical remarks, and a suggested improvement as regards the independent action of the screws on the screen.]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 139–41 (2 figs.).

D'ARSONVAL, A.—**Recherches de Calorimétrie.** (Researches on Calorimetry.)
[Describes various forms of (1) apparatus for maintaining a constant temperature, (2) regulators, (3) calorimeters.]
Journ. Anat. et Physiol. (*Robin*), XXII. (1886) pp. 113–61 (26 figs.).

DETMERS, H. J.—**The Numerical Aperture of an Objective in relation to its angle of aperture in air, water, and balsam.**
[Two tables: (1) Air angle, water angle, balsam angle, and N.A. for every 2° of *air angle* from 1° and 2° to 180°. (2) Balsam angle, water angle, and N.A. for every 2° of *balsam angle* from 1° and 2° to 180°.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 199–202.

Diller, J. S.—**The Microscopical Study of Rocks.**
[Brief notes on the history of the subject, on French and German petrological Microscopes, and on mounting.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 41–2 and 59.

Dudley, P. H.—**Photo-micrographs of Wood Sections.**
[Exhibition only. Photographs 0·93 in. in diameter, taken by lamplight on 8 × 10 in. bromo-gelatin plates, with a magnification of 10,000.]
Trans. N. York Acad. of Sci., III. (1885) p. 107.

Dunning, C. G.—**Note on a new form of Live-box or Zoophyte-trough.**
[*Ante*, p. 138.] *Journ. Quek. Micr. Club*, II. (1886) pp. 249–51 (3 figs.).

Eternod, A.—**Planche à dessin universelle pour les laboratoires de Microscopie.** (Universal drawing-board for microscopical laboratories.) [*Post.*]
Internat. Monatsschr. f. Anat. u. Histol., II. (1885) No. 6.

Ewell, M. D.—**Metal Micrometers.** [*Supra*, p. 521.]
The Microscope, VI. (1886) p. 63.

F.R.M.S.—**Campbell's Fine Adjustment.**
[Reply to Mr. Campbell's letter, *supra*, and pointing out that Mr. Nelson did originally recommend it for students' Microscopes. Gundlach and Ross have already applied the differential screw to fine adjustments.]
Engl. Mech., XLIII. (1886) p. 239.

Fennessey, E. B.—**[Eyes of Animals as Objectives.]**
["Have the eyes of animals ever been substituted for the objective of the Microscope? I often see the eyes of fish and birds fading into nothingness, and I feel regret that some means of utilizing them for optical purposes is not practised. Doubtless such lenses are perfect. Could they not be frozen with an ether spray whilst using them, or could not our scientists think of some substance which will preserve them from decay without destroying their form or impairing their transparency?"]
Engl. Mech., XLIII. (1886) p. 133.

Francotte, P.—**Microscope de voyage de Nachet.** (Nachet's Travelling Microscope.)
[Cf. Vol. II. (1882) p. 98.] *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 60–1.

Girard, A. C.—See *Peyer, A.*

Glasgow Microscopical Society, Formation of. *Nature*, XXXIV. (1886) p. 14.

Graff, T. S. Up de, Memoir of.
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 216–22. See also pp. 230–2.

Griffith, E. H.—**Some new and improved Apparatus.**
[Substage diaphragm (*ante*, p. 130). Mechanical finger objective (Vol. V., 1885, p. 709).]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 112–4 (4 figs.).
„ „ **Our Eighth [Ninth ?] Annual Meeting.**
[As to the prospects, &c., of the Chautauqua Meeting of the Amer. Soc. of Micr.]
The Microscope, VI. (1886) pp. 58–60.

Gundlach, E.—**On Immersion Objectives.** [*Supra*, p. 510.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 51–3, 236–7.
„ „ **Astigmatism and its relation to the use of optical instruments further considered.** [*Supra*, p. 509.] *The Microscope*, VI. (1886) pp. 63–5.

Hager, H.—**Das Mikroskop und seine Anwendung. Ein Leitfaden bei mikroskopischen Untersuchungen für Apotheker, Aerzte, Medicinalbeamte, Kaufleute, Techniker, Schullehrer, Fleischbeschauer, &c.** (The Microscope and its Use. A guide to microscopical investigations for chemists, physicians, medical officers, merchants, technicians, school-teachers, meat-examiners, &c.)
7th ed., viii. and 240 pp., 316 figs. (8vo, Berlin, 1886).

Heurck, H. van.—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Concld.*)
[Preparations (Prince of Monaco—Montaldo's Wood Sections)—Photograms—Various accessories.]
Journ. de Microgr., X. (1886) pp. 75–80.

HEURCK, H. VAN.—**Nouveaux Objectifs et Oculaires de Zeiss.** (New objectives and eye-pieces of Zeiss.) [*Ante*, p. 316.] *Ibid.*, pp. 91-3, from *Moniteur du Praticien*, Feb. 1886.

HITCHCOCK, R.—**Photo-micrography. V., VI.**
[Focusing. Exposure. 4. Developing.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 67-70, 92-5.

[HITCHCOCK, R.]—**Postal Club Boxes.**
[List of contents.] *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 16-8, 57-8.

" " **A New Objective.**
[H. R. Spencer and Co's. 1/16 in. homogeneous immersion.] *Ibid.*, p. 57.

HOEGH, E. v.—**Nachtrag zu 'Die Achromatische Wirkung der Huyghens'schen Okulare.'** (Addition to 'The achromatic action of the Huyghenian Eye-pieces.') [Cf. *ante*, p. 338.]
Central-Ztg. f. Optik. u. Mech., VII. (1886) p. 85.

HOPKINS, G. M.—**Microscopical Examination of Ciliated Organisms by intermittent Light.** [*Supra*, p. 135.]
The Microscope, V. (1885) pp. 279-81, from *Scientific American*.

HOWE, L.—**An Imperfection of the Eye and Test Objects for the Microscope.** [*Ante*, p. 147.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 91-2, pp. 244-5.

KELLICOTT, D. S.—**An efficient Pipette.** [*Ante*, p. 180.]
["An equally good, perhaps better, way to secure a pipette with all required advantages is as follows:—Take a proper piece of large rubber tubing, e.g. 3 in. long, with half or three-fourths inch bore, and two short rubber corks to fit, pass the tube through one stopper and into the other; drill a hole in the glass tube near the upper one, and bring all to place. This form works promptly, is durable, and has one advantage, when laid on the work-table the point is free from the same, so it does not gather dust.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 4-5.

KESTEVEN, W. B.—**Microscopical Drawing.**
[Thin glass cover in brass revolving frame placed at an angle in front of the eye-piece.]
Scientif. Enquirer, I. (1886) p. 68.

KING, T.—**On the use of the Magic Lantern for purposes of Teaching.** [*Supra*, p. 507.]
Proc. and Trans. Nat. Hist. Soc. Glasgow, I. (1886) p. xxx.

KINKELIN, F.—**The Dioptrograph.**
[Mechanical drawing apparatus for drawing the outlines of macroscopic objects, consisting of a pantograph, in which the tracer is represented by a tubular diopter, supported on a square table. For smaller objects the diopter is furnished with a lens.]
Amer. Naturalist., XX. (1886) pp. 406-8 (1 fig.), from *Humboldt*, I. Part 5.

KLÖNNE, J., and G. MÜLLER.—**Pendel-Objekttisch für Mikroskope.** (Pendulum stage for Microscopes.) [*Ante*, p. 127.]
Title only of German Patent No. 35,174, K. 4238, 14th July 1885.

KÜCH, R.—**Petrographische Mittheilungen aus den Südamerikanischen Anden.** (Petrological communications from the South American Andes.)
[Description of apparatus. *Post.*]
Neues Jahrb. f. Mineral., Geol., u. Palæontol., 1886, I. pp. 35-48 (2 figs.).

LAUDY, L. H.—**The Magic Lantern and its applications—Microscope attachment.**
Anthony's Phot. Bulletin, XVII. (1886) pp. 234-6 (4 figs.).

LEES, W.—**Acoustics, Light and Heat.**
[Microscopes, pp. 150-1. "The eye-piece is usually formed of several glasses . . . . The glasses are all made achromatic."]
New ed., 320 pp. and 209 figs. (8vo, London and Glasgow, n.d.).

LEWIS, W. J.—**Some new features in connection with electric illumination as applied to the Microscope.** [Title only.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, p. 249.

LOGAN, J. H.—**A new form of Life-slide.** [*Supra*, p. 519.]
Ibid., pp. 110-1 (1 fig.).

LOGAN, J. H.—**Remarks on a device for enabling two observers to view objects simultaneously.**

["Half of the rays from the object proceed directly up the main tube, and the other half are reflected into the other one. The reflected rays, however, do not cross those of the main tube, but are reflected outside; otherwise the arrangement resembles that of the Wenham binocular prism. Either such a modified Wenham prism may be used, or two plain reflectors. The one submitted for examination is an experimental one, and works fairly well. Experiments are still being made, the endeavor being to perfect an apparatus that will utilize the whole aperture of the objective in each tube, instead of half, as in the present arrangement."]

Ibid., pp. 120–1 (1 fig.).

MALLARD, E.—**Traité de Cristallographie géométrique et physique. Tome II. Crystallographie physique.** (Treatise on geometrical and physical Crystallography. Vol. II. Physical Crystallography.)

[Includes Microscope, apparatus, and methods.]

184 figs. and 8 pls. (8vo, Paris, 1884).

MARTIN, E. W.—**Photomicrography—Processes and results.**

[Title of paper only, with discussion by Dr. Julien and the President (Dr. J. S. Newberry). The latter thought that "the problem of a satisfactory microscopic attachment to the lantern still remained unsolved at present."]

Journ. N. York Acad. of Sci., III. (1885) pp. 105–6.

MARTIN, W. J.—**Astigmatism and the Microscope.** [*Supra*, p. 510.]

The Microscope, VI. (1886) pp. 79–80.

Matthews, Dr. J., Death of. *Journ. Quekett Micr. Club*, II. (1885) p. 279.

MAYER, A. M.—**A simple and inexpensive form of Black-ground Illuminator.**

[*Supra*, p. 514.] *Journ. New York Micr. Soc.*, II. (1886) pp. 28–30.

MERCER, F. W.—**Small Photo-micrographic Camera.**

[Described Vol. IV. (1884) p. 625.]

The Microscope, VI. (1886) pp. 60–2 (2 figs.).

MICHIE, W. E.—**Microscopical Optics.**

[Queries and answers. (1) The binocular prism fitting does not reduce the aperture of high-power objectives when used monocularly. (2) 1 in. diameter is too small for low-power eye-pieces.]

Micr. Bulletin, III. (1886) pp. 7–8.

Micrometer, Standard, Report of Committee on.

["Little progress in the work of obtaining copies of the standard for general use among microscopists." One copy broken. Standards should be made of material less liable to destruction than thin glass. Prof. Rogers has consented to prepare a series of copies on thick plate glass or other suitable material.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 212–3.

MITTENZWEY, M.—**Ueber die acromatische Wirkung der Okulare von Huyghens und Ramsden.** (On the achromatic action of Huyghenian and Ramsden eye-pieces.) *Central-Ztg. f. Optik u. Mechanik*, VII. (1886) p. 61.

MÜLLER, G.—See Klönne, J.

NELSON, E. M.—**Some remarks on the interpretation of Microscopic images with high powers.** [*Post.*]

Journ. Quekett Micr. Club, II. (1886) pp. 255–9, 283–4, and 286–7.

NOE, L. H.—**Magnification.**

[Reply to Mr. Bulloch's queries, *ante*, p. 149.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 58–9.

OBERSTEINER, H.—**Ein Schnittsucher.** (A section-searcher.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) pp. 55–7 (1 fig.).

Objectives, the new Abbe. *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 76–7, 88–92; *The Microscope*, VI. (1886) pp. 87–8, 111–9; *Science*, VII. (1886) pp. 247, 413–4; *Nature*, XXXIV. (1886) pp. 57–8.

ORTH, J.—**Cursus der normalen Histologie zur Einführung in dem Gebrauch des Mikroskopes, sowie in das pracktische Studium der Gewebelehre.** (Course of normal histology as an introduction to the use of the Microscope as well as to the practical study of histology.)

[Contains an introduction on the Microscope, and methods of preparation, pp. 1–65, 11 figs.]

4th ed., xii. and 360 pp., 108 figs. (8vo, Berlin, 1886).

P., W. G.—**The Huyghenian Eye-piece.**

[The answer to the question, "Is it achromatic?" requires a distinction to be made before we can give it. When it receives parallel rays it is achromatic; but when placed as it is in a telescope it is very far from being so.]

Engl. Mech., XLIII. (1886) p. 255.

PELLETAN, J.—**Microscope Minéralogique** (moyen modèle) de Bézu, Hausser et Cie. (Bézu, Hausser, & Co.'s Mineralogical Microscope—medium size.)

Journ. de Microgr., X. (1886) pp. 185–6.

Peyer, A.—**An Atlas of Clinical Microscopy.** Translated by A. C. Girard.

200 pp., 90 pls., and 105 figs. (8vo, New York, 1886).

ROGERS, W. A.—**Determination of the absolute length of eight Rowland gratings at 62° F.**

[Contains a description of a new comparator made in 1884.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 151–98 (3 figs.).

" " **Ruled plate for Blood-corpuscles.** [*Supra*, p. 520.]

11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 13.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances.**

[VII. "A thing of beauty, a joy for ever." Diatomic marvels. VIII., IX., X. Focal planes, their measurement by the focimeter and diatomic images.]

Engl. Mech., XLIII. (1886) pp. 115–6 (2 figs.), 159–60 (1 fig.), 203–4 (3 figs.), and 247–8 (5 figs.).

Also reply to Dr. Edmunds, *ante* p. 337, p. 126.

RUNYON, E. W.—**[Exhibition of Oxy-hydrogen Microscope.]**

[Construction only generally described—"The nose-piece to which the objectives are attached slides on three polished steel rods, as does also the stage with its substage, and both can be clamped in any desired position."]

Proc. San Francisco Micr. Soc., 1886, March 24th.

SCHIEFFERDECKER, P.—**Ueber eine neue Construction der Mikrometerschraube bei Mikroskopen.** (On a new construction of the micrometer screw for Microscopes.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) pp. 1–5 (2 figs.).

SCHULTZE, E. A.—**Electrical illumination for the Microscope.**

[Reports the successful use for the purpose of a small gas engine and dynamo.]

Journ. New York Micr. Soc., II. (1886) pp. 16–7.

SHANKS, S. G.—**A Contribution to Blood Measurements.**

[Description of the Microscope used and mode of measurement, with table of 242 measurements. "A blood-corpuscle seen with the vertical illuminator presents a novel appearance. It appears smaller than with transmitted light, that is, without coma."]

Amer. Mon. Micr. Journ., VII. (1886) pp. 25–6.

SMITH, H. L.—**Presidential Address.**

[The unconscious influence of science studies. See Vol. V. (1885) p. 1081.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 5–28.

" " **Device for testing refractive index of immersion fluids.**

[See Vol. V. (1885) p. 1066.]

Ibid., pp. 83–5 (1 fig.).

SORBY, H. C.—**The application of very high powers to the study of the microscopical structure of steel.** [*Supra*, p. 511.] *Ironmonger*, 1886, pp. 905–6.

Nature, XXXIV. (1886) p. 63.

Spencer and Tolles Memorial Fund.

[Report to Amer. Soc. Micr. of the condition of the fund, now amounting to $60·20.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 249–50.

STEIN, S. T.—**Das Licht im Dienste wissenschaftlicher Forschung. Heft III.** Das Licht und die Lichtbildkunst in ihrer Anwendung auf anatomische, physiologische, anthropologische, und ärztliche Untersuchungen. (Light as an aid to scientific investigation. Part III. Light and the art of photography in their application to anatomical, physiological, anthropological, and medical researches.)

2nd ed., viii. and pp. 323–472, 172 figs. and 2 photogr., 8vo, Halle, 1885.

STRATTON, S. W. AND T. J. BURRILL.—**A Heliostat for Photo-micrography.**

[Description of a moderately cheap instrument, and "simple and so adjustable as to eliminate as many of the errors of construction as possible, quickly put in operation, easily kept in order, and requiring but little attention after once being properly set and regulated."]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 103–7 (2 figs.).

THIESEN, M.—**Ueber die Ablesung von Normalbarometern und überhaupt von grösseren Flüssigkeitsoberflächen.** (On the reading of normal barometers and especially with large fluid surfaces.) [*Post.*]

Zeitschr. f. Instrumentenk., VI. (1886) pp. 89–93 (3 figs.).

Tolles Memorial Fund.—See Spencer.

VORCE, C. M.—**A combined focussing and safety-stage for use in micrometry with high powers.** [*Supra*, p. 517.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 115–9 (3 figs.).

WALMSLEY, W. H.—**How to make Photo-micrographs. III.**

[Describes the author's first camera (Vol. III., 1883, p. 556), and his enlarging, reducing, and copying camera, *post.*]

The Microscope, VI. (1886) pp. 49–53 (2 figs.).

ZIMMERMANN, O. E. R.—**Atlas der Pflanzenkrankheiten welche durch Pilze hervorgerufen werden. Mikrophotographische Lichtdruckabbildungen der phytopathogenen Pilze nebst erläuterndem Texte. Heft 2.** (Atlas of Plant-diseases produced by Fungi. Photo-micrographic illustrations of the phytopathogenic fungi, with explanatory text. Part 2.)

pp. 17–22 and plates III. and IV. with 15 figs. each.

Text 8vo, atlas fol., Halle a. S., 1885.

β. Collecting, Mounting and Examining Objects, &c.*

Hunting for Amœbæ.†—Dr. J. E. Taylor has found the following simple device for catching *Amœbæ* to be successful in the highest degree. He lowers one of the ordinary shilling glass troughs to the bottom of the fresh-water aquarium, and when the trough has been immersed about twenty-four hours, on being carefully brought up, numerous *Amœbæ* will be found crawling on the inner surfaces of the glass.

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Sci.-Gossip, 1886, pp. 113–4.

Preparing Sections for Examination with the highest Powers.* —Mr. J. W. Gifford thinks there is no more successful plan for demonstrating minute structure than Beale's process of preparing and staining tissues in glycerin and then teasing them out with needles, followed by the judicious application of heat and pressure, and finally mounting in pure glycerin. The method, however, prevents the use of the freezing microtome as glycerin freezes at so low a temperature, and it therefore occurred to him whether the substitution of a colloid, such as gum, for the glycerin at one stage of the process might not act as well as glycerin in preventing change.

The fresh material cut into small pieces should be placed in Beale's glycerin-carmine until the bioplasm is stained (10 to 15 hours), or better, inject the whole body or part with the stronger glycerin-carmine, and allow it to remain until stained; it should then be cut into pieces. After this place it in 2 parts glycerin to 1 water for 24 hours, followed by pure glycerin saturated with picric acid for 48 hours. The pieces are then taken out of the glycerin and (of course without washing) placed in a thick solution of gum acacia, also saturated with picric acid, for 48 hours. The small quantity of glycerin which adheres to them when placed in the gum and picric acid does not much retard freezing, and sections may easily be cut.

As soon as the sections are cut they are placed in a mixture of 5 drops of acetic acid to 1 oz. of glycerin, and after remaining in this for several days or a week will have swelled out to their original size if shrunk at first by the glycerin, and may then be mounted in glycerin with a trace of acid in the usual way.

Osmic Acid and Merkel's Fluid for Pelagic Fish-eggs, &c.†—Dr. C. O. Whitman proceeds by placing the eggs with a little sea-water in a watch-glass; then by the aid of a pipette a quantity of osmic acid (1/2 per cent.) about equal in volume to that of the sea-water is added. At the end of from five to ten minutes the eggs are washed quickly in water and transferred to a chrome-platinum solution, differing from Merkel's mixture in having a 1 per cent. solution of chromic acid. In this they remain from one to three days. By this treatment the blastoderm may be easily freed from the yolk and then having been thoroughly washed in water for some hours, the preparation is passed through the usual grades of alcohol, stained and sectioned or mounted *in toto*. The platinum chloride not only completes the work of hardening, but at the same time removes much of the brown or black colour imparted by the osmic acid. By this method a very marked differentiation is generally obtained as early as the 16-cell stage. In later stages of cleavage the distinction between central and peripheral cells becomes still stronger, so that it becomes possible to trace the entire history of the origin of the so-called parablast.

For the eggs of *Clepsine* Merkel's fluid is used, of its ordinary strength, for one or two hours only. Here the differential effects extend not only to the different germ-layers, but also to cell-groups

* Scientif. Enquirer, i. (1886) pp. 25–7. † Amer. Natural., xx. (1886) p. 200–3.

destined to form central nervous system, nephridial organs, larval glands, &c.

The author treats frogs' eggs, first with osmic acid for about twenty minutes, and then transfers directly to the chrome platinum solution (same strength as for pelagic eggs), for twenty-four hours. The eggs are next placed in water and freed from their gelatinous envelopes with needles and dissecting Microscope. They are next washed in flowing water for two hours, then treated with alcohol and stained.

Method of Killing Gephyrea.*—According to Dr. W. Apel the only successful method of killing these animals, in an extended condition, is by the use of hot water. The animal may be placed in a vessel of sea-water, and the temperature gradually raised to about 40° C.; or it may be seized by a pair of forceps while in a condition of extension, and plunged for a moment into boiling water. This latter treatment does not kill the animal, but renders it completely limp, in which condition it should be cut open and then placed in some hardening fluid.

Macerating Mixture for central nervous system of vertebrates.†—The following mixture, discovered by Landois, is recommended by Dr. H. Gierke as an excellent macerating agent, especially for the central nervous system of vertebrates:—Chromate of ammonium 5 grm.; phosphate of potassium 5 grm.; sulphate of sodium 5 grm.; distilled water 100 grm.

Pieces of fresh tissues are left in this fluid from one to three, or even four or five days, then transferred to a mixture (in equal parts) of this fluid with ordinary ammonia-carmine (24 hrs.).

Preparing the Hen's Egg.‡—A very important addition to this branch of technique has been made by M. M. Duval.

First in importance are the methods of orientation. After the appearance of the primitive streak, at about the twelfth hour of incubation, it becomes easy to distinguish anterior, posterior, and later regions in the blastoderm. Hitherto it has been a matter of conjecture whether anterior and posterior regions became morphologically defined at any considerable time before the formation of this streak; and no one, before Duval, attempted to clear up the question, simply because it appeared impossible to find any means of orienting sections at an earlier date. Duval addressed himself to the task of finding out the transformations of the blastoderm, which lead up to the establishment of the primitive streak, and to this end he was compelled to seek, first of all, for some reliable means of exact orientation.

Method of Orientation.—It was noticed by Balfour, and confirmed by Kölliker, that the axis of the chick embryo lies constantly at right

* Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 459–529 (3 pls.). See this Journal, *ante*, p. 73, and Amer. Natural., xx. (1886) p. 315.

† Arch. f. Mikr. Anat., xxv. (1885) p. 445. Amer. Natural., xx. (1886) p. 315.

‡ Ann. Sci. Nat.—Zool., xviii. (1884) 208 pp. and 5 pls. See this Journal, v. (1885) p. 615, and Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, pp. 163–7.

angles to the longer axis of the egg. If an egg, after one or two days' incubation, is opened, while held in such a position that its large end is turned to the left and its small end to the right of the operator, it will be found that the caudal end of the embryo is directed towards the operator, while the cephalic end is turned in the opposite direction. Out of 166 cases, Duval found only three that could be regarded as exceptions to the rule. Assuming that the orientation is the same before the appearance of the primitive streak, we have then a very reliable means of recognizing, even in the freshly-laid egg, when the blastoderm has a homogeneous aspect, the future anterior and the future posterior region. But this fact alone is not all that is required for complete orientation; the blastoderm must be hardened, and the means of orientation must be preserved. That portion of the vitelline sphere which bears the blastoderm must be so marked that the anterior and posterior regions of the blastoderm may be recognized after the process of hardening, and after the blastoderm, together with some of the circumjacent yolk, has been cut free from the rest of the egg. This may be done in different ways, according to the method employed in hardening.

I. *Osmic Acid Method.*—1. Make a triangular box without bottom, by folding a strip of paper 5 mm. wide and 50 mm. long.

2. After opening the egg carefully from the *upper* side, remove with a pipette the thin layer of albumen which lies above the cicatricula, so far as this can be done with safety.

3. Place the triangular box over the blastoderm in such a manner that the base corresponds to the future anterior region, and the apex to the future posterior region. While pressing slightly on the box in order to bring it into close contact with the surface of the yolk, fill it by means of a pipette with osmic acid (1/3–1/4 per cent.), and allow the acid to act for some minutes.

4. As soon as the area inclosed by the box begins to blacken, the whole should be immersed in a vessel of chromic acid, in which the paper box may be detached, and the vitelline sphere freed from the albumen and the shell.

5. The vitellus may now be transferred, by the aid of a very deep watch-glass, to another vessel of chromic acid, where it is allowed to remain one or two days, until the peripheral layers harden and form a sort of shell around the central portion which is still soft.

6. A triangular piece of this shell, inclosing the triangular area browned by the osmic acid, is next to be cut out with a pair of sharp scissors. The excised piece is then left a day or more in the chromic solution before treatment with alcohol.

II. *Alcohol Method.*—1. Open the egg as before, and, without attempting to remove the albumen, place the triangular paper box over the blastoderm; slight pressure causes the box to sink into the albumen till it is brought into contact with the yolk. By the aid of a pipette, fill the box with absolute alcohol; this coagulates rapidly the inclosed albumen, while the albumen outside the box remains fluid.

2. After cutting the chalazeæ close to the vitellus, the fluid

portion of the albumen is carefully drained off, leaving only the vitellus and the box with its coagulated contents in the shell.

3. The shell may now be filled with absolute alcohol until the yolk is completely covered, and then left for some hours, during which the more superficial layers of the yolk harden sufficiently to form a shell-like envelope of the softer central portion.

4. The triangular mass formed by the box, and the hardened albumen, is now ready to be cut out, in the same manner as in the osmic acid method. During this process, the paper box may become detached, either spontaneously, or with some assistance; or it may adhere so firmly that it cannot be safely removed. There is no inconvenience in leaving it in place, as it will cut easily when the piece is ultimately sectioned.

5. The piece is further hardened twenty-four hours in absolute alcohol, then preserved in alcohol of 36° (80 per cent.).

III. *Hot Chromic Acid.*—1. Treat with osmic acid as in I.

2. Place the whole in a solution of chromic acid, and heat to the point of boiling, over a water-bath.

3. After cooling, cut out the triangular piece as in I. (6), leave it for a few days in chromic acid, then transfer to alcohol.

Imbedding and Cutting.—Duval imbeds, after each of the foregoing methods, in collodion. The surface of each section is collodionized some seconds before drawing the knife, by allowing a drop or two of thin collodion to flow over it.

Staining.—The sections are placed in serial order on a slide, and then covered with picro-carmine, strongly diluted with glycerin. The sections may be left in the staining fluid twenty-four to forty-eight hours, the admixture of glycerin preventing drying. After they are sufficiently coloured, the staining fluid is allowed to drain off, and the slide is carefully washed with a pipette. The sections, still in place, are treated with successive grades of alcohol, and then mounted in balsam after being clarified in benzine ("benzine collas").

Mounting the Blastoderm in toto.*—During the first three or four days of incubation, Dr. C. O. Whitman has obtained good surface preparations of the blastoderm in the following manner:—

1. Break the shell by a sharp rap of the scissors at the broad end; then carefully cut away the shell, beginning at the place of fracture and working over the upper third or half.

2. After removing as much of the white as possible without injury to the blastoderm, place the rest of the egg, while still in the shell, in a dish of nitric acid (10 per cent.), deep enough to cover it.

3. The coagulated white should next be removed from the blastoderm by the aid of a brush or a feather, and the egg then allowed to remain in the acid thirty minutes.

4. Cut round the blastoderm with a sharp-pointed pair of scissors, taking care to cut quickly and steadily. After carrying the incision completely round, float the blastoderm into a watch-glass, keeping it right side up and flat.

* Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, pp. 166–7.

5. Remove the vitelline membrane by the aid of dissecting forceps, and the yolk by gently shaking the watch-glass and by occasional use of a needle. The yolk can sometimes best be washed off by means of a pipette.

6. Wash in water (several times changed).

7. Colour deeply with carmine or hæmatoxylin.

8. Remove excess of colour by soaking a few minutes in a mixture of water and glycerin in equal parts, to which a few drops (about 1 per cent.) of hydrochloric acid have been added.

9. Wash and treat thirty minutes with mixture of alcohol (70 per cent.), 2 parts; water, 1 part; glycerin, 1 part.

10. Transfer to pure 70 per cent. alcohol, then to absolute alcohol. Clarify with creosote or clove-oil, and mount in balsam.

The above method of treatment will also serve for blastoderms which are to be sectioned.

Preparing Siphonophora.*—Dr. A. Korotneff has obtained good sections of the very contractile stem of Siphonophora in the following way:—

After the Siphonophora has settled down a watch-glass full of chloroform is floated on the surface of the fluid, and the vessel covered up with a bell-jar. The animal, benumbed by the chloroform vapour, becomes extended. The bell-jar is then removed, and the animal suddenly immersed in some hardening fluid. The author employed a 1/2 per cent. chromic acid solution and a 1 per cent. hot sublimate solution. In the latter case, the animal was quickly transferred to 20–30 per cent. alcohol. With regard to the tentacles, it may be mentioned that the mucous layer separates into long unicellular tubes after teasing out and being treated with osmic acid. These tubes, the author thinks, are glandular, as they stain deeply with hæmatoxylin and alum carmine.

Preparing Spinal Ganglia.†—Herr M. v. Lenhossek found a 1–1·5 per cent. solution of superosmic acid to give most satisfactory results in the study of the structure of the spinal ganglia of the frog. The ganglia were left three-quarters of an hour in the fluid. Bichromate of potassium and alcohol were used for hardening, and celloidin was found most convenient for imbedding. Good results, especially in the investigation of the finer relations, were obtained by the use of gold chloride.

Modification of Pancreatic Cells during active secretion.‡—In studying the behaviour of the cells of the pancreas during very active secretion, Dr. S. W. Lewaschew used for hardening purposes alcohol and concentrated solution of sublimate, which proved very satisfactory. The tissue was then laid in turpentine or bergamot oil. Ehrlich's hæmatoxylin solution gave the best staining reactions. Ogata's suggestion of combined staining with various fluids—hæmatoxylin, eosin, &c., was also adopted.

* MT. Zool. Stat. Neapel, v. (1884) pp. 229–88 (6 pls.).
† Arch. f. Mikr. Anat., xxvi. (1886) pp. 370–453 (2 pls.).
‡ Ibid., pp. 453–85 (1 pl.).

Mounting Fresh-water Algæ.*—Mr. L. B. Hall finds a very successful process to be the use of pure glycerin, carbolated. The objects are first placed in a dilute solution of iodine (tinct. iod. 2 min., water 1 oz.) 2–5 minutes, then stained (iodine-green), and put into dilute glycerin (10 per cent.), and gradually transferred to thick glycerin.

Cultivation of Microbes.†—According to Dr. H. Fol, it is possible to obtain a perfectly sterile liquid by one of four methods, viz.:—

1. Filtering through some material whose meshes are sufficiently fine to arrest the smallest organisms. The only material really practicable for this purpose is the unglazed porcelain used by Pasteur and Chamberland.

2. Obtaining the liquid directly from the internal organs of one of the superior animals; the digestive tract being considered, for this purpose, an external organ. Pasteur's experiments have shown that the tissues of such animals are the most perfect filters known, neither permitting the entrance, nor tolerating the existence, of any foreign material, unless the tissues are diseased.

3. Sufficiently prolonged exposure to a temperature of at least 110° C. This is the lowest necessary for the destruction of spores, although 80° C. is sufficient to kill bacteria in the growing condition. The length of the exposure must not be less than an hour; the longer the time beyond this, the greater the security.

4. Intermittent heating, invented by Tyndall, and much used in Germany. This consists in making the spores germinate, in order to kill the full-grown bacteria at 80° C. For this purpose the vessels containing the fluid to be sterilized are kept at 20–30° C. to favour the growth of the spores, and are every day raised to 80° C. for one hour, to destroy such bacteria as have become fully developed. This method takes much time, and its results are always uncertain.

Of all these methods, the third, that of destroying the germs once for all, is the one giving the greatest security and ease of manipulation. It has but one fault, that of coagulating all albuminous substances which can be solidified at the temperature of boiling water.

Pure Cultivations of Bacterium aceti.‡—In order to obtain pure cultivations of *B. aceti*, Mr. A. J. Brown adopted, as the most suitable method, a combination of Klebs' "fractional" and von Nägeli's "dilution" methods. The author describes the appearance presented by the film formed on beer and other solutions. He considers that, besides *B. aceti* and *B. Pasteurianum*, there is a third species capable of oxidizing alcohol to acetic acid; he therefore describes the morphology of *B. aceti*, and the action upon it of various reagents. He then describes the action of *B. aceti* upon various substances. It oxidizes ethylic alcohol to acetic acid, and a trace of (probably) succinic acid. In an insufficient quantity of oxygen a trace of a substance resembling aldehyde is formed. When no alcohol is

* 11th Ann. Rep. Amer. Postal Micr. Club, 1886, pp. 13–4.
† La Nature, 1885. See Science, v. (1885) p. 500.
‡ Journ. Chem. Soc. Lond., l. (1886) pp. 172–87.

present, acetic acid is reduced by the bacterium to carbonic acid and water. With normal propylic alcohol, propionic acid is formed after fourteen days. Methylic alcohol had to be purified before *B. aceti* would act upon it, and then the solution became alkaline, ammonia being formed; this happened only after three weeks. *B. aceti* did not oxidize isoprimary butylic alcohol, and the organism will not even grow in amylic alcohol. From dextrose the author obtained gluconic acid; with cane-sugar he was unable to obtain any action; from mannitol, lævulose was obtained, without any acid being formed. The author gives constitutional formulæ for the products, constructed from considerations of the action of *B. aceti*. He concludes by saying that the above reactions "help to show that the vital functions of certain organized ferments are most intimately connected with the molecular constitution of the bodies on which they act."

Microphytes of Normal Human Epidermis.*—Dr. G. Bizzozero employed the following methods for demonstrating these organisms.

After removing the fat from the epidermis by means of alcohol and ether, the epidermic scales were either (A) soaked on a slide in a 50 per cent. acetic acid or a 10 per cent. solution of caustic potash, and examined after putting on a cover-glass; acetic acid preparations may be permanently preserved by placing a drop of glycerin round the edge of the cover-glass; or (B) they are teased out in glycerin, slightly coloured with methyl-blue, and then examined; or (C) they are placed in a small drop of 50 per cent. acetic acid on a cover-glass and after soaking for a quarter of an hour are needled out. The acetic acid is then driven off by gentle heat, the cover-glass passed twice or thrice through the flame of a spirit-lamp, the dried layer is then wetted for half-an-hour with some nuclear anilin stain (methyl-blue is the best), and having been next carefully washed with distilled water, the preparation, when dry, is mounted in dammar or Canada balsam.

Preparing Tubercle-bacillus.†—Dr. Glorieux has much improved Neelsen's method for demonstrating the presence of tubercle-bacilli in cover-glass preparations of sputum. The first step of Neelsen's process is to immerse the cover-glass in the following solution:—Fuchsin 1 grm.; absolute alcohol 10 grm.; 5 per cent. solution of phenic acid 100 grm.

The second step is to decolorize in a 25 per cent. solution of sulphuric acid. It is this second stage which has been modified by Dr. Glorieux, whose formula is:—Sulphuric acid 10 grm.; alcohol 15 grm.; distilled water 50 grm. Methyl-blue to saturation; filter.

Thus treated, cover-glass preparations may be double-stained in from 60 to 90 seconds.

Schulze's Dehydrating Apparatus.‡ — Prof. F. E. Schulze describes a simple contrivance for securing the rapid and yet uninjured dehydration of small and delicate objects.

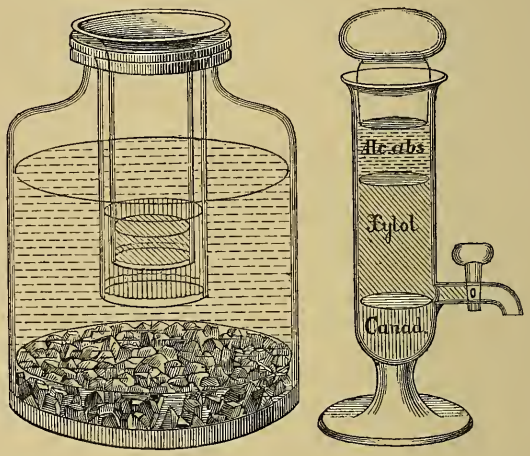
* Virchow's Arch. f. Path. Anat., xcviii. (1885) p. 441. See this Journal, v. (1885) p. 849.

† Bull. Soc. Belg. Micr., xii. (1886) pp. 44–8.

‡ Arch. f. Mikr. Anat., xxvi. (1886) pp. 539–42 (1 fig.).

The apparatus (fig. 109) is on the principle of a dialyser, and consists of a broad glass tube with a projecting upper rim (like that of a hat), and with a paper membrane at the lower end. This is inserted in a larger vessel with a broad rim at the neck. The two rims fit together closely, and seal the larger vessel. The latter is

Fig. 109.



filled to a convenient level with absolute alcohol, the smaller contains the object with a little of the weak alcohol in which it previously lay. A gradual diffusion occurs and a very perfect dehydration is rapidly effected. The process may be made more gradual by the use of a double tube, the outer containing weaker alcohol. At the foot of the large vessel is a layer of burnt sulphate of copper which prevents the dilution of the absolute alcohol. The dehydration of the inner tube containing the object may be conveniently tested (after twenty-four hours or so) by removing a little of the fluid in a pointed pipette, and allowing a drop to pass slowly into a test-tube with 98° alcohol. If the fluid be absolute alcohol, a small portion from the pipette will be detected passing upwards, or downwards if the fluid be below 98°.

Prof. Schulze also describes a modification of a method of securing the safe preparation of delicate objects by allowing them to sink through layers of different fluids. In his improved form a closed tube contains an inferior layer of Canada balsam, above that 3 c.cm. of xylol, and uppermost 1 c.cm. of absolute alcohol. At the level of the Canada balsam there is a cock for allowing the upper layers to flow off, after which the object is removed from the Canada balsam into which it has sunk.

Efficiency of the Micrometer-screw.*—Herr J. Ost discusses the action of the micrometer-screw as used in microtomes, and endeavours

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 295-300.

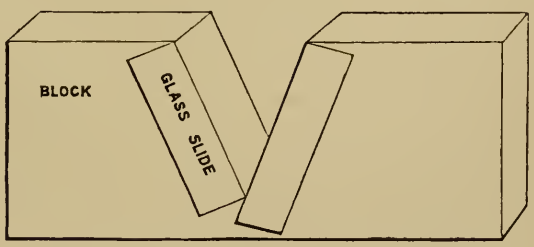
to show that it affords the most convenient and surest means of raising the object, as applied in the microtome which he has devised. Errors in the construction of the screw are not cumulative, and will not amount to anything that is appreciable in section-cutting; the thread of the screw regarded as formed by the hypothenuse of a right-angled triangle wound upon a cylinder is merely a particular application of the inclined plane of Rivet's microtome, and has the advantage of being more accurate and of insuring a longer surface of contact between the fixed and moving parts than is the case with the slider of the latter.

The author tested the accuracy of a microtome-screw (and that one which worked loosely in its bearings), observing under a Microscope the motion of a fine needle-point carried by the screw, using an eye-piece micrometer. The displacements produced by a single turn of the screw were measured for 25 turns; of these, 7 gave a motion of 543 μ, 8 of 534 μ, and 10 of 537 μ; similarly the displacements corresponding to each two divisions on the head of the screw, which was divided into 50 parts, were in 18 cases 20·8 μ, in 4 cases 19·5 μ, and in 3 cases 22·2 μ. The difference of 1·3 μ may reasonably be ascribed to errors of observation, and the author concludes that the accuracy of the screw is all that can possibly be required. Backlash may be got rid of by the use of a spring.

Rapid Section-cutting.*—For the benefit of those who have so little time for microscopic work that every minute is precious, Mr. J. E. Whitney describes a contrivance for section-cutting which is nearly as rapid as free-hand cutting, and yet enables really good sections to be made with more certainty. Where one wishes to make sections of numerous vegetable tissues for comparative study, and has only a short time for the purpose, the tedious process of imbedding necessary with ordinary machines is a serious obstacle.

To avoid the necessity of imbedding the object, the author simply cuts in a block of hard wood (say 3 in. by 4 in., and $1\frac{1}{2}$ in. thick) a wedge-shaped opening, $1\frac{1}{4}$ in. by 2 in. or thereabouts (fig. 110), into

Fig. 110.



which the object to be cut is placed so that its sides touch the tapering sides of the opening, and prevent motion. On the top of the block over which the blade of the razor is to pass cement two pieces of glass

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1886, pp. 122–3 (1 fig.).

slides with their smooth edges parallel with the edges of the wedge-shaped cut.

For the ordinary rapid examination of vegetable tissues, the specimen is held gently in the opening by the thumb of the left hand, while the razor dipped in alcohol is drawn steadily over the glass slips towards the apex of the wedge, with the cutting edge held at the usual angle. After the first cut, if uniformity in the thinness of the sections is not necessary, the object can be simply advanced slightly by the hand, and after a few trials it will be found that really thin sections can easily be made in this simple way.

When, however, it is necessary to have sections of extreme or uniform thinness, it is best to screw across the under side of the block a strip through which a thumb-screw with fine thread is fitted to work. By this means the object can be raised regularly any desired distance at each cutting.

The block can be prepared in a few minutes by any one, and with all ordinary vegetable tissues very satisfactory sections can be cut. Hard wood cannot be cut safely in a section-cutter without being first soaked or steamed, and as a keen-edged plane will cut beautiful sections quickly and easily, it is best to cut such wood in that way. Sections of different kinds of wood can be cut at the same time by screwing small blocks of each together and taking a section of all at one stroke of the plane.

Natural Injection of Leeches.*—Dr. C. O. Whitman has often noticed that leeches hardened in weak chromic acid, or in any chromic solution, are beautifully and naturally injected with their own blood. Where the circulatory system is to be studied by means of sections, this method seems to be the simplest and most reliable one. Not only the larger sinuses, but the intra-epithelial capillaries may be easily traced by this method, as was first pointed out by Prof. E. R. Lankester.†

Methods of Injecting Annelids.‡—For annelids with dark tissues like *Hirudo*, M. M. Jaquet recommends that a light-coloured (white or yellow) injection-mass should be employed, while for transparent animals dark colours are preferable. Chrome yellow serves as a good colouring substance. It is easily obtained by mixing solutions of bichromate of potassium and acetate of lead. A copious yellow precipitate is formed, which should be washed on the filter, and then exposed to the air until nearly dry. The pigment, after being reduced to a pulp-like state. is added to an ordinary aqueous solution of gelatin; and the mass is then filtered warm through linen. If the injection-mass is to be blue, then the gelatin may be dissolved directly in liquid Prussian blue, and the mass filtered through paper.

As a rule, annelids must be killed before they can be injected. Chloroform and alcohol are the means commonly employed in killing

* Amer. Natural., xx. (1886) pp. 313–4.

† Quart. Journ. Micr. Sci., xx. (1880) p. 306.

‡ MT. Zool. Stat. Neapel, vi. (1885) pp. 298-300. Cf. Amer. Natural., xx. (1886) p. 314.

for the purpose of injection; fresh water may also be used for some marine species. A leech, for example, is placed in water containing a small quantity of chloroform; after a few moments it sinks to the bottom and remains motionless. It should be allowed to remain in the water for one or two days before attempting to inject it.

The simplest and most convenient form of syringe consists of a glass tube drawn to a fine point at one extremity, and furnished at the other with a rubber tube. Preparatory to injecting, the glass should be plunged in warm water for a few moments; then, after expelling the water, it may be filled with the injection-mass by sucking the air from the rubber tube. If the injection-mass is turned into the large end of the glass, it may happen that granules are introduced which are large enough to obstruct the narrow passage of the small end. After inserting the cannular end in the vessel, clasp both with the forceps, and then force the injecting fluid, by aspiration through the rubber tube, which is held in the mouth. When the operation is completed, place the animal in cold water, in order to stiffen the injected mass.

Anilin Staining.*—Dr. Bareggi, in order to render more permanent preparations stained with anilin colours, proposes to merely cover the section, &c., with Canada balsam dissolved in chloroform, and to allow the balsam to dry slowly, no cover-glass being used.

When working with dry or with water-immersion lenses, such preparations can be examined without detriment, as water is not miscible with balsam. But when working with oil-immersion lenses and with cedar oil, which dissolves balsam, it is necessary to be careful during the examination.

It would perhaps be preferable to use instead of cedar oil the salt solutions which have been proposed for this purpose, or the solution of chloral hydrate in glycerin, or still better, the solution of zinc iodide in glycerin.

Chrome Alum in Microscopical Technique.†—Dr. G. Martinotti, from a consideration of the behaviour of potash alum which is a prominent constituent of certain stains (carmine, hæmatoxylin, &c.), wished to make some experiments with ammonia and chrome alums. The results from the use of ammonia alum were not encouraging, but by substituting chrome alum or the double sulphate of potassium and chromium for potash alum he obtained sufficiently satisfactory results.

Chrome alum is isomorphous with potash alum and crystallizes in dark violet octahedra soluble in water, but insoluble in alcohol. If the watery solution be heated above 80° C. the violet colour turns to a green, and this hue is retained on cooling. Carmine chromate is prepared by boiling 10 parts cochineal in 500 parts water and adding 1 part chrome alum, filtering while hot and then allowing it to stand. The residue is carefully washed and dried at a temperature not exceeding 30° C. It is easily soluble in ammonia, and possesses

* Gazzetta degli Ospitali, 1884, p. 645.

† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 361-6.

all the properties of ordinary carmine except in being of a dark violet colour. Over this the author is not so enthusiastic as over the next two solutions where he has substituted chrome alum for potash alum in the formulas given by Czokor and Grenacher for making alum cochineal and alum carmine. The ingredients are mixed in the exact proportions as given by Czokor and Grenacher. The mixture is then left in an oven at the temperature of about 70° C. for 24 to 48 hours. When cold the liquid is filtered.

Both fluids are of a violet colour, and both stain nuclei perfectly. The author gives the palm to the cochineal stain. Preparations may remain in this solution for more than 24 hours without becoming diffusely stained. If the preparations are to be preserved in resinous media it is necessary to wash carefully in water, otherwise the alum chromate, which is insoluble in water, is precipitated on the surface of the section as brownish needles. A special advantage of this cochineal chromate solution is that it keeps well for an indefinite period without the addition of any preservative agent. Another advantage is that the nuclei assume a violet colour closely resembling that given by hæmatoxylin.

Modification of Arcangeli's Carmine Stain.*—M. P. Francotte finds that in Arcangeli's first formula † 50 cgrm. carmine is too much, and proposes the following modified formula, which is based on the solubility of boric acid in alcohol. Alcohol at 90, 75 cc.; distilled water 25 cc.; boric acid 5 grm.; carmine 40 cgrm. This mixture is boiled for fifteen minutes, and a beautiful red alcoholic solution is obtained on filtration.

Staining the Central Organs of the Nervous System.‡—Prof. C. Golgi, after some strictures on gold chloride methods (which he condemns because neither the manner in which the interlacement of the fibres takes place, nor the different parts which contribute to their formation, are demonstrated) states that whatever success he has had is due to the three following methods:—

1. Method of black staining obtained by treating specimens successively with potassium or ammonium bichromate and silver nitrate.

2. Method of the successive action of a mixture of osmic acid and potassium bichromate followed by silver nitrate.

3. Method of the combined action of potassium and ammonium bichromate and perchloride of mercury (by transmitted light the colour is apparently black; by direct light, a metallic white).

By the method of the combined action of bichromate of potash and of nitrate of silver, the black staining is obtained as the result of two operations. Pieces of nervous tissue about a centimetre square are hardened in a 2 per cent. solution of bichromate, or in Müller's fluid. The strength of the bichromate may be gradually increased from 2 to 5 per cent. In any case, this fluid should be frequently

* Bull. Soc. Belg. Micr., xii. (1886) pp. 48–51.
† See this Journal, v. (1885) p. 1094.
‡ Arch. Italiennes de Biologie, vii. (1886) pp. 15–47.

changed. The proper degree of hardening is reached in from two weeks (in warm weather) to seven weeks (in cold weather). The second step is to immerse the hardened pieces in a 0·75 per cent. solution of silver nitrate for twenty-four to forty-eight hours. The room in which this silver process is carried on must be kept *well warmed.*

The black staining is successively imparted to the axis-cylinders of the nerve-fibres, the ganglion-cells, and, lastly, the neuroglia-cells. When the black staining is attained, and this is verified by examining a few trial sections in glycerin, the pieces are placed in alcohol, frequently changed, until the alcohol remains clear, in order to remove all traces of the silver nitrate. This must be done effectually, otherwise the specimens will not keep. The treatment preparatory to mounting in dammar, which is preferable to Canada balsam, consists in washing several times in absolute alcohol, transferring to creosote, and in clearing up in oil of turpentine or in oil of origanum. The sections are to be preserved in dammar *without* the imposition of a cover-glass. The author mounts his specimens on large cover-glasses and then adjusts them in a wooden frame or slide with a window, so that the sections are kept quite free from dust, and can also be examined from both sides. It is of course necessary to preserve the mounted specimens in a dark place.

The disadvantages of the method, says Prof. Golgi, are the length of time required to obtain the requisite reaction, the uncertainty arising from the varying periods necessary to produce the proper degree of hardness, and the different conditions in which the different layers of the same piece are frequently found. These disadvantages are modified by :—(*a*) Copious and frequent injections of either a $2\frac{1}{2}$ per cent. solution of bichromate, or a similar solution in which five or six grammes of gelatin have been dissolved. The injection may be made with an ordinary syringe or a siphon apparatus, through the aorta or carotid. (*b*) By hardening with bichromate at a constant temperature. In an incubator, maintained at a temperature of 20°–25° C., the reaction point was reached in eight or ten days. (*c*) By hardening in equal parts of Erlicki's and Müller's fluid, the necessary consistence was obtained in five to eight days.

The second method consists in hardening the pieces in a mixture of bichromate and osmic acid, followed by immersion in silver nitrate. It may be applied as follows: by immersing small pieces of quite fresh nervous tissue in the following mixture:—of potassium bichromate 2 to $2\frac{1}{2}$ per cent. solution, eight parts; of osmic acid 1 per cent. solution, two parts. Having been transferred to the silver nitrate solution, as in the first method, the black reaction is found to begin on the second or third day, and to be completed by the tenth or twelfth. But in this method the pieces must be allowed to remain in the silver nitrate until they are wanted for section, allowing two days for soaking in alcohol. Although this treatment gives sufficiently good and rapid results, it is better to place the pieces in the bichromate solution for two to thirty days, and then change to the mixture of osmic acid and bichromate, and afterwards in due

course to the silver nitrate. In this case, too, the pieces should remain in the silver solution until wanted for immediate use, when they are repeatedly soaked in frequently changed alcohol, passed through absolute alcohol, creosote, oil of turpentine, to dammar.

This last is the method most preferred by the author.

In the method of the successive action of bichromate of potash and of perchloride of mercury, the first stage is the same as that which is given for the bichromate and silver methods. This over, the pieces are placed in a 0·5 per cent. solution of perchloride of mercury. The reaction is effected in not less than eight days for small pieces, while for large, such as whole brains, two months at least are required. The perchloride solution must be renewed daily, until it is no longer tinged with yellow. When the reaction has reached its maximum, the nervous tissue is quite pale, and resembles fresh brain matter recently washed in water. The pieces of nervous tissue may be allowed to remain in the mercury solution for an indefinite period. The sections may be mounted in some resinous medium, but in either case frequent washing in water is necessary, in order to prevent the formation of a deposit of acicular crystals upon the surface. The sections are then dehydrated in alcohol, and having been cleared up in oil of cloves or creosote, are mounted in dammar or in Canada balsam.

Application of Weigert's modified Hæmatoxylin Stain to the Peripheral Nervous System.*—Dr. T. Gelpke's experience of the above method is that while it is most excellent in principle, giving most brilliant results with normal nerves, yet, when used to demonstrate certain morbid states, e. g. sclerosis, the nerve-fibres were found to remain quite unstained, either in longitudinal or in transverse section. By controlling experiments made with osmic acid and carmine on sclerosed nerves, and also by showing that the Weigert stain itself acted efficiently on normal nerves, the author concluded that the want of success was to be sought in the decoloration process. Further, that the ferridcyanide solution was too strong, and as the result of his experiments, he found that decoloration was most safely effected by using very dilute solutions of the reagent.

The author's emendation of this process is that for transverse sections the ferridcyanide solution should be diluted down to one-fiftieth of the strength given by Weigert. For longitudinal sections a somewhat stronger solution may be employed. Naturally, the time occupied by the stage is now much longer, decoloration taking from one to twelve hours.

Fixing Sections to the Slide.†—Mr. H. E. Summers says that the following method has been tested with paraffin and celloidin sections. For either kind of sections the slides are first coated with collodion, either by flowing from a bottle or by a brush, and allowed to dry. The celloidin used for imbedding, thinned with alcohol and

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 484-9.

† The Microscope, vi. (1886) pp. 66-7.

ether, answers admirably. The coated slides may be kept indefinitely before using.

Paraffin sections are arranged upon the slide and a small amount of a mixture of equal parts of alcohol and ether is then dropped upon the slide. The liquid will be immediately drawn under the sections. Bubbles of air will rarely remain beneath the sections, but, if they do, they may easily be displaced by gently touching the section with a soft brush. The liquid is allowed to evaporate spontaneously. When quite dry, which will take but a few minutes, the paraffin may be dissolved and the sections will be found firmly fixed.

Celloidin sections are placed for a few minutes in 95 per cent. alcohol, and then arranged on the coated slide. They are drained as free of alcohol as possible, and as soon as their surface is nearly dry, as is shown by its assuming a dull appearance, the mixture of alcohol and ether is dropped upon them rather freely. When this has evaporated until the surface of the sections again assumes a dull appearance, the slide is placed in 80 per cent. or weaker alcohol, and may then be treated by any of the reagents applicable to paraffin sections fixed with collodion.

The advantages claimed for this method are three: the use of heat is dispensed with, and thus one source of inconvenience and injury to the sections is avoided; the paraffin is not removed (or melted) until the sections are fixed, and thus in sections consisting of disconnected parts, the position of these parts is preserved; labour and work-table space are saved by having a single method, which is applicable to both paraffin and celloidin sections.

Peirce Cell for Opaques.*—This form of cell was devised by Prof. J. Peirce, for "dry mounts" (figs. 111 and 112). The cell and cap are made from sheet brass, the latter fitting not too tight nor too loose. While dust is perfectly excluded, the cover-glass and its frequent accompaniment of "dewed" under surface is done away with. "This gives the additional advantage that the light by which the object is seen does not have to pass twice through a cover-glass, and thus the object is seen in its full clearness and beauty." Prof. Peirce also recommends the use of these cells soldered to a 3 × 1 tin slide.

FIG. 111.

FIG. 112.

A.—**Mounting Odontophores of Snails.**
[Best mounted in a weak form of Goadby's solution.]
Scientific Enquirer, I. (1886) p. 68.

APEL, W.—**Beitrag zur Anatomie und Histologie des** *Priapulus caudatus* **(Lam.) und des** *Halicryptus spinulosus* **(v. Sieb.).**
[Method of killing Gephyrea. Amer. Natural., XX., 1886, p. 315; *supra*, p. 532.]
Zeitschr. f. Wiss. Mikr., XLII. (1885), pp. 459–529 (3 pls.).
See this Journal, *ante*, p. 73.

B.Sc.—**Double-staining Botanical Preparations.** [*Post.*]
Scientif. Enquirer, I. (1886) p. 33.

* Micr. Bull. (Queen's), iii. (1886) p. 3.

Beatty's (G. S.) Methods for staining and double-staining vegetable tissues.
[Reprinted from 'Pop. Sci. Monthly' and 'Amer. Journ. of Micr.']
Amer. Mon. Micr. Journ., VII. (1886) pp. 43–8.

BESSELL, J. B.—**Mounting Fish Skins.**
[For the polariscope, wash, dry under pressure, soak in spirits of turpentine for two or three days, and mount in balsam or balsam and benzole.]
Scientif. Enquirer, I. (1886) p. 73.

BIDWELL, F. H.—**Staining for diagnosis.**
[Has used ordinary eosine ink for staining urinary deposits.]
Micr. Bulletin (*Queen's*), III. (1886) p. 8.

BIZZOZERO, G.—**Nuovo metodo per la dimostrazione degli elementi in cariocinesi nei tessuti.** (New method for the demonstration of the elements in karyokinesis.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 24–7.

BOULT, H. R.—**Mounting Bird Parasites.**
[Directions for mounting the smaller kinds.]
Journ. of Micr., V. (1886) p. 119.

BUCHNER, H.—**Ueber das Verhalten der Spaltpilzsporen zu den Anilinfarbstoffen.** (On the behaviour of the spores of schizomycetes with the anilin stains.) [*Post.*]
Sep. Rep. SB. Gesell. Morph. u. Physiol. München, 1885, 4 pp. and 1 fig.
Cf. *Bot. Centralbl.*, XXVI. (1886) pp. 55–6.

C., A.—**Mounting Chemical Crystals.** [*Post.*]
Scientif. Enquirer, I. (1886) pp. 70–1.

CUNNINGHAM, K. M.—**[Arranged and other Slides from Vienna.]**
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

CURTIS, L.—**The Cultivation of Bacteria and the Cholera Bacillus.**
[Describes:—the preparation of peptonized gelatin and plate and needle cultures; growth of forms in hanging drops; culture on potatoes; cholera bacillus.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 142–50.

CUSHING, E. W.—**Bacillus tuberculosis.**
[Koch's method of preparing and other remarks.]
Micr. Bulletin (*Queen's*), III. (1886) pp. 2–3.

DEBES, E.—**Sammeln und Behandlung lebender Diatomaceen.** (Collection and treatment of living Diatomaceæ.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 27–38.

Diatoms, Sections of.
[Cementstein from Mors, Denmark.]
Micr. Bulletin (*Queen's*), III. (1886) p. 5.

DIENELT, F.—**Durability of White Zinc Cement.**
[Calling attention to transverse cracks caused by shrinkage, and suggested remedy by the editor of a coat of shellac in alcohol.]
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

DRAPER, E. T.—**Graphic Microscopy. II.**
[No. 3. Ovary of toad × 40. No. 4. Vertical section of tooth of cat × 30.]
2 pp. and 2 pls. (8vo, London, 1886).

EWING, P.—**On mounting small Mosses for Microscopic Examination.**
["The following was the medium employed, the specimens being mounted as transparencies on cards of a suitable size:—7 parts pure glycerin, 1 part French gelatin, 6 parts distilled water; add 1 drop carbolic acid to every 100 drops of above mixture. The whole to be boiled till the flakes caused by the carbolic acid disappear, and filtered through spun crystal."]
Proc. and Trans. Nat. Hist. Soc. Glasgow, I. (1886) p. xlviii.

F., M.—**A Hint on the keeping of Melicerta ringens.** [*Supra*, p. 450.]
Scientif. Enquirer, I. (1886) p. 46.

FLESCH, M.—**Notizen zur Technik mikroskopischen Untersuchungen am Centralen Nervensystem.** (Notes on the technique of microscopical investigations of the central nervous system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 49–52.

GAGE, S. H.—**Notes on Histological Methods,** including a brief consideration of the methods of pathological and vegetable histology and the application of the Microscope to Jurisprudence. 56 pp. (8vo, Ithaca, N.Y., 1885–6).

GIERKE, H.—**Die Stützsubstanz des Centralnervensystems.**
[Macerating mixture (Amer. Natural., XX. 1886, p. 315), *supra*, p. 532.]
Arch. f. Mikr. Anat., XXV. (1885) pp. 441–554.

Gierke, H.—**Staining Tissues in Microscopy. X.**
Amer. Mon. Micr. Journ., VII. (1886) pp. 70–3, 97–9.

GIFFORD, H.—**Eine Methode, unbehandelte Serienschnitte in situ aufzubewahren.** (A method of preserving series sections *in situ*.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 45–7.

GIFFORD, J. W.—**A Method for the preparation of Sections for examination with the highest powers.** [*Supra*, p. 531.]
Scientif. Enquirer, I. (1886) pp. 25–7.

GLORIEUX.—**Le Bacille de la Tuberculose.** (*Bacillus tuberculosis.*)
[*Supra*, p. 537.] *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 44–8, from *Rev. Médicale*, Louvain.

GOTTSCHAU, M.—**Erwiderung an die Herren J. Ost und Dr. A. Brass.** (Reply to J. Ost and Dr. A. Brass. [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 14–8.

GRIFFIN, A. W.—**Smith's Stannous Chloride Mounting Medium.**
[The stannous chloride must be of the utmost purity.]
Scientif. Enquirer, I. (1886) pp. 46–7.

GRIFFITH, E. H.—**Some new and improved Apparatus.**
[Turntable No. 4 improved; No. 6. *Post.*]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 112–3 (2 figs.).

GROULT, P.—**Le nouveau Microtome à levier.** (The new lever microtome.)
[*Post.*] *Le Naturaliste*, VIII. (1886) pp. 241–3 (8 figs.).

H., J.—**Balsam Mounts.**
[Pressure is a mistake. "For if, where the balsam is made to inclose the object, the cover is pressed down with but a very moderate degree of force, and so left, as the balsam shrinks by the evaporation of its essential oil it must pull the cover closer and closer to the slip, so that the ultimate pressure on the cover is in direct proportion to the amount of hardening which the balsam has undergone."]
Scientif. Enquirer, I. (1886) pp. 66–7.

HALL, L. B.—**Mounting Fresh-water Algæ.** [*Supra*, p. 536.]
11th Ann. Rep. Amer. Post. Micr. Club, 1886, pp. 13–4.

HALLER, B.—**Untersuchungen über marine Rhipidoglossen.**
[Macerating fluid for central nervous system of marine Rhipidoglossata (Amer. Natural., XX. 1886, p. 316). Glycerin, 5 parts; glacial acetic acid, 5 parts; distilled water, 20 parts. It causes no shrinkage and accomplishes its work in 30–45 minutes.]
Morphol. Jahrb., XI. (1885) pp. 321–430 (8 pls.).
See this Journal, *ante*, p. 225.

[HITCHCOCK, R.]—**Wax Cells.**
["We do not favour them so much as we did a few years back, for there is almost certain to be a deposit on the cover-glass after a time."]
Amer. Mon. Micr. Journ., VII. (1886) p. 56.

HÜPPE, F.—**Die Methoden der Bakterien-Forschung.** (The methods of investigating bacteria.) [*Post.*]
3rd ed., 244 pp., 40 figs. and 2 pls. (8vo, Wiesbaden, 1886).

IMHOF, O. E.—**Methoden zur Erforschung der pelagischen Fauna.** (Methods for the investigation of the pelagic fauna.) [*Post.*]
Zool. Anzeig., IX. (1886) pp. 235–6.

JAMES, F. L.—**Shrinkage of Cement Cells the Cause of Leakage in Glycerin Mounts.**
[Discussion only.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 228–9.

JAMES, F. L.—**A new Injecting Apparatus.** [*Post.*]
St. Louis Med. and Surg. Journ., L. (1886) pp. 237–9 (1 fig.).

" " **Elementary Microscopical Technology.**
[VII. Section-cutting (*contd.*). The section knife. Other accessories. Arrangement of the work-table. Cutting. Care of instruments. VIII. Staining animal tissues.]
Ibid., pp. 239–44 (1 fig.), 305–10.

" " **Cleaning old and damaged Slides.**
[Put them into a mixture of gasolin or benzin, spirits of turpentine and alcohol in equal parts. A good wiping and polishing leaves the slide optically clean.]
Ibid., p. 304.

JAQUET, M.—**Recherches sur le Système vasculaire des Annelides.**
[Methods of injecting annelids. (Amer. Natural., XX. 1886, p. 314.) [*Supra*, p. 540.]
MT. Zool. Stat. Neapel, VI. (1885) pp. 298–300.

JELGERSMA, G.—**Notiz über Anilinschwarz.** (Note on anilin-blue-black.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 39–40.

JOLY, J.—**On the Melting-points of Minerals.**
[Account of experiments with the Meldometer.]
Nature, XXXIV. (1886) p. 22
(Report of Proceedings of Dublin Univ. Exper. Sci. Assoc., March 16).

Kinne Self-centering Turn-table.
[Now made with projecting hand-rest.]
Micr. Bulletin (*Queen's*), III. (1886) p. 6.

KLEEBERG, A.—**Die Markstrahlen der Coniferen.**
[Directions for removing resin from conifers. *Ante*, p. 270.]
Bot. Ztg., XLIII. (1885) pp. 673–86, 689–97, 705–14, and 721–9 (1 pl.).

KÜNSTLER, J.—**Sur la Structure des Flagellés.** (On the structure of the Flagellata.) [Methods, *post.*]
Journ. de Microgr., X. (1886) pp. 17, 58–63 (1 pl. and 1 fig.).

LATHAM, V. A.—**The Microscope and how to use it. VI.**
[Double staining, *contd.*] *Journ. of Micr.*, V. (1886) pp. 105–11.

LENHOSSÉK, M. v.—**Ein neues Hülfsmittel zur Herstellung von Serienpräparaten aus dem centralen Nervensystem.** (A new expedient for making series preparations of the central nervous system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 53–5 (1 fig.).

LETT, H. W.—**Mounting Fish Skins.**
[Clean with potash and water and dry for two months in a warm spot. Mount dry.]
Scientif. Enquirer, I. (1886) p. 73.

LIST, J. H.—**Beiträge zur mikroskopischen Technik.** (Contributions to microscopical technique.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 43–4.

MADAN, H. G.—**Note on some organic substances of high refractive power.**
[(1) Naphthyl-phenyl-ketone dibromide. Ref. Ind. 1·666. (2) Metacinnamene. Ref. Ind. 1·593. (3) Monobromo-naphthalene. Ref. Ind. 1·662. "The most hopeful direction in which to look is undoubtedly towards some of those complex organic compounds which are now being built up by many workers in England and Germany."]
Proc. Phys. Soc. Lond., VII. (1886) pp. 364–6.

MANTON, W. P.—**On the preparation of Chick Embryos for microscopical examination.**
[Directions for preparing.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 66–70.

MIGULA, W.—**Notiz über eine Ausbewahrungsmethode von Algenpräparaten.** (Note on a preservative process for algæ.) [*Post.*]
Zeitschr. f. Wiss Mikr., III. (1886) p. 47.

MOLL, J. W.—**Micro-chemical determination of Tannic Acid.** [*Post.*]
St. Louis Nat. Druggist, VIII. (1886) p. 188, from *Chem. Ztg.*

Moore, A. Y.—**The detection of renal tube casts.**
[Directions for examining urine. Also as to mechanical stages. *Post.*]
The Microscope, VI. (1886) p. 80–3.

Moore's (A. Y.) Stained Amphipleura. [*Ante*, p. 376.]
Micr. Bulletin (*Queen's*), III. (1886) p. 3.

Nörner, C.—**Zur Behandlung mikroskopischer Präparate.** (On the treatment of microscopical preparations. [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 19–23 (1 fig.)

Onderdonk, C.—**Native Styrax.**
[Recommending native liquidambar from the tree for mounting.]
Micr. Bulletin (*Queen's*), III. (1886) p. 8.

Pfitzner, W.—**Zur Kenntniss der Kerntheilung bei den Protozoen.** (On nuclear division in the Protozoa.)
[Method of preparing *Opalina*. Amer. Natural., XX. 1886, pp. 408–10. See this Journal, *ante*, pp. 258–60.]
Morphol. Jahrb., XI. (1885) pp. 454–67 (1 fig.).

Pierce's (J.) Cell for Opaques. [*Supra*, p. 546.]
Micr. Bulletin (*Queen's*), III. (1886) p. 3 (2 figs.).

Prismatique—**Transparent Cements.**
[First English opticians that made cemented work were his grandfather and A. Ross. (Cf. *ante*, p. 337, Edmunds, J.) In præ-balsamic times serum from human blood was used.]
Engl. Mech., XLIII. (1886) p. 174.

Reynolds, R. N.—**Remarks on improved Methods.**
[1. To transmit sections by mail (*post*). 2. To mark desirable parts of mounts without Maltwood finder or special diamond. 3. To safely handle fresh balsam mounts. (Two pieces of thin gummed paper, 3/8 in. square, applied to the slide on opposite sides of the cover-glass, extending about 1/16 in. upon the cover.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 124–5.

Rocellin. [*Post.*] *The Microscope*, VI. (1886) p. 95.

Santonine, Preparing.
[Directions by H. F. Parsons, C. F. Tootal, and A. Nicholson.]
Journ. of Micr., V. (1886) pp. 118 and 119.

Schiefferdecker, P.—**Mittheilung vertreffend das von mir verwandte Anilingrün.** (Communication on the anilin-green employed by me.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 41–3.

Sedgwick, W. T.—**An alcoholic drip for the Thoma-Jung Microtome.** [*Post.*]
Amer. Natural., XX. (1886) pp. 488–90 (3 figs.).

Shanks, S. G.—**A method of mounting several groups of small microscopic objects under one cover.** [*Post.*]
Amer. Mon. Micr. Journ., VII. (1886) pp. 64–5.

„ „ **Mounting Starch.**
[Very thick Farrants' solution is the best.]
11th Ann. Rep. Amer. Post. Micr. Club, 1886, p. 14.

Smith, H. L.—**Mounting Media of High Refractive Index.**
[See Vol. V. (1885) p. 1097.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 86–90 (1 fig.).

„ „ **A new High-refractive Mounting Medium.**
[*Ante*, p. 356, and remarks by the President, C. Van Brunt.]
Journ. New York Micr. Soc., II. (1886) pp. 13–6, 18–9.

Smith, T.—**Notes on the Biological examination of Water, with a few statistics of Potomac drinking-water.** *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 61–4.

Steel, T.—**Method of mounting objects with Carbolic Acid.** [*Post.*]
Scientif. Enquirer, I. (1886) p. 41–3.

Streng, A.—**Ueber einige mikroskopisch-chemische Reaktionen.** (On some micro-chemical reactions. *Contd.*
Neues Jahrb. f. Mineral., Geol., u. Palæontol., I. (1886) pp. 49–61 (6 figs.).

Summers, H. E.—**New method of fixing sections to the slide.** [*Supra*, p. 545.]
The Microscope, VI. (1886) pp. 66–7.

SUMMERS, H. E.—**Improved method of constructing Slide Cabinets.** [*Post.*]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 108–9 (1 fig.).

TAYLOR, G. H.—**Water-washed Diatoms.**
[Describes the process of cleaning diatoms from mud by treatment with clean water, without the use of acids—at one point boiling in water with the addition of a little cooking soda.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 207–8.

" " **Cleaning Diatoms from Marine Muds.**
[Detailed directions.] *Ibid.*, pp. 208–10.

TAYLOR, J. E.—**Hunting for Amœbas.** [*Supra*, p. 530.]
Sci.-Gossip, 1886, pp. 113–4.

TAYLOR, T.—**Butter and Fats.** To distinguish one fat from another by means of the Microscope.
[General examination of butter and its substitutes by the naked eye. Microscopic test. How to crystallize butter and other fats, and separate the crystals so as to be seen with the naked eye or pocket lens. The butter of several States examined. Mounting butter crystals. Sulphuric acid and other tests for butter, oleomargarine, and butterine. How to detect the crystals of lard by the eye, unaided by a lens. General notes.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 128–38 (no plate yet) pp. 234–5.

" " [Reply to Prof. Weber.]
The Microscope, VI. (1886) pp. 78–9, see also pp. 85–6.

THOMPSON, J. C.—**Mounting** *Dermanyssus.*
[To avoid curling up of legs, allow it to walk on the slide, then drop tolerably cool glycerin jelly on it, and then warm cover.]
Journ. of Micr., V. (1886) p. 119.

Trichophyton tonsurans.
[Directions by T. Sympson and V. A. L. for preparing.]
Scientif. Enquirer, I. (1886) pp. 55–6.

Typical Slides.
[Report of Committee of Amer. Soc. Micr. as to collecting, storing, and circulating typical slides of mounted objects and illustrations of special methods, and recommendation to the Society "to acquire, hold, and circulate the same." Also rules for storing and circulating the objects.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 246–7.

UDE, H.—**Ueber die Rückenporen der terricolen Oligochæten.**
[Methods for showing dorsal pores of terricolous Oligochæta. *Post.*]
Zeitschr. f. Wiss. Zool., XLIII. (1885) pp. 87–143 (1 pl.).

VAN BRUNT.—See Smith, H. L.

VORCE, C. M.—**Killing Insects' Eggs.**
[Soaking in carbolic acid will destroy vitality without affecting the appearance for a dry or balsam mount.]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 14.

W[ARD], R. H.—**Curtain-ring Mounts.**
["Regularly go to pieces in the circuits," and comment by R. Hitchcock. "This we believe need not be. Curtain-rings are exceedingly useful in mounting, and it will be a pity if we must give them up."]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 15.

White Zinc Cement.
[Unfavourable reports of experiences with it, and comment by R. Hitchcock.] 11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 15.
Amer. Mon. Micr. Journ., VII. (1886) p. 56.

WHITMAN, C. O.—**Natural Injection.** (Leeches.) [*Supra*, p. 540.]
Amer. Natural., XX. (1886) pp. 313–4.

WHITNEY, J. E.—**Rapid Section-cutting.** [*Supra*, p. 539.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 122–3 (1 fig.).

WIARD, M. S.—**Preparing section of Human Toe-nail.**
[Place between two strips of moderately hard wood and plane off thin smooth shavings with an ordinary carpenter's plane—mount in balsam and benzole.]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 14.

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.

Edited by

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1886.

observation of unstained and stained bacteria. Considerable space is devoted to the methods of staining the bacillus of tuberculosis, and especially its spores. The method of treating sections of tissue for the purpose of showing bacteria, and the various culture methods and materials are given; and something is said of saprophytic and parasitic bacteria. The work is illustrated by good woodcuts and two lithographic plates.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Watson-Crossley Microscope.—This (fig. 113) is a combination of the Oblique Illumination Microscope of Messrs. Watson (see this Journal, Vol. I., 1881, p. 516) and the Swinging Tail-piece Microscope with illuminating prisms, of Mr. E. Crossley (ibid., p. 653).

The peculiarity of the former instrument, it will be remembered, consisted in the body-tube being set laterally on the limb, the latter being made to incline with the stage, on a horizontal axis in a line with the object, the mirror remaining fixed. By this means, and by the power of rotating the whole instrument round the mirror, illumination in all altitudes and azimuths could be obtained, without moving the eye, the light from the mirror remaining constantly upon the object.

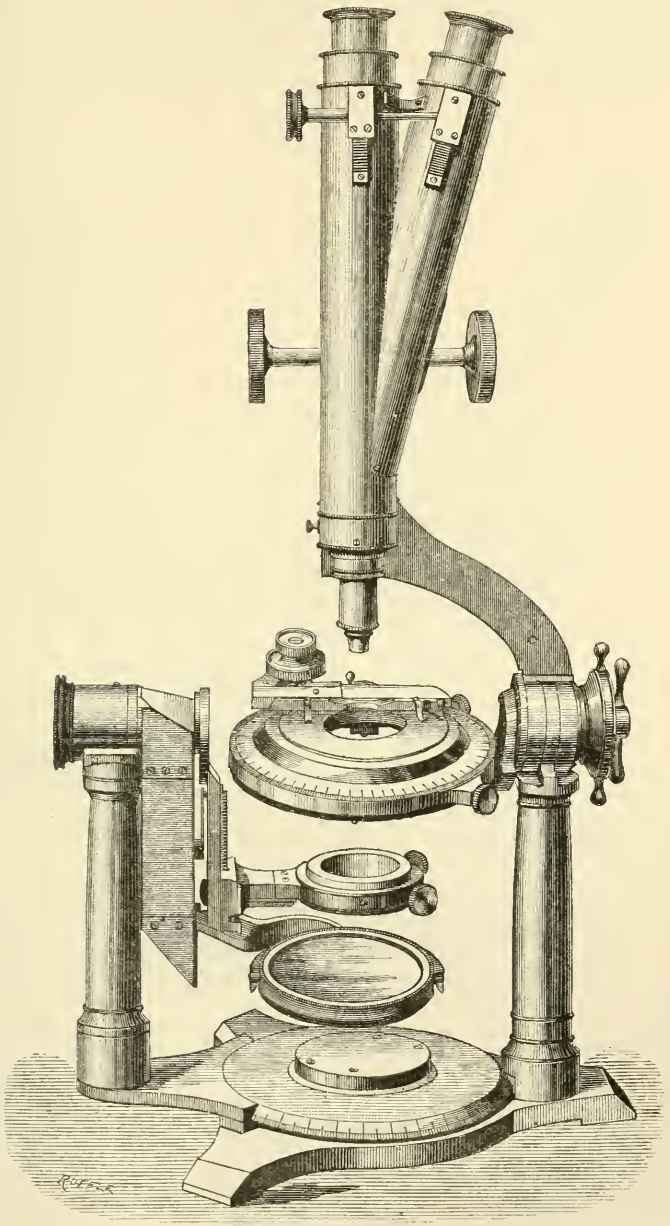
The second instrument was provided with a hollow swinging tail-piece, enclosing three prisms, by which the light from the lamp passing into the hollow trunnion axis was projected down the arm and thence upon the mirror; thus no change of the Microscope on its horizontal axis affected the illumination which remained constantly on the object.

The speciality of the new form consists in the above two ideas being combined. It would be difficult to do this if the tail-piece were retained in its ordinary place, as the one form requires much solidity in the axis on which the limb inclines, while the other necessitates the axis being made hollow. The swinging tail-piece with the substage and mirror is therefore separated from the Microscope and attached to a pillar on the opposite side of the base. As in the first-mentioned form, the mirror (detached from the tail-piece) can be fixed to the base. The stage also inclines on its axis as well as the limb with the body-tube.

Thus the observer has the choice of obtaining oblique light in one and the same instrument, either (1) by inclining the body-tube over the fixed mirror, or (2) by using the mirror on the swinging tail-piece.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

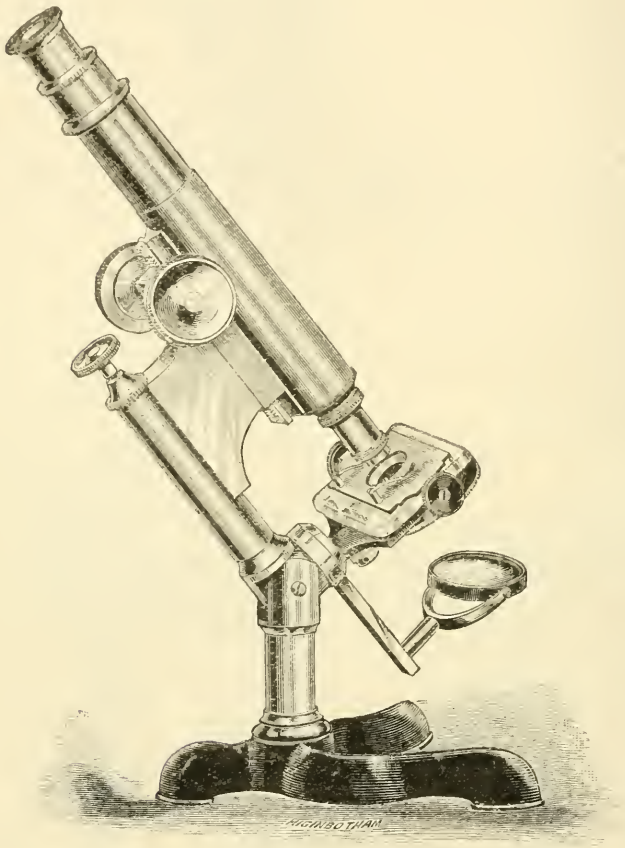
FIG. 113.



WATSON-CROSSLEY MICROSCOPE.

Bausch and Lomb Optical Co.'s Physician's Microscope.—The special features of this instrument (fig. 114) are the fine adjustment (described in Vol. II., 1882, p. 683), the cradle-joint for inclining, and the glass stage. The latter rests on a forked support and could be made to give in a different form one advantage of Mr. Nelson's divided

Fig. 114.

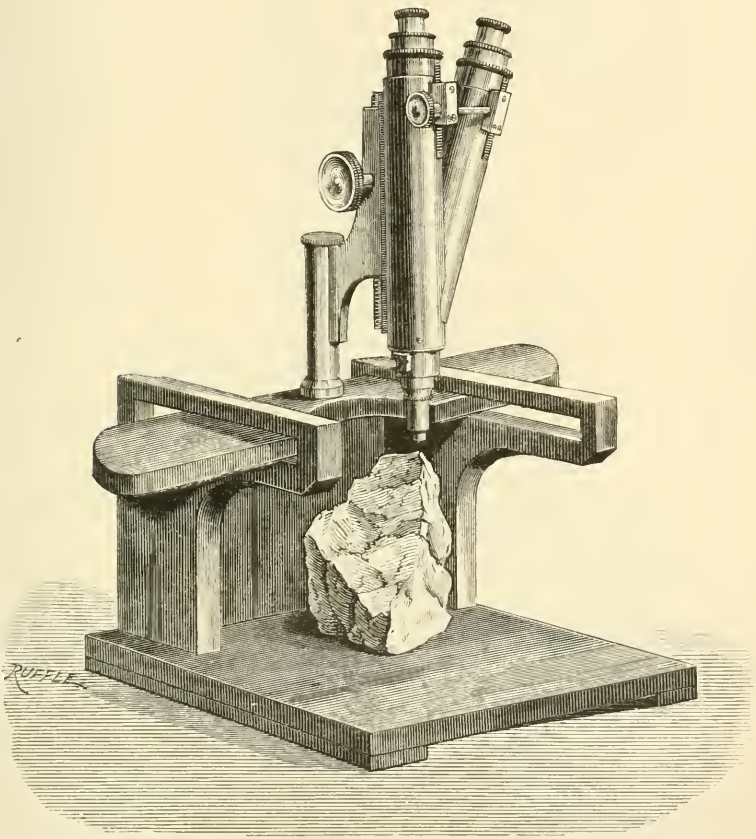


stage, as with glass the position of the illuminating apparatus would be readily seen. The slide-carrier would, however, require to be altered, so as not to impede the view beneath the stage. There is a removable substage and diaphragm.

The pillar and arm, in the original form, were marked so as to indicate the correct inclination of the body in the use of the camera lucida. The mirror is attached to a swinging tail-piece.

Beck's Mineral Microscope.—This (fig. 115) was devised by the late Mr. R. Beck for rapidly looking over large pieces of rocks. The body-tubes and pillar of a binocular Microscope are attached to a flat horizontal bar which is passed through longitudinal apertures in two

Fig 115.



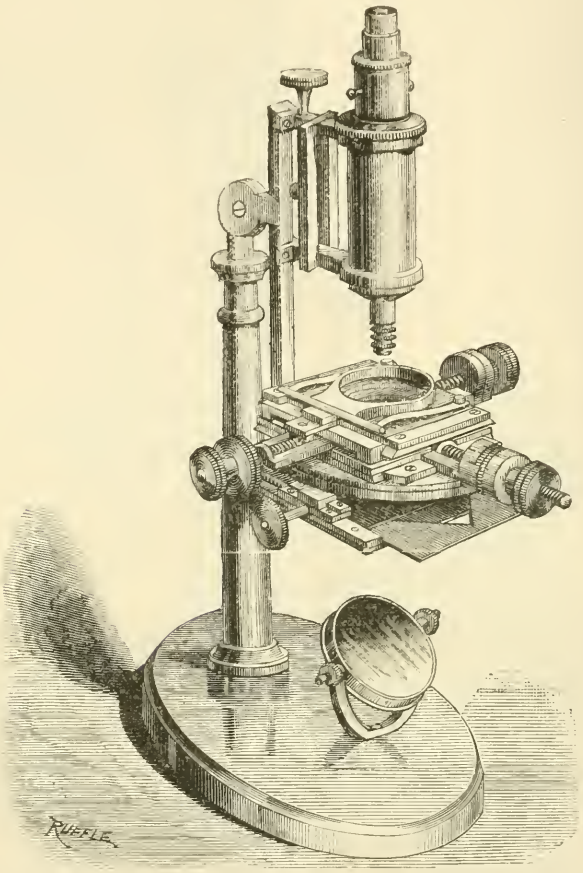
standards which rise from a large wooden base. The ends of the bar project sufficiently to allow of its being moved by the hands from side to side and from back to front, so that the Microscope can be passed over a large rock placed on the base. The latter is 11 in. × 10 in., and the bar is 6 in. above it.

Deutgen's Micrometer-Microscope.—This Microscope (fig. 116) was devised and constructed in 1845 by Herr H. Deutgen, of Groningen, for the physical laboratory of the University of that city.

The peculiarities are (1) the application of the Turrill system of mechanical stage, which had only then been recently invented by

Mr. Turrill in England; (2) the *two* screw stage-micrometers acting at right angles, so that measurements can be made in both directions, and (3) the variable diaphragm beneath the stage, consisting of two rectangular plates, each having a large V-shaped aperture, and so

FIG. 116.



arranged that a pinion at the side causes them to move together but in opposite directions, thus varying the size of the square aperture of the diaphragm from the full opening ($1\frac{1}{2}$ in.) to a minute hole.

The fine adjustment is by a direct-acting screw behind the body-tube, raising or lowering a stud to which is attached the support of the body-tube.

The stage has spring clips connected by a rod, to grip glass cells of special design.

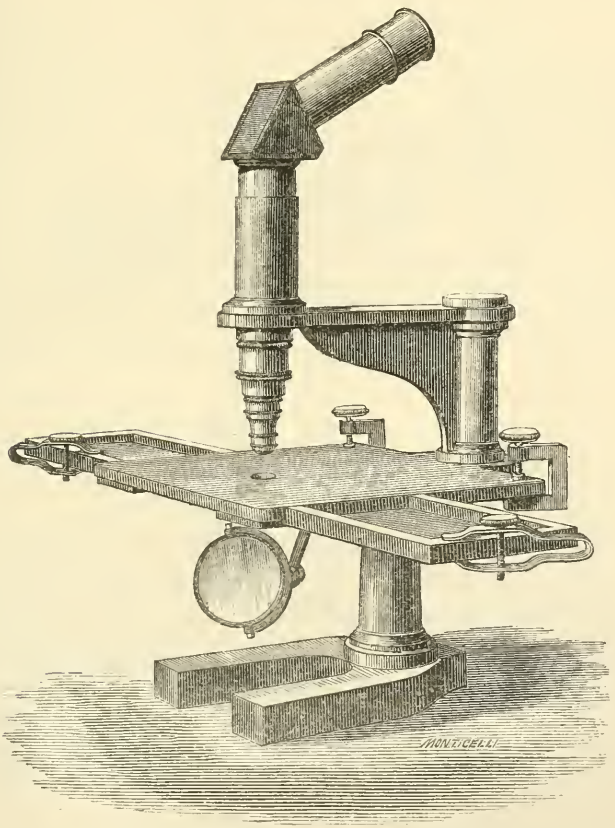
The question of duly balancing the instrument on its inclining

axis was wholly neglected in the design; and indeed the slender attachments of the body-tube with its focusing adjustment, the ponderous mechanical and micrometer stages, and the adjustable diaphragm on the long square bar indicate on the part of the maker a very imperfect estimate of the necessity of stability for the purpose he had in view.

Giacomini's Microscope with large Stage.—Signor F. Koristka, of Milan, sends us fig. 117 as showing the modifications which he has introduced into this instrument since its original design.*

The lateral "wings" by which the width of the stage is increased

Fig. 117.



to 40 cm. (wide enough to take sections of the entire human brain) are in the form of hollow trays, while the fine adjustment is now effected by an arrangement at the nose-piece acting similarly to the old form

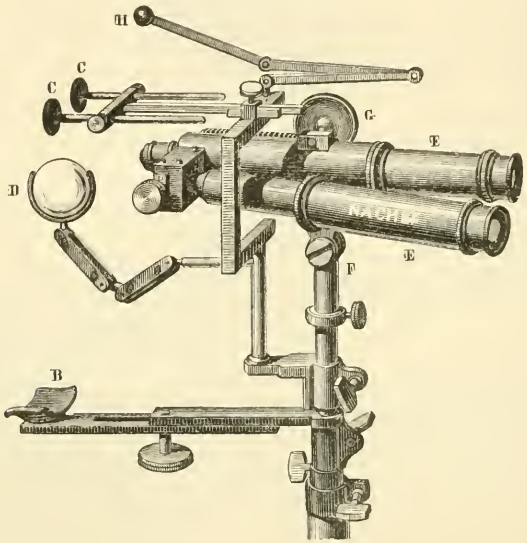
* See this Journal, v. (1885) p. 516.

of correction collar of an objective. The nose-piece consists of two tubes, the inner one being pressed upwards by a spiral spring encircling it; it is provided with two pins which travel in slots in the outer tube; a screw collar on the latter works against the pins, and thus controls the motion upwards or downwards of the inner tube.

Nachet's Corneal Microscope.—M. Nachet sends us fig. 118, showing his form of Corneal Microscope, which, unlike that by Schieck described Vol. IV. (1884) p. 954, has binocular body-tubes.

The body-tubes E E are attached to the standard F, which consists of three tubes sliding in one another and intended to be clamped to the table. The body-tubes can be inclined on a hinge joint. There is a coarse adjustment at G. The leather-covered pads C C form a rest for

Fig. 118.



the forehead of the person under observation, and B for his chin. They can be adjusted to different lengths. The little ball H is used as an object to be followed by the eye of the patient, so as to present different parts of the cornea to observation. D is a bull's-eye condenser. The screws on the standard are for adjusting the two arms in any desired position and for clamping the sliding tubes of the standard at any given point of extension.

The instrument is also adapted for examining aquaria, and surfaces of all kinds, the skin, &c.

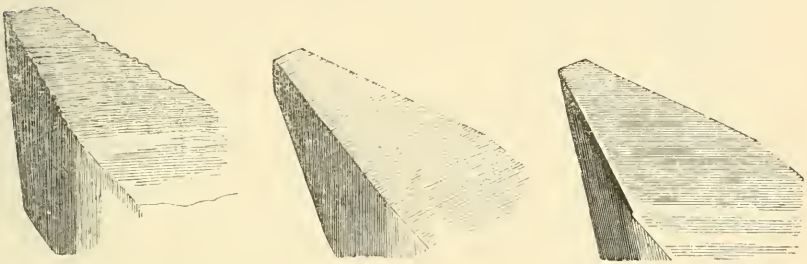
Use of the Microscope in the Mechanical Arts. *— Mr. G. M. Hopkins indicates the many uses which may be made of the Microscope in workshops, not only for making fine measurements and

* Central-Ztg. f. Optik u. Mech., vi. (1885) pp. 270–2 (10 figs.).

examining the quality of the work, but also in the selection of material and observing its behaviour under different conditions.

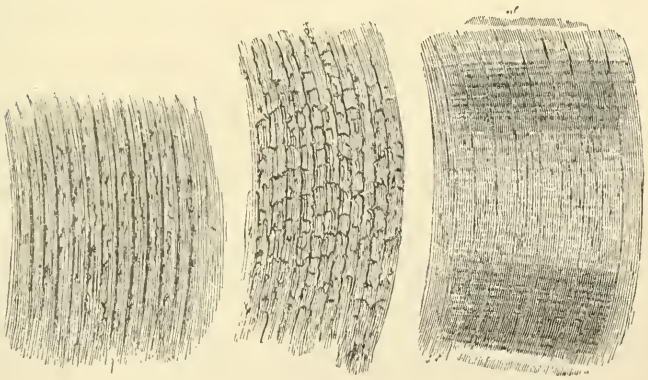
Thus the causes of the great differences in the efficiency of tools used in metal-working may best be detected and studied by the Microscope. The efficiency of the tool must depend not only upon the quality of the steel, but also upon the way in which the edge has been given to it. A tool sharpened upon a coarse grindstone is in reality grooved and notched, while one that has been smoothly ground

Fig. 119. Fig. 120. Fig. 121.



and finished upon a hone-stone shows a straight sharp edge; these characters are well seen with the Microscope, and are also betrayed by the surface of material worked by the tool. A coarsely ground tool (fig. 119) produces the furrowed and ridged surface of fig. 122;

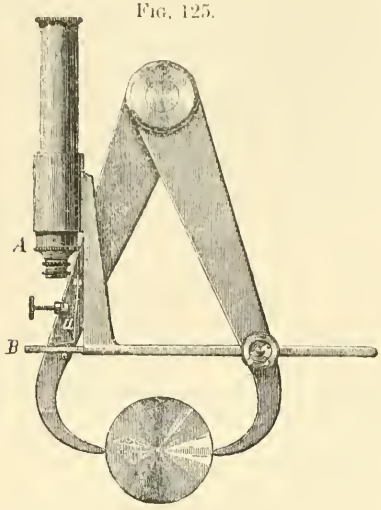
Fig. 122. Fig. 123. Fig. 124.



one that has been ground upon an emery wheel which does not run truly (fig. 120) works the surface shown in fig. 123, where the metal has been torn out and not cut by the tool, while fig. 124 represents the smoothly-cut surface worked by a well-finished tool (fig. 121).

Fig. 125 shows another purpose to which the Microscope can be applied in the workshop to obviate the difficulty often experienced in making accurate measurements with callipers. B is a bar with a micrometer scale, fastened to the right limb of a pair of callipers, and *a* is an index fastened to the left limb. The work having been calibrated in the usual manner, the position of the index upon the scale is accurately determined by means of the Microscope A which is also carried by the bar B; and it is clear that in this way a precision is secured which is quite unattainable by the ordinary methods of calibration.

Fig. 125.



Finally the Microscope can with advantage be used to criticize the efficiency of the emery wheel; for this there is no better criterion than an examination of the fine dust thrown off at the edge of the wheel. If the cement is not hard enough, the particles of emery are soon loosened and removed; if on the other hand there is too much hard

Fig. 126.

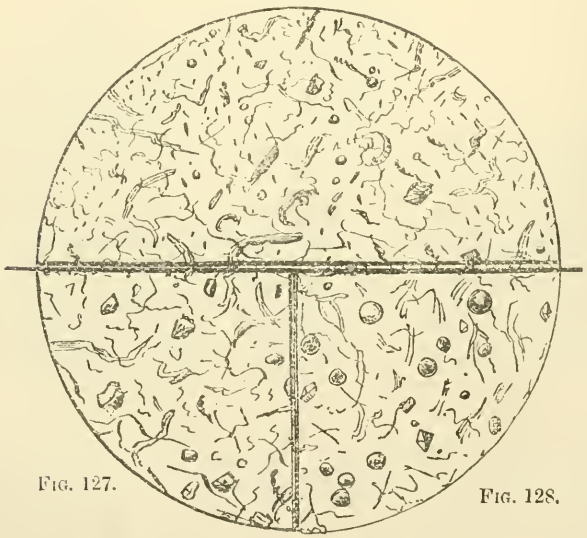


Fig. 127. Fig. 128.

cement, the emery will remain enclosed in it and the wheel will only do its full amount of work by the exertion of undue pressure. A careful examination of the dust especially with regard to the proportions of cement, emery, and iron or steel particles which it contains, will show without doubt whether the wheel is well made and is doing its work efficiently. Under the best conditions the grindings should consist mainly of iron or steel with few particles of emery and few spherules of molten metal; if there is much emery present, the wheel is wearing too rapidly; while the presence of much molten metal indicates that too much pressure is being exerted. Fig. 126 represents the dust from a good wheel; here there are only a few angular particles of emery, while the particles of metal are sharp and clean cut. Fig. 127 contains a large quantity of emery and only little cement, while the particles of metal are as in the previous case, and the wheel will wear out very quickly. Fig. 128 represents the dust of a wheel which contains too much cement. The great pressure necessary to make it cut was sufficient to fuse the particles of iron or steel.

Attached to the Königliche Technische Hochschule at Charlottenburg, Berlin, is a department for the preparation of microscopic sections where metals are cut, polished, etched, and mounted for the Microscope. With the sections are also to be obtained diagrams in one or more colours drawn to the scale of 50 : 1.*

The Microscope in the Workshop.†—Prof. W. A. Rogers in a paper read before the Boston Meeting of Mechanical Engineers, refers as follows to the use of the Microscope in the workshop :—

"In the ordinary operations of the workshop, the lathe and the planer are the primary tools, while the caliper, with the graduated scale, is the secondary tool. Let us take the most simple case. It is required to turn down a piece of metal to a given diameter. In order to make the assumed case as simple as possible, we will assume the required diameter to be an even inch. The caliper is set for this unit of length, either from a graduated scale or, more accurately, from an end-measure inch with parallel faces. The setting in the latter case is done by the sense of feeling. We thus introduce an additional element of complexity, since sight is at once the primary sense and the ultimate test of a given limit of extension upon which the workman must rely. When the market is supplied with graduated scales from which any required length may be taken by the sense of feeling, it will be in order to defend the practice of relying upon this sense as a final test in measurements of extension. As a differential test, it is both useful and accurate. As an absolute test it had better be abandoned. It is a makeshift at best. Assuming that the caliper has been set to an exact inch, the workman turns the piece of metal to the required size by a series of approximations with the ever-present risk of going beyond the required limit. During the final part of the operation he stops the lathe to test the

* Central-Ztg. f. Optik u. Mech., vii. (1886) p. 131.
† Cf. Engl. Mech., xlii. (1886) pp. 397-8.

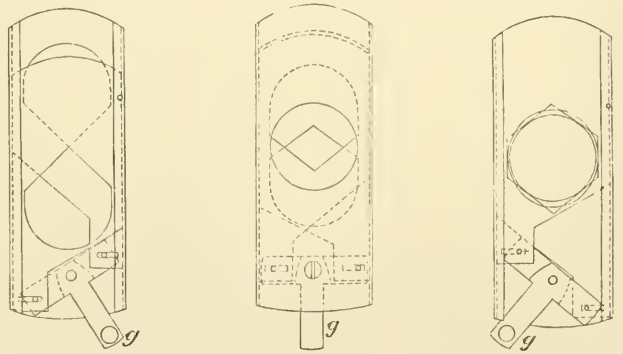
diameter with his caliper. He then takes another chip, stops, tries, starts, stops, tries, until the subtle and ever-varying sense of feeling satisfies him that he has obtained the correct diameter. But, after all, the uncertainty in the setting of the caliper remains, and this uncertainty is generally greater than that which would be found to exist in the comparative trials of the diameter. If, now, we increase the required unit, and especially if fractional increments are added, the problem of transferring a required length from a scale to a caliper becomes a most serious one.

"Only one other objection remains to be overcome. It is the common impression that the delicate adjustments of the Microscope which are continually demanded—especially the adjustment for focus —can only be made by the most delicate and sensitive means. No impression could be more erroneous. Give me a small lead hammer and I will set the top of my comparator to a given line in half of the time and with greater precision than it can be set by means of a screw movement. Give me a vertical movement by means of an eccentric disc and a long lever arm, and I will bring the surface of a plate weighing 100 lbs. into the focus of the objective quite as quickly and quite as accurately as a similar adjustment could be made in the hands of a professional microscopist."

Klönne and Müller's Diaphragm. — Herren J. Klönne and G. Müller have patented* an ingenious diaphragm shown in figs. 129–133.

It consists of two plates, each pierced with an aperture as shown in figs. 132 and 133. They are connected to a T-piece *g* by pins passing

Fig. 129. Fig. 130. Fig. 131.



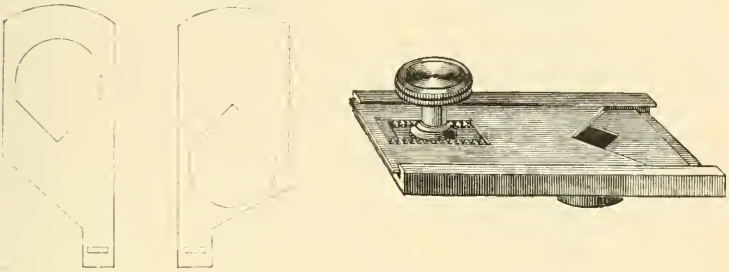
through the slots in the ends of the arms. This T-piece is attached to a frame sliding below the condenser, and just wide enough to allow of the plates moving backwards and forwards in grooves as the T-piece, turning on a central pin, assumes the different positions shown in figs. 129–131. In the first position the light is shut off, while in

* German Patent, Kl. 42, No. 34870, 26th August, 1885, 1 p. and 11 figs.

the last we have the full aperture. Any intermediate degree of illumination can be obtained; the illumination is made excentric by shifting the whole apparatus laterally.

An analogous device was constructed by Dollond, and is described and figured by Harting from a Microscope at Utrecht.* A practically identical form which we recently obtained in England, is shown in fig. 134, where two plates with V-shaped apertures are made to

Fig. 132. Fig. 133. Fig. 134.



move simultaneously in opposite directions by racks and a pinion. The aperture can thus be varied from a pin-hole to half an inch. Deutgen's Micrometer-Microscope (*supra*, p. 673) has the same form of diaphragm, which is however a fixture beneath the stage.

Now that the Iris diaphragm, however, in the form used by Messrs. Beck in their "Star" Microscope, can be made so cheaply, it would appear to supersede any of the forms of diaphragm above noted.

Lieberkühn Stops.†—Dr. G. W. M. Giles writes that during the process of examination and delineation it will be often found desirable to substitute direct for transmitted illumination, and to effect this change expeditiously he finds no appliance so useful as the old-fashioned but much-neglected Lieberkühn. To stop out the central rays of light he employs small discs of vulcanite, sawn out of a very thin piece of sheeting. By simply wetting them, these can be made to adhere to any part of the under surface of the slide, and can be shifted about if necessary with the tip of the finger, without removing the slide from the stage. By alternately employing direct and transmitted light, many details of structure can be learnt which could not possibly be made out by either alone, and it enables one also to fill in the natural colours in the finished drawing, which are quite lost by transmitted light.

Ross's Centering Glass.—This apparatus was designed by Mr. A. Ross for ascertaining whether stage diaphragms, illuminators, and other appliances are properly adjusted in the optic axis of the Microscope, and acts on the principle that when suitable lenses are inserted in the body, or superadded to the eye-piece at various positions, they

* Das Mikroskop, 1859, pp. 841–2 (2 figs.). † Sci.-Gossip, 1886, p. 121.

will give an extended conjugate focus to the object-glass, so as to convert the combination into a kind of telescope.

The apparatus (figs. 135 and 136) consists of a pair of plano-convex lenses mounted in a tube fitting in an adapter which is placed

Fig. 135.

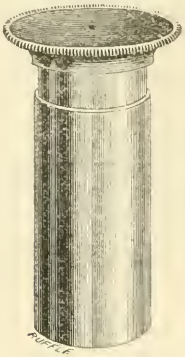
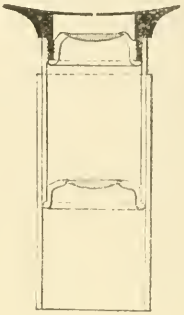


Fig. 136.



over the eye-lens of an ordinary eye-piece when the eye-guard is removed. A pin-hole diaphragm is fitted over the upper lens, and the combined focus of the two is about $\frac{1}{2}$ in. To allow of adjustment for focus the lenses slide in the adapter, and when adjusted the eye-point (or "Ramsden" circle) can be focused and viewed through them.

The centering glass is used in conjunction with a cap, having a pin-hole aperture, fitting over the illuminator, so that the collimation of the two pin-hole diaphragms with the source of light will afford a ready method of adjusting the illumination exactly in the optic axis.

In practice, the pin-hole cap is first applied over the illuminator, and the image of the source of light seen through it is centered approximately with the ordinary eye-piece; the centering glass is then put over the eye-piece, and the exact collimation is obtained by the adjustment of the centering-screws of the substage, and by slight movements of the mirror or source of light.

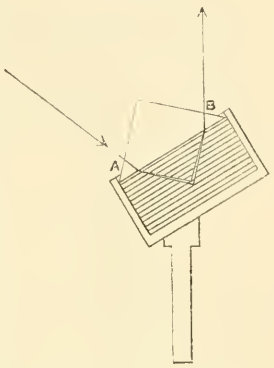
Amici Polarizing Apparatus.—We recently found in Florence a piece of apparatus belonging to an Amici Microscope, the construction of which was somewhat puzzling. On submitting it to Mr. H. G. Madan, he reports as follows:—

"The apparatus (fig. 137) consists of a square brass box containing 10 thin plates of glass (the glass has a decided blueish tinge, and is not very perfectly polished). On the top of the plates lies a right-angled prism of glass (refractive index = 1·512); the hypothenuse of the prism being parallel to, and in contact with, the top plate. The box is supported on a brass stem in such a position that the plane of the glass plates makes an angle of 118° (approximate) with the axis of the Microscope, under the stage of which it is fitted; and it

can be turned round on this stem in such a way as to preserve this angle constant for all azimuths.

When it is placed so as to reflect light from the sky or a lamp up the body of a Microscope, this reflected light is found to be plane-polarized in the usual manner effected by reflection from a bundle of glass plates. It seems clear that the instrument is intended for use as a polarizing mirror, and its action is of the following kind.

Fig. 137.



A .beam of ordinary light incident on the prism at A emerges from the lower face, when it falls on the latter at angles less than the critical angle 41° 24′, deviated (and, of course, also dispersed) to such an extent as to fall on the bundle of glass plates at the polarizing angle, 56°. It is thus polarized by reflection in the usual way, and passes upwards into the prism near the edge B. In its passage through the prism its dispersion is entirely corrected, and it emerges as a colourless plane-polarized beam in such a direction as to illuminate an object on the stage and enter the object-glass of the Microscope.

The main advantage which the apparatus was intended to secure seems to be, to enable a ray to fall on the pile of plates at the polarizing angle without the necessity of placing the plates very obliquely to the axis of the Microscope. Thus there is a considerable gain in convenience and compactness."

Winkel's Micrometer Eye-piece.—In such micrometer eye-pieces as that of Gundlach (fig. 138), where the micrometer *m* is

Fig. 138.

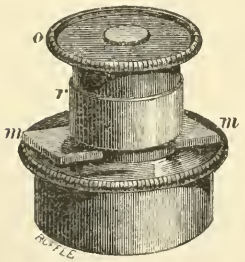
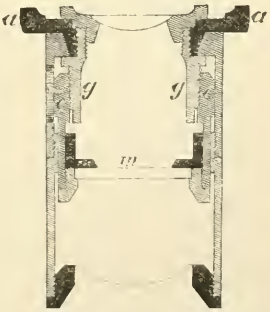


Fig. 139.



inserted in a slit (covered by a ring *r*) and the eye-lens *o* is focused on the micrometer by moving it in or out, the magnifying power is altered with each change in the position of the eye-lens.

Herr R. Winkel * has endeavoured to remove this objection by leaving the eye-lens in a fixed position and moving the micrometer vertically by the contrivance shown in fig. 139. Here the micrometer m is raised or lowered by turning the cap a, which is connected with a piece g having a thread cut in it, and by this means e with the micrometer is raised or lowered in a similar manner to the arrangement for correction-adjustment in objectives.

Herr R. Winkel overlooked the fact, however, that in getting rid of the objection to any movement of the eye-lens he had introduced a similar cause of error. Any movement of the micrometer shifts it from the plane of the image, and to bring the latter into coincidence again it is necessary to refocus the objective, and this alters the magnifying power.

Method of Webbing the Filar Micrometer.†—Mr. D. Gill gives the following directions for webbing a micrometer.

A spider (the variety is marked by a cross on the back, and is found in English gardens about decayed wood) is caught, and placed on a wire fork. The insect immediately attaches a web to the wire and begins to lower itself by the web to the ground. This web is wound up on the fork till ten or twelve turns, separated by a convenient space, have been secured. A brush with varnish is then passed along the prongs; the webs are thus securely fixed to the fork. The parallel prongs of the fork must be sufficiently far apart to allow the web-frame of the micrometer to pass between them. The frame to be webbed is placed on a flat dull black surface between the prongs of the fork, the latter being carefully arranged so that one of the webs lies nearly in the furrow ruled in the frame for its reception. As the web-frame is generally thicker than the fork, the web will now be stretched across the former, with a certain amount of tension, and is brought into the furrow with a finely pointed piece of soft wood. If the surface of the frame is well polished, and the furrows sharply cut without "burr," the web should leap sharply and decidedly into its place. Each end of the web is then secured by a drop of shellac varnish, which should be allowed to harden thoroughly before the frame is touched. The webs can be very readily so handled against a black background, with the aid of a hand lens of two or three inches focus. In experienced hands this method gives good results, but the following, which is generally followed on the Continent, is preferable.

A web about two inches longer than the width of the frame, is unwound from a cocoon,‡ and small pieces of lead are attached to its extremities by beeswax. One end of the web, with its attached lead, is laid on a piece of cork floating in a tumbler of water; the other

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 41-3 (2 figs.). Cf. Zeitschr. f Instrumentenk., v. (1885) p. 326.

† Encyclopædia Britannica, 9th ed., xvi. (1883) p. 248.

‡ It is asserted that webs from cocoons are more elastic, better shaped, and more durable than those obtained during an effort of the insect to escape. The best webs we have seen were from a cocoon obtained in Holland, but we have been unable to ascertain the name of the species of spider.

end is allowed to hang down in the water, where it becomes thoroughly saturated and untwisted. It is then laid across the fork, and dropped into its furrows in the manner above described, the little lead weights exerting a definite tension.

Varnish * is immediately applied to secure the webs, and the frame is not touched till it is dry.

The bevel-edge of the web-frame introduced by Repsold offers great facilities for accurate webbing, and should, Mr. Gill says, be employed in all future micrometers.

Schröder's Differential-screw Fine Adjustment.—This device by Dr. H. Schröder was exhibited by Messrs. Ross in the Inventions Exhibition of 1885, and is shown in figs. 140 and 141.

Fig. 140.

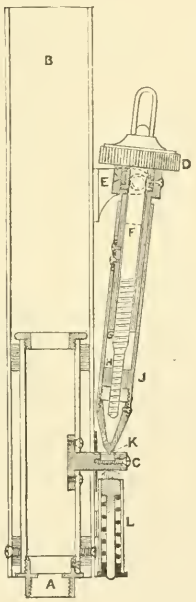
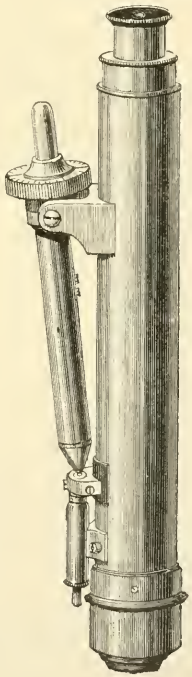


Fig. 141.



The nose-piece A is attached to a tube which is fitted to slide accurately in adjustable bearings in the body-tube B. The nose-piece tube has a short projecting arm C, by means of which it is pressed upwards by a strong spiral spring mounted in a cylindrical

* Argelander used to apply two drops of varnish at each end of his webs. He first fixed each extremity by a drop of shellac varnish, and after that had dried he applied a drop of copal varnish nearer the centre of the frame; the latter took a long time to harden, but gave ultimately a much stronger attachment.

box L outside the lower end of the body-tube. The arm C is moved against the spring by the differential-screw mechanism (with milled head D) which is gimballed on a bracket E attached to the upper part of the body-tube.

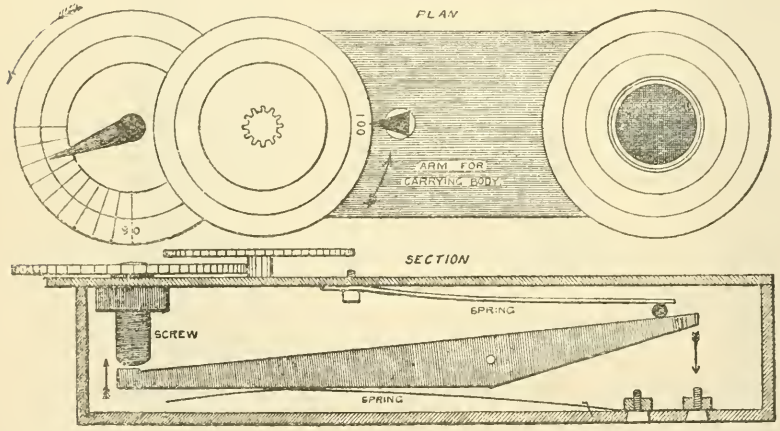
The differential-screw mechanism consists of a steel rod F (connected with the milled head D) which has two screw threads at the lower end, one working in a thread cut in the end of the inner tube G, and the other in the block H, which is soldered within the sheath J). When the milled head is turned to the left, the block, and with it the sheath, moves downwards while the rod itself, carrying the block and sheath, moves upwards. As the screws are cut respectively to 45 and 52 threads to the inch, the resultant motion is equivalent to the difference between the two screws, that is, to the motion of a screw of nearly 335 threads to the inch.

The end of the sheath is tipped with a small sphere K of polished steel, while the projecting arm of the nose-piece tube against which the end works has a corresponding concave bed of polished agate.

Delicate Fine Adjustment.*—A delicate system of fine adjustment is described anonymously, but said to be "after Dr. Royston-Pigott." It is shown in section and plan in fig. 142.

The primary wheel carries an axis of steel, 1–3 inch thick, having an external thread exactly $101\frac{1}{3}$ turns per inch, which travels

Fig. 142.



in a brass nut having 60 turns of a corresponding thread. This wheel has 100 teeth on the rim and engages a pinion of 10 teeth which forms one piece with the secondary wheel (removable at will), also divided into 100 parts. Each of the divisions on the secondary wheel represents a movement of the focal plane through a space of 1/230,000 in. There is also provision for changing the fulcrum so

* Eng. Mech., xliii. (1886) p. 340 (2 figs.).

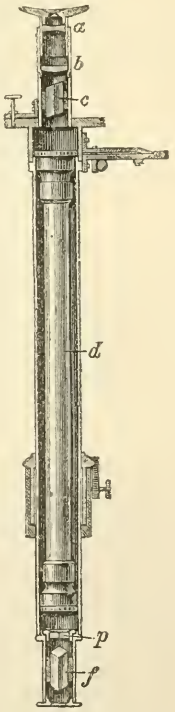
as to make the advantage of the leverage 4 instead of 2·3 times; the finest wheel divisions then read 1/400,000 in. focal motion.

The lever is very strong and rigid, and by a fork rests upon two studs diametrically placed on the sliding tube carrying the objective.

The sliding tube bears upon extremely thin edges so as to make contact with as small surfaces as possible and thus minimize the friction. It should be highly polished and trued with crocus and paraffin, and when finished well supplied with chronometer oil. A further advance would be to have the pivot holes of the lever jewelled, drilled, and polished into a conoid form. Great care should be taken to thoroughly "true" spherically the free end of the fine screw.

Several degrees of strength were tried of the depressing springs, acting as safety-guards on the objective touching "cover." That finally selected (on reversing the instrument so that the objective was vertical and the wrong way up) gave a resistance of 4 oz. Less than this strength would be sufficient were the Microscope used perpendicularly. "On the extreme accuracy of simultaneous contacts and pressures depends the steadiness of the image under high powers, which should never dance in focusing ever so lightly, as it nearly always does in most Microscopes."

Fig. 143.



Mechanical Stages.*—Mr. A. Y. Moore "condemns such mechanical stages as have the milled heads above the stage. They are all well enough for amateur work—looking at mounted slides—but the *room* is not there, and the usual form of stage is to be preferred, even though the projection of the milled heads may be such as to prevent the complete rotation of the stage (and this is a very nice point—to talk about)."

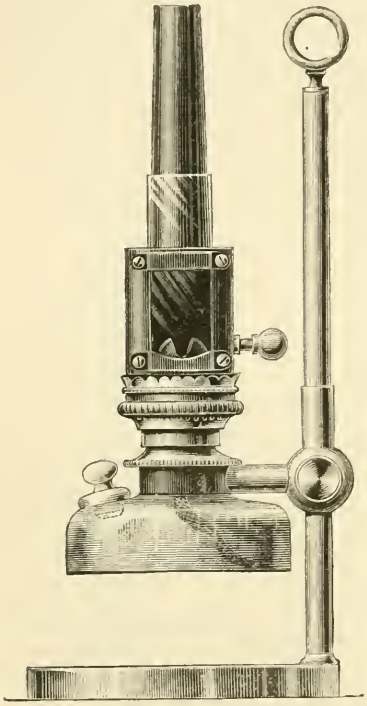
Ultzmann's Saccharometer.—Dr. R. Ultzmann has designed a cheap saccharometer to be used with any Microscope. The instrument (constructed by Reichert, of Vienna) is a Mitscherlich saccharometer of small size; it requires no special source of light, since when adapted to the Microscope it is sufficiently illuminated by the concave mirror.

In fig. 143 *a* is the eye-piece and *b* the objective of a small Galilean telescope, of which the focus is at *p*; *c* is the upper Nicol prism, to the mounting of which is fixed a vernier; *d* is the glass tube which holds the sugar solution, *p* is the plate of right- and left-handed quartz, and *f* is the lower Nicol. In using the instrument the body-tube is removed and replaced by the saccharometer; the mirror is then adjusted so as to send the light up the tube.

* The Microscope, vi. (1886) pp. 80–3.

The graduated circle of the upper Nicol is so divided that each division corresponds to the rotation produced by 1 per cent. of grape-sugar in the solution at a temperature of 20° Celsius; and by means of the vernier, readings are made to 0·1 per cent. In the case, therefore, of raw sugar, the percentage must be taken as three-quarters of the number of divisions indicated on the scale, that being the ratio of the rotatory powers of raw and grape sugar. In all respects the instrument is used exactly as any saccharometer of similar construction. The advantages claimed for it are that it is cheap, requires no special stand or artificial light, and gives the percentage of sugar in diabetic urine, &c., directly by the vernier readings.

Fig. 144.



Baker's New Microscope Lamp.—This lamp (fig. 144) is a simplified and economical form of the one recommended * by Mr. E. M. Nelson for high-power work. Its chief advantages are that the flame can be used much nearer the table than in the ordinary Microscope lamps, while the dark-chamber metal chimney is arranged to receive a 3 × 1 in. slip, which can be of white, blue, or ground glass. Brass plates with various sized slots for regulating the amount of light can also be inserted in front of the glass slip.

The metal chimney can be adapted to any ordinary paraffin lamp.

Examination of Graduated Circles with two and four Microscopes.†—When the errors of a divided circle are to be determined microscopically for small arcs round the whole circle, a very large number of observations is required. Dr. O. Schreiber investigates the general theory of the problem, and shows how it may be simplified in practice by a suitable selection and arrangement of the observations. The divided circle is fixed and is centered on a disc which is free to rotate; the Microscopes can be moved independently of one another about the centre of the disc, so as to traverse the whole circle. Given a certain number of divisions on the circle and a certain number of Microscopes, the theoretically perfect method would make

* See this Journal, iv. (1884) p. 125.

† Zeitschr. f. Instrumentenk., vi. (1886) pp. 1–5, 47–55, 93–104.

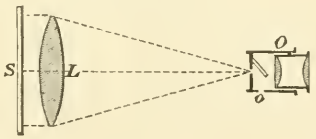
it necessary to fix the Microscopes successively in all possible positions with regard to one another, for each position to set all the divisions in succession under one Microscope and make readings in all the others. With four Microscopes and seventy-two arcs of 5° each, this would involve six million readings.

Dr. Schreiber's simplified method is as follows:—Fix the Microscopes at certain equal distances corresponding to certain arcs; bring one division into the first Microscope A, and measure micrometrically the distance of the division seen in each of the Microscopes from its zero point. These readings form a "set." A second set is got by turning the disc until the next division comes into A; observe all the arcs in this way, then all these sets form a "series." Thus a *series* consists of as many sets as there are arcs, and a *set* of as many readings as there are Microscopes.

It is impossible to abstract the details given by the author, for which reference must be made to the original paper. He finally gives "schemes" or arrangements of the observations for the following three cases; (1) Two Microscopes; (2) four Microscopes which can be fixed in any positions; (3) four Microscopes fixed in pairs opposite to one another; and compares the number of readings which they involve, from which it appears that method (2) is the most advantageous.

Measuring the Focal Length of a Lens.*—Prof. E. Lommel adopts the following method:—At the point in the tube of an eye-piece O (fig. 145) generally occupied by the cross-wires, a semi-circular screen is fixed which obscures half the tube, the screen being divided into two quarter-circles by a narrow vertical slit. Behind this is a mirror or prism which sends light from an opening *o* in the side of the tube through the slit and into the lens L, which is so placed that its axis coincides with that of the eye-piece; behind the lens is a plane mirror S which reflects the light back through it. The distance between lens and eye-piece is altered until the image of the slit appears sharply defined, and without parallax, as a prolongation of the slit itself. The distance between the lens and slit will then be the focal length, since the rays are in this case refracted through the lens as a parallel pencil, reflected back as parallel rays, and converge again to the principal focus at the position of the slit. This length is most conveniently measured by fixing the lens and the eye-piece upon stands which slide upon a graduated bar.

Fig. 145.

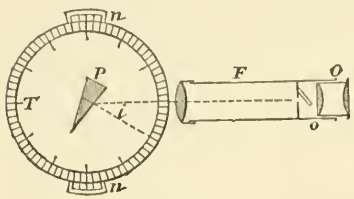


Measuring Indices of Refraction.†—Prof. Lommel also describes the following method:—The telescope F (fig. 146) of a spectrometer, fixed and focused to an infinite distance, is provided with the eye-piece O *o* described in the preceding note; the prism P whose

* Zeitschr. f. Instrumentenk., v. (1885) p. 124 (1 fig.).
† Ibid., p. 125 (1 fig.).

index is to be measured is adjusted in the usual way and fixed on the graduated disc T (with vernier at n and n), which is free to turn. The prism is first placed with one face perpendicular to the telescope, so that the image of the slit reflected from the face is seen in the centre of the field. This is the initial position. As the prism is turned a spectrum appears in the upper half of the field; each line of the spectrum, as it is made to coincide with the slit, represents a ray which has been refracted into the prism, reflected normally at the second face, and refracted out by the same path; hence the angle through which the prism has been turned is the angle of incidence i for that ray, while the angle of refraction is the angle of the prism. If the prism be turned further until the second face is perpendicular to the telescope, the difference of readings for the initial and final positions gives the latter angle, which is therefore the angle of refraction r for each ray. Then $\mu = \dfrac{\sin i}{\sin r}$.

Fig. 146.



The spectrum will reappear before the final position is reached at the point where the rays are refracted through the second, and reflected internally at the first surface; and the angle i is now the difference between the corresponding reading and that of the final position; this gives a second determination of the index. This method dispenses entirely with the usual collimator; it will be noticed, however, that the angle of the prism must be less than the critical angle of its substance.

This method is practically identical with that adopted by Prof. Abbe in his Refractometer, and Prof. Lommel subsequently acknowledged this,* not being aware of Prof. Abbe's paper.

Optical method for the absolute measurement of small lengths.†—M. M. de Lépinay makes use of Talbot's fringes, which are produced when a parallel-faced transparent plate is interposed in the path of a beam of light which has passed through a diffraction grating. If μ is the index of the plate, t its thickness, n the order of the fringe, then $2\,\dfrac{\mu - 1}{\lambda}\,t = n$.

The author measured by this means the thickness of a quartz plate cut parallel to the axis, and about 4 mm. thick, using the third spectrum produced by a grating of 400 lines to 1 mm. μ was taken as the mean of the best known measurements, λ as the mean of the wave-lengths found by Mascart, Ditscheiner, and Van der Willigen. Rays of different wave-lengths give a succession of values for t, of which the mean is taken. The author claims greater accuracy for

* Zeitschr. f. Instrumentenk., v. (1885) p. 200.
† Comptes Rendus, c. (1885) pp. 1377-9.

this method than can be attained by employing the fringes of Fizeau and Foucault. Conversely, having measured the thickness by other means, the author has applied the formula to determine the wave-length of the ray D_2, and finds a value identical with Angström.

It has been pointed out * that the author is not justified in concluding that the values found by Ditschreiner and Van der Willigen are incorrect, because it is not known to what degree of accuracy the thickness of the quartz plate had been measured.

Dotted appearance on Pleurosigma angulatum.†—Mr. J. B. Dancer once found that the oblique markings of a damaged valve had been removed by abrasion against the cover-glass; by no modification of the light could they be rendered visible. When, however, oblique illumination was directed in a line with the length of the valve, the transverse markings were distinctly visible and apparently uninjured. At first he thought that moisture had obtained access through the crack in the thin cover, and he dried the slide over the flame of a spirit-lamp carefully and repeatedly, but could not make the oblique lines visible, although they were distinctly visible on other broken valves contiguous to the special one under examination, and also on some portions of this valve; the oblique markings which had been dislodged were lying beside the edge of the damaged valve. Reasoning from what he had seen, he was led to imagine that the oblique markings were on the upper convex surface of the valve, and that the transverse markings were on the inside or concave surface. If we assume that the section of these raised markings are semi-cylindrical in form—that is, being rounded at the top—there would be an imperfect cylindrical lens formed wherever these pellucid ridges crossed the lower or transverse markings. These would present focal points of light and possibly images of objects, such as are seen in the eyes of beetles under certain conditions of illumination; if this be true, the so-called beads have no existence.

Mr. Dancer in a subsequent communication ‡ writes as follows:—"In my letter of the 28th May, I assume that the cross section of the ridges or markings on *P. angulatum* are semi-cylindrical, and also state that the *A. pellucida* ridges would form imperfect cylindrical lenses, where they cross the lower transverse markings. To render my meaning more intelligible, I may say that I had in my mind the lens introduced, I believe, by Chamblant, of Paris, about fifty years ago. If two pieces of polished glass, semi-cylindrical in section, have their flat surfaces placed one on the other with exactly their cylindrical surfaces at right angles to each other, a perfect lens is formed, having no spherical aberration. These lenses are much used in Paris, and occasionally in England, for hand reading-glasses and spectacle eyes. I have had such in use for both purposes for over forty years. Now, if we conceive that a number of minute lenses of this form were placed in juxtaposition, and examined under a Microscope, they would show images of any objects placed between the mirror and the

* Zeitschr. f. Instrumentenk., v. (1885) p. 325.
† Engl. Mech., xliii. (1886) p. 283. ‡ Ibid., p. 329.

source of the illumination; in fact, they would exhibit the same appearances as those presented by the eye of a beetle when viewed microscopically. From this we may assume that when the markings on diatoms are exactly at right angles, the most perfect lenticular performance would be visible.

A very pretty microscopic object may be produced in the following manner:—Place a metal ring on a slip of glass; in the centre of the metal ring put a minute quantity of the flowers of sulphur, and place a thin cover-glass over the metal ring; then hold the strip of glass at some distance above the flame of a spirit-lamp, in order to sublime the sulphur; when the slip of glass is placed under the Microscope, and viewed with a moderately low power, the sublimed sulphur will appear as minute plano-convex lenses, in which the image of an object placed between the mirror and the source of light will be beautifully shown. These plano lenses will remain transparent so long as the cover-glass is kept moderately warm. When cooling, the act of crystallization may be observed; when cold, these minute hemispheres are opaque. It may be necessary to repeat the experiment to insure the best results. If too much sulphur, or too much heat, the lenses are not microscopic. By blowing through a heated glass tube, on to the surface of the cover-glass, the act of crystallization can be retarded."

"**Central v. Oblique Light.**"—Mr. E. M. Nelson thinks* that he has been hardly dealt with by the "Royal Microscopical Society," † who in place of meeting his "criticisms on their teaching" in a proper scientific spirit, have made a "personal attack" upon him and are threatening him with their sledge-hammer. This is the story of the wolf and the lamb in an intensified form.

How criticism should be met depends upon circumstances, and there are occasions when "personal attack" (adopting Mr. Nelson's term) is the only remedy, except silence, which is open to the aggrieved party.

Suppose Mr. Nelson had, for instance, published a statement expressive of his regret that Prof. Huxley was so determined an opponent of Darwinism, and that, in consequence, he intended to demonstrate the falsity of the Professor's teaching. Does he suppose that Professor Huxley would proceed to discuss the matter in a "proper scientific spirit," or that if in place of treating it with silent contempt (as he probably would) he made a "personal attack" by way of reply, would any one consider it as otherwise than well-deserved?

But Mr. Nelson has gone much further even than the case we have put. When he first misrepresented the "Royal Microscopical Society" as teaching the views which he combated, we pointed out that not only were those views not held as suggested, but that we had never met or heard of *any one* who holds or had ever held them. In decent society it is usual, when a person has disclaimed an opinion improperly attributed to him, to do one of two things—either to withdraw it (with or without an expression of regret at having made it,

* Engl. Mech., xliii. (1886) p. 300. † See note *supra*, p. 574.

according to the taste or temperament of the person guilty of the misrepresentation), or to substantiate it by a complete demonstration.

Mr. Nelson has attempted the latter alternative in a way which we will not characterize, but which can be properly appreciated from what follows.

Mr. Nelson's original statement, it will be remembered, was that the "Royal Microscopical Society" taught that "*nothing can be known about the structure of the diatomaceæ because all the diffraction spectra are not admitted*," a proposition which is so absurd on the face of it, that we find it impossible to believe that Mr. Nelson can have honestly supposed it to be held by any human being of only average intelligence, much less taught by the "Royal Microscopical Society."

The proof of his assertion Mr. Nelson gives as follows:—"Whether, for example, *P. angulatum* possesses two or three sets of striæ, whether striation exist at all, whether the visible delineation is caused by isolated prominences, or depressions, &c., no Microscope however perfect, no amplification however magnified, can inform us. Mon. Micr. Journ., xiv. 1875, p. 250."

Thus, although the pages of this Journal teem with passages which show that the views attributed to the Society are purely imaginary, Mr. Nelson passes over every one of them, even the authoritative paper of Prof. Abbe himself, and goes back more than ten years to cite a paragraph from the Monthly Microscopical Journal, which, as is well known, was an independent publication not under the control of the Society.

Is that a course of proceeding which entitles its author to demand that he should be dealt with in a purely scientific spirit?

Moreover, the paragraph quoted, as will be seen, in no way supports Mr. Nelson's original statement, or shows that any one, much less this Society, ever taught that unless all the diffraction spectra are admitted nothing can be known of the structure of the diatomaceæ. The Fellows of this Society hardly require to be reminded of what the diffraction theory really does teach, viz. first, that according to the coarseness or fineness of the structure, a greater or less number of the spectra are admitted, and secondly, that the greater the number admitted, the nearer will the image resemble the object. Were we far wrong in saying that a writer had mastered but little of the diffraction theory, who could sweep together the diatomaceæ in general—the coarse as well as the fine—as is done in Mr. Nelson's original statement, and who was further so oblivious of what has been said as to the indications of structure given by even a portion of a set of spectra as to write that this Society taught that "*nothing* can be known of the structure of the diatomaceæ, because "*all* the diffraction spectra are not admitted"?

As we said before, it was so much of a puzzle to us to comprehend why Mr. Nelson should go so far out of his way to try and fasten upon people views which existed only in his own imagination that we could only account for it by the supposition that he had been led away by the practice well known in other quarters to which we

referred, and had attributed to the Society the most absurd views for the purpose of glorifying himself by showing how he could dispose of them.

We fail to see the good of such tactics, for even if for the time the writer is able to pose as a victor, the victory in a few weeks is turned into worse than a defeat when the demonstration of the discreditable arts to which he has had to resort is published.

Mr. Nelson deprecates the sledge-hammer being applied to him. We shall be only too glad to put the sledge-hammer back in its place when he returns to the usages not only of scientific but of all decent persons, and abstains from the misrepresentations in which he has recently indulged.

Interpretation of the Six Spectra of Pleurosigma angulatum. This article by Mr. E. M. Nelson * is the most striking instance which we can recall, at any rate in microscopical matters, of a critic being "hoist by his own petard."

The article purports to show the error of the view of Dr. Eichhorn in his paper on this subject, referred to in this Journal, I. (1878) p. 186, and while to some extent excusing Dr. Eichhorn for his mistake, insists that the support given to him by "the R.M.S. is quite unpardonable."

Now, the simple fact is that Mr. Nelson has found a most egregious marc's-nest. The very thing that Mr. Nelson declares Dr. Eichhorn ought to have said, but did not say, he does say. The very thing that Mr. Nelson considers Dr. Eichhorn to be wrong in saying, he does not say.

Mr. Nelson has mixed up the *images* seen in the Microscope and the real structure of the *objects* which furnish those images, so that while Dr. Eichhorn who had "never seen a diatom" (as Mr. Nelson himself says) deals necessarily exclusively with images, and those false ones, he is denounced for his fallacies in dealing with true structures; and this Society, who for many years have published in every number of the Journal a table showing how many lines to the inch can be resolved with a given aperture, are supposed to believe than an aperture of 0·50 N.A. will resolve 100,000 per inch! †

All this arises from the fact that Mr. Nelson has never read the paper which he elaborately criticizes, either in the original German or translation. This is a strong assertion to make, and we should not venture to do so at second-hand, or if we had not extracted the admission from Mr. Nelson himself.

* Engl. Mech., xliii. (1886) pp. 337–8 (5 figs.) and 396.

† It would hardly be fair to deal seriatim with the various mistakes of Mr. Nelson's paper as they all flow from the one cardinal error of supposing that Dr. Eichhorn had predicted "true markings" in place of admittedly false images, but there is one matter of fact which should be corrected. Mr. Nelson declares that the points in question cannot be seen in the way described, but only by *enlarging* the diameter of the dioptric beam and cutting out the six spectra, "and until they are cut out nothing will be seen of the intercostal markings." The simple fact is that they were seen by Prof. Abbe, Mr. Stephenson, and other Fellows with a very *narrow* dioptric beam and without one of the six spectra being cut out.

The best, however, remains to be told. Mr. Nelson expresses his astonishment that it was not seen that "*insistance on the accuracy of Dr. Eichhorn's interpretation stultifies Prof. Abbe's magnificent diffraction theory.*" Now the problem solved by Dr. Eichhorn was set to him by Prof. Abbe himself; the solution was printed and published under his auspices; and it was sent by him to the Society as a remarkable confirmation of the diffraction theory! As the paper in this Journal from which Mr. Nelson quotes plainly states the part which Prof. Abbe's University took in the matter, the wonder is that no suspicion crossed Mr. Nelson's mind when he was writing as to the error into which he had fallen. It was hardly likely that any University would take the pains to make public the work of a student which "stultified the whole of the magnificent theory" of one of their most illustrious professors!

Mr. Nelson's mistake has its origin, we fear, in another attempt to throw a stone at the "Royal Microscopical Society." We are hardly called upon to repress a feeling of satisfaction that it should have resulted in so notable a miss.

Allison, F. B.—See Dancer, J. B.

American Society of Microscopists.—Ninth Annual Meeting.
[Circulars issued by the President, Secretary, and Director of Working Session.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 114 and 119.
Micr. Bulletin (*Queen's*), III. (1886) p. 17.
The Microscope, VI. (1886) pp. 124–8.

Auckland (N.Z.) Microscopical Society, First Annual Meeting of.
Journ. of Micr., V. (1886) p. 196.

B., L. B.—**True cause of dotted appearance in** *P. formosum.*
Engl. Mech., XLIII. (1886) p. 300–1.

Bertrand, E.—**Nouvelles dispositions du Microscope permettant de mésurer l'écartement des axes optiques et les indices de réfraction.** (New arrangement of the Microscope allowing of the measurement of the separation of the optic axes and the indices of refraction.) [*Post.*]
Bull. Soc. Minéral. de France, VIII. (1885) p. 377.
„ „ **Sur la Mésure des indices de réfraction des éléments microscopiques des Roches.** (On the measurement of the indices of refraction of the microscopic elements of rocks.) [*Post.*] *Ibid.*, p. 426.

Bleekrode, L.—See Thompson, G.

Cutter, E.—**Cam Fine Adjustment?** [*Post.*]
The Microscope, VI. (1886) pp. 101–4 (1 fig.).

Dancer, J. B.—**What is the true cause of the dotted appearance on the P. angulatum.** [*Supra*, p. 691.]
Engl. Mech., XLIII. (1886) p. 283 and 329.
See also F. B. Allison, p. 351.

Dancer (J. B.), Proposed Annuity for.
[Statement of his services to science. "He invented microscopic photographs, which so much delighted and astonished us twenty-five or thirty years ago," and brought out excellent Microscopes moderate in price.]
Nature, XXXIV. (1886) p. 200.

Dieudonné, E.—**De l'Electro-mégaloscopie.** (On electro-megaloscopy.) [*Post.*]
La Lumière Électrique, XIX. (1886) pp. 64–7 (3 figs.).

Directory, Science.
[Microscopical and other Societies, *contd.*] *Sci.-Gossip*, 1886, p. 138.

Ewell, M. D.—**On Fine Measurements.**
[Criticism of Dr. Shanks' blood measurements, *supra*, p. 529.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 119-20.

Exner, S.—**Ueber Cylinder, welche optische Bilder entwerfen.** (On cylinders which form optical images.) [*Post.*]
Arch. f. d. Gesammt. Physiol., XXXVIII. (1886) pp. 274-90 (10 figs.).
Exner's Repert. d. Physik, XXII. (1886) pp. 299-313 (10 figs.).

Francotte, P.—**Description du nouveau Microscope à dissection de Zeiss.** (Description of Zeiss's new dissecting Microscope.) [*Ante*, p. 507.]
Bull. Soc. Belg. Micr., XII. (1886) pp. 79-82 (1 fig.).

Giles, G. W. M.—**On Marine Collecting with the surface net.**
[Discs of vulcanite for use with lieberkühn, *supra*, p. 681.]
Sci.-Gossip, 1886, p. 121.

Gladstone, J. H.—See Thompson, G.

Gothard, E. v.—**Apparate für Aufnahmen himmlischer Objecte.** (Apparatus for photographs of celestial objects.)
[Describes the application of a Microscope to a telescopic camera for focusing.]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 5-14 (10 figs.).

Harrington, M. W.—**The Microscope and the Telescope.**
[Reply to the question what is the difference between them.]
The Microscope, VI. (1886) pp. 106-7.

Hénocque.—**Appareils destinés à l'examen du sang.** (Apparatus for the examination of the blood.)
[The apparatus (resembling Donné's lactoscope and Hermann's hæmatoscope) allows of the examination of undiluted blood, which is placed between two plates of glass which have a triangular prismatic space between them varying from 0 to a third of a millimetre. The advantages claimed are that the blood does not require to be diluted, a minimum quantity only of blood is required to be used, and above all, it is not necessary to have recourse to the comparison of different tints. The plates can be applied to any spectroscope, and oxyhæmoglobin, hæmoglobin, and methæmoglobin can be successfully studied.]
Journ. Soc. Scientifiques, I. (1885) p. 24. (Soc. de Biologie 11th Jan.)

[Hitchcock, R.]—**Microscopical Exhibitions.**
["It is undoubtedly true that the efforts of any committee to please all the members of a society are fruitless, for there will always be some disaffected ones. It is impossible to know just what everybody wants, until somebody is assigned to a part that he does not want. Then, when too late to make any changes, the committee learns that such a person will not be present. This is one of the difficulties in arranging a systematic display of this kind. Some persons will not sacrifice personal interests to the wishes of a majority. They seem to think they should be permitted to show what will probably give them most notoriety, or attract most general attention to their work. Not being allowed to do that, they stay away entirely."]
Amer. Mon. Micr. Journ., VII. (1886) p. 117.

Höegh, E. v.—**Die achromatische Wirkung der Okulare von Ramsden.** (The achromatic action of the Ramsden eye-pieces.)
Central-Ztg. f. Optik u. Mech., VII. (1886) pp. 110-1.

Jennings, J. H.—**[Photo-micrography,** or] how to photograph Microscopic Objects; or lessons in Photo-micrography for beginners. And a chapter on preparing Bacteria, by R. L. Maddox.
viii. and 128 pp. and 30 figs. (8vo, London, 1886). (Reprinted from the 'Photographic News,' with many additions.)

Mayer, A. M.—**On the Well-Spherometer;** an instrument that measures the radius of curvature of a lens of any linear aperture.
Amer. Journ. of Sci., XXXII. (1886) pp. 61-9 (7 figs.).

Miles, J. L. W.—**President's Address** [to the Manchester Microscopical Society].
[Deals mainly with illumination.]
Ann. Report for 1885 (1886) pp. 15-25.

NELSON, E. M.—**Central *v.* Oblique Light.** [*Supra*, p. 692.]
Engl. Mech., XLIII. (1886) p. 300.

" " **The resolution of Diatoms whose striæ are of unequal fineness.** [*Post.*]
Ibid., p. 328 (1 fig.), p. 396.

" " **The interpretation of the Six Spectra of Pleurosigma angulatum.** [*Supra*, p. 694.]
Ibid., pp. 337–8 (5 figs.), p. 396.

Objectives, New.

["The new 1/8 in. objectives of Zeiss, made of the new glass, will be in the market very soon—indeed, they are expecting daily to receive a supply. Hereafter Mr. Zeiss will not make any more of the celebrated 1/18 in. objectives, but will provide another lens to take its place."]
Amer. Mon. Micr. Journ., VII. (1886) p. 118.

PELLETAN, J.—**La Théorie du Microscope et l'Optique simplifiée.** (The theory of the Microscope and simplified optics.)

[Characteristic introduction to a series of articles intended to be published on simplified optics.]
Journ. de Microgr., X. (1886) pp. 279–85.

Piersol's (G. A.) Photograph of Bacillus tuberculosis.

[× 1090—"shown as clear and distinct as when viewed with the Microscope."]
Amer. Mon. Micr. Journ., VII. (1886) pp. 99.

Queen's (J. W. & Co.) Acme No. 4. Microscope. [*Post.*]
Micr. Bull. (*Queen's*), III. (1886) p. 17 (1 pl. and 1 fig.).

Resolving 152,000 lines to the inch.

[Correspondent thinks that "*with a little patience* it could be accomplished, for I have already resolved 140,000 with the same objective and illumination!"]
Micr. Bull. (*Queen's*) III. (1886) p. 14.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances. XI., XII.**

[Diatomic beading and images. Diatomic colours.]
Engl. Mech., XLIII. (1886) pp. 313–4 (7 figs.), pp. 383–4 (2 figs.).

[ROYSTON-PIGOTT, G. W.]—**Delicate Fine Focussing Adjustment.** [*Supra*, p. 686.]
Engl. Mech., XLIII. (1886) p. 340 (2 figs.).

S., H. G. F.—**A Concentric Microscope.**

[Modifications in Cox's Microscope with concentric movements * would give it the essential features of the best known English and American Microscopes. (1) The tail-piece (preferably one only) should have a clamp above the stage to fix it parallel to the optic axis; (2) the mirror-bar should be removable, and arranged to clamp on one of the feet of the base; (3) the stage should have mechanical movements like "Watson's or Ross's best diatom stage"; and (4) a "combination condenser" like Swift's or Pillischer's should be applied. "The concentric or radial construction . . . gives such extreme stability at every angle of inclination that . . . it seems destined to supersede the 'Jackson' model, as that superseded the 'Ross' with the majority of makers."]
Engl. Mech., XLIII. (1886) p. 352 (2 figs.), p. 375.

THIESEN, M.—**Ueber die Ablesung von Normalbarometern und überhaupt von grösseren Flüssigkeitsoberflächen.** (On the reading of normal barometers and large fluid surfaces.)

[The difficulty of exact readings where the surface of the mercury is large has led to various contrivances based on the principle that the distance between an object and its image seen in a plane reflecting surface is bisected by the surface. Marek substituted for Pernet's fixed index the image of a horizontal thread thrown by a lens into the centre of the tube; but the results obtained are not satisfactory. Dr. Thiesen uses the scale at the back of the tube as the object; the reading for the surface of the mercury is then found by a simple micrometric measurement of the dis-

* Cf. this Journal, iv. (1884) pp. 279–81.

tance between a division on the scale and its reflected image. If, e.g., the distance between 771 mm. and its image measured in fractions of one of the visible intervals is 1·4 mm., then the true reading is 771·7 mm. A great advantage of the method is that it obviates all cathetometer adjustments and errors. The errors introduced by refraction through parts of the glass tube, while not entirely eliminated, are less pronounced than in other methods.]

Zeitschr. f. Instrumentenk., VI. (1886) pp. 89–93 (4 figs.).

Thompson, G.—**The determination of the Index of Refraction of a fluid by means of the Microscope.** *Nature*, XXXIV. (1886) pp. 157 and 217. Also criticisms by J. H. Gladstone and L. Bleekrode, pp. 192 and 290.

Thompson, S. P.—**Notes on some new Polarizing Prisms.**

[1. Ahrens', *ante*, p. 397. 2. Simple modification of the Nicol prism, giving wider angle of field. *Post.*]

Phil. Mag., 1886, pp. 476–80 (1 pl.).

Toison, J.—**Éclairage intensif en micrographie.** (Condensed illumination in microscopy.)

[Suggests as a substitute for the Abbe condenser an objective—1/7 in. 0·94 N.A.—fixed in the cylinder diaphragm-holder.]

Journ. Sci. Méd. Lille, 1885, 5 pp.

Wallace, E., Jun.—**The Amateur Photographer: A Manual of Photographic Manipulation, intended especially for Beginners and Amateurs.** 205 pp., 1 phot., and figs. (8vo, Philadelphia).

Waterhouse, A.—**Blood Measurements.**

[Table of measurements of blood-corpuscles of various species of Mammals].

The Microscope, VI. (1886) pp. 97–101.

Weyers, J. L.—**Le Microscope Entomologique.** (The Entomological Microscope.) *CR. Soc. Entomol. Belg.*, 1886, No. 71, pp. xc.–xciii.

β. Collecting, Mounting and Examining Objects, &c.*

Histophysics of the Red Blood-corpuscles.†—Drs. S. J. Meltzer and W. H. Welch have had occasion in the course of their investigation on the colouring matter of the blood, to search for the remains of the uncoloured red blood-cells, the so-called phantoms. Their experience was that these can be rendered more evident by means of certain substances capable of coagulating albumen, such as prussic acid (saturated solution), pyrogallic acid (20 per cent.), copper sulphate (10 per cent.), chlorate of potash (6 per cent.), silver nitrate (3 per cent.). The phantom corpuscles appear as dark rings; on the application of chlorate of potash as pale bluish discs. The last three reagents have the advantage of not altering blood-corpuscles present with the phantoms.

Counting Blood-corpuscles.‡—For counting white blood-corpuscles M. J. Toison adopted the staining method, using the basic anilins, of which he found methyl-violet 5 B the most reliable.

The formula given is:—Distilled water, 160 c.cm.; glycerin at

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Centralbl. f. d. Med. Wiss., 1884, p. 721.

‡ Journ. Sci. Med. de Lille, 1885, 4 pp.

30°, 30 c.cm.; soda sulphate, 8 grms.; soda chloride, 1 grm.; methyl-violet 5 B, 0·025 grm. The violet was dissolved in the glycerin, diluted with half the distilled water, the salts in the other half; the two mixed and filtered when cool. The staining fluid was mixed with the blood and then placed in a cell or moist chamber. The staining action is well marked in 5 to 10 minutes, and attains its maximum in 20 to 30 minutes. The white blood-corpuscles appear as small granular violet balls, which are easily distinguished from the greenish coloured red corpuscles.

Obtaining Hæmoglobin Crystals.*—Dr. St. v. Stein places a thin layer of fresh defibrinated blood upon a slide, and when it begins to dry at the edges, covers it over with Canada balsam, which should not be too fluid as the crystals are then less permanent. As long as the balsamic odour is perceptible, the specimens remain without a cover-glass. The balsam layer is then removed by means of a knife moistened with ether, turpentine, or oil of cloves. A cover-glass is put on and sealed up with balsam or asphalte. Such preparations have kept well for ten years.

Preparing Muscle to show Nerve Extension.†—The procedure used by Dr. R. Mays for making preparations to show nerve extension in muscle is a combination of the osmic acid method with gold staining. The addition of the gold salt is to prevent the browning and clouding of the muscle substance, which occurs after osmic acid only, associated with the previous swelling of the muscle in dilute hydrochloric acid. Dr. Mays' procedure with thin muscle from which he obtained suitable preparations is as follows:—

The fresh muscle is placed in a mixture of 0·5 per cent. gold chloride solution (1 part), 2 per cent. hyperosmic acid (1 part), and water 50 parts. It is then cleared up in a mixture of glycerin 40 parts, water 20 parts, and 25 per cent. hydrochloric acid, 1 part. This procedure does not, however, prevent clouding and browning in thick muscles. To avoid these inconveniences altogether, Dr. Mays recommends the following method. The fresh muscle is laid for 12 hours in a 2 per cent. solution of acetic acid, then for 2 to 3 hours in the gold-osmium solution (0·5 per cent. gold chloride solution 1, 2 per cent. osmic acid 1, 2 per cent. acetic acid 50). For clearing up the above, glycerin mixture is used.

Although the foregoing methods give excellent results, they fail to distinguish between the intra- and hypolemmal parts of muscle; but in an appendix Dr. Mays adds a method by which this differentiation becomes possible and which shows that by the gold-osmic-acid treatment the nerve-fibres are stained to their ends, i. e. up to their entrance into the muscle. The muscle is thoroughly soaked in a 0·5 per cent. solution of arsenious acid, and then for 20 minutes in a freshly made mixture of 1 per cent. gold chloride, 4 parts; 2 per

* Centralbl. Med. Wiss., 1884, p. 404.

† Zeitschr. f. Biol., xx. p. 449. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 401–2.

cent. osmic acid, 1 part; 5 per cent. arsenic acid, 20 parts. The muscle having been washed, is exposed for three hours to the sunlight at a temperature of 45° in a bath of 1 per cent. arsenic acid solution. The glycerin and hydrochloric acid mixture is used for clearing up. In successful preparations the nerve with its hypolemmal parts is stained throughout.

Demonstrating Nerve-endings in Striated Muscular Fibre of Man.*—For this purpose Prof. M. Flesch proceeds as follows:—

The muscles are placed as soon as possible *post mortem* in a 0·5 per cent. gold chloride solution until they appear of a straw yellow colour; they are then exposed to the light in dilute acetic or formic acid. After reduction has taken place, the muscle is ready for examination. Hardening is done in alcohol and imbedding in tallow and paraffin without previous saturation with turpentine or chloroform.

The author calls attention to the fact that in one and the same specimen, differences of staining are discernible after treatment with gold chloride; these in some measure depend upon the unequal saturation of the muscle with the gold solution, but in greater part are to be referred to structural differences of the muscular fibres. Differences of staining in reference to intensity and quality are distinguished, the former depending on the histological non-equivalence of individual fibres; the latter consisting in the staining showing every transition stage from rose through purple-red, and violet to pure blue.

Demonstrating an Endothelial Element of the Primitive Nerve Sheath.†—To show the intercellular substances in the vicinity of the nuclei of Schwann's sheath, Dr. A. Gruenhagen teases out the nervus ischiadicus of the frog; then pours over the preparation for two or three minutes some drops of a 1/2 per cent. solution of silver nitrate. He then washes with H^2O, dehydrates in absolute alcohol, stains with concentrated hæmatoxylin, dehydrates again, and mounts in balsam.

Preparing Batrachian Larvæ and Regulating the Circulation.‡—Dr. S. Mayer describes two methods of much technical interest.

The first is a process by which living larvæ can be fixed for microscopic research in a very short time, and this without damage, as is the case with curara injection. It consists first in passing a moderately strong current through the brain and cord, and then placing the larvæ in a solution of curara. By the electrization the animals are fixed in half a minute and the fixation is rendered permanent in the curara solution, the electric palsy being at once succeeded by the curara palsy. By this means the larvæ can be brought in a few minutes to a condition suitable for microscopical

* MT. Naturforsch. Gesell. Bern, 1885, pp. 3–25 (1 pl.).

† Arch. f. Mikr. Anat., xxiii. (1884) pp. 380–1 (1 fig.).

‡ SB. K. Akad. Wiss. Wien, xci. (1885) pp. 204–38 (3 pls.). Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 390–1.

examination, while the curara method by itself requires at least a quarter of an hour.

The second procedure is a very simple method for influencing the rapidity of the blood current in the larval tail. It depends on Dr. Mayer's observations that by the imposition of the cover-glass the blood current ceases in the covered parts of the larva, even though the cover-glass be supported at the edges by glass splinters, but that it is again restored as soon as a drop of water is run under the cover-glass. Dr. Mayer traces back these appearances to the pressure which exists in consequence of the capillary adhesion between the cover-glass and the highest point of the object. The addition of water whereby the cover-glass is removed from the object, now brings it to pass that the capillary-adhesion pressure is either diminished or altogether removed according to the size of the drop added. Accordingly in the size of the drop of water exists a means of keeping the blood current at its normal rapidity, or of diminishing it in any desired degree to complete arrest.

Preparing the Radula of Cephalophorous Mollusca.*—Dr. R. Rössler places the living animals for half an hour in a moderately hot concentrated sublimate solution; then having got ready the pharynx, he treats it for another half hour with sublimate, washing thoroughly with water and staining with picro- or borax carmine, or with hæmatoxylin.

According to the author, paraffin penetrates between the toothlets of the radula with great difficulty, and most sections are consequently torn in cutting. The best results were obtained by transferring the object from absolute alcohol to yellow benzol, slowly adding warmed paraffin, and finally transferring to pure paraffin. The paraffin is afterwards dissolved out in benzol. Turpentine oil should be avoided, as it makes the radula brittle.

Thin Sections of Entomostraca, &c.†—Dr. G. W. M. Giles describes a method of obtaining thin sections of Entomostraca and other minute crustaceans, which he believes is somewhat novel. On account of their small size and the hardness of their chitinous coats, they do not lend themselves well to the paraffin method, as the knife is apt either to ride over them or to compress them, and drive out the paraffin filling up their interstices. Moreover, on account of the bulk of the apparatus and the difficulty of maintaining a constant temperature by means of spirit-lamps, it is extremely difficult in practice to carry it out on shipboard. The method described is, however, a somewhat rough and uncertain one, and it is only occasionally that results at all comparable to those of the paraffin method are obtained. It is, moreover, applicable only to very minute organisms.

The course of procedure is as follows:—The animal is taken from absolute alcohol and immersed in oil of cloves, where it is left until it is completely clarified. It is then placed in a watch-glass

* Zeitschr. f. Wiss. Zool., xli. (1885) pp. 447–82 (2 pls. and 1 fig.). See this Journal, v. (1885) p. 434.

† Sci.-Gossip., 1886, p. 122.

containing a few drops of Canada balsam (undiluted), and placed over a spirit-lamp at such a height as to melt without danger of burning the balsam. In about a quarter of an hour the balsam has driven out the clarifying agent, and penetrated throughout the entire structure of the animal. A single drop of balsam is now placed on a glass slip, and heated until it cools hard. Now take up the animal, together with a bead of balsam, on the point of a needle, and place it on the balsam on the slide, previously warmed, and prop it up in such a position that the plane of the sections desired may be parallel to that of the slide, holding it thus until the balsam has cooled sufficiently to keep it so.

There is just one consistency of balsam at which it may be readily sliced with a razor, without sticking to the blade, and yet is not brittle; and it is this condition which it is desired to obtain for the bead on the slide. Accordingly, when quite cold, it should be tested with the edge of a scalpel. If too soft, the slide must be warmed over a lamp for a while; if too hard, it must be removed from the slide and replaced in the watch-glass, to which a drop of fresh balsam has been added. In the difficulty of obtaining exactly the right consistence lies the uncertainty of the method; but when this is hit upon successfully, really beautiful sections can be most easily obtained by slicing down the bead with a sharp razor or lancet, as in the ordinary hand method. The sections may be allowed to fall from the razor on to the slide until all the material is exhausted, and then covered with dilute balsam under a large cover-glass, or they may be picked up one by one on the point of a needle, and arranged in order on a separate slide, which has been varnished with a thin coat of balsam so as to retain them in their respective places while mounting. The method is also useful for obtaining sections of coralline Algæ, whose structure, when deprived of their lime, is so rotten that it is extremely difficult to mount even the smallest sections whole, unless supported by some exceptionally firm imbedding material.

Preparing Echinodermata.*—Dr. O. Hamann obtained good fixation without undue contraction by injecting the somatic cavity of Asteridea with a 1 per cent. chromic acid solution. When injected the animals are to be placed in a vessel containing a similar fluid. Good results were also obtained from a 1 per cent. chromic acid solution to which a few drops of a 1 per cent. osmic acid solution had been added, and also from Kleinenberg's picro-sulphuric acid. These acids are also advantageous, because they slowly decalcify the star-fishes and therefore render them more amenable to the sublimate solution. By the use of boiling water the ambulacral feet may be obtained in their extended position, while preservative media penetrate only slowly and irregularly within the substance of the body.

For staining, the author used Ranvier's picro-carmine, also a neutral (acetic acid) carmine, Böhmer's hæmatoxylin, and also

* 'Beiträge zur Histologie der Echinodermen, Heft 2, Die Asteriden,' 126 pp., 7 pls. and 3 figs., 8vo, Jena, 1885.

Ehrlich's hæmatoxylin to which eosin had been added in the following proportion:—100 cc. Ehrlich's logwood solution, 15 cc. of 1 per cent. watery solution of eosin. For staining maceration specimens, a methyl-green solution with acetic acid proved useful.

Preserving Cilioflagellata.*—Prof. O. Bütschli preserves Cilioflagellata in picrosulphuric acid, afterwards changing to alcohol. By this means the flagella are extremely well retained. The posterior flagellum was well observed after the action of osmic acid vapour; but a 1 per cent. solution caused it to disappear.

Mounting Foraminifera in Balsam.†—Mr. J. Carpenter gets rid of the air in Foraminifera by boiling them in dilute potash for a few moments, afterwards in pure water, and thoroughly drying them. Then put them into a test-tube with spirit of turpentine, and boil for a few minutes over a spirit-lamp. When wanted for mounting, place a drop of balsam on a slip, take up a small quantity of the shells on the point of a pen-knife or a homœopathic spoon, and immediately place in the balsam; then put on the cover-glass, but do not use any pressure. They require baking in a slow oven for some time to thoroughly harden the balsam.

Water-washed Diatoms.‡—Dr. G. H. Taylor recommends the following method of preparing samples. A quantity of the mud containing the diatoms is placed in a large jar with two or three times its bulk of clean water, and thoroughly shaken up. After settling for ten minutes, about half the water is poured off into another jar, and the first is refilled, shaken, allowed to settle as before, and most of the water poured off. This is kept up until the water is perfectly clear at the end of ten minutes. The light portions poured off are saved for future treatment. The heavy material which contains all but the smallest diatoms has much sand mixed with it. To get rid of this it is shaken up in the jar of water, and the top part almost immediately poured off. This is repeated several times, refilling the jar with pure water each time until the heavy sand remaining shows but few diatoms mixed with it. The material obtained by the last pourings, consisting of nearly all the diatoms, and the *fine* sand, is now boiled in water with the addition of a little cooking soda, and is then placed in a large bottle filled with pure water, shaken up, and poured off after standing five minutes. The bottle is refilled, and the process continued for several hours, the time of settling being gradually reduced to three or even two minutes. The remaining material is then placed in a shallow dish, a little at a time, with a small quantity of water, and gently rocked and rotated, causing the diatoms and lighter particles to rise in the water, when they can either be poured off or dipped out with a pipette, leaving most of the sand behind.

* Morphol. Jahrb., x. (1885) pp. 529–77 (3 pls. and 4 figs.). See this Journal, *ante*, p. 460.

† Journ. of Micr., v. (1886) p. 50.

‡ Proc. Amer. Soc. Micr., Eighth Ann. Meeting, 1885, pp. 207–8.

Cleaning Diatoms from Marine Mud.*—Dr. G. H. Taylor places a quantity of the mud containing diatoms in a large jar, which is then filled with clean water, thoroughly shaken, and allowed to settle for ten minutes. One-half is then poured off into another jar, the first refilled, shaken up, and again allowed to settle for ten minutes, when the top portion is poured off into a third jar. This process is continued with the first jar until the water is clear after settling for ten minutes. The material is then taken from the first jar in small quantities, and "sanded" by placing each portion in a shallow dish with a moderate quantity of water, and rotating the dish so as to cause a vortex in the water, when the diatoms and lighter matter will rise in the water, and can be poured off into a bottle, leaving the sand and heavier particles behind. This process is repeated with each portion until only sand is left in the dish. The "sanded" material is now placed in an evaporating dish and dried. When dry, nitric acid is poured upon it, and it is boiled until fumes cease to appear, when a few grains of bichromate of potash are dropped in, and, after boiling for a few minutes more, allowed to cool. When cool, the acid is poured off, the dish refilled with sulphuric acid, boiled, and a little bichromate of potash added. When the sulphuric acid has thoroughly cooled, it is poured off, *but not into water*, and the material in the dish washed two or three times with clean water, stirring it up well on each supply, and allowing it to settle each time before decanting.

It is now again "sanded" by rotating the dish and pouring off the top portion of the fluid into the bottle, adding more water each time, until only sand is left in the dish. The material in the bottle, now rich in diatoms, is shaken up, allowed to settle, and the water poured off, until every trace of acid is removed, when the material is returned to the clean evaporating dish, which is nearly filled with water and boiled. A very small piece of caustic potash is now added, and the boiling continued for two or three minutes, when the contents are poured into the bottle. The material is now again washed by shaking, settling for five minutes, and pouring off most of the water, repeating the operation with fresh quantities of clean water and decreasing the period of settling to two or three minutes, until the water is free from any trace of alkali. The material is now again "sanded" in small quantities at a time, and the lighter portion drawn off by means of a dropping tube. The material thus withdrawn contains almost all the diatoms. When all the material has been treated in this way, it is extremely rich, containing but little sand and a small amount of vegetable silica, but may be still further improved by more time and labour. The material is washed several times in distilled or filtered rain-water, and about five to seven minutes allowed for settling. About twenty drops of ammonia are now added, the fluid well shaken, and the washing continued as before. One or two more "sandings" with distilled water will now give pure diatoms free from foreign matter or sand. Care should be taken not to overlook the large forms of diatoms which frequently adhere to the glass.

* Proc. Amer. Soc. Micr., Eighth Ann. Meeting, 1885, pp. 208-10.

Engelmann's Bacterium-Method.* — Dr. T. W. Engelmann replies to various objections to his bacterium-method for detecting the evolution of oxygen,† especially those of Pringsheim,‡ and points out the limits to the use of the method, which cannot be applied to the quantitative determination of the oxygen evolved. He further describes the conditions most favourable for the employment of the process.

The drop must contain only a single kind of bacterium, and must therefore be taken from a pure culture. The best results are obtained with a bacterium of high oxygen-requirement. The bacteria should be neither too large nor too small; cocci of 1–2 μ diam., or rods 2–3 μ in length and about 1 μ in diam. afford the best results. The number of individuals of the bacterium must be large enough for them to collect rapidly round the source of oxygen; the drop should appear slightly turbid to the naked eye. During observation, evaporation must be carefully prevented from the margin of the cover-glass.

Solid Nutritive Media for Bacteria.§—M. E. de Freudenreich compares Dr. Hesse's apparatus, for testing for Bacteria in the atmosphere, with that of Dr. Miquel, of Montsouris. In the former case, air is drawn through a tube lined with gelatin; in the latter method the air is passed through water and then distributed in drops to a series of tubes containing sterilized broth. The advantage in this latter method lies in the fact that, when any alteration is observed in the broth in any one tube, this tube can be examined; whereas in Hesse's method, in order to examine a single colony the whole apparatus has to be exposed to the atmosphere, and disturbing conditions may occur; and although as a rule Bacilli develope on the spot on which they fall, yet not unfrequently, and especially during summer, they may spread so rapidly that the whole of the gelatin becomes liquid.

The author undertook numerous comparative experiments with the two methods. Out of a series of seven experiments, undertaken at the same time and place, and using peptonized gelatin in the one apparatus and peptonized beef broth in the other, he obtained the following results: Four were more favourable to the liquid medium (that is more bacteria were found by this method than by the gelatin method, in the same volume of air); one was favourable to the solid medium; two gave identical results with the two media. The author, therefore, concludes in favour on the whole of Dr. Miquel's method; but adds that Dr. Hesse's is not to be neglected, on account of the ease of transport and manipulation of his apparatus.

Cultivation of Comma-bacilli.‖—Dr. F. Hueppe has obtained very interesting results as to the spores of the cholera bacillus by slide-cultures, which during the observations were kept at a temperature of 34°–37° C. on a hot stage. The slides used were hollow ground, so as to

* Bot. Ztg., xliv. (1886) pp. 43–52, 64–9.
† See this Journal, i. (1881) p. 962.
‡ Ibid.
§ Arch. Sci. Phys. et Nat., xv. (1886) pp. 105–20.
‖ Fortschr. d. Med., iii. (1885) p. 619.

allow a sterilized cover-glass to fit over them. The nutrient media were thin layers of gelatin or agar. By this means the lively movements of the bacilli were limited as to their locality, and thus became accessible to continuous observation. Of course sufficient provision was made for the presence of air and moisture. Geissler's parallel-walled chamber upon which very thin layers of gelatin and agar can be spread, proved of much service. For the hot stage the Löwit-Reichert modification of Stricker's stage, for which there is a special condenser, was used.

Special Criterion of Tubercle-bacilli.* — Dr. Voltolini states that if cover preparations of phthisical sputum be laid in strong nitric acid (1·45–1·50 sp. gr.) before staining with the Ehrlich solution, the bacilli are afterwards found to have a granular moniliform appearance. The author considers this a special characteristic of tubercle-bacilli, as he has not found it in any other micro-organism, not even in the Lepra-bacillus.

Application of "Ranvier's" Alcohol.†—Dr. J. H. List recommends one-third (Ranvier) alcohol, in conjunction with 10 per cent. salt solution as the best isolation medium for pavement epithelia, one of its principal merits being that cells thus isolated stain extremely well. Ranvier's alcohol is, however, less suitable for goblet cells which are much better studied after being treated with Müller's fluid or osmic acid.

Schällibaum's Collodion.‡—Mr. A. B. Lee finding it stated § that it is necessary when using Schällibaum's fixation method to heat the slide until the oil of cloves is driven off, writes to say that this is an error, and that it is not necessary to heat the fixative to such an extent, but merely until the clove oil runs easily. For this purpose a water bath may or may not be used; it is quite sufficient to hold the slide for a few seconds over a spirit-lamp or Bunsen's burner, moving it to and fro the while. The procedure is as safe as it is convenient.

Imbedding with Benzol and Cutting very delicate Objects.‖—Dr. A. Brass after alluding to the inconveniences attending the employment of chloroform for imbedding histological preparations, strongly advocates the use of benzol for this purpose.

The stained and hardened objects are first of all immersed in concentrated alcohol, which is dehydrated by the addition of dried copper sulphate. All the water having been removed from the section the alcohol is passed off and the preparations covered over with pure benzol. The stoppered glass vessel in which the previous steps are effected, is then transferred to a water bath at a temperature of 30°, and as much finely scraped paraffin added as will dissolve. After being kept at this temperature for half an hour, the preparation is transferred to pure paraffin which is just at its melting point. To every 100 parts of paraffin about four to six parts of white wax are added. Preparations the size of a pea are left in the paraffin for

* Breslauer Aerztl. Zeitschr., 1885. No. 15.
† Zeitschr. f. Wiss. Mikr., ii. (1885) p. 514.
‡ Ibid., p. 522. § Ibid., p. 571. ‖ Ibid., pp. 300–5.

half an hour; for larger objects a correspondingly longer time is required. The preparations thus soaked in paraffin are next allowed to set on a glass plate. The sections are fixed in the usual manner by the shellac solution, and this having been done the paraffin is dissolved out in benzol. When it is certain that all the paraffin has disappeared, Canada balsam dissolved in benzol may at once be dropped on and the cover-glass put in place.

When dealing with delicate sections or with fragile and easily lacerable tissues, all disposition to tear or break up may be avoided by brushing over the upper surface of every section, as soon as it is cut, a thin layer of collodion. By this means the preparation is covered and held together by an adhesive and continuous coat. The collodionized surface is that which is applied to the slide. The other steps of the process are, of course, the same as before.

It may be noticed that all the author's specimens were treated with a 5 per cent. solution of sublimate heated to 60°–70°; pieces the size of a pea are to be left in for 10 minutes; those the size of a walnut for half an hour. Thus hardened, the specimens are transferred directly to 70 to 80 per cent. alcohol for at least 12 hours, and afterwards to 90 per cent. alcohol until all traces of the sublimate have disappeared. The complete extraction of the sublimate may be known by evaporating a drop or two of the last spirit in a watch-glass, in order to ascertain if any acicular crystals of sublimate be deposited.

The author recommends carmine for staining purposes, and the fluid he employs is made as follows:—To a large teaspoonful of carmine are added 500 grammes 70 per cent. alcohol, and to every 100 grammes of the foregoing 15 grammes pure hydrochloric acid. The mixture is then boiled for some time in a water bath. After boiling there should be a residue of carmine; if not, add more carmine and boil again. The spirit lost by evaporation is to be replaced by 96 per cent. alcohol. The fluid, having been filtered, is ready for use. Preparations may be stained in bulk, and overstaining removed by the use of 70 per cent. alcohol.

By the foregoing method the complicated karyokinetic figures and every intracellular detail can be demonstrated in the clearest manner.

Sections of Teeth.*—Dr. W. C. Brittan finds that very beautiful sections of the jaws of small animals with the teeth *in situ* may be made in the following way:—

The jaws of a well injected animal are placed for a few days in 50 per cent. alcohol, then into absolute alcohol for about two weeks, then with a fine sharp file cut away the bone from both sides of the jaw where the section is desired until, by holding to the light, the pulps of the teeth are visible, carefully keeping the piece and the file wet with alcohol during the operation. Thoroughly wash the piece with a soft brush in alcohol and place in clove oil for a few hours, or until clear. Then transfer to a very thin solution of balsam in benzole, gradually thickening the solution from day to day by adding pure balsam until the tissues are thoroughly permeated. This is an

* The Microscope, vi. (1886) pp. 128–9.

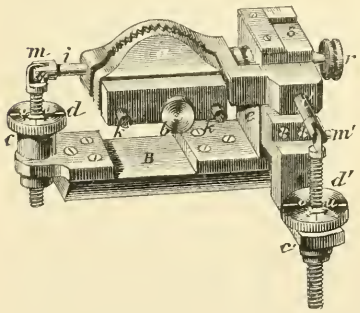
important part of the process, and should not be hurried. Now place the piece in a shallow dish and add pure balsam enough to cover it and evaporate to hardness, being careful not to raise the heat above 110° F. When the balsam is hard the section may be worked down to suit. The balsam will hold the soft parts in position while this is being done. Use water as a lubricant for this part of the work. The section made to suit, dissolve out the balsam with benzole, place in absolute alcohol for a day, clear again in clove oil and mount.

Sections made in this way are necessarily somewhat thick for the reason that the different parts which it is desired to show in the section seldom lie in the same plane, consequently they are best mounted in a cell ground into the slide, which allows the cover-glass to be brought down close. The method may seem somewhat tedious and certainly requires some patience, but the results more than repay for the trouble. Dammar will be found the best medium for mounting.

Henking's Microtome Object-holder for accurately adjusting the Object.‡—Dr. H. Henking's object-holder (fig. 147) aims at giving a measureable rotation to the holder by means of adjusting screws, so that sections may be cut at definite angles to one another.

The clamp *a*, made in a curved form for convenience in holding curved objects and to avoid interference with the knife, is connected with a ball-and-socket joint contained in *e s*, which can be fixed when necessary by the screw *r*. The movable half of the clamp slides upon the guides *k k* and is adjusted by the screw *b*; in the fixed half are two cylindrical holes directed accurately towards the centre of the ball joint. *i* and *i'* are two rods which slide in these holes, and their extremities are hinged at *m* and *m'* to two long screws which are raised or lowered by the nuts *d* and *d'* fixed in position, but free to turn in the collars *c* and *c'*. By means of these nuts, therefore, a rotation can be given to the clamp about either of the axes *i* or *i'*, and may be measured by divisions upon *d* and *d'*. The screw which works in *d* is only half as long as that at *d'*, because the object can be roughly adjusted in this direction in the jaws of the clamp, and *d* is only required for small motions. On the plate which covers the ball-and-socket joint is a vernier scale for indicating the thickness of the sections. By pushing the object-slide along for distances between 1 mm. and 1/40 mm., sections can be obtained without any further assistance than that of a sharp knife.

Fig. 147.



* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 491–6. Cf. Zeitschr. f. Instrumentenk., v. (1885) pp. 314–5 (1 fig.).

Staining.*—Prof. M. Flesch considers the action of staining media; first the inorganic, and secondly the organic.

The action of the *inorganic* salts, silver, gold, iron, may be summed up by saying that the various appearances produced by metallic impregnation are to be explained partly from the physiological condition of the material examined, partly from various chemical affinities to particular tissue elements, and partly to differences in physiological constitution. As examples of the foregoing he gives two illustrations of specimens treated with silver nitrate, one showing a section of cartilage of frog silvered *en masse* with a weak solution of silver nitrate, and the other giving the appearances of quite fresh cartilage of frog silvered in section with the same solution. The differences between the results are to be explained by the greater imbibition capacity of the second kind, and are not to be attributed to chemical differences.

The effect of an *organic* stain is produced either by chemical combination or by surface attraction, i. e. by mere adhesion or infiltration of the stain without chemical union. Examples of the former are to be found in safranin, methyl-violet, &c., in their action on amyloid substance; in borax-carmine on hæmatoxylin; in Merkel's stain for the salivary ducts. An intermediate variety, one consisting partly of infiltration and partly of chemical union, may be found in neutral litmus solutions which stain the cell-substance red and the nuclei blue.

The action of infiltration is dismissed in a few words, as Gierke's published researches have anticipated further remarks. Dr. Flesch, however, urges that the hardening process must count for something in the result of staining processes, and concludes his paper by insisting on the significance of a physical characteristic—the unequal susceptibility for imbibition of the tissues and their elements—and the influence of the fixative changes on this susceptibility from imbibition of organic material.

Weigert's Hæmatoxylin Stain for the Central Nervous System.—Prof. M. Flesch in some comments † on his experience with Weigert's method says that preparations which have been washed in water in the usual way, after coming from Müller's fluid, can be stained, provided the sections (made in celloidin) are treated a few minutes in 1/2 per cent. solution chromic acid, and then, after being washed in water, placed in the colouring fluid. The sections stain very much quicker than by Weigert's method. The decolouring process of Weigert is followed. Creosote is decidedly preferable to xylol as a clarifier.

According to Dr. C. S. Minot,‡ Weigert's hæmatoxylin method may be used after any method of hardening and cutting, provided the sections are treated 5–15 minutes in 1 per cent. bichromate of potas-

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 464–77 (2 figs.).

† Ibid., i. (1884) pp. 561–6.

‡ 'Whitman's Methods in Microscopical Anatomy and Embryology,' 1885, p. 192.

sium, then washed in water, and transferred to the staining mixture. Instead of bichromate of potassium, the following mixture may be used with equal success, but with somewhat *different* results:—Water, 100 ccm.; alum, 1 grm.; bichromate of potassium, 1 grm.

Weigert's Improved Method for the Central Nervous System.*—Prof. C. Weigert's method has been adopted everywhere with great rapidity, as it offers advantages exceeding those of other methods. One of its imperfections (which has been obviated by Prof. Flesch) is that it is only applicable to preparations which have become browned by the action of chrome salts. Another is that it does not stain so many fibres (in the cerebral cortex for example) as can be shown by Exner's osmium method. Prof. Weigert has accordingly made some further improvements which obviate this objection. The new process is as follows: —

1. The pieces fastened to a cork with celloidin are immersed in a solution of copper oxide (a saturated filtered solution of this salt diluted with an equal volume of water) and allowed to remain in an incubator for two days. It does not matter if the pieces are still brown or have become green, so long as they were once brown. Moreover, if they have lain in alcohol for some time, a surface precipitate is not so easily thrown down. After the copper treatment the pieces become green, the celloidin blueish green. They may now be preserved in 80 per cent. alcohol.

2. For staining the sections the hæmatoxylin solution is now modified by adding a slight quantity of some alkali; it is a matter of indifference which; this addition gives it a brownish violet tone. The proportion of a saturated alkaline solution is one to one hundred of the logwood solution. In this solution the sections are placed, and owing to the action of the copper no incubator is needed. For cord sections two hours suffice; brain preparations require an immersion of twenty-four hours, in order that the fine cortical fibres may be stained. The staining solution can only be used once.

For differentiation the borax and prussiate solutions must be diluted with an equal volume of water.

Skatol and Carbazol, two new Reagents for Woody Fibre.†—Dr. O. Mattirolo proposes skatol and carbazol as substitutes for phloroglucin and indol as tests for wood fibre. Both of these bodies give identical reactions, i. e. they impart a violet red colour to ligneous tissue. Carbazol is doubly recommended, as it is found in commerce, and is almost altogether without odour; while skatol is so offensively malodorous that this property of itself is almost sufficient to bar its use in micro-chemistry. Carbazol, one of the products of crude anthracene, boiling between 320° and 360°, is produced in the manufacture of anilin from coal. Skatol is obtained from human fæces or by synthesis in the dry distillation of nitrocuminate of barium.

The author has demonstrated microscopically that skatol and

* Fortschr. d. Med., iii. (1885) p. 236. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 399-401.

† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 354-5.

carbazol impart a red violet colour to ligneous tissue. Sections are immersed in an alcoholic solution of these bodies for a few minutes, and having been placed in a drop of hydrochloric acid are thus examined under the Microscope. The reaction begins at once and increases in intensity after a short time. The stain, like that of phloroglucin and indol, unfortunately is not permanent. The author mentions that piridina and chinolina also give the characteristic reaction.

New Fixative Medium.*—Herren C. Born and G. Wieger have found a new medium in quince-juice for fixing serial sections or for staining sections on the slide. This is free from the objections inherent to Giesbrecht's shellac medium, Mayer's white of egg fixative, or Schällibaum's mixture of collodion and oil of cloves.

The fixative is prepared by adding to every two volumes of quince-juice one volume of pure glycerin and a little carbolic acid to prevent the formation of fungi.

The medium is applied by spreading a thin layer upon a slide; the paraffin-imbedded section is then placed thereon, and without any haste, as the glycerin prevents the adhesive layer from drying too quickly. Excess of the fixative medium should be wiped off with a clean cloth in order to prevent the section from moving about. The slide is then dried in a warm chamber at a temperature of 30°–40° C. for twenty minutes or longer. On its removal the water is found to have disappeared by evaporation, and the paraffin in a smooth layer. The paraffin is then dissolved out in turpentine and the slide is then transferred to absolute alcohol for half an hour at least. After the alcohol bath the section may be stained with any kind of dye, anilin colours for choice; it is then washed with water or spirit and cleared up in the usual way. Throughout the process the adhesion remains perfect and the fixative does not take up a trace of colour. Even under the Microscope the fixative can scarcely ever be perceived.

There are two points in this manipulation which it is necessary to observe very strictly; the first is that the slide must be perfectly clean, otherwise the fixative may fail to adhere properly. It is recommended to lay the slides for half an hour in cold soap and water and dry them carefully with a clean cloth. The second point is that in transferring from absolute alcohol to a watery staining or washing fluid, the slide must always pass through at least one intermediate stage of alcohol, i. e. alcohol of 50°, otherwise the violence of the diffusion currents may be too strong for the fixative and cause the section to become separated from the slide.

Chlorophyll for Staining.†—To the numerous vegetable products applied to staining, Dr. N. Trinkler adds chlorophyll. He obtains it from the leaves of *Syringa vulgaris* by extracting for twenty-four hours with alcohol, evaporating the filtered extract to dryness and dissolving this in water. The filtrate is a dark green with a trace of brown in it.

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 346-8.
† Arch. f. Mikr. Anat., xxiv. (1885) p. 174.

Staining with Phenol and Logwood.—Mr. C. H. Hughes writes us as follows:—

"Phenol has now and then been referred to, but there seems to be some doubt as to its value. It is said to destroy delicate tissue and bacteria. I cannot speak decisively with regard to the bacteria, but it has no ill effect whatever on the most delicate tissue, and since I have used it successfully in staining and mounting spermatozoa (human and animal), I am entitled to think it does not destroy bacteria, which are hardly more delicate, though of course it kills them.

I put some chips of logwood in phenol, and in about half an hour have a dark-brown fluid, which stains with great rapidity, and no deposit as with the alcohol and aqueous methods. A small quantity of bicarbonate of soda dissolved in water is mixed with phenol, depositing copiously but leaving some still in solution, and kept as developer. The logwood stain is poured off the section and a few drops of the soda solution poured on, when a magnificent purple is developed. Young bone and attachments of muscles are wonderfully set off. Nigrosin, about 5 grains to an ounce of phenol, is unsurpassed for central system, and seems to act more much powerfully than with spirit. I have been trying for some years to effect solution of carmine in phenol. If a good solution like that of hæmatoxylin and nigrosin could be effected, no other dye would be needed by the histologist—for tissues, at least.

If films of bacteria, or of spermatozoa, are exposed to Erlicki's fluid or some of the chromic solutions for a primary effectual coagulation of the albumen, I am satisfied the two dyes named would be efficient in strongest solution."

Staining Pneumonia-cocci.*—Dr. Ribbert recommends the following for cover-glass preparations, viz.:—100 parts water, 50 absolute alcohol, 12 per cent. glacial acetic acid, dahlia to saturation.

The covers are only just touched with the above, washed in water, and examined. Mounted in glycerin or balsam, the cocci appear deep blue, while the capsules are a pale blue. The stain does not last more than a few months. This method is unsuitable for sections.

Staining Recurrens Spirilla in Blood-preparations.†—Dr. K. Günther "fixes" very thin layers of spirilla-blood either in the flame of a spirit-lamp or in a thermostat (5 minutes), at a temperature of 75° C. Only basic solutions of anilin dyes made with anilin water were found to have any staining power. Of these, gentian violet was found to give the most intense stain (100 cc. anilin water, 11 cc. saturated alcoholic solution of gentian violet). Before staining, it is necessary to wash the cover-glass in a solution of 5 parts acetic acid to 100 parts water for 10 seconds, and after blowing off the greater part of the acid fluid, to neutralize the rest by holding the cover-glass over an open bottle of liquor ammoniæ fort. for a few seconds. If this be not done, the deep staining of the blood-plasma and corpuscles will prevent all but a very few spirilla from being seen.

* Deutsch. Med. Wochenschr., 1885, p. 136.
† Fortschr. d. Medicin, iii. (1885) p. 379.

After the acetic acid process, the covers are immersed in the gentian violet solution for a few seconds only, then washed carefully in water, and finally mounted in xylol balsam.

Staining Capsule-Cocci.*—The difficulty experienced in staining capsule-cocci arises from the fact that the ground-substance of the preparation is so deeply coloured that the enveloping capsule is invisible, although the cocci can be discerned.

This difficulty Dr. C. Friedländer points out may be obviated by first passing the preparation thrice through the flame of a spirit-lamp, and then immersing for one or more minutes in one per cent. acetic acid. The superfluous acid fluid is blown by means of a pipette, and the preparation dried in the air is placed in the gentian violet solution (100 cc. anilin water, 11 cc. saturated alcoholic solution of gentian violet) for a few seconds, washed with water, and examined. By this process the ground-substance remains colourless, while the capsules, if any, stand out quite prominently. By cautious treatment with weak acetic acid or alcohol, the characteristic form of the sphærobacteria sometimes appears, for the staining of the capsules is less resistant to both of these reagents than that of the bacteria themselves. In the majority of recent cases of fibrinous pneumonia, capsule-cocci can be found in the manner above indicated, but within the pneumonic exudation other Micrococci forms appear, chiefly Diplococci. These forms may be distinguished from capsule-bacteria both by the want of capsule and also by their smaller dimensions.

After-Staining by the Haidenhain Method.†—Prof. W. Flemming states that preparations made by this method may be much improved by after-staining with Grenacher's alum-carmine or with Delafield's or Böhmer's hæmatoxylin. The blackened pieces, as small as possible, are after being washed in water to be immersed in the stain for two or three days, and then before cutting are to be further hardened for some hours in absolute alcohol. Sections of mucin glands stained with hæmatoxylin show a beautiful violet colour on these cells. It may be remarked that for successful staining the blackening should not be too intense.

Nuclear Stain in Osmic Acid Preparations.‡—The objection is often raised that hardening in pure osmic acid is an impediment to good staining. This inconvenience Prof. W. Flemming finds may be obviated by an after treatment with bichromate of potash, when a good stain is effected by means of Böhmer's or Delafield's hæmatoxylin. After treatment with bichromate is, however, unnecessary if the osmic acid preparations are not kept too long in alcohol, and have not become too much darkened. They are best stained before they are transferred to alcohol. Alum-carmine also gives a good stain with osmic acid preparations in twelve to twenty-four hours. The author uses a 1 or 2 per cent. watery solution (not the vapour) of osmic acid, and hardens in the dark for about six hours, and mounts in glycerin.

* Fortschr. d. Medicin, iii. (1885) p. 380.
† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 517–8. ‡ Ibid., pp. 518–9.

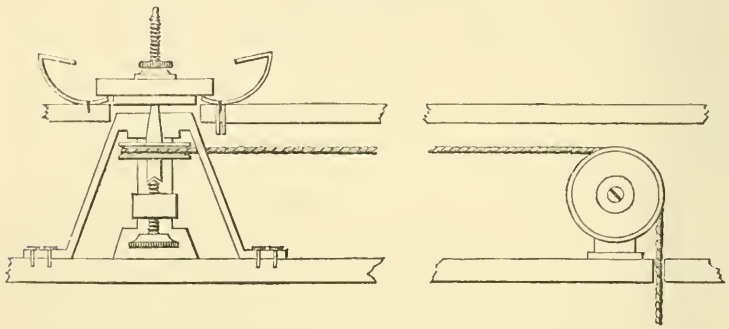
Demonstration of Goblet-cells.*—For this purpose, Prof. W. Flemming recommends not only hæmatoxylin, which imparts a deep blue or violet colour to the contents of the goblet-cells in osmium preparations, but also the osmium mixture † followed by staining with gentian or safranin. The cell-contents then appear blue or reddish brown, and stand out sharply even under low powers.

Horizontal Lathe for Grinding and Polishing hard Objects.‡—Prof. A. Eternod has a grinding lathe by which hard objects are more easily prepared than by the ordinary grindstone or the dentist's polishing lathe. Its main feature consists in being horizontal, and it is hence very convenient to manipulate.

It is made from the table of a sewing machine with its wheel and pedal. The movement is communicated by means of an endless cat-gut band running round a system of wheel pulleys. The details of the machine will be understood from fig. 148.

Prof. Eternod uses emery plates and Arkansas and Turkey stones

Fig. 148.



for grindstones. The Turkey stone is recommended on account of the fineness of its grain for giving a perfect polish. Drainage of the fluids employed for moistening the stones is effected by means of a zinc plate provided with an overflow pipe. The plate also serves to collect the sections as they leave the grindstone, and prevents the operator from being splashed.

Various kinds of Slides.§—Dr. O. A. Wall describes the various kinds of slides in use, commencing with the ordinary 3 in. by 1 in., and the so-called "French" paper-covered slides $2\frac{1}{4}$ in. by 3/4 in.

Sections of minerals are frequently mounted on special sizes of slides, which are wider and shorter, or about 2 in. by $1\frac{1}{4}$ in., so as to allow a larger cover-glass to be used, and at the same time to be more easily rotated with the stage of the Microscopes made for lithological work, when the sections are to be examined with the polariscope. These

* Zeitschr. f. Wiss. Mikr., ii. (1885) p. 519.

† Cf. Zeitschr. f. Wiss. Mikr., i. (1884) p. 349, and this Journal, v. (1885) p. 554.

‡ Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 507-9 (3 figs.).

§ St. Louis National Druggist, viii. (1886) pp. 24 and 39.

larger slides are occasionally of use when it is desirable to mount whole sections of thick rhizomes, roots, and similar preparations.

Some German workers prepare their slides by cementing very narrow strips of glass across the two ends of the slides, so that when the slides are laid upon each other, these strips prevent one slide from injuring the next one, and the slides may be packed away without having the ordinary grooved boxes. These slides, however, says Dr. Wall, "are not often employed in this country, for while it is true that they offer some practical advantages, they are anything but pretty in appearance, and it seems to be a pity to mount a good preparation in such a shabby manner."

"Some ornamental effects in mounting are obtainable by using coloured glass for the slides. For opaque mounts, slides of very dark-blue glass (pot-metal) present a fine background. A pretty effect is produced with some opaque objects mounted on these dark-blue slides, by illuminating with the bull's-eye lens, and at the same time reflecting the light upwards with the mirror, thus showing the brightly illuminated object on a rich blue ground. This method is very pleasant to the eyes. If the light is not reflected upwards with the mirror, such slides appear perfectly opaque and black.

Another pretty kind of slide may be made by cutting the slides from coloured glass (flashed metal), and then painting a heavy circle with varnish on the centre of the slide on the flashed side by the aid of the turntable, and then, when dry, placing a drop of hydrofluoric acid in the centre of the ring, and making a circular spot of clear glass on which the preparation may be mounted. By having slides of red, yellow, blue, purple, and other colours, prepared in this manner, quite a pleasing variety may be given to the appearance of a collection of mounted specimens. The roughness of the glass produced by the acid disappears when the preparation is mounted in balsam, and, in fact, this kind of slide should only be used for balsam mounts for low powers.

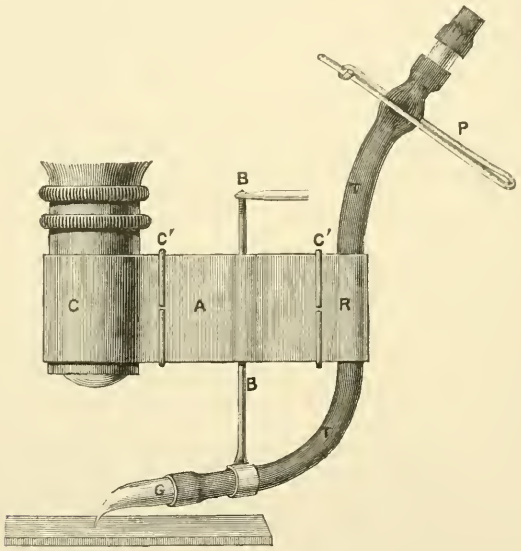
Still another, and very pretty slide, may be made by giving one side of a plain glass slide the appearance of ground glass, by grinding on a slab of plate glass with emery flour and turpentine. The preparation is to be mounted on the ground side with balsam. This kind of slide, like the last, is only to be used for objects for low powers. For some preparations, which should not be subjected to pressure, glass slides may be obtained, on one side of which depressions are ground, in which the object may lie when the cover-glass is put on. These slides are to be preferred to cells for fluid mounts in many cases, but as they are expensive, they are not as frequently used as they would be if they were sold at more reasonable prices. This might readily be done, we should think, as the grinding and polishing of these depressions is not so very expensive. The writer once had such depressions ground in a few hundred slides at 1½ cents per slide; and even at twice or three times this price they would still be cheap compared with the prices commonly asked for them. As they are so convenient for many purposes, it is to be hoped that they may be obtainable at more reasonable prices."

Cleaning Slides.* — Dr. F. L. James takes a wide-mouthed (12–14 oz.) jar, of sufficient depth, and half fills it with a mixture of gasoline or benzine, spirits of turpentine, and benzol. The slides are dropped into this and left overnight. When ready to wipe them, take out each slide separately, and give it a good hard wipe with a piece of muslin, and then polish with another clean bit of the same stuff. "Try the plan once, and you will never use any other. Slides thoroughly cleaned thus possess a quality which, in making glycerin or aqueous mounts, is absolutely invaluable. While they are optically and practically clean, such slides retain upon their surface an exceedingly tenuous film of resinous matter that prevents water or glycerin from attaching itself to the surface, and the consequence is that the surplus of such fluid, after a cell is closed, rolls off the slide without moistening it in the least. Cement, on the contrary, attaches itself with extraordinary firmness and evenness."

Apparatus for Sorting and Arranging Objects.—Mr. J. Hippisley suggests the apparatus shown in fig. 149 for sorting and arranging microscopic objects.

A broad piece of sheet metal A is formed into a clip C at one

Fig. 149.



end so as to slide over the objective and into another at R to hold a flexible indiarubber tube T. This tube has at the lower end a curved glass tube G terminating in a very fine capillary point which nearly touches the slide. By raising or lowering the rod B B

* The Microscope, v. (1885) pp. 253–4, from St. Louis National Druggist.

the vertical distance of the tube G can be regulated. The adjustment of G to the centre of the field is obtained by turning B B. Two sliding clamps C′ C′ serve to tighten C and R.

The apparatus can be used either for directing moisture from the mouth on the objects on the slide, and temporarily securing them until finally mounted, or by adding a wire clip at P and pressing the tube T below that point with the thumb and finger, the tube can be used as a syringe, so that it can be made to take up or emit a drop of fluid.

The flexibility of the tube obviates the danger of any breakage by overpressure of G on the slide.

Mounting several Groups of small Microscopic Objects under one cover.*—Mr. S. G. Shanks gives the following directions for mounting pollens, which will also suffice for other small objects:—

The pollens should be gathered from freshly opened flowers, and may be teased from the anthers with a needle into small bottles, which, after the pollen is thoroughly dry, should be kept corked.

Prepare a card marked with three, four, or five spots, all arranged within the limits of a 3/4 in. cover-glass, place a glass slip upon the card, and put a minute drop of turpentine on the slip over one of the marked spots. A needle with a little turpentine on it will serve to convey a small amount of pollen from the bottle to the drop of turpentine on the slip. Cohering masses of pollen should be separated with the needle and spread as evenly as possible over 1/8 in. of space on the slip. A small drop of balsam, just sufficient for the purpose, is then dropped on the pollen.

The next specimen of pollen is similarly arranged over another spot, and a small drop of balsam applied as before. When the several pollens are in place the slide should be set aside and covered from dust for twenty-four or forty-eight hours, or until the balsam has become somewhat hardened and the pollens fixed in their respective places. A drop of fresh balsam may then be placed in the centre between the groups and a cover applied with very gentle pressure, and all allowed to harden as usual. If the first balsam drops are not sufficiently hard when the cover-glass is adjusted, the fresh balsam will liquefy all too rapidly, and the pollens will run together or creep out with the surplus balsam. Two strong a pressure will also cause the pollens to mix by producing currents in the balsam as the cover settles into place.

The names of the flowers from which the pollens are gathered should be written on the label in small characters and occupy the same relative positions as the specimens do under the cover. This will enable one to find a given specimen or name quickly.

This method may be employed for Foraminifera, seeds, diatoms, scales, or any other small objects which might be placed together for the purpose of comparison.

Cassia Oil for Mounting.—This medium has already been recommended for immersion and probably also for mounting, though we

* Amer. Mon. Micr. Journ., vii. (1886) pp. 64–5.

are not aware of the fact. Mr. A. C. Cole recently brought us some slides of *Heliopelta*, *Coscinodiscus*, *Trinacria*, and *Triceratium*, mounted in this medium, which (at any rate for the diatoms in question) prove that cassia oil can hardly be surpassed as a mounting medium. The clearness with which the markings are shown is very remarkable.

The refractive index of cassia oil is about 1·640.

Mounting with Carbolic Acid.*—Mr. T. Steel has varied somewhat the process of carbolic-acid mounting, described by Mr. J. R. Y. Goldstein.†

If the object is an insect, it is treated with potash or soda in the usual manner, to render it transparent; it is then rinsed in water and passed into spirit. The carbolic acid is prepared as follows:—Take, say, 1 oz. of Calvert's pure solid acid, and melt it by placing the bottle in warm water; when thoroughly fluid, add about 30 drops of spirit, shake well, and allow to cool; if it crystallizes again, melt as before, and add 10 or 15 drops more spirit, and again shake and allow to cool. Now melt a portion of balsam on the slide, and remove air-bubbles; heat the balsam until it is sufficiently evaporated to become firm on cooling; allow to cool. Place three pieces of thin wire as supports for the cover-glass. In the meantime the object should have been removed from the spirit and placed in a short test-tube containing some of the carbolic acid, and allowed to soak until quite saturated; or it may be gently boiled, which is the quickest way. When boiling, the tube should be kept shaken. A few seconds is all the heating required. This boiling is a capital way of getting rid of air-bubbles, and, if necessary, the tube should be allowed to cool and again heated, and this will seldom fail to displace any persistent bubbles. The object being now thoroughly permeated by the acid, the tube is allowed to cool. A drop of carbolic acid is now placed on the surface of the hard, cool balsam on the slide by means of a dipping-tube; the object is then taken out of the tube on a mounted needle, or the contents of the tube emptied into a little dish, and the object taken out and at once placed in the drop of acid on the slide and arranged as desired. The cover-glass is taken in the forceps, and a drop of the acid spread on its under surface. Should any air-bubbles appear in this drop of acid during the spreading, they are best got rid of by holding the cover-glass for a moment over the lamp. The cover-glass is held in place by a light wire clip; and the excess of acid absorbed by bibulous paper.

When the excess has been absorbed, the slide is gently warmed, and as the balsam softens, the spring clip presses the cover-glass down into position. The slide, with the clip still on, is baked in the usual manner. Six to twelve hours is sufficient baking for most slides, but that depends on the degree to which the balsam has been evaporated before placing the object. When the operation of baking has been satisfactorily accomplished, the slides are allowed to cool, always keeping on the clip till they are quite cold.

* Scientif. Enquirer, i. (1886) pp. 41–3.
† See this Journal, iii. (1880) p. 858.

Turntable Improvements.*—Mr. E. H. Griffith writes:—"Turn a disc of zinc-white cement on the centre of the turntable and when hard, ring with pen and ink. For centering purposes the white centre is of great value. The cement can easily be removed with benzole at any time if desired."

Cover-glasses in the Tropics.—Mr. J. C. Douglas writes from Calcutta:—"We find it very difficult here to get good cover-glasses; they rapidly become frosted and worthless. They appear to be of a soft lead glass. Would not a green hard glass be more likely to stand? If you could give any information as to how to get good covers it would be a great service to many. The glasses commonly arrive unfit for use, so that instructions as to keeping them in spirit, acid, or other medium are useless. I think it probable green covers would stand and be preferable in other ways from the greater resistant powers of the green as compared with the soft glass."

Mr. T. Curties informs us that repeated complaints from Indian correspondents were referred to Messrs. Chance Brothers who were unable to provide a harder thin glass. They recommended its being packed and kept in lime; no good result followed the use of this, or of French chalk which was also tried. Both rendered the surface deposit harder than ever and more difficult to remove. The last experiment tried was with clove oil, and this has proved quite successful. Dr. Plaxton of Colombo, who suggested its use, writes:—

"I think we have hit upon the right mode of preserving cover-glass. I used some yesterday, now two months since it was received, and it was in perfect condition."

Cover-glass Cement.†—Dr. L. Heydenreich gives the following approximate formula for cover-glass cement:—Amber, 25 parts by weight; copal, 25 do.; linseed oil boiled and with addition of manganese borate, 50 do.; oil of lavender, 50 to 60 do.; artificial cinnabar, 40 to 60 do. The following directions are given for preparing the cement in small quantities (one or two pounds). The amber resin finely divided is put into a tall glazed vessel and dissolved by the aid of heat in a sand-bath. When perfectly melted, the linseed oil, previously raised to its boiling-point, is added. When the two are well mixed they are poured back into the vessel in which the oil has been heated. 0·25 per cent. manganese borate is added and the whole allowed to boil gently for two hours. When the mixture has cooled down to about 70°, so much oil of lavender is added as will render it of a syrupy consistence. The whole is then put aside for a week or two until it has cleared up. The copal is prepared in a similar manner. The two varnishes are mixed together and then the cinnabar is thoroughly rubbed in. The cement is then poured into stoppered bottles or collapsible tubes. If the varnish should become too thick, it may be thinned down by working a little ol. lavandulæ into the quantity required for immediate use.

Prepared in the above manner and, so to speak, for home con-

* The Microscope, vi. (1886) p. 83.

† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 333–8.

sumption, the cement will always be more or less dark. Perfectly clear, sherry-coloured varnish can only be obtained by going through a series of solutions which are only suitable for the preparation of large quantities.

Amber-lac for closing Microscopical Preparations.*—Dr. W. Behrens recommends amber-lac for ringing round cover-glasses, closing preparations, &c. The first kind, a commercial preparation, he used was probably made from broken up amber-refuse, but it must have contained other constituents as it was of a dark olive-brown colour. In bulk it was opaque, but in thin layers on glass had a beautiful amber tint. The solvent, judging from the smell, was, principally at least, linseed oil. Two other kinds marked J and O were also examined. O was a fluid of a bright cognac colour. J was a brownish black liquid quite non-transparent.

Specimens closed with this medium were found to be perfectly hard in about a week, and when submitted to severe tests gave evidence of tenacity. The specimens used were vegetable preparations mounted in glycerin.

Why do Dry Mounts Fail?†—Miss M. A. Booth, in looking over her collection of slides, representing the work of European and American preparers, with a view to noting their keeping qualities, has been so surprised at the number of failures as to query whether permanence in microscopical work is possible. Why is it that so large a proportion of dry mounts fail? Obviously because that motto which should emphatically be the microscopist's motto, *festina lente*, is not heeded by all workers. The advances in the merely mechanical portions of mounting have evidently not kept pace with those in its purely scientific departments, or else microscopists sometimes forget to take counsel of their good common sense in the use of cements. In her collection are slides which have cost hours of skilful manipulation and yet are utterly ruined because of inattention to the details of the proper use of a cement. How do we sometimes apply balsam to a mount? By running it under the cover and trusting to capillary attraction to fill the field. But why should this law of capillary action be operative in the case of the balsam and suspended in that of the cement? From careful observation and a not limited experience—speaking of dry mounts of diatoms and the like—Miss Booth is convinced that success or failure depends not so much upon the kind of cement used, as upon the care with which it is used.

In her own work, however, she has fixed upon white zinc as the most reliable cement, and has sent out hundreds of slides made with this cement, accompanied with the request that all failures be returned, so that she might replace them with perfect slides; but not a slide has ever been returned. It has been her experience that white zinc properly prepared and properly used never fails. The secret of success with good white zinc is, that the rings shall be

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 54–7.
† Micr. Bulletin (Queen's), ii. (1885) pp. 17–8.

thoroughly dry, prepared at least forty-eight hours, and preferably more, before using. It may be objected that so much drying consumes too much time. Slides can be ringed at the rate of a gross an hour, and this at odd moments when no other species of microscopical work is possible. These slides, packed in rack boxes, occupy but little space, are free from dust, and reliable slides are always ready for immediate use. In deep cells for opaque mounts, it is not found that those slides whose cells contain an aperture are any more free from dewy deposits upon the cover than those which are hermetically sealed.

The following form of cell she has found very satisfactory. Use no volatile substance within the cell; paste a dead black paper upon a white (not much glazed, and therefore absorbent) one, and from this cut with a gun-punch disks of the desired size; centre a slide, and paste a disk upon it (black side down), to exclude the light; upon this cement with gold size a brass curtain-ring, flattened or not, according to the depth of the cell required; run on a background with any shade of water-colour paint which best exhibits the object, leaving a white margin around the edge of the cell; cement the cover with a small quantity of white zinc to the ring; colour the cell as may be desired; run on the copal mixture [already described] giving added security to the cover and rounding out the cell. This makes a neat and durable mount, and no dewy deposits have ever, to her knowledge, appeared upon the covers of cells so made.

With regard to the prevention of "dewing" in transparent mounts, she has found it essential that the objects should be thoroughly dry. If diatoms, use the covers direct from the brass mounting table; or if such as have been breathed upon, as scales, see that the moisture is fully evaporated, and in sealing, use the smallest quantity of cement consistent with a perfect adhesion of the cover-glass.

Labelling Slides.*—It is suggested that a good plan is to punch some squares or circles out of very thin talc; cover the end of the glass slip with a thin layer of gilder's whiting and gum-water; when dry, write on this with common ink, let it dry, put a very small drop of Canada balsam upon it; cover with a circle of thin talc, and allow all to dry; then clean the edges with benzole and water mixed. It will not peel off or get dirty like printed labels.

Slide Labels.†—Mr. E. H. Griffiths writes that "very beautiful and very practical labels for Microscope slides may be quickly made with the brush and pen. On the ends of the slides turn smooth discs of good, clear white zinc cement, and with finishing colours border to suit the fancy. With a pen, write or print on the white centre whatever is desired."

Cabinet for Microscopical Preparations.‡ — Prof. A. Eternod describes the cabinet in use at the histological laboratory of Geneva, as being especially suitable for large institutions.

* The Microscope, v. (1885) p. 179. † Ibid., vi. (1886) p. 84.
‡ Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 511–3 (2 figs.).

A cabinet of this sort, constructed to hold about 7000 preparations, consists of a double tier of small drawers, and three larger ones, intended for the accessories of the collection, such as catalogues, drawings, &c. Each drawer is divided into four compartments by

Fig. 150.

Fig. 151.

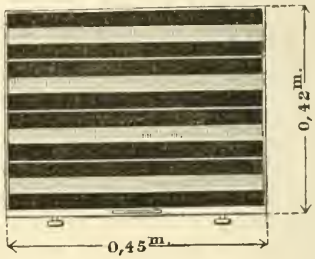


Fig. 152.

thin strips of wood, fig. 150. The floor of each compartment is black with a white stripe running down the middle, fig. 151. This colour arrangement facilitates reference, for the slides are marked with a diamond point, no labels being used. Thus the black band shows up the inscription, the white the specimen. The drawer labels, written on card or Bristol board, are slipped into a groove let into the front of the drawer, fig. 152. Thus the contents of a drawer may be re-labelled with the greatest ease.

The depth of the drawers is calculated to allow for cell-slides.

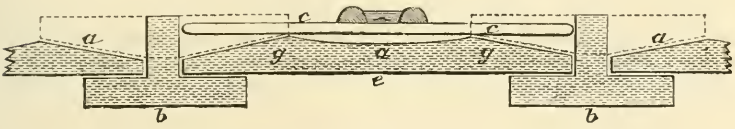
Improved Method of Constructing Slide Cabinets.*—Mr. H. E. Summers' aim in making this cabinet, was to combine the advantages of the different existing cabinets, and at the same time to so simplify the construction that it could be made cheaply and by an ordinary carpenter, with the tools usually at his command. The advantages are:—1. Each slide should have a separate compartment. 2. The slides should be easily removable. 3. They should not rest upon the support immediately beneath the object. 4. They should lie flat while the cabinet is in its ordinary position. 5. They should be so held that the object cannot be injured if the cabinet is overturned in transportation.

The cabinet was intended for slides of the ordinary length, 3 in., but of two widths, 1 in. and 2 in. The drawers are made up of strips or mouldings of two forms. These are shown in section in fig. 153 in the relative position they occupy when joined. A slide *c* is also shown in place. The strips *a a* and *b b* run from the front to the back of the drawer. The slide *c* rests on the two ridges *g g* of the strip *a*. Between the ridges the strip *a* is slightly hollowed, to prevent contact of the slide beneath the object, and consequent soiling. From the ridges to the edges, the strip *a* is levelled, so that one end of the slide may be tipped up by pressure upon the opposite end,

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 108-9 (1 fig.).

in order that it may be grasped more readily. The strips *a a* rest in rebates in the strips *b b*. These rebates are of such a depth that when the strips *a a* are in place, the upper surface of one of the thickest slides in use will be just a trifle lower than the top of the strips *b b*.

Fig. 153.



The cover-glass or cell upon the slide may project above the top of the strips *b b*. The object will then extend up into the space *e* of the drawer above. This space should hence be high enough to admit the deepest cells.

The partitions between the sides of adjacent slides are merely short, thin strips of wood, tin, or better, ferrotype plate, set at proper intervals in grooves sawn across the upper part of the strips *b b*. If desired, the portions may be continuous across the drawer, but the short strips seem to serve every purpose, and are more easily inserted. If a cabinet has been entirely divided up for slides 1 in. wide, and it is desired to insert one 2 in. wide, a portion can be removed without in any way disturbing the rest of the drawer.

When these drawers are inserted in a cabinet, the strips *b b* are allowed to slide upon, or at least approach very near to, the corresponding strips of the drawer below. In case of overturning, the slides are held in place by the side projections of the strips *b b* of the drawer above. The two outer strips *b b* of each drawer form the sides of that drawer, the side projections of the strips in this case sliding in grooves in the sides of the cabinet, thus supporting the drawer. In the front and back of the drawer, it should be observed that the part opposite the space *e* must belong to the drawer *below*, in order that the deeper cells may not be injured when the drawers are slid in or out. The irregularity thus produced may be rendered inconspicuous by placing over these portions the porcelain tablets usually used for the numbers of the drawers and of the contained slides.

Transmitting Sections by Post.*—Mr. R. N. Reynolds, having occasion frequently to send sections by post, has successfully used the following plan by which the objects are kept saturated with alcohol without infringing the law forbidding the postage of liquids.

In a wide-mouthed half-ounce bottle a little alcohol is placed, sufficient to saturate the papers used in packing the sections. Some 2 in. squares of tissue paper are then cut, on which the name of the section is written with a lead pencil; on this the section is placed and the paper folded over it, care being taken not to fold the section; the parcel is then dropped into the bottle, resting flat on the bottom.

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, p. 124.

Repeat this with as many sections as desired, or until the bottle is filled. In case the parcels do not fill the bottle, complete it by a wad of tissue paper. The bottle may then be posted as usual by boring a hole in a block of wood and packing with paper. The sections are, of course, removed on reaching their destination by unfolding the parcels in alcohol and floating off the specimens.

In the case of very delicate sections it is well to float them into paraffined paper or writing paper; straighten out the folds of the section by holding the folded portion in alcohol and manipulating it with a small red sable brush; then cut away the uncovered portions of the paper and pack as before.

Polarized Light as a means of recognizing Irritable Conditions of the Nerves of the Scalp.*—Dr. J. Pohl-Pincus announces that by an examination of the hair roots by polarized light, peculiar changes may be observed whenever the patient suffers from physical irritation or mental excitement. This statement is the result of investigations which have now been going on for twenty-five years, and the later observations in the course of the research have uniformly confirmed those made earlier.

The hair bulbs are divided into three groups, as follows:—Group A: If, in healthy conditions of the body and mind, the hairs that fall out daily are examined microscopically by polarized light, the enlarged bulbous end of the root will show a white contour, and a yellowish or brownish-red centre. Group B: In all irritable conditions of moderate grade, all painful conditions of any organ, also in emotional disturbances of moderate grade, without any apparent bodily disease, the bulbous end of the hair root increases in length and breadth (in proportion to the irritation), the central part appears under polarized light of a violet, blue, or bluish-green colour, separated from the white contour by bands of yellow and red. Group C: In higher grades of bodily disease or mental disturbance, the bulb becomes still larger, and the blueish centre changes to green, yellow, or orange. A few hairs of the B and C types are found in normal conditions, especially in those more advanced in life. Dr. Pincus gives thirty-one cases showing the effects of painful disease, but more especially of depressing emotions, upon the appearance of the hair root. The conclusion to be derived from these researches is that bodily disease or mental excitement causes circulatory disturbances, and in consequence a change in the normal nutrition and pigmentation of the hair. This is only in accordance with previous observations, and the chief merit of the author's plan lies in his obtaining a means by which very slight and temporary changes in tissue growth can be detected and approximately measured.

Feather-crystals of Uric Acid from a Caterpillar.†—Dr. S. Lockwood prepares these crystals in the following way:—Have ready say, six slides, absolutely clean. Puncture the caterpillar with the

* Lancet, 1886, i. p. 848.

† Journ. New York Micr. Soc., i. (1885) pp. 217-8.

point of a penknife or of scissors: a drop of green liquid will exude. Put some of this on each slide, spreading it out a little so that it shall not be too thick. Place the slides in a temperature of about 70° F., and put over them a piece of paper to exclude light and dust. In about half an hour they should be dry, and, if successful, the crystals, few or many, should be formed. Mount with balsam. If the crystals are *urea*, early mounting is advisable, since their easy solubility might put them in peril, on account of the natural moisture in the air. If they prove to be *urates*, which are not so soluble, the mounting can, if necessary, be deferred.

Preparing Micro-crystals.*—Dr. K. Haushofer points out that, although it is useful to produce microscopical preparations for the purpose of comparison and demonstration, yet it should not be forgotten that a single precipitate or a single crystallization rarely shows all the important forms of a compound, and that, as a rule, the same compound has to be prepared several times, under different conditions, if we desire to obtain a perfect standard of comparison. If we neglect these precautions, and rely merely on a single preparation, we shall occasionally arrive at incorrect judgments.

Many of the chemical compounds are quite unsuited for permanent preparations, as, for example, many salts of silver, mercury, and lead, the majority of the carbon compounds, &c. In most cases it is found to be a more efficacious plan to put up the crystals dry, and protected against dust by a cover-glass fixed by Canada balsam, than to imbed them in a resinous medium. If the nature of the preparation permits, care should be taken to wash away any secondary crystals which might obstruct observation, and also any residues from the precipitant, or from the original solution. This is very often favoured by the circumstance that the micro-crystals of a precipitate adhere pretty firmly to the slide in which the reaction has taken place, and especially when precipitated by heat. It is then merely necessary to put the slide in a sloping position in a vessel of water, and having withdrawn it with care, to allow it to dry in an almost vertical position. If the precipitate does not adhere firmly enough to the slide, the latter is placed in a large test-tube, water is poured over it, and the precipitate allowed to subside. Every drop of the water may be removed by decanting. The precipitate is then placed on a slide, and left just as it is, or the greater part of the water removed by the aid of blotting-paper. Of course, only quite insoluble precipitates tolerate washing without injury to the crystals. Very slight degrees of solubility are recognizable by a roughening of the crystalline surfaces.

Micro-chemical Demonstration of Albumen.†—Dr. O. Loew has employed two tests for albumen, viz. the Berlin blue test and the biuret test. In the Berlin blue reaction the preparations were

* Haushofer's 'Mikroskopische Reactionen,' 1885, pp. 161–2.
† Bot. Ztg., xlii. (1884) p. 273.

placed for an hour in a mixture of 1 vol. aqueous solution of ferridcyanide of potash (1–10) and 2 vols. acetic acid (1 vol. acid sp. gr. 1·063 to 1 vol. water). He then decanted with 60 per cent. alcohol until the fluid no longer had an acid reaction, and no longer became blue on the addition of ferridchloride, and finally placed the preparations in a solution of ferridchloride. By this means the nuclei, starch, and to some degree the chlorophyll-granules (from which the colour had been removed by absolute alcohol) were stained blue, the rest of the protoplasm remaining unstained.

As specially suitable for this method, strips of epidermis from the leaves of *Orchis* are recommended. With *Spirogyra* this procedure does not yield the desired results, although the cell-contents of this alga are rich in albuminoids. The absence of the reaction depends possibly upon some specific arrangement of the albumen molecules; consequently, *Spirogyra* has to be treated by the biuret test, which is done as follows:—The algæ are steeped for 12 hours in a dilute solution of potash and yellow prussiate of potash, and next in a solution of the same salt with acetic acid. After being washed with water, and then in 60 per cent. alcohol, they are finally placed in a dilute solution of iron chloride. Or, instead of the foregoing, the algæ may be placed for 15 minutes in a 25 per cent. solution of potash, and then for an hour in an acid solution of prussiate of potash. Having been washed as before, the chlorophyll is withdrawn with absolute alcohol, and the blueing of the protoplasm effected with ferridchloride solution.

With regard to the biuret test, which consists in the application of copper sulphate and of potash, the author remarks that a rose-colour is imparted to the protoplasm of the older cells if the order of the reagents be reversed.

Micro-chemical Reaction for Demonstrating Reducing Sugars.* —Herr A. Meyer recommends the following procedure:—

Sections, two to four cell-layers thick, of the plants to be examined are placed for a short time in a saturated watery solution of sulphate of copper, then shaken quickly once in water and directly after immersed in a boiling solution of 10 grms. Seignette salt and 10 grms. caustic potash in 10 grms. water. After some seconds, in all the cells which contain reducing sugar, a precipitate of copper oxydul is thrown down while all the other cells remain perfectly colourless. By this method the disturbing formation of copper oxide is prevented, and a more accurate conclusion as to the distribution of sugar in the tissues is possible.

Polarization of Bi-axial Crystal Plates cut vertically to an Optic Axis.†—Flat, optically bi-axial crystals, which are cut vertically to one of the optic axes, must, according to theory, always remain uniformly dark when examined under the Microscope with crossed nicols with one complete turn of the stage. Herr E. Kalkowsky shows that the appearances required by theory are never attained in

* Ber. Deutsch. Bot. Gesell., iii. (1885) p. 332.

† Zeitschr. f. Krystallog. u. Mineral., ix. (1884) pp. 486–97 (1 pl.).

observation, because the simultaneous fulfilment of the following five conditions is demanded:—(1) The plates must be perfectly parallel, have perfectly smooth surfaces, and be composed of quite pure material. (2) The plates must be absolutely vertical to one optic axis. (3) Must be for one kind of light only. (4) The incident light must consist of parallel rays. (5) The Microscope must be absolutely free from defects. As conditions 1 and 2 are only occasionally, and 3, 4, 5 never, fulfilled, theory and practice give contradictory results. Frequently, when thin-ground, section surfaces may be found which remain uniformly clear, and without the appearance of interference colours when examined with crossed nicols. This property of remaining clear between crossed nicols depends on the phenomenon of internal conical refraction. The author then shows how, by means of plates of bichromate of potash, this internal conical refraction can be studied. A plate of this salt is fixed with wax to a rod, and the rod fastened in such a manner that the optic axis lies in the centre of the field of vision. Instead of the lower nicol, a very small diaphragm is inserted. Over the diaphragm a strip of tinfoil, perforated by a tiny hole, is placed, so that the hole lies in the centre of the visual field. The Microscope is then pushed under the bichromate plate, and the diaphragm raised until it is quite close to the plate. The Microscope is fitted with a weak objective and a strong ocular. At a certain focus, instead of the round hole, a bright ring is perceived. The light of this ring is polarized, as may be proved by placing a nicol on the ocular. Hence the author shows that, in spite of theory, a plate cut vertically to one optic axis is always bright between crossed nicols. The internal conical refraction was also examined in topaz, andalusite, staurolith, adular, diopsid, epidote, and arragonite.

Enock's Sketches.—Under this title Mr. F. Enock is issuing lithographic illustrations of some of his slides, the various parts being numbered and named. In addition a short explanation is given, the following being that accompanying sketch No. 3—the head of a ground-bee:—

"This bee belongs to Section 2 of the British Aculeate Hymenoptera, in which the hairs on the body, &c, are more or less branched or plumose, especially those on the legs of the present example, *Colletes Daviesana*.

The tongue (10) is short and bifid, a good type of the Obtusilingues.

The labial palpi (11) are hidden away under the lingua (10), and cannot be seen from the upper side. The paraglossa (8) are two small organs, having a few strong hairs on the margin, situate on the upper side, and at the base of the lingua (10).

These bees burrow in the sand, using their mandibles (5) for this purpose, and wear the tips quite blunt by the time they have completed their work.

This head is specially prepared for the paraboloid, but by carefully illuminating with the 'silver side reflector,' the puncturation on the face, &c., can be well brought out."

It is intended to issue sketches of all the mouth-organs of British bees and other interesting insects. Such sketches will undoubtedly be of great value to scientific students.

We have before had occasion to commend the practice of supplying with slides an explanatory description of the object, thus enabling the microscopist to take an intelligent interest in what he sees. We hope Mr. Enock will find an adequate reward for his enterprise.

Francotte's Manual of Microscopical Technique.*—While there are a profusion of works in German dealing with microscopical technique, the number written in either English or French is very limited, and Dr. Francotte's book will be welcomed by a considerable number of practical microscopists who read French.

The first part contains an excellent statement of the modern optical theory of the Microscope—one of the best that has yet appeared—with descriptions of instruments. The second part deals with fixing, hardening, staining, and other reagents, and with methods of investigation. A special feature of this part is the tables showing in a convenient analytical form the course of the various processes. The third part contains a variety of practical "exercises" for the student in histology, embryology, zoology, comparative anatomy, &c. Throughout the book descriptions and illustrations are given of accessory apparatus, microtomes, &c. The only unfavourable remark that we can make is that some of the original illustrations are unusually rough, but this, as always, is no doubt to be laid to the door of the publisher, and not the author.

ANDEER, J.—**Das Resorcinderivat Phloroglucin.** (The resorcin derivative phloroglucin.) [*Post.*]
Internat. Monatsschr. Anat. u. Histol., I. (1884) pp. 350–3.
Centralbl. Med. Wiss., Nos. 12 and 33, pp. 193 and 579.

ARTHUR, J. C., C. R. BARNES, and J. M. COULTER.—**Handbook of Plant-dissection.**
[Contains a chapter on instruments, reagents, section-cutting, mounting, &c.]
xxii. and 256 pp., 2 pls. (12mo, New York, 1886.)
Cf. *Nature*, xxxiv. (1886) pp. 261–2.

BARNES, C. R.—See Arthur, J. C.

BARRETT, J. W.—**The Preparation of the Eye for Histological Examination.** [*Post.*]
Quart. Journ. Micr. Sci., XXVI. (1886) pp. 607–21.

BEHRENS, T. H.—**Sur l'analyse microchimique des minéraux.** (On the microchemical analysis of minerals.)
Ann. de l'École polytechnique à Delft, 1885, p. 176.

Benda.—**Modified Hæmatoxylin Method.** [*Post.*]
Nature, XXXIV. (1886) p. 236,
(transl. of *Proc. of Berlin Physiol. Soc.*, May 28).

Biggs, H. M.—See *Hüppe, F.*

BIZZOZERO, G.—**Ueber den Bau der geschichteten Pflaster-epithelien.** (On the structure of stratified epithelia.) [Methods. *Post.*]
Internat. Monatsschr. Anat. u. Histol., II. (1885) pp. 278–83 (1 pl.).

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* Francotte, P., 'Manuel de Technique Microscopique, applicable à l'Histologie, l'Anatomie Comparée, l'Embryologie et la Botanique,' viii. and 433 pp., 110 figs., 8vo, Bruxelles, n.d. (1886).

Blish, W. G.—**Preserving Paste Eels.**

[To preserve paste eels, the paste should be kept in a wide-mouth bottle, loosely stoppered, placed in a cool place. If the eels are not doing well, add a piece of bread, or prepare some fresh paste, preferably of rye flour. Paste containing a good supply of eels will keep for weeks without moulding.]

Amer. Mon. Micr. Journ., VII. (1886) p. 78, from *Scientif. American.*

Born, C., and G. Wieger.—**Ueber einen neuen Unterguss.** (On a new fixative.) [*Supra*, p. 711.] *Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 346–8.

Brauns, R.—**Ueber die Verwendbarkeit des Methylenjodids bei petrographischen und optischen Untersuchungen.** (On the applicability of methyl-iodide to petrological and optical investigations.) [*Post.*]

Neues Jahrb. f. Mineral. Geol. u. Palæontol., 1886, II., pp. 72–8.

Brayley, E. B. L.—**The Natural Preservation of Rotifera and other Pond Organisms.** [*Post.*] *Sci.-Gossip*, 1886, pp. 149–50.

Brevoort, H. L.—**Fur Fibres as shown by the Microscope.**

3 pp. and 14 pls. (4to, New York, 1886).

Cf. *Journ. N. York Micr. Soc.*, ii. (1886) pp. 69–71 (1 pl.).

Brittan, W. C.—**Sections of Teeth.** [*Supra*, p. 707.]

The Microscope, VI. (1886) pp. 128–9 and 134.

Bütschli, O.—**Einige Bemerkungen über gewisse Organisationsverhältnisse der sogenannten Cilioflagellaten und der Noctiluca.** (Some remarks on certain relations of the so-called Cilioflagellata and Noctiluca.)

[*Ante*, p. 460, and *supra*, p. 703.]

Morphol. Jahrb., X. (1885) pp. 529–77 (3 pls. and 4 figs.).

C.—**Examining rare fluids containing crystals or lymph.**

[For examining rare fluids containing crystals or lymph, place a little in an ordinary vaccine tube, as supplied for taking lymph off a child's arm, seal the ends in a gas flame, taking care not to heat the fluid. Next take a slip of cardboard (thin) about the size of a glass slide, cut out a space in the centre in the shape of a diamond, place the tube, which is about 1/16 in. in diameter, over the centre of the card, and gum a strip of gummed paper across the tube, leaving the ends to project past the strip.]

Scientific Enquirer, I. (1886) p. 56.

Carnoy, J. B.—**Karyokinesis in Arthropods.** [*Post.*]

Amer. Natural., XX. (1886) p. 578, transl. from 'La Cellule' (Louvain, 1885).

Cement, Insoluble.

[Take of gum shellac, 3 parts; indiarubber, 1 part; by weight. Dissolve the rubber and shellac in separate vessels in ether, free from alcohol, applying a gentle heat. When thoroughly dissolved mix the two solutions, and keep in a bottle tightly stoppered. This glue resists the action of water, both hot and cold, and most of the acids and alkalies. The addition of not over 2 per cent. of potassium bichromate to a solution of glue, and subsequent exposure of the glued parts to the sunlight, will make an insoluble cement.]

Scientif. Enquirer, I. (1886) p. 110, from *Scientif. American.*

Cole's (A. C.) New Slides. [*Supra*, p. 717.] *Sci.-Gossip*, 1886, p. 139.

Coulter, J. M.—See Arthur, J. C.

Ehrlich, P.—**Ueber die Methylenblaureaktion der lebenden Nervensubstanz.** (On the methyl-blue reaction of living nerve-substance.) [*Post.*]

Biol. Centralbl., VI. (1886) pp. 214–24.

Deutsch. Med. Wochenschr., 1886, No. 4.

Cf. also *Centralbl. Med. Wiss.*, 1885, pp. 113–7.

„ „ **Hämatoxylinlösung.** (Hæmatoxylin solution.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) p. 150.

Fischl, J.—**Erfahrungen über einige neue Untersuchungsmethoden des Gehirns.** (Experiments with some new methods for the brain.) [*Post.*]

Prager Med. Wochenschr., 1886, No. 2.

Wiener Med. Wochenschr., 1886, No. 5.

Flint, J. M.— **On the Collection and Method of studying Foraminifera.**
[Cf. *ante*, p. 133.] *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 105–8.

Francotte, P.—**Manuel de Technique microscopique applicable à l'histologie, l'anatomie comparée, l'embryologie et la botanique.** (Manual of microscopical technique applicable to histology, comparative anatomy, embryology, and botany.) [*Supra*, p. 728.]
viii. and 433 pp., 110 figs., 8vo, Bruxelles, n.d. (1886).
Cf. E. Rouffart, *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 82–7.

Frenzel, J.—**Ueber die Mitteldarmdrüse (Leber) der Mollusken.** (On the mid-gut gland (liver) of the Mollusca.)
[Methods, *post*. Cf. also this Journal, V., 1885, p. 792.]
Arch. f. Mikr. Anat., XXV. (1885) pp. 48–84 (1 pl.).
„ „ **Einiges über den Mitteldarm der Insecten sowie über Epithel-regeneration.** (On the mid-gut of insects and regeneration of epithelium.)
[Methods, *post*. Cf. *ante*, p. 231.]
Ibid., XXVI. (1885) pp. 229–306 (3 pls.).

Friedmann, M.—**Ueber eine Modification der Weigert'schen Färbemethode für die markhaltigen Fasern der Centralorgane.** (On a modification of Weigert's staining method for the medullated nerve-fibres of the central organs.)
[Weigert's more recent copper method supersedes this.]
Neurol. Centralbl., 1885, p. 35.

G., R.—**Gum Tragacanth.**
[The best material for sticking labels to glass. As it will not dissolve in water like gum arabic, some find difficulty in preparing it. The best way is to select three or four white pieces, about the size of a coffee-berry, and place in a 2-oz. wide-mouthed bottle; then pour over it acetic acid so as to hardly cover the gum, and place the bottle aside until the next day, by which time the gum will have absorbed the fluid and become very much swollen. Now add water, stir well, and in a day or two a semi-transparent jelly will be the result. A drop or two of pure carbolic acid should be added, and it will then keep for any length of time without getting mouldy.]
Scientif. Enquirer, I. (1886) p. 46.

Gage, S. H.—**The Limitations and Value of Histological Investigation.**
Proc. Amer. Assoc. Adv. Sci., XXXIV. (1885) pp. 345–9.
„ „ **Cutting sections of Cartilage.**
[Mainly directions for making sections freehand of the fresh material.]
Journ. New York Micr. Soc., II. (1886) p. 67, from 'Notes on Histological Methods.'

Giles, G. W. M.—**On Marine Collecting with the Surface Net.**
[Notes on preserving (resinous media not suitable; use glycerin or glycerin jelly for all except shelled mollusca and worms). Cells. Making thin sections of Entomostraca and other minute Crustaceans. *Supra*, p. 701.]
Sci.-Gossip, 1886, pp. 121–3.

Gillo, R.—**On making useful Collections of Insects: A plea for the more general use of the Compound Microscope by Collectors.**
Journ. of Micr., V. (1886) pp. 168–78.

Griffith, E. H.—**Turn-table improvement.** [*Supra*, p. 719.]
The Microscope, VI. (1886) p. 83.
„ „ **Slide Labels.** [*Supra*, p. 721.] *Ibid.*, p. 84.

Gruenhagen, A.—**Ueber ein Endothelial-Element der Nervenprimitivscheide.** (On an endothelial element of the primitive nerve-sheath.) [*Supra*, p. 700.]
Arch. f. Mikr. Anat., XXIII. (1884) pp. 380–1 (1 fig.).

Hamann, O.—**Beiträge zur Histologie der Echinodermen. II. Die Asteriden.** (Contributions to the histology of the Echinodermata. II. The Asteridea.)
[Methods, *supra*, p. 702.] 126 pp., 7 pls. and 3 figs. (8vo, Jena, 1885).

Hansen, E. C.—**Méthodes pour obtenir des cultures pures de Saccharomyces et de micro-organismes analogues.** (Methods for obtaining pure cultures of Saccharomyces and analogous micro-organisms.)
Medd. Carlsberg Laborat., II. (1886) Part 4.

HEIDENHAIN, R.—**Eine Abänderung der Färbung mit Hämatoxylin und chromsauren Salzen.** (A change of colour with hæmatoxylin and chromates.) [*Post.*]
Arch. f. Mikr. Anat., XXVII. (1886) pp. 383–4.

Hüppe, F.—**The Methods of Bacteriological Investigation**; written at the request of Dr. R. Koch; translated by *H. M. Biggs*. [*Supra*, p. 669.]
218 pp. (8vo, New York, 1886).

KALKOWSKY, E.—**Elemente der Lithologie.** (Elements of lithology.)
[Contains a description of methods of investigation.]
vii. and 316 pp. (8vo, Heidelberg, 1886).

Koch, R.—**Method of Staining Tubercle Bacilli.** Transl. by *R. Persh.* (*In part.*)
Micr. Bulletin (*Queen's*), III. (1886) pp. 22–3, from *MT. K. Gesundheitsamte*, II.

L., V. A.—**Interesting Experiment for the Microscope.**
["The embryo grain of wheat, at the time of blossoming, being carefully taken out of the husk, will be found to have a small downy tuft at its extremity, which, when viewed in a Microscope, greatly resembles the branches of thorn, spreading archwise in opposite directions. By expanding a few of the grains and selecting the most perfect, a very pretty microscopic object will be obtained for preservation."
Scientif. Enquirer, I. (1886) pp. 87–8.

" " **Preparing Barbadoes Earth.** *Ibid.*, pp. 92–3.

LATHAM, V. A.—**The Microscope, and how to use it. VII.**
[Hardening agents.] *Journ. of Micr.*, V. (1886) pp. 179–84.

LETT, H. W.—**Mounting Fish Skins.**
[Too much pressure will make the scales smooth.] *Ibid.*, p. 91.

LINDT, O.—**Ueber den Nachweis von Phloroglucin.** (On the demonstration of phloroglucin.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 495–9.

MADDOX, R. L.—**[Preparing Bacteria.]** See Jennings, J. H., *supra*, p. 696.

MARTINOTTI, G.—**Berichtigung.** (Correction.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) p. 57.

MEYER, A.—**Microchemische Reaction zum Nachweis der reducirenden Zuckerarten.** (Microchemical reaction for demonstrating reducing sugars.) [*Post.*] *Ber. Deutsch. Botan. Gesellsch.*, III. (1885) p. 332.

MEYER, V.—**Trocken- und Erhitzungs-Apparate für das chemische Laboratorium.** (Drying and heating apparatus for the chemical laboratory.) [*Post.*]
Ber. Deutsch. Chem. Gesellsch., XVIII. (1885) p. 2999 (1 fig.).

MINOT, C. S.—**Structure of the Human Skin.**
[Contains a method of isolating the epidermis of human and other embryos from the underlying dermis. The method is also convenient for the study of the development of hairs. *Post.*]
Amer. Natural., XX. (1886) pp. 575–8 (2 figs.).

MOLL, J. W.—**Eene nieuwe microchemische looizuurreactie.** (A new microchemical reaction for tannin.) [*Post.*]
Maandblad voor Natuurwetensch., 1884.
Bot. Centralbl., XXIV. (1885) p. 250.

MÖLLER, J.—**Mikroskopie der Nahrungs- und Genussmittel aus dem Pflanzenreiche.** (Microscopy of the foods and drinks of the vegetable kingdom.)
394 pp. and 308 figs. (8vo, Berlin, 1886).

NISSEN, F.—**Ueber das Verhalten der Kerne in den Milchdrüsenzellen bei der Absonderung.** (On the relation of the nuclei of the milk-gland cells during secretion.) [Methods, *post.*]
Arch. f. Mikr. Anat., XXVI. (1886) pp. 337–42 (1 pl.).

ORTLEB, A. and G.—**Anleitung zur Mikroskopischen Untersuchungen** und Beobachtungen mit der Lupe von Kleinen Tierchen, wie Milben, Trichinen, Infusorien, Würmern, Insekten, &c., Pflänzchen und Mineralien. Nebst Anleitung zur Herstellung und Aufbewahrung der Präparate.
56 pp. and 3 pls., 8vo, Berlin, n.d.

Persh, R.—See *Koch, R.*

PISENTI.—**Di una modificazione alla formula del carminio alluminoso.** (On a modification of the formula for alum-carmine.) [*Post.*]
Gazzetta degli Ospitali, 1885, No. 24.

Potato, Rush, and Vegetable Ivory, Preparing.

[Partially desiccate, either by immersion in methylated spirit for a few days, or by exposure to the air. Sections may be readily obtained by imbedding and cutting in paraffin. Such sections mounted in balsam are very beautiful, the starch being seen *in situ*, whilst if polarized light be employed, each granule gives its characteristic black cross.

After prolonged soaking in cold water, may readily be cut in the microtome. The sections should be mounted unstained in balsam, and though not usually regarded as polariscopic objects, nevertheless, when examined with the selenite, yield very fine colours].

The Microscope, V. (1885) p. 215.

Pringsheim, N.—**Ueber die Sauerstoff-abgabe der Pflanzen im Mikrospectrum.** (On the excretion of oxygen by plants in the microspectrum.) [*Post.*]

Ber. Deutsch. Bot. Gesel., III. (1886) *Generalversamml.* pp. lxxii.–lxxx.

Rinnböck's Slides of arranged Diatoms.

[Physician has ordered him to do no microscopical work for a year, "but I fear that is for ever."]

The Microscope, VI. (1886) p. 134.

Rohrbeck, H.—**Trocken-apparat für Laboratorien mit Ventilation.** (Laboratory drying apparatus with ventilation.) [*Post.*] *Chem.-Ztg.*, 1885, No. 21.

Bot. Centralbl., XXVI. (1886) pp. 313–5.

Rollett, A.—**Untersuchungen über dem Bau der quergestreiften Muskelfasern.** (Researches on the structure of the striated muscle fibres.) II.

[Methods, *post.*]

Denkschr. Akad. Wiss. Wien, LI. (1885) 48 pp. and 4 pls.

Rouffart, E.—See Francotte, P.

Seguin.—**Anilinblauschwarz als Tinctionsmittel für Hirnschnitte.** (Anilin-blue-black as a staining medium for brain sections.)

Schweizer Correspondenzblatt, XIV. (1884) p. 45.

Selenka, E.—**Metallmodelle nach mikroskopischen Präparaten.** (Metal models of microscopical preparations.) *SB. Phys.-Med. Soc. Erlangen*, 1886, 3 pp.

Seymour's (M. L.) Injecting Apparatus.

[A column of mercury can be set at various heights in a slotted tube and delivers mercury to a jar partly filled with water, forcing the air into a second jar with the injecting solution. An Asheroft pressure gauge is connected with the latter.]

St. Louis Med. and Surg. Journ., L. (1886) pp. 237–9 (1 fig.).

Sharp, B.—**Fermentation in Perenyi's Fluid.** [*Post.*]

Proc. Acad. Nat. Sci. Philad., 1886, p. 61.

Slack, H. J.—**Pleasant Hours with the Microscope.**

[Mouth-organs of Rotifers.] *Knowledge*, IX. (1886) pp. 246–7 (4 figs.).

Streng, A.—**Ueber eine neue Mikroskopisch-chemische Reaction auf Natrium.** (On a new micro-chemical reaction for sodium.)

Ber. Oberhess. Gesell. f. Natur- u. Heilk. Giessen, XXIV. (1885) pp. 56–8.

„ „ **Mikroskopisch-chemische Bestimmung von Kobalt und Nickel.** (Micro-chemical determination of cobalt and nickel.) *Ibid.*, pp. 56–8.

Vries, H. de.—**Over het algemeen voorkomen van circulatie en rotatie in de weefselcellen der planten.**

[Movements of protoplasm in tissue-cells.] [Methods, *supra*, p. 266.]

Maandbl. voor Natuurw., 1884. See *Bot. Centralbl.*, XXIV. (1885) p. 79.

W., E. W.—**Cement for Micro Work.**

["This cement I have found unfailing in micro work under a finishing varnish:—Gold size, 2 oz.; white lead, 1/2 oz.; red lead, 1/4 oz.; patent dryers, 1 dram. Grind the white lead, red lead, and dryers very fine, then add the gold size, which must be the very best and old."]

Scientif. Enquirer, I. (1886) p. 112.

Wagner, F. v.—**Das Nervensystem von Myzostoma.** (The nervous system of Myzostoma.) [Methods, *post.*] 52 pp., 1 pl. (8vo, Graz, 1886).

Wieger, G.—See Born, C.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Nachet's Large Microscope.—The modern form of M. A. Nachet's larger Microscopes is very familiar to English microscopists, and in the latest modification of the "Grand Modèle perfectionné" all the leading features are retained. The modifications relate principally to (1) the fine-adjustment, (2) the substage, (3) the mirror, and (4) the stage.

The *fine-adjustment* is on the well-known Continental model, but the action of the spiral spring is reversed, that is, it is now arranged to draw the sheath connected with the body-tube *downwards*, instead of pushing it upwards as formerly; by this alteration the fine-adjustment screw controls the movement by the contact of its point with a hardened steel plate, greatly reducing the friction, whereas formerly the screw passed through a nut against which the spiral spring pressed upwards, causing much friction. The result is claimed to be "a precision and smoothness quite remarkable," with, at the same time, complete rigidity in consequence of the extent of the surfaces of contact in the prismatic column, so that the second (Jackson) slow motion of the older form is not required.

The *substage* is centering, and to change the condensers, &c., can be turned back from the stage on a pivot, which can also be removed when required, being attached to a short arm sliding in grooves in the tail-piece and moved up and down by a lever. The pivot contains a slow motion, allowing the illumination in the substage to be focused very exactly on the object.

The *mirror* is attached by a series of short arms with three articulations acting at right angles to each other, so that it can be moved in all directions for obtaining the effects of oblique light. Its distance from the stage can also be varied.

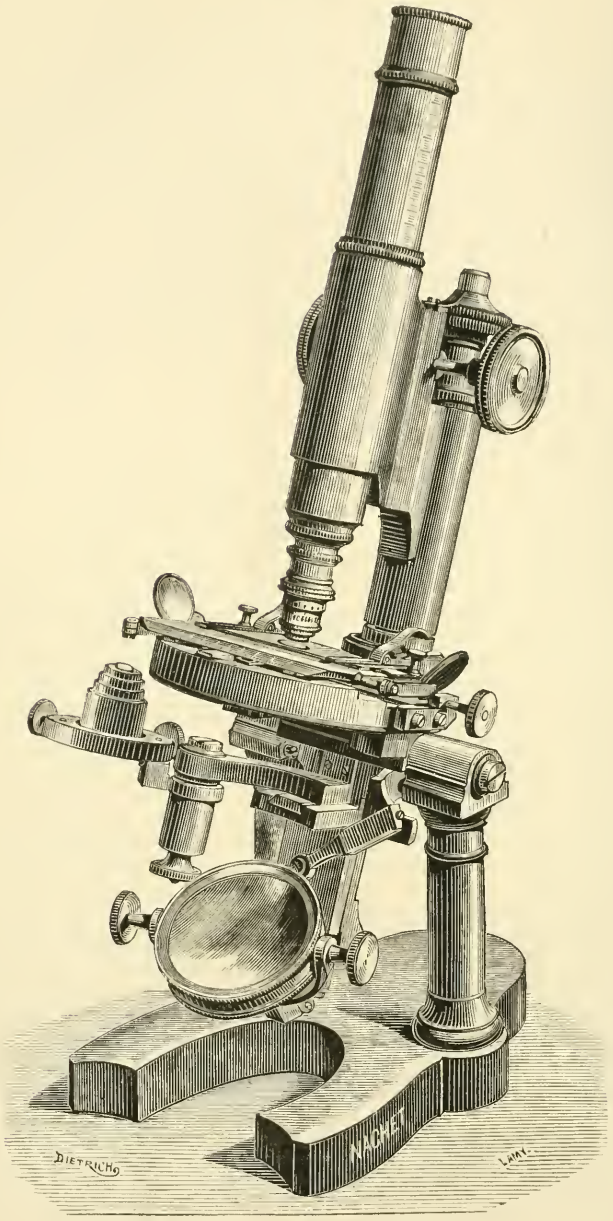
The modification of the *stage* is, however, the most striking of the novelties, as it comprises an arrangement for observing the approach of the objective to the cover-glass. It is thus described by M. Nachet †:—

"To the stage can be adapted at pleasure an arrangement which is very useful in the examination of rare or precious slides. It is composed of two small mirrors, one concave, placed at the level of the stage on the left, and movable in all directions, so as to send rays of light grazing the surface of the stage. The second one (plane) is placed opposite on the right, and is inclined at 45°, so as to deflect the rays vertically. The image of the end of the objective brightly illuminated is received on the small mirror on the right, and at a

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

† 'Catalogue descriptif des Instruments de Micrographie construits par A. Nachet,' 64 pp., 72 figs., 2 heliographs, and 1 col. pl., 8vo, Paris, 1886.

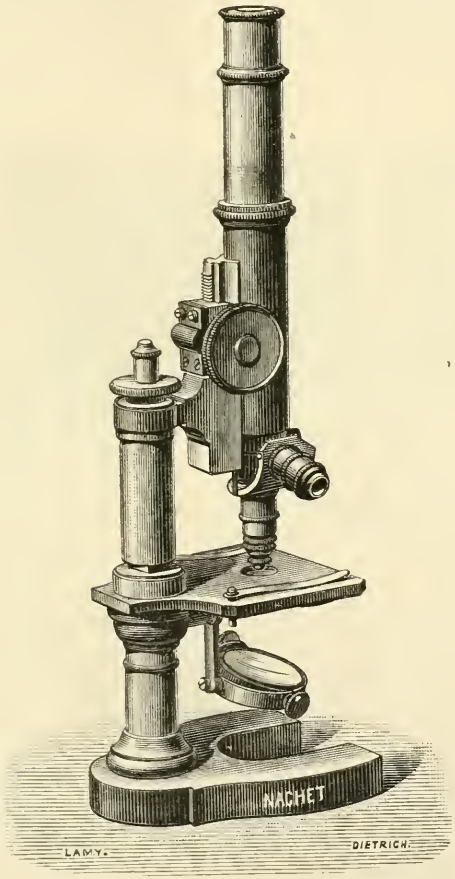
Fig. 157.



Nachet's Large Microscope.

glance it can be seen whether it is in contact or not. The layer of immersion liquid allows the grazing rays to pass even when the first lens is nearly in contact with the slide. This arrangement is very useful, and will be popularized more and more as an adjunct in the use of very high power objectives."

Fig. 158.



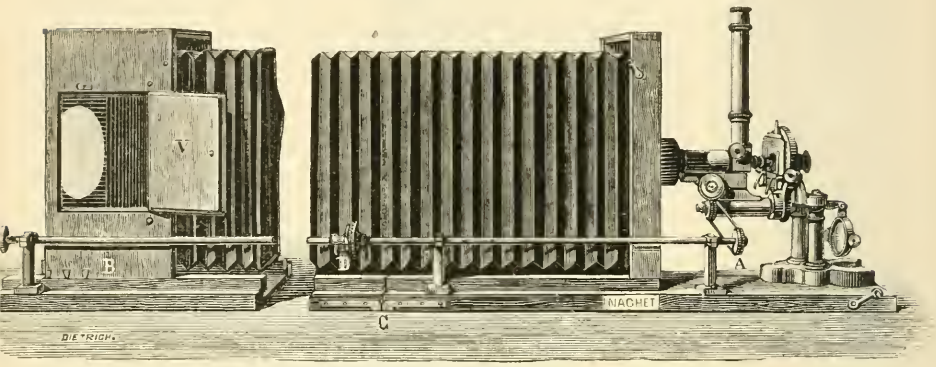
Nachet's Microscope with fixed Revolver for Objectives.—This Class Microscope (fig. 158) represents another attempt * to cope with the tendency of French students to unscrew the objectives of Micro-

* See this Journal, v. (1885) p. 514.

scopes placed in their hands ["instrument très solide pour être mis entre les mains des élèves et éviter le dévissage des objectifs" *]. The objectives are attached to a revolver so that they cannot be unscrewed, neither can the lens-cells be removed. The revolver consists of an angle-plate shaped like a sector and suspended in front of the body-tube to swing on its centre, so that either objective can be brought to the axis of the body-tube. The brass mounts of the objectives are so arranged that the foci are approximately in the same plane.

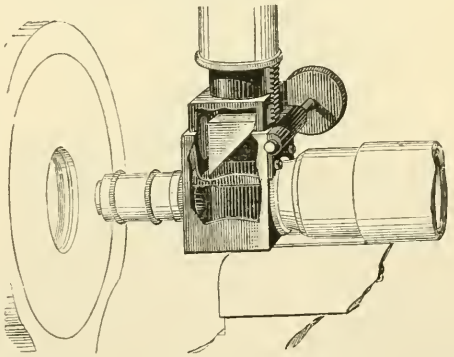
Nachet's Photo-micrographic Microscope.—M. Nachet's Micro-

Fig. 159.



scope and camera complete are shown in fig. 159, and an enlarged view of part of the Microscope in fig. 160.

Fig. 160.



The Microscope has a special arrangement for allowing the image to be viewed in the eye-piece previous to its projection on the ground

* Op. cit., p. 17.

glass, thus facilitating the adjustment of the illumination, the arrangement of the object, &c. This consists of a rectangular box containing a total reflecting prism, which can be raised or lowered by rack and pinion. In the former case the rays will pass to the camera, and in the latter are reflected upwards through the subsidiary body-tube.

The projection apparatus consists of a substantial wooden base, having grooved flanges near the edges on which a bellows camera B, extensible to upwards of 6 feet in length, is fitted to slide smoothly.

The Microscope is placed at the free end of the base and in a horizontal position; the body-tube is then connected with the front of the camera by adapter-tubes of special construction, by which the focusing movements of the Microscope are not interfered with, and at the same time all extraneous light is shut out at the junction. The milled head of the fine-adjustment screw is provided with a groove in which travels a cord connecting it with a grooved wheel A, to which a rod F D (jointed at D) is attached, so that the focusing can be actuated by the milled head at F, i. e. from the extreme length of the camera.

For the general class of photo-micrographic work the camera is not required to be more than about half the total length of its extension; to reduce it, the end B is slid forward on the base within C, the focusing rod is divided at D, the portion F D being removed, together with the pillar support below F, and the hinge C then permits the tail-piece of the base to be folded beneath the front part, and fixed by hooks at either side.

For focusing, the image is received on the ground glass and viewed in the usual manner, or a sheet of white cardboard is substituted for the ground glass and the image is viewed through the opening at the side V.

This plan of substituting a piece of white paper for the ground glass is one that is very little used in England. It was, we believe, originally suggested by M. Moitessier,* and was applied in the first instance to a vertical camera and Microscope where the height of the ground glass above the stage rendered it difficult to manipulate, but by adding the box at the end of the bellows, the observer was able to focus from the side, looking *up* at the image, and also to dispense with the equally inconvenient use, in M. Moitessier's opinion, of long rods or similar arrangements for focusing. In his view, also, paper is decidedly preferable to ground glass, "the grain of which gives rise to diffraction phenomena, which are extremely objectionable, and which often prevent the proper focusing of delicate objects." "With the paper the image will always be much sharper than when seen after transmission through ground glass, and the adjustment for focus can be made much more precisely and conveniently."

* A. Moitessier, 'La Photographie appliquée aux recherches micrographiques,' 1866, pp. 128-9.

Nachet's Photographic Microscope for Instantaneous Photographs.—This (fig. 161) is an ingenious arrangement for taking instantaneous photographs of living microscopic animals, and is based on the principle of M. Nachet's double-bodied Microscope.

Over the objective (fig. 162) is placed a prism, which prevents

Fig. 161.

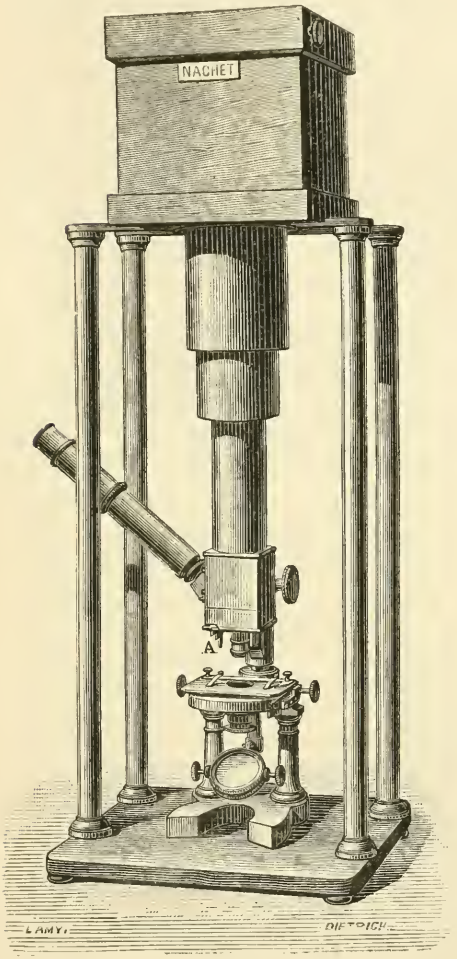
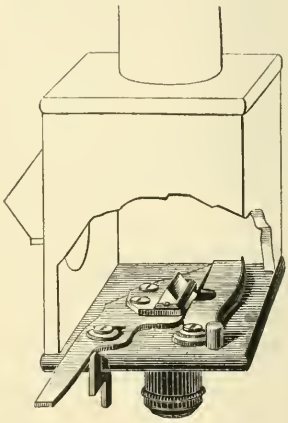


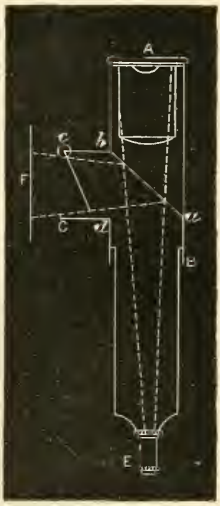
Fig. 162



any of the rays from the object passing to the camera (which is supported on four pillars above the Microscope), and diverts them into the inclined body-tube fitted with an ordinary eye-piece. The

observer keeps his finger on a trigger A acting on the spring lever to which the prism is attached, and at the right time moves the prism on one side by a slight pressure, allowing the image to pass to the camera for a fraction of a second, the prism falling back again into its place.

Fig. 163.



By a special contrivance in the body-tube each observer can regulate his focus once for all, so that whenever the image is sharp as seen through the eye-piece it is at the same time exactly focused on the sensitive plate.

This is a better plan than that of M. Bourmans,* who endeavoured to "photograph a fugitive object, observing it at the same time throughout the whole duration of the exposure" by the arrangement shown in fig. 163. A B is a vertical tube having a horizontal side-tube C. The body-tube with objective E moves freely in A B. At *a b* is placed a plane plate of glass silvered on its lower surface with a very thin layer of silver. This will reflect 75 per cent. of the rays to the sensitive plate F placed at the end of the short side-tube C, and at the same time sufficient light will be transmitted through the plate to enable the observer to keep the object under observation through the eye-piece A. At *c d* is a shutter which is kept closed until the focus is adjusted, when it can be raised by turning the button at *c*.

Fuess's Petrological Microscopes.—Herr R. Fuess has considerably modified his Petrological Microscope, which now has the form of fig. 165.†

The body-tube has two openings, one at *k* for the insertion of the Bertrand lens *f*, and the other at N for the analyser. The lens is attached to the draw-tube R, which can be raised and lowered by rack and pinion at T; the plate *g* is a stop, which prevents it from being drawn out of the tube unless extra pressure is used, when the plate will spring a little and allow the lens to pass.

The analyser N is attached to the plate *o o*, by which it slides in or out of the tube as desired. An analyser S can be applied over the eye-piece, and a quartz plate, &c., inserted in the slit above the objective, which can also be centered.

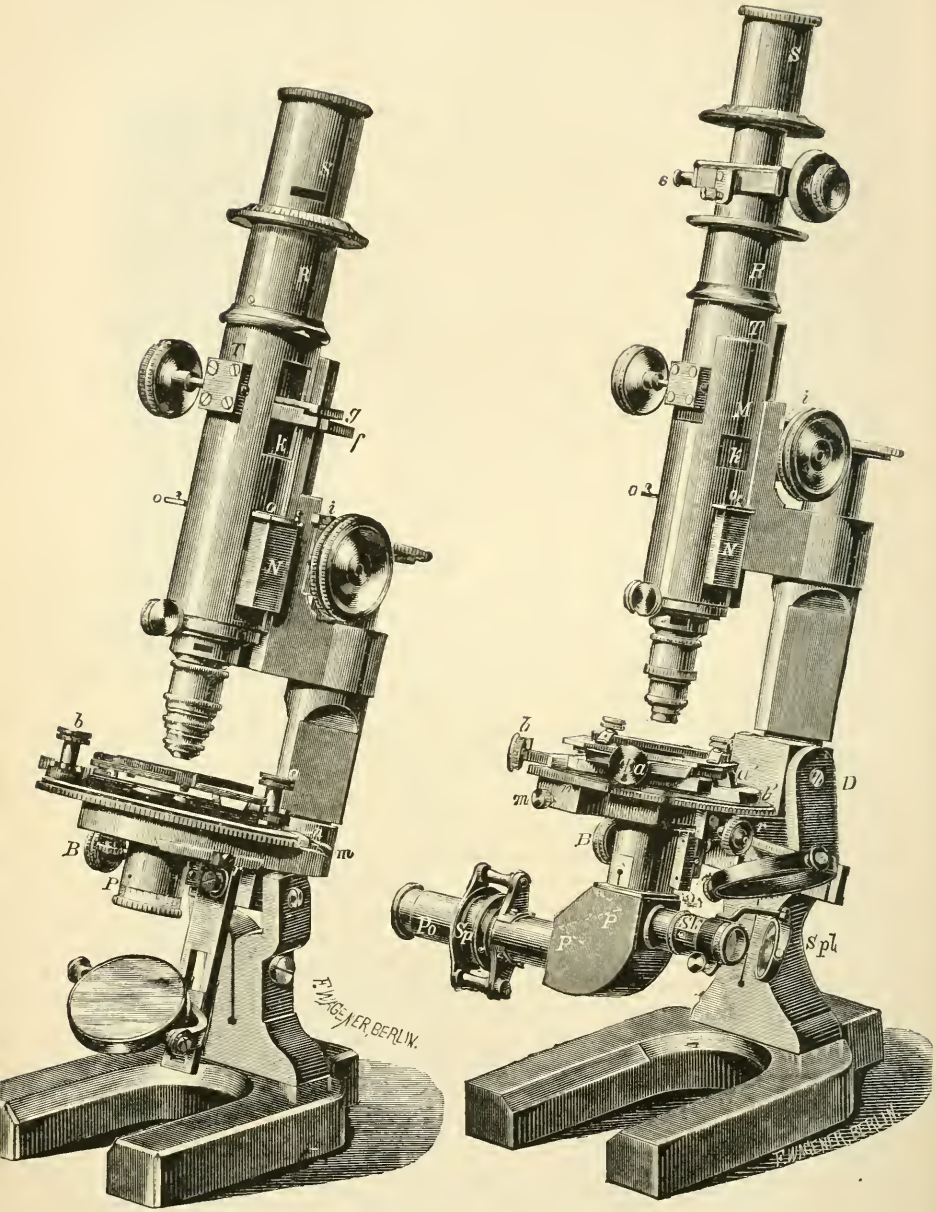
The polarizer P has a rack-and-pinion motion B, and the milled head of the fine-adjustment is graduated and reads against an index *i*.

To the rotating stage-plate is applied a mechanical stage with

* Cf. Girard's 'La Chambre noire,' 1870, pp. 58–60 (1 fig.).

† Cf. Rosenbusch's 'Mikroskopische Physiographie,' 2nd ed., 1885, i. pp. 562–4 (2 figs.).

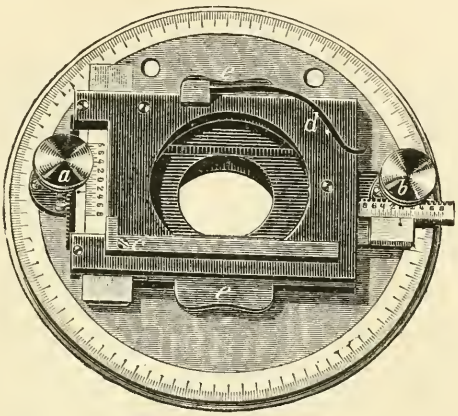
Fig. 164. Fig. 165.



Fuess's Petrological Microscopes.

finders, shown in fig. 166, in which the milled heads *a b* for the rectangular movements are placed within the circumference of the

FIG. 166.



stage. There are two verniers, one of which is shown at *n* (fig. 164). The rotation of the stage can be stopped by the arm *m*.

FIG. 167.

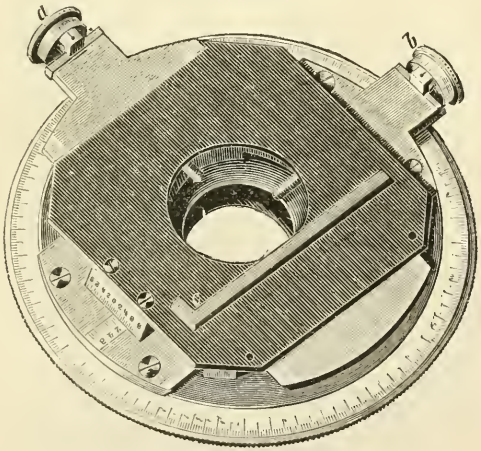
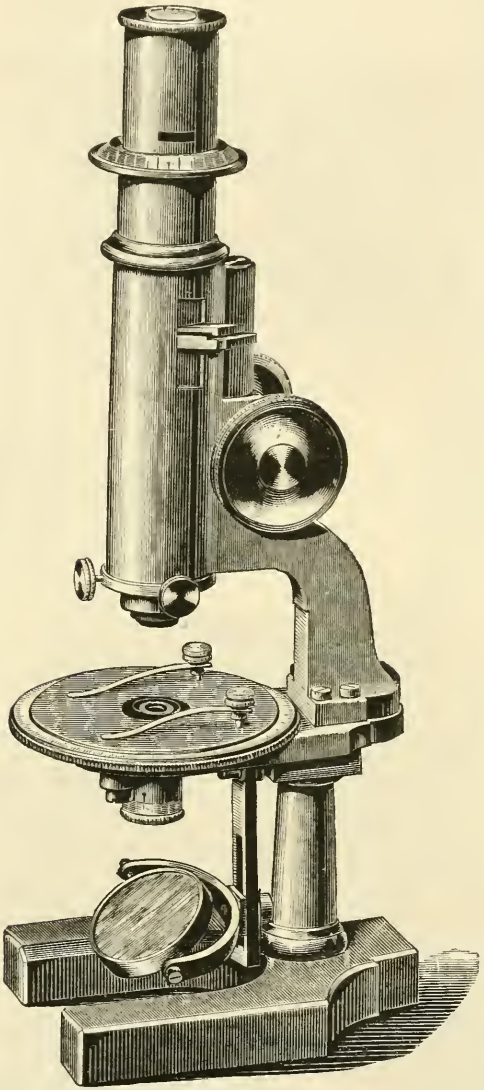


Fig. 165 is substantially the same form of instrument with a screw micrometer eye-piece *s* and an Abbe spectro-polarizer (Po, Sp, P, Sk, Spl).

The stage for this form is shown in fig. 167.

Three other simpler forms are made by Herr Fuess, the simplest of which is fig. 168.

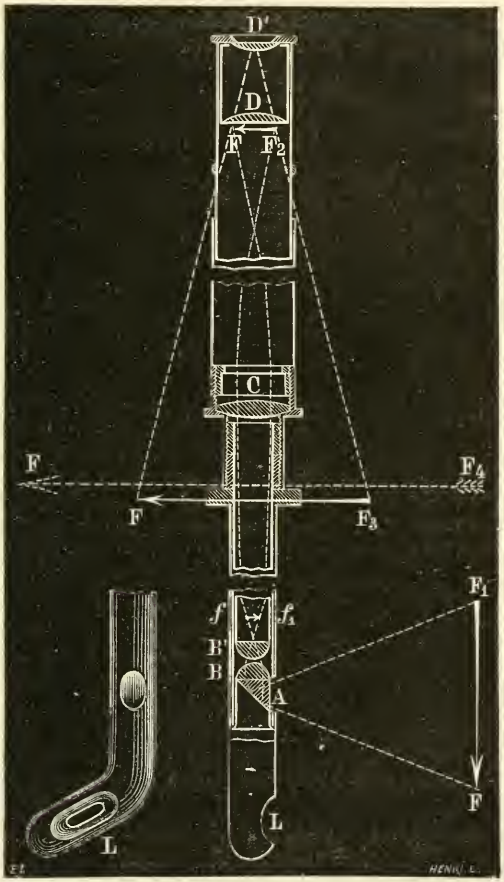
Fig. 168.



Fuess's Petrological Microscope (Simple Form).

Electro-megaloscope.*—M. E. Dieudonné describes and figures Dr. Boisseau du Rocher's Megaloscope for examining the stomach, bladder, and other internal cavities. A full translation of the original article having been already given,† we need only add the description of fig. 169, which shows the apparatus for examining the bladder.

Fig. 169.



At the lower end of the tube is a lateral aperture closed by a right-angled prism A. Above the prism are two hemispherical lenses B B′ with the convex surfaces turned to each other. A diminished image of an object F F_1 is formed at $f f_1$ which serving as an object to the lens C in the upper part of the tube, a second, still diminished, image is formed at F F_2. This gives with the Ramsden eye-piece D D' an image F F_3, a little larger than the original object.

* La Lumière Électrique, xix. (1886) pp. 64–7 (3 figs.).

† See this Journal, v. (1885) p. 1061.

A stronger eye-piece would give a larger image, as at $F F_4$.

The lower part of the tube, which carries at L the incandescent electric light, is shown in perspective as well as in section.

Cramer's Movable Stage.*—Dr. C. Cramer's movable stage (figs. 170 and 171), is described with a wealth of detail which seems inseparable from the descriptions of similar apparatus by Continental writers. It fits over the fixed stage, and acts as a finder.

Fig. 170 shows the apparatus as seen from above. It is so fitted to the stage that the screw S is at the right hand of the Microscope.

Fig. 170.

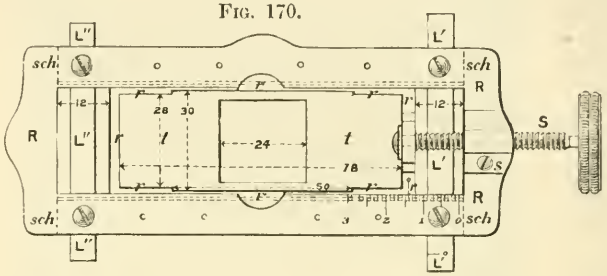
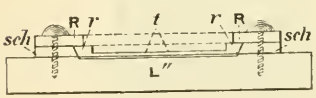


Fig. 171 is a section as seen from the left end. The apparatus consists of a frame R of lacquered brass about 14 cm. long and 2·5 mm. thick, the long sides of which are bowed out in the middle to prevent any collision between the objective and the frame. The two cross-pieces L′ L″ project over the edge of the stage, so that the apparatus can be pushed forwards and backwards as required. L′ is the longer of the two and has a line and letter *o* marked on its lower end. This index is intended to be used in conjunction with a millimeter scale on the edge of the stage. The cross-pieces L′ and L″ are not united directly to the frame R, but by means of two rectangular brass slips; the dotted lines *sch* fig. 170 show their extent in horizontal projection, and fig. 171 gives them in section, and shows that they slope inwards and downwards, forming a kind of groove for the reception of a slide, moving parallel to the long axis of the apparatus. This slide consists of a blackened brass plate *t* not more than 1/2 mm. thick, provided in the middle with a square opening, the sides of which are 24 mm. long. It is stiffened with a thin blackened framework *r*. The long side pieces of the frame *r* are sloped inwards so as to fit accurately in the groove. The slide is therefore firmly held in its movements to and fro. According as the screw S is turned one way or the other the slide *t* will be moved to the right or the left, the extent of the movement being 24 mm., the width of the quadrangular central aperture.

Fig. 171.



* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 5-14 (2 figs.).

To mark the place of any small object it is merely necessary to read off the number on the millimeter scale, fig. 170. This gives what may be termed the movable ordinate. The fixed ordinate is obtained by keeping the line —° on L′ at a prearranged point, or by having another millimeter scale marked along this side of the stage. Thus any spot in a specimen can always be found at once.

The object of the central widening of the frame *t* is for the admission of slides of the "Giessener Format." The longer length and shorter breadth of *t* are for slides of the English and Vienna sizes.

Zeiss's Apochromatic Objectives, Compensating Eye-pieces, and Projection Eye-pieces.—As a rule we do not notice in the Summary the catalogues or price lists of manufacturers, but the catalogue just issued by Dr. C. Zeiss * of the new objectives and eye-pieces, contains so much interesting as well as useful information for microscopists that we reproduce it nearly *in extenso*.

Apochromatic Objectives.—In the construction of the objectives thus designated, new kinds of glass and a greatly improved method of correction have been employed, with the result that the secondary spectrum is removed, and the spherical aberration uniformly corrected for the different parts of the spectrum. There is, therefore, a much more perfect concentration of the rays in the image than with the best objectives hitherto made, and in the case of the chemically effective rays, there is neither focal difference nor spherical aberration.

They also allow very high eye-pieces to be used without detriment to the accuracy or brightness of the image, thus giving high magnifying power with relatively long focal length, and enabling a series of very varying amplifications to be obtained with the same objective.

The natural colours of objects, even in the more delicate tints, are reproduced unaltered by these objectives, in consequence of the very slight intensity of the residual tertiary spectrum.

The differences in the amplification of the image for the various colours are reduced to the same amount in all the objectives, and are removed by the compensating eye-pieces hereafter described. The images therefore are uniformly free from colour throughout the whole field of view.

The spherical aberration outside the axis is so completely corrected that the sharpness of outline existing in the centre of the field of view is maintained almost up to the margin, although the focal adjustment between the centre and margins is necessarily somewhat different in consequence of the unavoidable curvature of the surface of the image.

The construction of each objective is based on calculations which extend to the smallest details of optical action. Every element—radii of curvature, thickness, diameter, and distance of the lenses from one another—are all accurately adjusted and numerically determined for each objective, with regard to the spectrometrical constants of the various kinds of glass employed, and the numerous conditions which have to be simultaneously fulfilled. The technical execution is

* Zeiss, C., 'Neue Mikroskop-Objective und Oculare aus Special-Gläsern des Glastechnischen Laboratoriums (Schott and Gen.),' 14 pp., 8vo, Jena, 1886.

carried out exactly on the data furnished by these calculations, with the strictest check on all the elements in the various stages of manufacture, and without any subsequent empirical touching up.

In the list given below the objectives are arranged according to their aperture. In the second column are the different focal lengths, while the third column gives the corresponding amplification obtained with the objective (the quotient of the conventional distance of distinct vision, 250 mm., divided by the focal length of the objective).

The objectives are constructed according to order, either for the Continental tube-length of 160 mm. or for the English of 250 mm. (or 10 in.). The three dry objectives of 6, 12, and 24 mm. focal length are, however, made exclusively for the English tube-length, as these objectives are not adapted for the Continental form. The tube-length is measured from the upper surface of the setting of the objective to the upper margin of the body-tube on which the eyepiece rests.

Great care must be taken to preserve the correct tube-length, as any deviation materially injures the performance of the objectives, particularly those for homogeneous immersion.

The settings of all the objectives are engraved with the name of the firm and also with the aperture, focal length, and length of the body-tube, for which they are adjusted. In ordering it is desirable that these three points should be specified so as to avoid any mistake as to the particular objective required (thus: Apochrom. 1·30, 2·0 mm., short tube).

The apertures given are the guaranteed minimum values; the real aperture is nearly always rather higher. The focal lengths are exactly as stated.

Apochromatic Objectives.

	Numerical Aperture.	Equivalent Focal Length in mm.	Objective Magnification for 250 mm.
Dry	0·30	24·0* 16·0	10·5 15·5
	0·60	12·0* 8·0	21 31
	0·95	6·0* 4·0	42 63
Water-Immersion ..	1·25	2·5	100
Homogeneous-Immersion	1·30	3·0 2·0	83 125
	1·40	3·0 2·0	83 125

The dry objectives of 0·95 aperture and the water-immersions are always provided with correction collars. The divisions on the

* See *supra*, lines 8–12.

collar give the thickness of cover-glass in hundredths of a millimetre. The correction for the proper thickness of cover must always be carefully made when using these objectives, or otherwise there will be a considerable falling-off in their performance.

The homogeneous-immersion objectives are only supplied in fixed settings as any alteration in the distance of their lenses interferes with the perfection of the correction. Slight variations in the thickness of the covers from the medium value (0·16 mm.) for which the objectives are corrected, have no influence on the image, but considerable variations should be compensated for by slightly lengthening the body-tube with thinner covers and shortening it with thicker ones.

The slightly thickened cedar oil (n D = 1·515) accompanying the objectives (and to be obtained at any subsequent time) should alone be used. Other substances should not be employed unless measurements of the refractive index and dispersion show exact correspondence with it. Mixtures of fennel oil and such like endanger the objectives.

To meet the desire for the highest possible objective-magnification, the homogeneous-immersions are also made with a shorter focal length of 2 mm., as well as with one of 3 mm., although it must still be regarded as an open question whether any decided advantage can be gained by the former. The impassable barrier to the increase of useful magnifying power which is fixed by the limit of aperture at present attainable, can already be reached, without loss, by an objective of the focal length of 3 mm., as the latter objective will bear the application of correspondingly higher eye-pieces without any appreciable detriment to its performance.

The objectives (homogeneous-immersion) of 1·30 aperture have so great a working distance that they will work through covers more than 0·30 mm. in thickness. With an aperture of 1·40 the working distance is reduced to 0·25 mm. These objectives require very careful handling, because in order to obtain the larger aperture the metal setting of the front lens has to be turned extraordinarily thin so that any blow or strong pressure upon the front of the objective is likely to injure it. For both reasons, therefore, the objectives with the slightly lower aperture are undoubtedly more convenient for regular use. The larger aperture will, however, of course allow of a rather higher degree of optical performance being reached.

No attempt is made to exceed an aperture of 1·40, as the small percentage of possible increase would render the objectives almost valueless for any scientific investigation.

With regard to the prices of the objectives, which, especially in the case of the dry series, may appear to be very high in comparison with the usual charges, it must be borne in mind that the apochromatics are far more complicated in their construction, and if their special qualities are to be maintained they must be far more difficult to manufacture than the ordinary objectives. Moreover the number of such objectives manufactured must be extremely limited, even with the resources of a large factory. The objectives, however, like all productions of our firm, stand on an absolutely free basis. The glass

employed is, by our own instrumentality, accessible to any one, and no optician is in the least degree prevented from producing the same objectives as good and as cheap as he can.

Compensating Eye-pieces.—These new eye-pieces have been designed for the purpose of compensating certain errors in the image formed by the objective, outside the axis, which cannot be corrected in the objective itself. They are specially arranged for use with the apochromatic objectives, and materially improve their performance by giving a uniformly colourless image.

The eye-pieces may also be effectively used with relatively wide-angled objectives of the old form, but when used with the ordinary medium and low power dry objectives, the images which they give outside the centre of the field are inferior to those obtained with the eye-pieces hitherto used. On the other hand, the apochromatics of 0·95 and upwards allow of the use of ordinary eye-pieces without any material detriment to their performance. The dry objectives of 0·60 and 0·30, however, are absolutely dependent on the compensating eye-pieces; if used with the ordinary ones the images will be confused by colour-fringes.

The compensating action of the eye-pieces on certain chromatic aberrations in the objective-image, can be well seen with the higher powers where the diaphragm limiting the field of view is outside the lenses. The edge of this diaphragm will be found to show a deep red border, whilst when used with the apochromatics the image remains quite colourless up to its margin.

The classification of these eye-pieces is carried out on the principle suggested by Prof. Abbe, viz. on the increase in the total magnifying power of the Microscope obtained by means of the eye-piece as compared with that given by the objective alone. The ratio of the magnification obtained with an eye-piece and a given body-tube, to the real magnification of the objective itself (or in other words, the number which denotes how many times an eye-piece increases the magnifying power of the objective, when used with such a body-tube) gives the proper measure of the eye-piece magnification, and at the same time the figures for a rational numeration.

On this basis the series of eye-pieces is arranged according to their magnifying power:—

1 2 4 8 12 18 27

the figures serving at the same time as the designation of the eye-pieces.

The magnification obtained by combining an eye-piece with any objective, is arrived at directly by multiplying its number by the magnifying power of the objective, as given in the preceding list. An objective of 3·0 mm. focal length, for example, gives a magnification of 83·3 (at the conventional distance of 250 mm.); eye-piece 12, therefore, gives with this objective $12 \times 83{\cdot}3 = 1000$ for the same distance of vision.

In order to obtain the most favourable results, it is necessary that the eye-pieces used on Continental and English Microscopes respec-

tively, should be of different formulæ, because of the very different paths which the rays take in the two cases owing to the great difference in the lengths of the body-tubes. Both series are arranged to give precisely the same magnifying powers, the difference in the body-tubes being compensated for by the focal lengths.

The settings are so adjusted in both series, that the lower focal point of all the eye-pieces lies at the same plane when inserted in the body-tube. No alteration of adjustment is, therefore, required on changing the eye-piece, and the optical tube-length (i. e. the distance between the upper focal point of the objective, and the lower one of the eye-piece) which is the standard factor for the magnifying power, remains constant. This optical tube-length in the Continental Microscopes (excluding small differences between the various objectives) is equal to 180 mm., and in the English 270 mm., provided that the length of the body-tube from the upper surface of the setting of the objective, to the upper end of the tube on which the eye-pieces rest, is 160 and 250 mm. respectively.

Compensating Eye-pieces.

	Finder Eye-pieces.		Working Eye-pieces.				
Eye-piece Magnification	1	2	4	8	12	18	27
	For the Continental Tube.						
Equivalent Focal Length in mm.	180	90	45	22·5	15	10	—
	For the English Tube.						
Equivalent Focal Length in mm.	—	135	67	34	22·5	15	10

The eye-piece 1 is only made for the Continental Microscopes, and 27 only for the English, as the former would be too large for the English body-tubes, while the latter would have an inconveniently short focus with the Continental.

The eye-pieces of unusually low power, designated "Finders," serve the purpose of reducing to its lowest limits the available magnification with each objective, thus facilitating the preliminary examination of specimens, and avoiding the labour of searching for particular points with high powers. The Finder eye-piece 1 enables an objective to be employed with its own proper magnifying power, i. e. as if it were used as a magnifier without an eye-piece. In both the diameter of the field of view amounts to fully a fifth of the focal length of the objective used, with a relatively small angle—12° in 1, and 24° in 2. This is particularly favourable for rapid searches.

These Finder eye-pieces are of special service with water- and oil-immersion objectives, where great inconvenience is caused by having to change an objective already adjusted for another of longer focus.

The working eye-pieces for regular observation are likewise of

entirely new construction. They commence in both series with a magnifying power of 4, and are convenient to work with even in the highest numbers. The eye-point in all lies so high above the upper surface of the eye-lens, and the diameter of the lens is so large, that the usual inconveniences attending the use of eye-pieces of short focus are completely obviated.

The ordinary drawing prisms, and particularly the Abbe camera, may be used without difficulty on Nos. 4 to 18 inclusive.

All the eye-pieces are supplied in cylindrical mounts, the external diameter of which is 23·3 mm. for the Continental body, and 35·0 mm. for the English. Adapters to fit them to larger bodies can be made by any workman.

On each eye-piece is engraved the magnifying power, the focal length and tube-length for which it is adapted, as well as the name of the firm.

TABLE OF MAGNIFYING POWERS OF THE APOCHROMATIC OBJECTIVES, WITH THE COMPENSATING EYE-PIECES FOR A VISUAL DISTANCE OF 250 mm.

Focal Length of the Objective.	Finder Eye-piece.		Working Eye-piece.				
	1	2	4	8	12	18	27
24·0		21	42	83	125	187	281
16·0	15·5	31	62	125	187	281	—
12·0		42	83	167	250	375	562
8.0	31	62	125	250	375	562	—
6·0		83	167	333	500	750	1125
4·0	62	125	250	500	750	1125	—
3·0	83	167	333	667	1000	1500	—
2·5	100	200	400	800	1200	1800	—
2·0	125	250	500	1000	1500	2250	—

Projection Eye-pieces.—For such purposes as require the projection of a real image, but more particularly for overcoming the inconveniences which arise in photo-micrography when the objective alone is employed, as also in the use of the ordinary eye-piece or amplifier, a specially constructed projection series is supplied which externally resemble eye-pieces, and fit into the body-tube of the Microscope in the same manner.

They consist of a convex lens and a compound system, which like the apochromatic objectives, is most carefully corrected both spherically and chromatically, and is entirely free from any secondary chromatic aberration, and free from difference of focus between the visual and chemical rays. Between the convex lens and compound system, a diaphragm is introduced for limiting the field. The system can be made to approach or recede from the diaphragm.

When used to project an image on a screen for demonstration, or upon a photographic plate, the objective of the Microscope remains exactly in the same condition as when observing with an eye-piece. After a preliminary adjustment of the specimen by means of the ordinary eye-piece, the projection eye-piece is put in its place and its

projection-lens so adjusted that the edge of the diaphragm is focused as sharply as possible on the screen or ground glass of the photographic camera. This is accomplished by drawing out the projection lens more or less according as the distance between the screen or plate and the Microscope is reduced or increased. Finally, the image of the object is sharply focused on the screen or ground glass by the usual adjustments. The length of body for which the objective is adjusted for observation with an eye-piece, must always be exactly retained.

The cap of the projection eye-piece forms a diaphragm by which any false light from the body-tube is completely shut off. The size of the aperture of this diaphragm corresponds with the highest aperture of the apochromatics. When using either those of 0·6 or 0·3 it may occasionally be desirable to decrease the available aperture of the objective in order to obtain uniform sharpness of definition up to the margin of the field. For this purpose each projection eye-piece is supplied with two diaphragms of smaller apertures which fit in place of the normal one. It must not be forgotten to remove these from the eye-piece if the full aperture of the objective is to be effective.

Projection by this method gives extremely sharp, uniformly illuminated, pictures of any desired degree of magnification.

The projection eye-pieces are specially corrected for the apochromatics on the principle of the compensating series of eye-pieces, but may nevertheless be advantageously employed with ordinary achromatic objectives of large aperture. They are constructed for both Continental and English Microscopes, on somewhat different formulæ, according to the difference in tube-length. There are two numbers for each series, giving an

$$\text{Eye-piece magnification of } \begin{cases} 2 \text{ and } 4 \text{ for the } 160 \text{ mm. body.} \\ 3 \text{ and } 6 \text{ for the } 250 \text{ mm. body.} \end{cases}$$

These figures indicate, as in the compensating eye-pieces, the ratio in which, by means of the eye-piece and the given length of body-tube for which it is adjusted, the focal length of the whole Microscope is less than that of the objective alone (in so far as the eye-piece is adjusted to great distance).

For instance, the projection eye-piece 2 diminishes the focal length of each objective by exactly one-half; an objective of 3 mm. therefore will, with this eye-piece, project as large an image as an objective of 1·5 mm. without it, the screen or plate remaining at the same distance.

As the linear magnification of a projected image is the quotient obtained by dividing the distance of the image from the posterior focal point of the objective by the equivalent focal length of the latter, we can determine the magnification at any distance of the image from the eye-piece, by dividing this distance expressed in mm. by the focal length of the objective used, and multiplying the result by the number of the projection eye-piece employed. Thus the objective of 3 mm. gives with the projection eye-piece 2 an image magnified 1000 times at a distance of 150 cm., $\left(\frac{1500}{3} \times 2 = 1000\right)$. This rule holds good

for greater distances, but in the case of the smaller it gives too high a reading.

The diameter of the image on the screen or plate when the eye-pieces 2 and 3 are used is about 1/5 of the distance of the image, and with 4 and 6 about 1/3 of that distance.

The image distance may be reduced in the case of 2 and 3 to about 400 mm., and in 4 and 6 to about 250 mm., reckoning from the eye-piece. It can be increased to any desired amount.

For purposes of demonstration and for photo-micrography, where small pictures only are required, or in cases where the plate can be placed at a long distance, the projection eye-pieces of low magnifying power, such as 2 or 3, are to be preferred; for photographing with a short camera, however, the higher ones should be used.

It would be too much of an innovation to print the price list in full here, but we may mention that the prices of the objectives rise from 5*l.* for the dry 16 mm. to 20*l.* and 22*l.* 10*s.* for the homogeneous-immersion of 2·0 mm. and 3·0 mm. and 1·30 N.A., and 25*l.* and 27*l.* 10*s.* for those of 1·40 N.A. The eye-pieces vary from 1*l.* to 2*l.*

Prof. Abbe and Dr. O. Schott have also issued a pamphlet* descriptive of the new kinds of glass made at the glass manufactory at Jena, with full details as to their optical and other properties,† and a list of the various kinds, 44 in number, now supplied. The following are most of the novelties in the list:—

	Refr. Index for D.	Medium Dispersion.
Light Phosphate-Crown	1·5159	0·00737
Medium do.	1·5590	0·00835
Heavy Barium-Phosphate-Crown	1·5760	0·00884
Heaviest do.	1·5906	0·00922
Boro-silicate-Crown	1·5100	0·00797
Light Borate-Crown	1·5047	0·00840
Barium-silicate-Crown	1·5399	0·00909
Heavy do.	1·5726	0·00995
Heaviest do.	1·6040	0·01092
Boro-silicate-Flint	1·5676	0·01216
Borate-Flint	1·6086	0·01375
Heavy do.	1·6797	0·01787
Heaviest Silicate-Flint	1·9626	0·04882

Suggestions are made as to the glass best suited for various purposes, and on commencing the perusal of these passages we had the idea that we were coming to a description of the glass used for the new objectives. The following ingeniously worded paragraph, however, closes the subject:—

"In the case of Microscope objectives which require for the attainment of the highest capacity of performance not only agreement in the course of the dispersion of the crown and flint, but also the correction of the spherical aberration and its chromatic difference, it must be left to the skill of the practical optician to choose the most suitable means from the above series. The new objectives of Zeiss show what can be attained by their practical use."

* 'Glasschmelzerei für Optische und andere Wissenschaftliche Zwecke. Productions- und Preis-Verzeichniss,' 20 pp. and 1 pl., 8vo, Jena, 1886.

† See this Journal, *ante*, p. 316.

Observation of Opaque or Quasi-opaque Objects in the Microscope.—Dr. John Anthony writes us as follows:—

Given a Microscope, an objective, and a good "bull's-eye" side-light, the examination of opaque or quasi-opaque objects would seem to be a very simple affair, but experience teaches that much management is required to bring out all the points of structure in an object, or in making such object show at its best in any subsequent examination. It is therefore hoped that the following practical results of many years' work with the Microscope will be received by the Society in the spirit in which they are tendered.

A very large class of objects examined by aid of the Microscope are either opaque or semi-opaque. No one can doubt that if we are able to make out the structure of an object by merely looking *upon* its surface, the result is far more satisfactory than can be got by any process of seeing *through* it. But some objects which are semi-opaque, though the amount of transparency be but small, lend themselves to a combination of both methods, and the effect of this double lighting properly balanced is charming and instructive beyond expression. This may be instanced in the examination of the beautiful whole-insect preparations of Mr. Enock. The mere "bull's-eye" side-light would not reveal half the structure, and no one knows better than Mr. Enock himself the enormous gain by supplementing the light of the bull's-eye by a flood of transmitted light, illuminating in this case the body of the insect by means of the achromatic condenser, and balancing by careful manipulation the respective amounts of light; the effect, when properly got, is little less than magical, so much so, that even the advanced microscopist would not find his time wasted by practising this double-illumination on some rather intractable object.

In this double-lighting sometimes a better effect can be got by using the spot-lens instead of the achromatic condenser, in aid of the bull's-eye or silver side-reflector. In my hands the bull's-eye, which is really a French "crossed lens," of some 5 in. diameter, and so giving a flood of light, does not yield nearly so *pure* an image as a good parabolic reflector, which in its turn is somewhat troublesome to use.

Where there is a want of transparency in the object, then the use of the Lieberkühn comes in with advantage. This Lieberkühn was much in vogue in the early days of the Microscope, and its use is not to be despised for certain objects; it fell into disfavour from a tendency to illuminate an object equally all round, and to afford no contrast of light and shadow, no "boldness of image"; but this quasi defect is very readily obviated by blacking about one-third of the silver reflecting surface with Indian ink, which does no sort of damage, and so a preponderance of light on the one side can be got *of a very pure quality*, and with the advantage—a very great one, that with the finger and thumb grasping the tube of the Lieberkühn, the illumination can be made to revolve in azimuth, and so bring out salient points under every condition of light and shadow—a mode of verification which no searcher for truth would be disposed to neglect.

It has been assumed so far, that white light has been used, both

reflected and refracted, but observers have called attention to the effects got by mounting the objects on slips of "flashed" or "pot" glass, so as to show colours when the object is viewed transparently, and it is obvious that similar effects could be got by the coloured glasses used as screens; all may be useful, and there is certainly a charm in trying the various devices.

Before giving the very simple method, which in my hands produces by far the best effects, I would say that the habit of mounting objects in dark cells, either lined with wax or arranged with black paper pasted behind the slide, cannot be too much deprecated; if there can be a worse plan, it is putting an object intended to be looked at by reflected light into a cell built up upon white or opal flashed glass, as the glare of light from the polished surface is destructive of all comfort or precision in examination, and no manipulation on my part has been able to obviate the discomfort inseparable from this well-meant but mistaken arrangement.

When an object, then, is absolutely opaque, the following method would seem to fulfil all the conditions for its examination. Half a dozen pill-boxes are selected of a size to drop like caps on to the achromatic condenser, which is assumed to be always in position for use. On the outside flat part of these pasteboard caps are gummed rounds cut from various coloured French unglazed papers; these colours preferably shades of green, from emerald to olive, inasmuch as the chitin, which is so preponderant in all insect-preparations, is a shade of red, and the "complementary colour" of red is of course green. This law of "complementaries" or contrasts will be found to aid most agreeably in the display of an object, and to add much to its distinctness. The primary or secondary colours, or even neutral tints, may be used at will, as a colour-battery of this kind would not be costly, and it is evident that little or no trouble would be involved in the substitution of caps, without any disturbance of the side-light; or by racking the condenser armed with this colour-cap to form a tinted background of the desired shade or brightness, having the advantage of absolute freedom from glare, and forming a contrast to the local colour of the object under examination.

Sundry analogous devices have been tried, such as cards like object-slips, covered with coloured unglazed paper put behind the object at various distances; and they have this advantage, that they can be pitched at an angle and so give the effect of a graduated background, the defect being that they are rather apt to tumble out of the position in which they may have been placed. So the coloured cap to condenser has been preferred for continuous use.

Thus three methods are advocated for illuminating opaque or semi-opaque objects:—(1) For semi-opaque light, *on* by bull's-eye or silver side-reflector, and *through* by achromatic condenser or spot-lens when suitable. (2) For opaque objects uncovered, or mounted in transparent glass cells, the Lieberkühn partly blackened and revolved during use. (3) Colour-caps used on the condenser, and racked up and down; or coloured cards below the object, illuminated by bull's-eye or side-reflector.

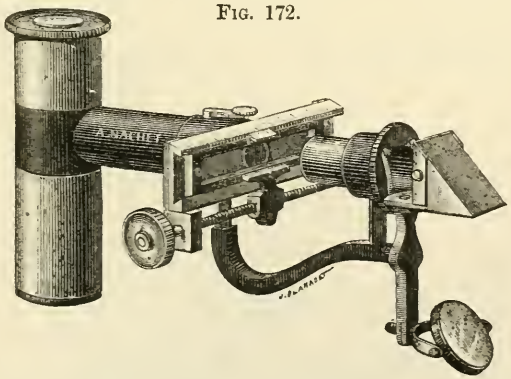
Examination of specimens by Coloured Light.*—Dr. M. Flesch recommends the insertion of a neutral tinted slide in the Abbe condenser when examining sections stained with red and blue dyes. As an example of the advantage may be cited the fact that some ganglion-cells stained with Merkel's indigo and carmine mixture have a special tendency to assume a blue colour, while others are stained red. This difference is found to be augmented by the use of artificial illumination and a neutral tinted slide.

Again, in making an examination of sections stained with eosin and hæmatoxylin, and where, owing to the thickness of the specimens the eosin stain could not be recognized, a successful result was obtained by using polarized light with a selenite plate, so placed that the field of vision showed up yellow. The large cells impregnated with eosin were thus seen to be of a red colour, while the blue nuclei had apparently disappeared.

Ahrens' Polarizing Prism.—Mr. Ahrens has recently added to his prism † a thin cover-glass at the end-face crossed by the line of section, thereby making this line almost imperceptible as well as affording protection against scratches. He has also found a new method of cutting the prism by which there is extremely little waste of spar.

Michel-Lévy's Comparator.—M. Michel-Lévy's Comparator (figs. 172 and 173) is based on the comparison of the colour of a crystal seen under the Microscope with that given by a wedge of quartz producing three orders of tints and which is taken as the unit of comparison.

Fig. 172.



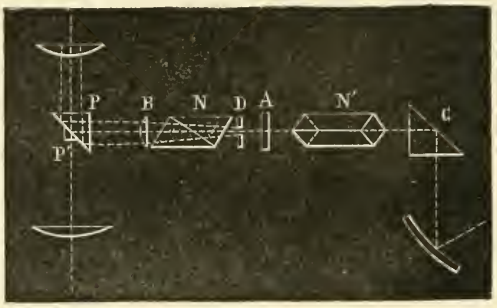
At NN′ fig. 173 are two Nicol prisms, between which slide the quartz A and a diaphragm D. The rays reflected from the small mirror are diverted at right angles by the prism C through the nicols, quartz and diaphragm, and made parallel by the lens B, being then reflected by the prism P through the eye-lens. To the hypothenuse

* Zeitschr. f. Wiss. Mikr., iii. (1886) p. 52. † See this Journal, *ante*, p. 397.

surface of P is attached a small prism P'. This allows the rays from the crystal on the stage to pass up to the eye which views them surrounded by the rays from the quartz, and a ready comparison is thus made.

By turning the milled head the quartz wedge can be moved in a horizontal direction, and a graduated scale enables the displacement to be measured in order to identify the tints.

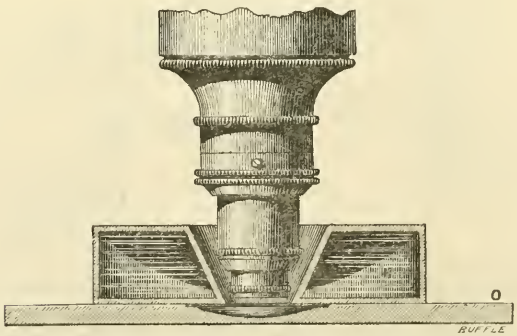
Fig. 173.



The light for the small mirror should be taken from the same source as that for the mirror of the Microscope, so as to avoid any error in the value of the tints. The apparatus is applied with best advantage to very small thin plates of minerals, not going beyond the tints of the first three Newtonian orders.

Israel's Warming Apparatus as a substitute for the Hot Stage.* —Dr. O. Israel's apparatus is so constructed that the illumination of

Fig. 174.



the objects is not interfered with, and the slide is warmed from above. It consists of a slide O (fig. 174), having a central hollow-ground well,

* Zeitsch. f. Wiss. Mikr., ii. (1885) pp. 459–63 (3 figs.).

round which is sunk a groove 0·1 mm. deep and 1 mm. broad, into which the cover-glass fits so that its upper surface is flush with that

Fig. 175.

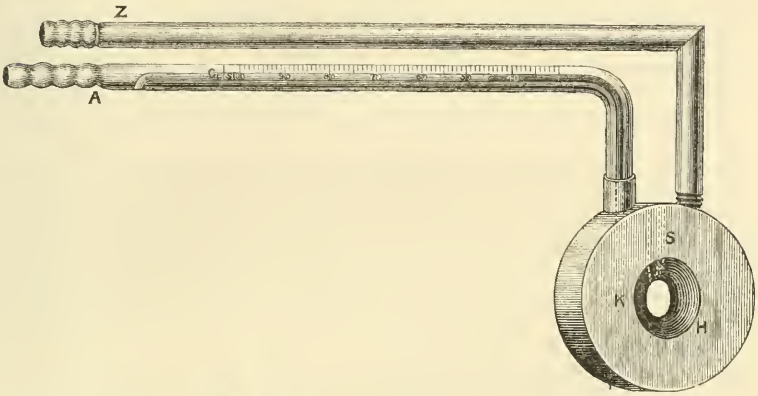
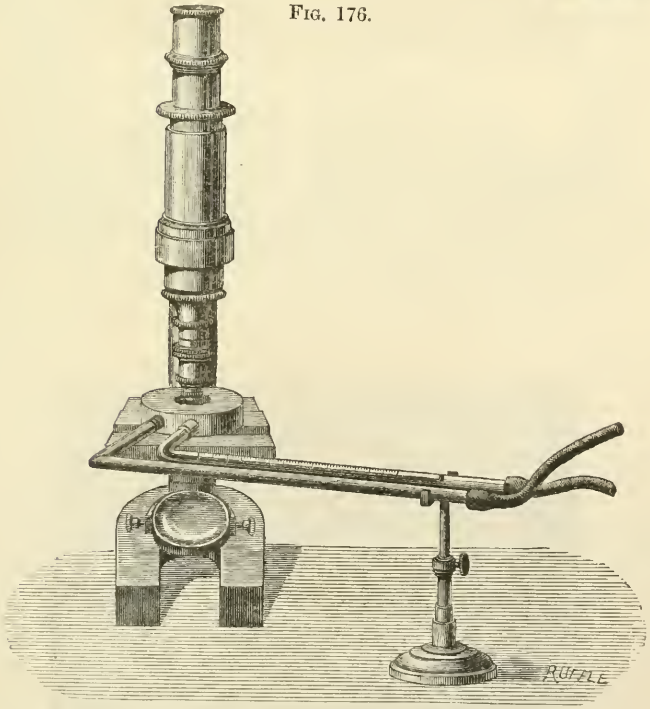


Fig. 176.



of the slide. Such a chamber is the more easily heated, since the glass itself acts as an insulator to the stage. The hot-water apparatus

consists of a flat, round metal box (figs. 174 and 175, H), with a central conical aperture. The entrance and exit pipes for the heated water (fig. 175, Z, A) are set on at a right angle to the side: the former, Z, is a metal tube; the latter, A, a glass one, is fitted with a thermometer, the bulb of which, K, passes into the box. A current is maintained by a partition S between the openings of the two pipes. These are supported by a stand (fig. 176), and their ends connected with rubber tubes.

Two precautions are necessary in using this apparatus. The first is to get rid of all air-bubbles in the water, and the second is to ascertain the temperature of the hot chamber. This is best done in the manner described by Koch.* The materials employed by Dr. Israel for ascertaining this latter point are a mixture of paraffin and vaselin, from which a substance with the desired melting point is easily prepared. Repeated trials with this apparatus show that if a temperature of 37° C. be required for the hot chamber, the temperature of the water in the capsule must range between 42° and 47° C. The apparatus can be adapted for direct heating after the manner of Max Schulze's stage if so desired.

Delage's Reversible Compressor.—Prof. Y. Delage has devised a form of compressor for the most delicate observations, figs. 177 and 178,

Fig. 177.

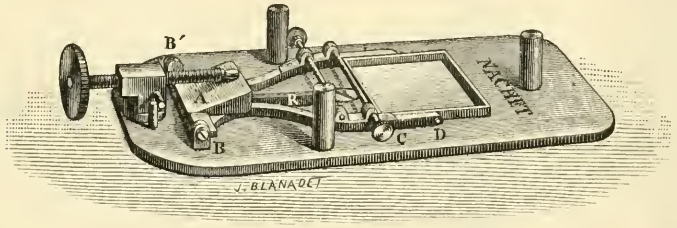
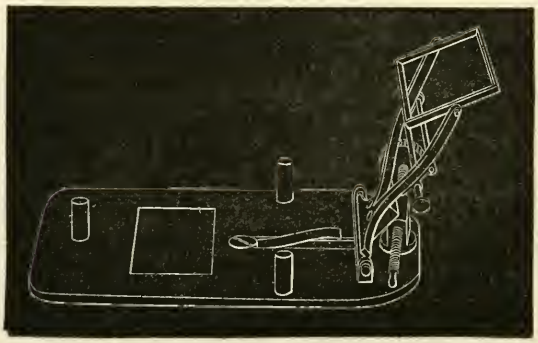


Fig. 178.



* Cohn's 'Beiträge zur Biologie der Pflanzen,' ii. p. 284.

in which the pressure is effected by the action of a screw on an inclined plane A, and working against the spring R. When the screw is turned on one side, the upper part of the compressor can be raised on the pivots BB' as shown in fig. 177. The frame holding the upper plate has a gimbal motion on the pivot D (and the corresponding one on the opposite side) and the frame can be detached by pressing the pin C and the corresponding one on the opposite side, causing the frame-holder to spring open slightly. The two glasses being oblong and lying crossed it is easy to add a drop of liquid during compression.

The compressor can be reversed, and in that case rests on the three small pillars which are high enough to allow the milled head of the screw to clear the stage.*

Coles' Self-adjusting Frog-plate.†—Mr. A. H. Coles' frog-plate is shown in fig. 179 (under side). It is 2 in. by 5 in., and it is claimed that "its adjustability, lightness, simplicity, the ease with which the

Fig. 179.

frog is secured without injurious pressure or loss of any blood, together with its cost, commend it to all users of the Microscope."

The binding cord is passed as usual over the plate and round the pins, and its free end is secured by simply drawing it under one of the small spring clips on the edge of the plate. The long springs are for holding the plate securely on any stage.

Micro-stroboscope for observing Muscle-contraction in Insects.‡ Prof. E. v. Fleischl employed in his experiments on muscle contraction in insects a "micro-stroboscope."

The poles of a small chromic acid battery were connected with the extremity of the exposed nerve proceeding from the insect wing, and the electric connection was made through the intermediation of small strips of tinfoil, insulation being effected by vaselin. This was carried out on the stage of a Microscope, and the observations were made under comparatively low powers. As the images of the tetanized muscle were imperfect and distorted, a "stroboscopic" disc of

* See Arch. de Zool., 1886.
† Micr. Bull. (Queen's) iii. (1886) p. 11 (1 fig.).
‡ Arch. f. Anat. u. Physiol., 1886 (Physiol. Abtheil.) pp. 67–71.

blackened cardboard was fitted closely over the eye-piece of the Microscope in such a way that the object was seen through the radial fissures, the images of the contraction and relaxation of the muscular fibrils being thus made perfectly clear and undistorted and easily observed.

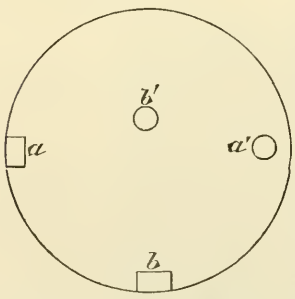
Determining the Thickness of Arterial Walls.*—Dr. H. Stahel uses the following method for ascertaining the thickness of arterial walls.

By means of a micrometer-screw having a thread of 0·5 mm., the milled head of which was divided to permit readings to 0·001 mm., a plate was moved up through the stage aperture, on which a square piece of artery, protected by a cover-glass, was placed. In order to avoid any chance error which might be caused by the unequal thickness of the cover-glass, the centre of the latter was always placed over the spot to be measured. The piece of artery and the cover-glass were accurately adjusted to the plate by the aid of slight pressure. The pieces should not be too large: as a rule, pieces the sides of which were 2 to 3 mm. were used. Vertically over the plate carrying the artery and cover-glass a needle was fastened by a band. The plate was then raised by the micrometer-screw until the needle-point touched the upper surface of the cover-glass. Accurate apposition was obtained by means of a hand-lens. The height was then read off on the micrometer-screw head. The height thus ascertained gave the thickness of the artery plus that of the cover-glass. The artery was then removed and the thickness of the cover-glass found in a similar manner, and the difference between the two gave the thickness of the arterial wall.

For the sake of accuracy frequent measurements were taken, and it was found in the result that the thickness of an artery's wall could be ascertained to within 0·01 mm.

Resolution of Diatoms whose Striæ are of unequal fineness.†—Mr. E. M. Nelson writes:—"Every diatom resolver with oblique light will have noticed the great difficulty there is (which in some cases amounts to an impossibility) to focus at the same time the longitudinal and transverse striæ of some of the Diatomaceæ. This will be found especially to be the case in diatoms whose striæ are of unequal fineness, such as *Navicula cuspidata* (36,000 and 65,000 per inch). Some observers have maintained that this appearance is the true structure, and that the coarse markings are on the exterior surface of the valve, while the fine are on the interior. To those who, like myself, hold that striæ are imperfectly resolved perforations, this theory is, of

Fig. 180.



* Arch. f. Anat. u. Physiol., 1886 (Anat. Abtheil.) pp. 45–63 (12 figs.).
† Engl. Mech., xliii. (1886) p. 328.

course, quite untenable. I wish to show how these differences of foci may be accounted for by the spherical aberration of the objective used.

Let fig. 180 represent the back of a 1/4 in. objective of 0·71 N.A., focused on a *Navicula cuspidata*, illuminated by two oblique beams, *a*, *b*, at right angles to each other; *a'* will represent the diffraction spectrum of the first order originated by the illuminating beam *a*, and the fine longitudinal striæ; and *b'* that by the beam *b* and the coarse transverse striæ.

It is evident that if the lens has not its spherical aberration properly balanced, the rays *a a'* passing through the outer zone of the objective will have a shorter focus than *b b'*. In other words, when the transverse striæ are in focus you will have to focus the lens further down before the longitudinal striæ appear. This is precisely what occurs in practice. The experiment is nothing more nor less than a refined kind of Abbe's test.

For my own part, I prefer to test an objective by flooding it with light from a large axial illuminating cone."

Actinic Contrast in Photo-micrography.*—Dr. G. A. Piersol considers that successful photo-micrography depends especially upon three conditions: (*a*) having all parts of the object accurately in the same plane; (*b*) having a well-marked differentiation between the elements of the tissues; and (*c*) having the object so stained and illuminated as to insure sufficient actinic contrast between it and the surrounding field or background.

The successful acquisition of the condition of actinic contrast, is not always readily had. While the blue stainings (hæmatoxylin, methyl-blue) are, of course, more actinically powerful than the reds and browns, yet so much depends upon the individual specimen in regard to opacity and thickness, that each case must be determined for itself. While a thick section stained in carmine will yield but a dark mass without detail, a similar section stained in hæmatoxyliu may furnish a satisfactory picture. But the days of thick sections are past; the question now is, how shall we stain and illuminate the thinnest possible sections so as to yield good photographs?

While a very delicate section well stained with hæmatoxylin is all that can be desired for examination, we shall soon find that actinically it is far too transparent to produce a vigorous photograph, there being insufficient actinic contrast between the general blue colour of the field illuminated by the blue monochromatic light from the ammonia-sulphate of copper cell, and the bluish purple of the section. When the preparation of the specimen is under control, it will be found advantageous to prepare a few sections as already suggested,† by which the thinnest sections in the brown colours always markedly impress the plate.

In many cases, however, it is inexpedient to specially prepare objects for photography. For such cases a very valuable adjunct will

* Amer. Mon. Micr. Journ., vii. (1886) pp. 121–3.

† See this Journal, v. (1885) p. 559.

be found in the use of different coloured lights produced by tinted glasses, carefully adapted to the intensity and colour of the staining. The use of glass, or of solutions of a colour complementary to that of the object, has been long employed in the arts in reproducing paintings. Koch, in his 'Traumatic and Infective Diseases,' relates his experiences with this method, but condemns it as impracticable. On account of the length of exposure and vibration "the picture does not have sharpness of outline sufficient to enable it to be of use as a substitute for a drawing, or, indeed, even as evidence of what one sees." *

Notwithstanding the unfavourable experience of this skilled investigator, some subsequent results by this method have been most encouraging. Defrenne obtained excellent photographs of the *Bacillus tuberculosis* by means of fuchsin staining and green glass, and quite recently the author's own experience with this same bacterium and stain have been very gratifying. Since then a number of modifications have been tried. As a result of these experiments the practical deductions have been reached, that when the staining and thickness of the specimen are insufficient to give the necessary actinic contrast with the colour of the field, we can best succeed by employing a coloured glass, whose tint will be such as to give the contrast, as well as to afford light to sufficiently impress the plate where not occupied by the object. Such a colour will not be the complementary one in many instances. With blue stainings the use of the complementary yellow would yield but a faint image, since the weak actinic power of the transmitted rays are insufficient to deeply affect the unoccupied parts of the field. The substitution, however, of a suitable shade of green affords sufficient contrast of the object as well as permits the passage of rays sufficiently actinically powerful to adequately impress the surrounding parts of the plate.

With all these colours the exposure is greatly lengthened, with a medium green it being five to seven times longer than with blue light; as, however, the normal exposure is seldom over one second, the increase has practically little disadvantage. Not only for very minute objects, as bacteria, stained with methyl-blue, under high power, but equally for very thin hæmatoxylin or carmine sections under low amplification, has this green glass proved most useful. By its use it is always possible to obtain pictures, where all the merits of vigorous negatives with the beautifully sharp details alone obtainable from the thinnest sections are combined, and where the usual method yields but a weak image.

These suggestions apply especially to sunlight. To those engaged in such work, who have never employed these means, the shades of green offer themselves as valuable modifications of illumination well worthy of a trial. The exact time required—a matter of importance—must be determined for existing conditions by each manipulator.

Mr. J. W. Queen suggests † a trial of the stained gelatin plates now coming into use for the purpose of securing contrast. The

* Magnin and Sternberg's Bacteria, 2nd ed., 1884, p. 195.

† Micr. Bulletin (Queen's), iii. (1886) p. 32.

sensitiveness of these plates is much greater than usual, so that the time of exposure will be diminished instead of lengthened, and by using plates variously stained suitable contrasts might be obtained with differently stained specimens.

Mr. R. Hitchcock also refers * to the so-called ortho-chromatic or iso-chromatic sensitive plates now sold which "may be found useful in photo-micrography, but it is well to consider that they differ from other plates mainly in their greater sensitiveness to the less refrangible rays, while they are scarcely less sensitive to the blue which still preponderates. For this reason, in order to obtain strictly uniform results for all colours, coloured screens must be used, particularly when working with sunlight. The great advantage of such plates rests in the fact that they are sensitive to the red and less refrangible rays which do not at all, or only slightly, affect the ordinary plates."

Abbe, E., and Schott, O.—**Glasschmelzerei für optische und andere wissenschaftliche Zwecke—Productions- und Preis-Verzeichniss.** (Glassworks for optical and other scientific purposes—Catalogue.) [*Supra*, p. 856.]
20 pp. and 1 pl. (8vo, Jena, 1886).

Alferow, S.—**Nouvel Appareil, servant à compter exactement les globules sanguins.** (New apparatus for exact counting of blood-corpuscles.)
[The enumeration method is more important than the moist chamber. Instead of counting by means of squares on the slide or in the ocular, a record of the blood-corpuscles is made on the ground glass plate of a photo-micrographic camera, which is fixed in the tube as far as possible from the objective. Fine adjustment is made with the stage. Instead of the preparation itself, a representation of it is thus used for the enumeration.]
Arch. Physiol. Norm. et Pathol., III. (1884) pp. 269–86 (3 figs.).

Andrieu, L.—**Sur un Chromatomètre, destiné à mésurer la couleur des liquides.** (On a Chromatometer for measuring the colour of liquids.) [*Post.*]
Comptes Rendus, CIII. (1886) pp. 281–4 (1 fig.).

Bausch, E.—**Illuminating Apparatus for the Microscope.**
[Description of the various forms.]
Bull. Rochester Acad. Sci., 1886, pp. 1–8.

Berger, C. L.—**Hilfsapparate für die Bedürfnisse der Werkstatt. III. Apparat zur genauen Bestimmung der Brennweite von Objectivgläsern.** (Apparatus for the exact determination of the focal length of objectives [of the telescopes of geodetic and astronomical instruments]).
[Contains a description of a Microscope used for fixing spiders' threads, *post.*]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 272–6 (3 figs.).

Czapski, S.—**Die Mikrometerbewegung an den neueren Zeiss'schen Stativen.** (The fine-adjustment to the newer Zeiss stands.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 207–9 (1 fig.).

Denaeyer, A.—**Procédé phototypique industriel applicable à la reproduction des photomicrographies.** (Phototype process applicable to the reproduction of photo-micrographs.) [*Post.*] *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 92–6.

English *v.* Foreign Microscopes.
[Inquiry by "Briton" (1) why English Microscope-makers should be unable to compete with the foreign makers? or (2) if they are able, why our schools of science should be so flooded with foreign instruments? Replies by S. Bottone that it arises from the "disparity in the prices of labour and food here and on the Continent"—by "Another Briton," suggesting

* Amer. Mon. Micr. Journ., vii. (1886) pp. 155–6.

a meeting at which "the whole of the opticians in London be invited to show the special forms of instruments they consider most useful to students"—by "Prismatique"—A. Caplatzi, that the foreigner can underbid us because he is better trained, more industrious, soberer, and more provident, &c., &c.—by "Prismatique" (2) that most of the foreign work is "make-believe," while our own is genuine—E. Holmes —A. K. C.—W. S. Franks—"Orderic Vital."]

Engl. Mech., XLIII. (1886) p. 580; XLIV. (1886) pp. 16, 39, 66, 88, 111.

Fasoldt, C.—**Resolution of 200,000 lines to the inch.**

["We have lately, with the use or aid of the second fine adjustment and internal illumination, resolved 200,000 lines per inch with homogeneous-immersion 1/16 in., and also with 1/12 in. homogeneous. Should you find or hear of an 'incredulous Thomas,' send him here. Only provided he has got first-class eyes, we will show him the 200,000. Furthermore, there is no reason for ridiculing, as not only one but a number have seen them, and would make affidavits accordingly if desired."]

Micr. Bulletin (*Queen's*), III. (1886) p. 32.

Giles, G. W. M.—**On Marine Collecting with the Surface-net.**

[Describes and figures a Botterill life-cell and aerating apparatus.—Also remarks on the handiest form of simple Microscope, and on examining and preparing the objects collected.]

Sci.-Gossip, 1886, pp. 79-80 (2 figs.).

Gower, H. D.—**How to make a Tint-reflector.**

[Wooden pill-box and thin glass cover; or thin silvered glass, if the image is to be thrown down on a sheet of paper.]

Sci.-Gossip, 1886, p. 172 (4 figs.).

Groth, P.—**Physikalische Krystallographie und Einleitung in die Krystallographische Kenntniss der wichtigeren Substanzen.** (Physical Crystallography and introduction to the crystallographic knowledge of the more important substances.)

[Part I. The physical properties of crystals. Part II. The geometrical properties of crystals. Part III. (pp. 543–674, figs. 565–621). The apparatus and methods for crystallographic-physical researches. A. Goniometer and refractometer. B. Polarization apparatus. C. Microscopes and microscopical measuring apparatus. (Includes Koch's Microscope for determining the elasticity coefficients, *post.*) D. Cutting and grinding apparatus.]

2nd ed., xv. and 710 pp., 631 figs. and 1 pl. (8vo, Leipzig, 1885).

Heurck's (H. van) Photographs of Amphipleura and Nobert's Bands.

[Includes note by Dr. Royston-Pigott that "they have in my opinion no equals."]

Amer. Mon. Micr. Journ., VII. (1886) p. 138.

„ „ **Method of taking Photo-micrographs.** [See *infra*, p. 900.]

Engl. Mech., XLIII. (1886) pp. 548-9, from *Brit. Journ. of Phot.*

Hitchcock, R.—**Photo-micrography. VII.**

[4. Developing *contd.*]

Amer. Mon. Micr. Journ., VII. (1886) pp. 131-3, 141-2.

Jennings, J. H.—**How to photograph Microscopic Objects.** A Manual for the practical Microscopist. (8vo, New York, 1886.)

Kerber, A.—**Ueber die Chromatische Korrektur von Doppelobjektiven.** (On the chromatic correction of double objectives.)

Central-Ztg. f. Opt. u. Mech., VII. (1886) pp. 157-8 (2 figs.).

"Lens."—**Black Illumination without Parabola.**

[The writer racked back and finally removed the parabola without losing the black ground!—the explanation being that, instead of placing the mirror in the axis, he had placed it excentrically.]

Engl. Mech., XLIII. (1886) pp. 509-10.

Levi, J. N.—**Photo-micrographic Work and Apparatus.**

Bull. Rochester Acad. Sci., 1886, pp. 10-21.

MAYALL, J., Junr.—**The Microscope.** (Cantor Lectures.)
[I., II., III., IV., V. Origin of the Microscope. Modern Microscopes to the date of the application of achromatism. Achromatic Microscopes.]
Journ. Soc. Arts, XXXIV. (1886) pp. 987–97 (12 figs.); 1007–21 (19 figs.); 1031–48 (21 figs.); 1055–81 (25 figs.); 1095–1121 (26 figs.).

[MOORE, A. Y.]—**High *v.* Low Powers.**
[Note as to the relative capacities of a 1/6 in. of 1·35 N.A. and a 1/50 in. of 1·17 N.A., with editorial comments.]
The Microscope, VI. (1886) pp. 176–7.

NELSON, E. M.—**Some remarks on the interpretation of Microscopic Images with high powers.**
["I will now, if you will allow me, sum up the lessons taught by this resolution. They are five in number:—
1. There are no such things as markings on the Diatomaceæ. The so-called markings on the Diatomaceæ are the structure of the Diatomaceæ. One might, with equal propriety, call ribs markings on a skeleton.
2. The complete destruction of the hemispherule, bead, and pearl theory.
3. The contradiction of the statement 'that you cannot know anything about the structure of the Diatomaceæ, because all the diffraction spectra are not taken up.'
4. The great superiority of illumination by an axial cone to that by an oblique pencil.
5. The solution it affords to the questions—What is focus? What is adjustment?"]
Journ. Quekett Micr. Club, II. (1886) pp. 255–9, 283–4, and 286–7.

NORTON, C. E.—**Photo-micrography without a Camera.**
["In every respect it is equal or superior to the method with the camera, with the possible exception of photography of opaque objects."]
Amer. Mon. Micr. Journ., VII. (1886) pp. 152–3.

PIERSOL, G. A.—**Actinic Contrast in Photo-micrography.**
[Also remarks by J. W. Queen (*Micr. Bulletin*, III. (1886) p. 32) and R. Hitchcock (*Amer. Mon. Micr. Journ.*, VII. (1886) pp. 155–6). *Supra*, p. 865.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 121–3.

POULSEN, V. A.—**Elektrik Lys** anvendt paa Microscopet samt en Beskrivelse af en af Instrumentmager L. Nyrop construeret Lampe.
[Small Edison lamp fixed beneath the stage and having a polished metal funnel reflector.] *Hosp. Tid.*, III. (1885) p. 81.

QUEEN, J. W.—**New Acme Lamp for Microscopic use.** [*Post.*]
Micr. Bull. (*Queen's*), III. (1886) p. 27 (1 fig.).

[QUEEN, J. W.]—**Prodigious Effulgence.**
["A series of leading articles by Dr. Roystou-Pigott, entitled 'Microscopical Advances,' is running in the 'English Mechanic.' What great scientific value the editor has discovered in these nightmare-generating ecstasies we fail to conjecture."]
Micr. Bull. (*Queen's*), III. (1886) p. 27.
„ „ **Parfocal Eye-pieces.** [*Post.*] *Ibid.*, p. 31.

ROLLER, C.—**Die mikroskopische Untersuchung des Schweinefleisches auf Trichinen und Finnen.** (The microscopical examination of pork for trichinæ and measles.)
[Chaps. 3–6, pp. 12–7 on the Microscope.]
2nd ed., 34 pp. and 6 pls. (8vo, Trier, 1886).

SAHLI, H.—**Ueber einen automatischen Regulator für Brütöfen mit Petroleumheizung.** (On an automatic regulator for incubators with petroleum heating apparatus.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 165–73 (3 figs.).

SCHOTT, O.—See Abbe, E.

SHANKS, S. G.—**Measuring Blood-corpuscles.**
[Reply to Dr. Ewell's criticism, *ante*, p. 696.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 138–9.

Stahel, H.—**Ueber die Beziehung der Wanddicke der. Arterien zum Blutdruck.** (On the relation of the thickness of arterial walls to the blood pressure.)
[Method of measuring, *supra*, p. 864.]
Arch. f. Anat. u. Physiol. (*Anat. Abtheil.*), 1886 pp. 45–63 (12 figs.).

Stein, S. T.—**Das Licht im Dienste wissenschaft icher Forschung.** Band II. Heft 4. Specieller Theil III.–V. Die Photographie im Dienste der Astronomie, Meteorologie und Physik. (Light in furtherance of scientific research. Vol. II. Part 4. Photography in astronomy, meteorology, and physics.)
2nd ed., viii. and 192 pp., 135 figs. and 1 phot. (8vo, Halle a S., 1886).

Stowell, C. H. and L. R.—**Valedictory—Introductory.**
[Announcement of retirement from the editorship of the journal, and introduction of new editors. Also "salutatory" note of new editors.]
The Microscope, VI. (1886) pp. 172–4.

" " " **At last.**
[On the retirement of the editor of the Amer. Mon. Micr. Journ.]
The Microscope, VI. (1886) pp. 174–6.

Sydow, P.—**Anleitung zum Sammeln der Kryptogamen.** (Guide to the collection of Cryptogams.)
[Contains "The Microscope" pp. 6–19. Also measuring, drawing, mounting, and culture methods.]
iv. and 144 pp., 10 figs. (8vo, Stuttgart, 1885).

Vignal, W.—**Chambre chaude à régulateur direct pour le Microscope.** (Hot stage with direct regulator for the Microscope.) [*Post.*]
Arch. de Physiol. Norm. et Path., VI. (1885) pp. 1–10 (2 figs.).

Zeiss, C.—**Neue Mikroskop-Objective und Oculare** aus Special-Gläsern des Glastechnischen Laboratoriums (Schott & Gen.). (New Microscope objectives and eye-pieces of special kinds of glass from the glass manufactory of Schott and partners.) [*Supra*, p. 849.] 14 pp. (8vo, Jena, 1886).

β. Collecting, Mounting and Examining Objects, &c.*

Preventing the crumpling up of the Germinal Disc.†—Prof. G. Romiti has been endeavouring to find a means to prevent the crumpling up of the germinal disc of the hen's egg, which occurs during hardening in osmic acid or in osmio-chrom-acetic acid. Foster and Balfour had recommended for this purpose, to allow the germinal disc to get slightly dry on a glass plate and to place the embryo thus fixed on the glass plate in the hardening medium. Romiti substitutes a watchglass for the glass slide; the embryo is placed on the convex surface, and isolated in the blastoderm in salt water or in very dilute bichromate of potash.

New Method for demonstrating Karyokinetic Figures.‡—Prof. G. Bizzozero has devised a new method for demonstrating karyokinetic figures. For the iodine solution (Gram's method) is substituted a 1 per 1000 solution of chromic acid. The sections, made from material hardened in alcohol, are left for 5–10 m′ in the Ehrlich solution (gentian violet 1, alcohol 15, anilin oil 3, water 80), then, having been rapidly washed in absolute alcohol, are trans-

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; 6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Boll. Soc. Cult. Sci. Med. Siena, iii. (1885) (Sepr. Repr.) pp. 5–6.

‡ Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 24–7.

ferred to the chromic acid solution for 30–40 m″. They are then returned to absolute alcohol for 30 or 40 m″, where their colour is somewhat diminished. In order to fix the colour better in the figures it is well to return the sections for 30 m″ to the chromic acid solution and then back again to absolute alcohol for 30–40 m″. This done, they are passed into oil of cloves, which extracts more colour. The author states that his experience is that oil of cloves exerts less influence on the nuclei in fission than those in repose. Consequently he uses oil of cloves as long as the colouring matter is extracted, in preference to alcohol which acts on both kinds of nuclei alike.

Better results are sometimes obtained by combining the effects of the two solutions. The procedure is then as follows:—5 to 10 m′ in the Ehrlich stain; wash for 5 m″ in absolute alcohol; 2 m′ in the iodine solution; 20 m″ in the chromic acid solution; 15 m″ in absolute alcohol; then 30 m″ in the chromic solution; 30 m″ in absolute alcohol; repeated washing in oil of cloves until the section is only faintly coloured; then dammar. The latter method is more suitable for examining nuclei of the liver, salivary glands, kidney, and pancreas; the former answers well with lymphoid tissue.

The preparations should be examined with an Abbe condenser without a diaphragm or with a very large one. In successful preparations the cell protoplasm is uncoloured, and in the nuclei in repose only the faintly stained nucleoli are to be seen, while the figures are a deep, almost brown, violet.

Preparations which have been hardened in chromic acid or in chrom-osmio-acetic acid stain well by this method if the sections are well washed in alcohol.

Reagents for studying the Structure of Gland-cells.*—1. Chromic acid.—Dr. J. H. List uses this as a 0·1 per cent. solution for eight days when needed for isolation hardening. When required for sections a 1/4 per cent. solution is used for three days; the specimens are then thoroughly washed, and having been hardened in alcohol to dehydration, are imbedded in celloidin. They are then stained with anilin, e. g. Weigert's Bismarck brown, rosanilin nitrate, and dilute Renaut's hæmatoxylin-glycerin. Sections made by this method show the structure of gland-cells (both goblet and mucous cells) excellently.

2. Müller's fluid.—This imparts the requisite hardness in a week or so; the specimens having been soaked for twenty-four to forty-eight hours, the isolated elements may be stained with methyl-green (1 per cent.), anilin-green (1 per cent.), or rosanilin nitrate. When sections are required, after the Müller's fluid the pieces are soaked and then hardened in alcohol, imbedded in celloidin, and then stained as before (No. 1).

3. Osmic acid.—This is used as a 0·5 or 1 per cent. solution. Small pieces of tissue are left in the 1 per cent. solution twelve to twenty-four hours; in 0·5 per cent. solution twenty-four to forty-

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 514–6.

eight hours. They are next thoroughly soaked for three or four days and the gland-cells isolated by teasing in distilled water or in glycerin and water (equal parts). Hæmatoxylin or Renaut's hæmatoxylin-glycerin are the best stains.

4. Flemming's mixture.—Pieces of tissue are left for not longer than twenty-four hours in the mixture and afterwards soaked for several days and then hardened up to dehydration in alcohol, imbedded in celloidin, and stained as before.

5. Alcohol.—70 to 90 per cent. alcohol may be used for pieces of limited size; the various structures are well preserved, and staining is almost always successful.

Preparing Striated Muscular Fibres.*—Dr. A. Rollett places small pieces of muscle just removed from the living animal in albumen of a fresh-laid hen's egg, and then cuts them in a freezing microtome (Jung's). A well-tempered knife is necessary. The still frozen section is placed on a slide, and can be examined at once with the albumen still adhering to it, or the latter may be replaced by a mixture of two parts glycerin and one part water. The sections are transparent and uncrumpled. Crumpling occurs when sections of frozen muscle are produced without the aid of albumen.

A similar procedure can be applied to the muscle of beetles which have lain only a short time in alcohol. The sections are put straight into glycerin. Muscles hardened for a longer time in alcohol are cut in celloidin. The objects are laid for twenty-four or forty-eight hours in a thin solution of celloidin, and then placed for twenty-four hours in a celloidin solution composed as follows:—Celloidin, 1 grm.; mixture of ether and alcohol in equal volumes, 4 c.cm.

The object immersed in this solution is then placed in a small covered vessel until the celloidin has, through slow evaporation of its solvents, assumed a jelly-like consistence. The mass is then cut all round and turned on to a glass plate, then reversed and put back in the glass vessel, some fresh solution is poured over, and the object sinks down in the midst. When taken out of the jelly-mass it is hardened in a mixture of 93 per cent. alcohol two parts and water one part, for twenty-four hours, staining with a weak solution of Renaut's hæmatoxylin, then alcohol, origanum oil, and dammar resin in xylol.

Isolating the Epidermis of Human and other Embryos from the Dermis.†—Dr. C. S. Minot describes a method for this purpose which is also convenient for the study of the development of hairs.

It is well known that if the fœtus dies and is retained, it is preserved for a considerable period without disintegration of the tissues in the amniotic fluid. In specimens thus preserved it is often found that the epidermis is loosened so much that strips can be removed without tearing off the underlying tissues. Now, as the amniotic fluid is little more than a salt solution, the facts just stated naturally suggest that a salt solution preserved from septic changes

* Denkschr. Math.-Naturw. Kl. K. Akad. Wiss. Wien, li. (1885) 48 pp. and 4 pls. Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 92–3.

† Amer. Natural., xx. (1886) p. 575.

is sufficient to loosen the epidermis of the embryo. His experiments have satisfied the author that a sojourn of several days in a 0·6 per cent. solution of common salt, with 0·1 per cent. thymol added to prevent putrefaction, is a simple and satisfactory way of liberating the embryonic epidermis from its connections, so that pieces can be easily removed for histological examination, for which they are apparently still adapted; even the minute structure of the nucleus will persist through this treatment, though imperfectly.

Preparing Stratified Epithelia.*—Dr. G. Bizzozero proceeds to the examination of fresh epithelial scrapings from inside the cheek, by removing, first of all, other morphological elements in the following manner:—

Some saliva obtained by means of a pipette is transferred to three or four times its bulk of a 0·75 per cent. solution of common salt. The mixture is thoroughly stirred up and then allowed to stand. When the epithelial cells have sunk to the bottom, forming a white sediment there, the supernatant fluid is decanted off, and is replaced by a fresh quantity of salt solution. This procedure having been repeated three or four times the salt solution is replaced by dilute alcohol in which the epithelial cells may remain unimpaired for a length of time. In order to bring out quite clearly the linear striation, some iodide of potash solution is added.

Preparing Central Termination of Optic Nerves of Mammalia.† Sig. T. Bellonci hardens the part of the brain to be examined in osmic acid (½ to 1 per cent.) from 14 to 20 hours: then makes free-hand sections in 70 per cent. alcohol, and then immerses for three or four hours in 80 per cent. alcohol. After having been repeatedly washed the sections are placed in water under a cover-glass, and some ammonia is added. This makes the brain substance as transparent as glass, with the exception of the medullated fibres, which remaining black, stand out so clearly that it is easy to follow their course. Thickish sections allow the course of the fibres to be followed for a longer distance than thin ones.

Preparing the Brain.‡—Dr. J. Fischl would seem to have had less encouraging results from Weigert's hæmatoxylin stain than other observers. He found that ganglion cells gave the best results when hardened in alcohol. The most advantageous stains were alum carmine, borax carmine, hæmatoxylin, safranin, dahlia, and vesuvin. Flemming's fixative fluid is much praised. The author has tried Flesch's indigo carmine and borax carmine, but his results were not so satisfactory as those from the foregoing methods.

Examination of the Cerebral Cortex.§—Dr. Nissl states that isolation, without preceding maceration, may be carried out in any indifferent fluid (maceration having no special significance in the study

* Internat. Monatsschr. f. Anat. u. Histol., ii. (1885) pp. 278–83 (1 pl.).

† Arch. Ital. Biol., vi. (1885) p. 405.

‡ Prager Med. Wochensch., 1886, No. 2, and Wiener Med. Wochenschr. 1886, No. 5. Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) p. 100.

§ Ber. Naturforscher-Versammlung Strassburg, 1885, pp. 506 and 135.

of the nervous elements). When the fibres are the object in view, hardening should be effected in bichromate of potash, but if good images of nerve-cells be desired, alcohol should be employed. The latest modification of Weigert's hæmatoxylin should be used for staining nerve-fibres, but anilin colours are necessary for the cells. Magenta, dahlia, and vesuvin are especially suitable.

The procedure is as follows:—Harden and cut in 95 per cent. alcohol. Stain in a watery solution warmed to evaporation. Wash in 95 per cent. alcohol. Clear up in oil of cloves. Pass through benzin to Canada balsam. The author lays especial stress on controlling the results by simultaneous examination of the cortex of a normal brain.

Preparing the Iris of Man and Vertebrates.*—Dr. J. Koganeï removes the pigment epithelium, when not required for examination, by the aid of a fine camel's hair brush. The removal is facilitated by allowing the iris to remain in Müller's fluid for a longer time than usual. The pigment masses within the iris substance are decolorized by immersion in chlorine water for a few hours. When the pigment assumes a light brown tone, the specimen should be removed, as too long action of the chlorine water destroys the tissues. Peroxide of hydrogen gives no better results. The endothelium of the bird's iris can be demonstrated without the aid of the silver treatment, which is more especially suitable for the iris of white mice, rats, and rabbits. A fresh bulb is fastened down on its posterior pole, the cornea is snipped off, and a 0·25 per cent. silver solution is carefully dropped on the exposed iris by means of a pipette, until the silvering is sufficient. The iris is then cut out and inspected *in toto*. Any damage to the iris is thus avoided.

In order to show the posterior limiting membrane of the human iris devoid of nuclei and pigment, the author gives the following method:—The posterior iris pigment is brushed with a fine fairly stiff brush, until the pigment is to some extent removed from the radiating folds. The posterior surface is then carefully scraped with a scalpel, thus retaining the part of the boundary membrane which is made up of fine radiating fibres. These fibres swell and become pale in acetic acid, become brittle in 20 per cent. nitric acid, but remain firm and separate from one another easily in 30 per cent. caustic potash. The fibres are unaffected in trypsin solution. The limiting membrane takes up colouring matter with difficulty. Eosin answers best. Carmine and hæmatoxylin not well. Picric acid and palladium chloride stain it and the connective tissue yellow.

Preparing the Retina.†—Dr. W. Krause describes a variety of methods for preserving, hardening, staining, and imbedding the retina.

A 10 per cent. solution of chloral hydrate is very suitable for preserving purposes. From teased-out preparations of the retina

* Arch. f. Mikr. Anat., xxv. (1885) pp. 1–48 (1 pl.).

† Internat. Monatsschr. f. Anat. u. Histol., i. (1884) p. 225. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 396–7.

thus treated are obtained excellent images of the finer parts of the retina, especially from the layers of the rods and cones.

The author recommends hardening and staining the retina *in situ*, i. e. while still associated with the sclerotic and choroid, with a 0·3 to 1 per cent. hyperosmic acid or 0·2 per cent. chromic acid solution. For the latter he uses alum carmine and picrocarmine. Very fine staining was obtained by means of iron and vanadium chloride in combination with 2 per cent. tannic or gallic acids. By these reagents the rods and cones, the internal granular layer, and the nuclei of the ganglion cells took on a deep blue to a black colour; while the rest of the constituents of the retina remain unstained. They bore after-staining with anilins, especially acid fuchsin, well.

In cutting the retina, the chief difficulty is to obtain sections which have a perfectly flat surface throughout, and which on their whole extent show the same retinal layers. The cause of this difficulty lies in the spheroidal form of the retina itself, and secondly, in the faulty placing of the preparation in the microtome. Krause tried to do away with this inconvenience by imbedding pieces of the retina in the object-carrier itself, by means of paraffin, a piece of cork, and some tin-foil. A disc of paraffin, to which the proper consistence had been given by mixing some vaseline with it, was fixed to the cork, and this latter fastened on the carrier. The tin-foil was apparently used merely for the purpose of keeping the retina straight. By this means Krause obtained perfectly flat sections.

Preparation of the Eye for Histological Examination.*—Mr. J. W. Barrett thinks that sections of the entire eye can only be prepared with the aid of imbedding and infiltrating materials; if celloidin is to be used the eye should be opened by a short incision through the sclerotic, and should be placed in Müller's fluid and chromic acid solution, or better 2½ per cent. watery solution of carbolic acid if a section of the lens is desired. After alcohol of various strengths it should be stained with alcoholic borax carmine (formula: carmine, (No. 40) gr. xv.; borax, 1 dram; water to 8 oz.; dissolve by warming, and slowly evaporate to 4 oz. Add 7 oz. of alcohol). After washing it should be transferred to alcohol and then to an equal mixture of alcohol and ether. After twenty-four hours it should be transferred to a thin solution of celloidin in equal parts of alcohol and ether. In two or three days the celloidin will have penetrated, and the eye may be now imbedded.

This should be done in a box with a perfectly flat floor, and the eye covered with a tolerably thick solution of celloidin. Put under a bell-jar, the alcohol and ether will diffuse and the celloidin slowly consolidate; the bell-jar must be lifted from time to time. The time necessarily varies from one to six days. If the whole mass is too large for sections, it may be cut into slices about a quarter of an inch thick. Directions for cutting are added. Sections of parts of the eye, without the lens, of young or of embryonic eyes may be readily obtained by infiltrating and imbedding in paraffin by the chloroform process.

* Quart. Journ. Micr. Sci., xxvi. (1886) pp. 607–21.

The best sections of the retina were prepared by fixing and hardening in the watery solution of osmic and chromic acid (1/4 per cent. chromic acid, 1/10 per cent. osmic acid) in which they were placed for from 24–48 hours, and then put into alcohol and carbolic acid for 14 days more; the retina was then stained in bulk, Kleinenberg's solution being the best when thin sections are required; and finally, infiltrated and imbedded in cacao butter; this gives the thinnest and best sections with a minimum amount of trouble. A piece of the eye must be dehydrated in alcohol, cleared in oil of cloves, and placed in the butter melted at 35° C. for from four to six or even twelve hours; it should then be imbedded in the butter in the usual way. When the butter is quite hard the sclerotic and part of the choroid should be detached with a sharp scalpel, so that the retina and part of the choroid alone remain to be cut into sections. The mass cut away should be replaced by a little melted butter.

Substitute for Bone-grinding.*—Prof. W. Flemming uses bones which have become perfectly decalcified by the prolonged action of chromic acid, hydrochloric acid, and spirit. From this material sections 10 to 25 μ thick are made under spirit, and then steeped in water. After having been dried on blotting-paper, they are spread out on a glass plate, and then covered with another. The glass plates with inclosed sections having been placed in a dish are covered up with spirit. In about half an hour the sections have become sufficiently flat to allow of their removal to absolute alcohol. When thoroughly dehydrated, they are spread out flat on a glass plate and covered with a layer of blotting-paper, over which is laid another glass plate. In this position they lie for at least a day, until they are dry. The drying may be hastened by slight heat.

In order to mount the sections warm balsam must be employed. A drop of melted balsam is placed both on the slide and cover-glass, the section is spread out carefully in the balsam on the slide, and the cover-glass then imposed. A stiff clip must be put on at once.

The defect of this method is the large areas of tissue which sometimes fail to show the canals and canaliculi; a defect caused probably by their walls having become agglutinated during decalcification and having failed to separate when drying. But with this exception, the process may be recommended as an efficient substitute for the slow and tedious process of grinding bones down for microscopical preparations, the canals and canaliculi in the dried and decalcified sections giving as good results as those obtained by the more tedious and difficult method.

Preparing Mid-gut Gland (Liver) of Mollusca.†—Dr. J. Frenzel's examination of the gland tissue was made in dilute sea-water or in salt solution of not less than one per cent. Hardening, especially of sea molluscs, did not succeed perfectly (sublimate in aq. dest., sea-water, or weak spirit act best; osmic acid is useless as it does not

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 47–9.

† Arch. f. Mikr. Anat., xxv. (1885) pp. 48–84 (1 pl.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 85–6. See this Journal, v. (1885) p. 792.

penetrate). The sections having been stained are stuck on with chrome-gum, which is made as follows:—Gum arabic dissolved in water to a thin mucilage, chrome-alum dissolved in water, added in excess to the former; glycerin a considerable quantity; of spirit a small quantity, to render the gum more easily spread on glass. A thin layer of the adhesive is spread on the slide with a brush or with the finger. The paraffin preparations are then laid on and allowed to dry at a temperature of 30°–45° C. Then turpentine, alcohol, or staining with an alcoholic or watery fluid, washing, alcohol, &c.; balsam.

Karyokinesis in Arthropods.*—In the study of karyokinesis in the Arthropods, Prof. J. B. Carnoy obtained the best results with the two following mixtures:—

(1) (Modified form of Flemming's mixture). Chromic acid (2 per cent. or more), 45 parts; osmic acid (2 per cent.), 16 parts; glacial acetic acid, 3 parts. (2) Corrosive sublimate; glacial acetic acid (1 per cent.). The object (testes) is left from one to ten minutes in one of these mixtures; then washed in distilled waters and further hardened in alcohol.

Preparing the Mid-gut of Insecta.†—According to Dr. J. Frenzel chromic acid is not suitable for the examination of the intestine of Arthropoda. A mixture of nitric acid and an alcoholic sublimate solution gave satisfactory results. The strength of the alcohol and the amount of sublimate in solution does not appear to matter. The author used 80 per cent. alcohol with sublimate half saturated. No particular caution is necessary as to the amount of acid; a drop too much or too little doing no damage. To the above solution a drop of concentrated sulphuric acid is added to every one or two cubic centimetres. The presence of this acid induces a quicker penetration of the preservative fluid into the tissues and hinders the formation of insoluble mercurial compounds. The more acid the solution and the smaller the piece of tissue the shorter the time it is left in the fluid. For pieces about the size of a pea five to ten minutes are quite sufficient. After hardening in sublimate, alcohol is advantageous. The tissue is washed and left in 90 per cent. alcohol.

Methods of Studying the Nervous System of Annelids.‡—Maceration is the best means of demonstrating the existence of a peripheral nervous system (*Polygordius*, *Protodrilus*, and *Saccocirrus*), and of showing its relation with the central nervous system. As macerating agents, M. J. Fraipont employed weak alcohol (36–48 hours), chromic acid (1/100 per cent., 24 hours), and a weak solution of bichromate of potash (48 hours).

After treatment with one of these agents, a definite portion of the

* "La Cytodiérèse chez les Arthropodes," p. 211 (Extrait de la Revue 'La Cellule,' i., 1885). Cf. Amer. Natural., xx. (1886) p. 578.

† Arch. f. Mikr. Anat., xxv. (1885) pp. 229–306 (3 pls.). See this Journal, *ante*, p. 231.

‡ Arch. de Biol., v. (1884) pp. 251–4. Cf. Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, pp. 198–9.

annelid may be placed on a slide, teased apart under the dissecting Microscope with fine needles, and then examined in a drop of the macerating fluid; or it may be freed from its cuticula, and subjected to gradual pressure under a cover-glass. This treatment causes the preparation to flatten out, but does not dissociate the tissues so far as to obscure the relations existing between the different layers and their constituent elements.

In some cases good results may be reached by giving light taps on the cover-glass with the point of a needle for ten minutes or more. In either case the progress of dissociation can be followed with the Microscope.

Specimens to be sectioned with the microtome should be so killed that they remain straight and extended. They may be killed by adding very slowly alcohol to the water. As soon as they cease to move they should be taken out and extended on a slide, and then hardened with alcohol, osmic acid, picro-sulphuric acid, chromic acid, or corrosive sublimate.

Another method of killing is to pour hot corrosive sublimate over the worm after it has been stretched out on a dry slide. A mixture of osmic acid (1 per cent.) and chromic acid (1/5 per cent.) in equal parts was also employed with some success.

For colouring, borax carmine was used after sublimate and chromic acid; picrocarminate of ammonia after alcohol, osmic and picric acids; hæmatoxylin and anilin dyes after chromic acid.

Preparing the Nervous System of Myzostoma.*—Dr. F. v. Wagner preserves the material for examination partly in picrosulphuric acid and partly in Lang's fluid. A hot saturated solution of sublimate was found to be the best fixative. Picrocarmine was principally employed as a staining agent. To obtain distinct staining of the nuclei of the abdominal ganglia the animals were left in picrocarmine five to seven days; in alum carmine ten to twelve days. When picrocarmine is used the superfluous staining matter and acid should be removed by long immersion in weak spirit. The sections, which were from 0·01 to 0·015 mm. thick, were fixed by Giesbrecht's method. In order to bring the outline of the nervous system and the nerve-trunks into view, moderate crushing under the cover-glass is employed.

Natural Preservation of Rotifera and Pond Organisms.†—Mr. E. B. L. Brayley, by the following formula (which he thinks is original), has been enabled to mount, amongst others, *Melicerta*, *Œcistes*, *Stephanoceros*, *Asplanchna*, *Synchæta*, *Eosphora*, *Scaridium*, &c., the tube-dwellers all fully extended from their tubes, and the others with cilia exserted in a natural manner. In the transparent forms the internal structure can be easily studied.

Chromic acid, 2 gr.; saturated aqueous solution of salicylic acid, 1/4 oz.; distilled water, 1 oz. Add about two drops of the above to each

* F. S. Leuckart, 52 pp., Graz, 1886 (1 pl.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) p. 84.

† Sci.-Gossip, 1886, pp. 149–50.

teaspoonful of the water containing the rotifers. Its action should be very slow, taking six or more hours to kill, the animal swimming about as usual for some time. If too much be used the rotifer at once doubles up, swells, and is useless. The water should hardly be perceptibly tinted. Mount in the same water in which the creature is killed. It is preservative as well as fixative. With muddy water, transfer the rotifers to clean before adding solution. With Floscules it is advisable to fix in the same cell they are intended to be finally mounted in, as moving disarranges the setæ. To study internal structure, first starve the rotifer for a few hours in clean water. There are two points which make failure possible. First, the exact quantity to use—this can be acquired by practice alone; use as little as possible. Second, in certain waters a thick deposit is thrown down some hours after the solution is added. The only way to obviate this is to transfer the rotifers to fresh water and try again. Some mounts of *Asplanchna priodonta* are as perfect now as when put up two years since. Seal with Ward's brown cement: this had better be used with all the organisms; it is very reliable and easy to work.

The following formulæ are also given for Infusoria and other organisms:—

For *Carchesium* and other Vorticellina use a saturated solution of picric acid. Apply suddenly when the zooids are extended: well wash in alcohol. To stain prepare as follows: alcohol, 75 per cent., 2 oz.; hydrochloric acid, 4 drops; carmine, 3 grains. Boil this preparation slowly for 10 minutes; when cold, filter. If the stain shows a tendency to yellowness add one or two drops of ammonia, until the right colour is restored, and filter again. After staining wash out the excessive stain in acidulated alcohol, then transfer through absolute alcohol and cloves to balsam. The transference into the cloves must be carefully done, or great shrinking will take place. Introduce a few drops of oil of cloves into the bottom of a precipitating glass containing the alcohol, and let the stained Infusoria gravitate into the cloves, then withdraw the alcohol, add a little more cloves, and transfer into balsam. Picric acid will not satisfactorily kill *Paramecium*, *Urostyla*, &c.

Salicylic vinegar (pyroligneous acid, 100 parts; salicylic acid, 1 part) will be found the most generally useful. It kills such forms as *Paramecium*, *Coleps*, *Spirostomum*, *Stentor*, &c., and certain *Vorticellæ* fully extended, and can be used as a mounting medium.

A saturated solution of bichloride of mercury is very useful for fixing *Paramecium*, *Urostyla*, &c., but generally causes *Vorticellæ* to contract. Great care must be taken to wash away every trace before mounting.

The efficacy of all the foregoing solutions largely depends on the particular medium used being applied suddenly and in a concentrated form; that is, have as little water surrounding the Infusoria as possible.

Osmic acid is very useful at times, applied as a vapour. Put the drop of water with the Infusoria on the cover-glass, and hold it over the mouth of a bottle containing osmic solution. A drop applied to

water containing any Tentaculifera fixes them most satisfactorily. Care must be taken not to use too much, or they will become blackened and useless.

Entomostraca and small larvæ can be fixed with bichloride of mercury, and after being thoroughly washed, mounted in Noll's medium. Salicylic vinegar (as above), 1 vol.; dilute glycerin (glycerin, 1 vol.; water, 4 vols.), 10 vols.; Farrant's medium, 11 vols. This is generally a most useful fluid to keep by one, but does not answer where the integument of the object is very chitinous. Vermes are fixed admirably either by picric acid solution, or bichloride of mercury, and *Hydræ*, by bichloride of mercury solution. *Hydrachnæ* may be splendidly preserved by putting them living into a cell containing a saturated solution of boro-glyceride, and sealing the mount down. The animal will probably live in this for a day or two, and then will be perfectly preserved in form and colour; while for Algæ, a few drops of saturated aqueous solution of salicylic acid added to the water will preserve *Volvox*, showing cilia, and *Spirogyra*, without contracting chlorophyll spirals, &c. Use very little of the solution, otherwise it will bleach.

Preserving Preparations of Algæ.*—Dr. W. Migula, after alluding to the difficulty of preserving good preparations of algæ, e. g. Desmidiaceæ, on account of the plasma crumpling under the influence of glycerin and acetate of potash, and also because the more complex fluids destroy the chlorophyll, states that the contraction of the protoplasm may be perfectly prevented, if, so long as the algæ are in pure water, a drop of 1 per cent. osmic acid be placed on the edge of the cover-glass. By this means the plasma is fixed without tissue change, and after about 10 or 20 minutes the acetate of potash may be added. Desmidiaceæ retain their form and the structure of the plasma excellently.

Removal of Siliceous Coverings from Fossil Diatoms.†—Dr. O. N. Witt gives, by way of introduction, an account of the preparation of material for microscopical research, which forms an important contribution to the preparation-technique of fossil diatoms.

Dilute hydrochloric acid is poured over bean-sized pieces of the raw material, which is then heated in a water-bath. As there is but little chalk or iron in solution, the adhesion of the particles is much diminished, a condition favourable to further procedure. The acid is then poured off and the residue washed with distilled water. It is next heated with a 20 per cent. solution of carbonate of soda, in which it is boiled for six or eight hours. The result is a fine soft powder, which is again washed by decantation with distilled water. The powder is then treated with strong hydrochloric acid whereby fresh quantities of chalk and iron are dissolved. The author then treated the material (after first washing out the hydrochloric acid) with fuming nitric acid, to which had been added some chromate of

* Zeitschr. f. Wiss. Mikr., iii. (1886) p. 47.

† Sapiski Russischen Mineral. Gesell., xxii. (1885). Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 573-5.

potash. By this means the greatest part of the organic substances contained in the marl was destroyed.

Then follows a treatment, the object of which is the decomposition of the sulphur present. This consists in acting on it with concentrated sulphuric acid. If the operation is to succeed well, certain precautionary measures have to be observed. After the treatment with nitric acid, washing must be carefully performed, and the whole residue collected in a small paper filter; when this fluid is quite dropped away it is further dried in a folded filter-paper in such a way that no pressure is exerted on it. The filter is then opened, and with a platinum spatula the whole mass is put into very concentrated sulphuric acid which has been previously placed in a hemispherical porcelain or platinum dish. The dish is covered with a watch-glass, and the sulphuric acid made to boil. As a rule this (acid) gets stained black from the presence of organic substances, paper-fibres, and the like. Saltpetre is then added until the mixture becomes white. The sulphuric acid is boiled for at least one hour. By this means the whole of the sulphur is completely decomposed. When the vessel is cooled down, its contents are poured into distilled water. All the siliceous matter sinks to the bottom in two or three hours, and can be perfectly washed by decantation.

The fine snow-white shining precipitate thus obtained is now examined microscopically. If it still contains sulphur or its insoluble decomposition-products, recognized by their form and their opacity, these must be removed by careful treatment with dilute solution of soda. This last step is scarcely necessary in well-conducted operations, and the last steps of the procedure can be entered on. The whole mass must be allowed to settle in a glass jar, and the supernatant water poured off as completely as possible. The strongest ammonia is then poured over the precipitate, stirred up, covered with a watch-glass, and allowed to stand for twenty-four hours. The glass is then filled up with distilled water and the precipitate washed several times at intervals of two hours. The first water is slightly clouded (like milk), from the presence of finely divided amorphous silicic acid, which only settles after standing for twenty-four hours. The washings are to be continued until the supernatant water is perfectly clear and bright. The residue in the glass consists of pure siliceous organisms, which are preserved for use in well-closed flasks under alcohol.

By this ammonia treatment the very small particles of amorphous silicic acid acquire a motion, by the aid of which they are kept buoyed up, as it were, in the fluid, while the far larger siliceous organisms sink down between these to the bottom of the vessel.

Cultivating Schizomycetes.*—In his investigations on putrefaction Bacteria and their relation to septicæmia, Dr. G. Hauser employed Koch's method, to which, as it is so well known, we need not further allude. His procedure for breeding the Schizomycetes,

* Hauser, J., 'Ueber Fäulnissbacterien und deren Beziehung zur Septicämie. Ein Beitrag zur Morphologie der Spaltpilze,' 15 pls., 8vo, Leipzig, 1885. Cf. Zeitschr. f. Wiss Mikr., ii (1885) pp. 551 5.

isolated from putrefactive foci, in pure hydrogen or in carbonic acid gas, is, however, original.

Two ordinary test-tubes, one 20 cm. long, of strong but easily fusible glass, and provided with a secondary tube drawn off to a point, the other about two-thirds the length, are united about their lower third by a small glass tube. The larger tube is closed by a cotton-wool plug, while the smaller is filled almost to the mouth with cotton wool. After the apparatus is sterilized by heating to 170° C., the larger test-tube is drawn out, pretty thin, at its upper third, and its lower fourth filled with Koch's gelatin. After waiting several days to see if it remain unclouded, it is inoculated with the fungi to be examined, and the upper end melted off where it was drawn out. The side tube and the connecting pipe are then drawn out fine, the latter about the middle. The smaller test-tube is fitted with a caoutchouc plug perforated by a glass tube in connection by a rubber pipe with the gas apparatus. As soon as the fore part of the side-tube is broken off the gas rushes in, filtering through the cotton-wool plug in the smaller test-tube, whereby all impurities, especially Bacteria, are prevented from entering.

A quarter of an hour suffices to drive all the air from out both tubes and to replace it with the desired gas. While the stream is in full flow, the points of the side- and the connecting-tubes are melted off. In this way any gas can be supplied to a gelatin cultivation without possibility of escape.

New Hardening Mixture.* — Dr. J. B. List has suggested a hardening mixture which, he says, gives pre-eminently satisfactory results with delicate and complex tissues. It consists of a half saturated watery solution of sublimate, to every 1 ccm. of which solution is added one drop of picrosulphuric acid. Histological relations are not only well preserved, but delicate easily lacerable organs acquire a consistence which enables them to withstand teasing out with needles.

The author's method is merely to put two or three drops of the solution by means of a pipette on the exposed organs, and allow it to work for two or three minutes. He then washes with distilled water, and mounts in glycerin. After-staining was found to be very easy, picrocarmine being usually adopted. By this method the author succeeded in demonstrating the intestinal canal, nervous system, &c., of Coccida.

Stein's Simple Imbedding Apparatus.†—Prof. S. v. Stein recommends instead of the clamp arrangement on the microtome, a metal box open above, and consisting of two tubes of tin. The undermost tube, provided with a bottom, is 10 mm. high ; the upper one, 30 mm. high, is pushed over it. From the floor of the box project three screws, 4 mm. high, for the better adhesion of the imbedding mass. When used the upper tube is oiled, the imbedding mass poured in until the screws are covered, the specimens adjusted and then the metal tube

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 43-4.
† Centralbl. Med. Wiss., 1884, p. 100.

is filled up with imbedding mass (1 part oil, 2 parts wax). When quite cooled down the upper tube is removed. Cutting is best done under water.

The advantages claimed for this method, which is especially recommended for preparations of the nervous system, are (1) the object is not subjected to any pressure; (2) the knife keeps sharp for a long time.

Imbedding Pharmaceutical Preparations.*—Dr. E. Vinassa imbeds pharmaceutical preparations in a mixture of glycerin and gelatin under the vacuum pump. This pump is of copper of 5 litres capacity, heated by steam and connected with a Körting's pump. The floor of the vacuum pump is covered with a layer an inch thick of paraffin (melting point 56°); during the whole time it is in use it is kept at a temperature of 58°–60° C. In the bath are placed five tall and widish boxes, which are for imbedding masses of different consistencies. The formula for the imbedding mass is, Gelatina alba, 15 grm.; aqua; glycerinum, āā, 100 grm. After the bath has been warmed for some time the pressure is regulated so as not to exceed 200 mm. The air in the cell-spaces is thus slowly driven out and the mass begins to froth. After the lapse of some hours the air is so far removed from the object that the stopcock of the air-pump may be gradually opened until the manometer indicates about 720 mm. By this measure the water is driven off, and in a few hours the gelatin assumes the consistency of a stiff jelly.

For hygroscopic or very mucilaginous roots, or such as have large air-passages, the quantity of water in the imbedding mass must be reduced one-half. Very fibrous tissues require to be left longer than usual in the air-pump.

Very dense woods such as *Lignum juniperi* and *Taxi* require to be left *in vacuo* for four hours in a mixture of equal parts water and glycerin, so that all the air is replaced by glycerin. This done they are removed to a warm vacuum for eight to fourteen days until frothing no longer occurs. When this has been repeated two or three times, they will be found quite ready for cutting. Woods rich in resin or pigment must be first macerated in alcohol. The *Rhizoma Caricis*, *Arnicæ*, *Graminis*, *Stipites Dulcamaræ*, &c., after having been saturated with gelatin, must be fixed in elder pith for cutting.

The author has tried paraffin and its mixtures, and also oils mixed with tallow or wax, but has always failed to obtain satisfactory results.

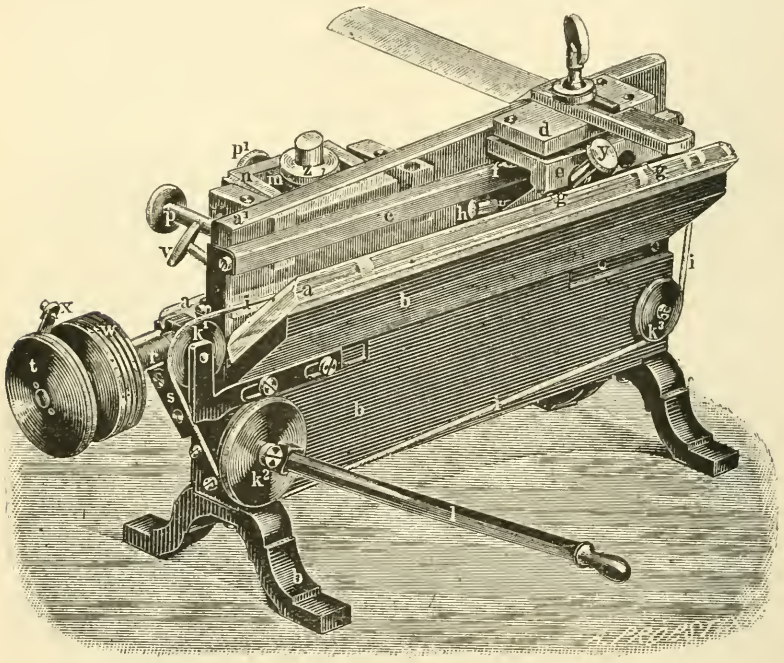
Imbedding Media for Diatoms.†—Mr. J. Deby uses, as imbedding media for diatoms, chloride of zinc or chloride of magnesia mixed with their respective oxides. As soon as the mixtures have become hard, thin sections can be made in the same way as with ordinary rock. If sufficient care is taken, it is not difficult to obtain sections of a less diameter than the areola of a *Triceratium* or of a *Coscinodiscus*.

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 320–5.
† Journ. Quek. Micr. Club, ii. (1886) pp. 308–9.

Becker's Sliding Microtome.*—Dr. J. W. Spengel describes an improved form of sliding microtome (fig. 181) devised by him in conjunction with Herr A. Becker, who is also responsible for the workmanship.

In general aspect and in principle it resembles its predecessors of the same type, the Rivet, Thoma-Jung, &c., while the novelty of its details gives it its characteristic features. For instance, the slide-ways are made of plate glass, which allows a perfectly free and even to and fro motion of the slide or carrier without the aid of any lubricant. The stand *b* is made of cast iron. The side-plates *a* are set on the middle plate *a'* at an angle of about 45°; greater

Fig 181.



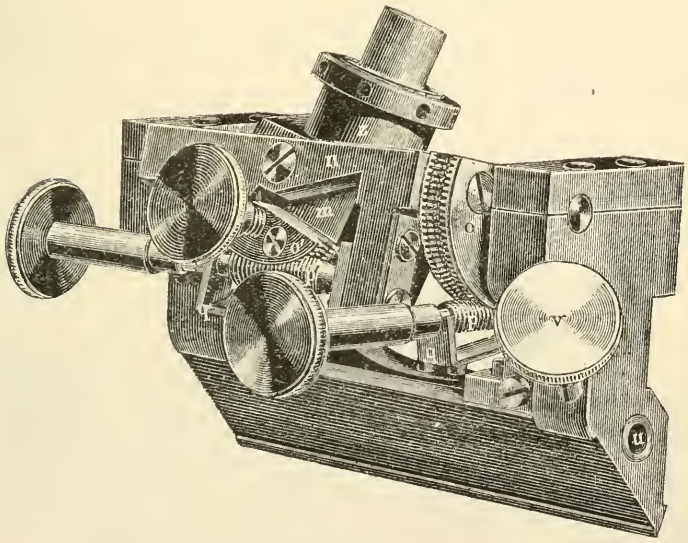
certainty being obtained at this angle than when the slide works at a less inclination, as in the Jung microtome. The firmness of the carrier's movement is increased by strong springs which work against the under surface of the longitudinal bar *c* fitted to the central plate. The knife-carrier is provided with an arrangement for altering the position of the knife. Its upper part, a plate *d*, does not rest

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 453–9 (2 figs.).

directly upon the body *e* but is separated from it by a small ball, around which it can be moved to the desired inclination, by means of three screws *f*. In order to lessen the friction of the carrier on the slide-ways, its under surface is fitted with four ivory points *g*, inserted as near the corners as possible, and in order to balance the resistance produced by the pressure of the springs, both ends are fitted with two small rollers *h*.

The uncertain results produced by machines worked by hand, and in which the slide-ways must be lubricated, are avoided by means of the following arrangement: a catgut band *i* runs from one end of the carrier over four rollers $k_1\, k_2\, k_3\, (k_4)$ to the other. k_2 is fitted with a winch handle *l*, by which it is easily turned. The catgut band is

Fig. 182.



not fastened directly to the carrier but to a wire, passing through the lower part thereof and fastened to it by a screw *y*.

The object-carrier is very similar to that first used by Jung. A short metal tube *z* is fastened by means of a binding-screw to the inner of the two frames. The inner frame turns about a transverse axis which has its bearing in the outer frame, and this latter turns round a longitudinal axis and the bearings are in the carrier. The ordinary complicated manœuvres for putting the object into a proper position, are in this machine effected by the turning of an endless screw. In each frame is a circular disc, or rather a section of one, *o o'* fig. 182, along the edge of which a female screw-thread runs. Against this worm works a short screw *p p'* which is braced up by a

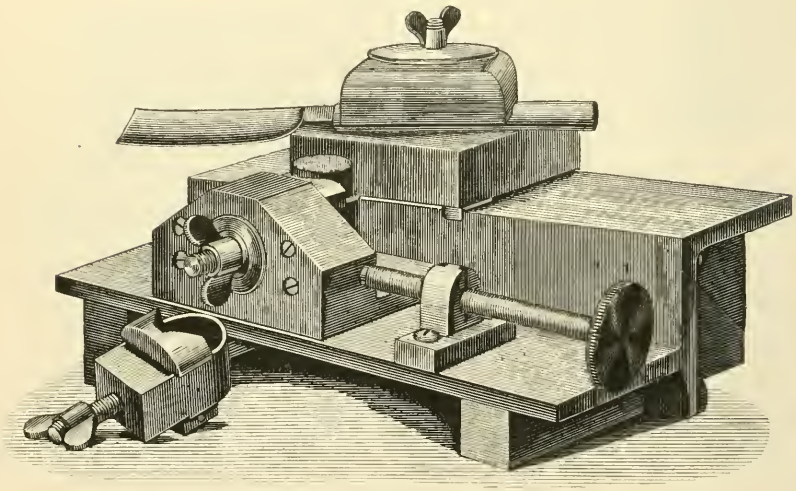
spring q q'. By working either of these screws, the corresponding frame turns on its axis.

A micrometer-screw r measuring 10 cm. serves to drive up the object-carrier. Its head t projects some way from the microtome, and may have any diameter. Communication between the front end of the screw and the carrier is obtained by means of a steel cylinder which passes through the opening u in the carrier, and which by means of a binding-screw v can be fixed at any point. The rotation of the screw is rendered audible by a catch x working on the barrel w. The latter has five divisions marking 1/2, 1/3, 1/5, 1/10, and 1/50 of a turn, which for corresponding sections gives a thickness of 1/40, 1/60, 1/100, 1/200, and 1/1000 mm.

Hildebrand's simple and effective Microtome.*—Dr. H. E. Hildebrand has devised a microtome of great simplicity and of small cost, and which he says equals in effectiveness any hitherto produced.

The body of the instrument (fig. 183) is of cast iron, 30 cm. long and 18 cm. broad. The upper aspect shows three surfaces,

Fig. 183.



which serve as slide-ways for the knife and object-carriers. The former moves along the upper or horizontal surface; the latter along the lower one which is sloped. The vertical surface is common to both, and prevents any lateral yielding. All three surfaces are planed perfectly smooth. On the lower part of the inclined plane is a female screw for the reception of a micrometer-screw with a large milled head. When the screw is turned, it pushes the object-carrier

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 343–5 (1 fig.).

forwards up the inclined plane. Each carrier runs on three ivory knobs. The knife-carrier is kept straight on the slide-way by means of two lateral flanges which work against the vertical plate. The object-carrier is fitted with two knobs which bear against this surface. The motion is very smooth and safe. Both carriers can be removed and replaced without losing their position. The knife-carrier consists of a flat support for the knife and of a clamp; it revolves round a central screw, and is provided with a groove below for the reception of the cylindrical knife-handle. In this way the knife can be adjusted both for its surface and longitudinal axis. The object-carrier consists of a simple block of wood provided with the above-mentioned projections, three below and two at the side. In the middle it has a 25 mm. opening for a binding-screw.

It is often desirable to place an object in a particular position, and this is provided for by a very simple screw clamp with universal movement. This is represented in the foreground of fig. 183. Although this apparatus is made in one piece (except the vice), it can be more easily described as if it consisted of several parts. A screw bolt with a head 25 mm. square is fitted with a metal loop, the ends of which are fastened to two sides of the square bolt for the reception of a movable block or vice, flat on the side turned towards the bolthead, and fluted towards the concavity of the loop. This clamp or vice is twice as long as it is broad. The arrangement of the object-carrier is as follows:—Upon the broad base (9 × 9 cm.) of this carrier, a block of such thickness is fastened vertically, that about three-fifths of the space towards the vertical surface remains free. This upright block is perforated for the reception of the above-mentioned bolt with its loop. Two-thirds of this perforation is of the same width as the diagonal measurement of the bolthead, so that this therefore can revolve within the round opening. The next, however, is wide enough to let the bolt itself pass through. If the cylindrical object-holder be placed between the vice and the loop, and the screw of the bolt turned, it will be firmly held, because the screw draws the loop but not the vice towards it. As the axes of the object-holder and of the screw clamp stand vertically towards each other, the object may be inclined in any direction. When used, the object-carrier is held with the thumb and index finger of the left hand, and pressure made backwards towards the micrometer-screw, and onwards towards the vertical plate.

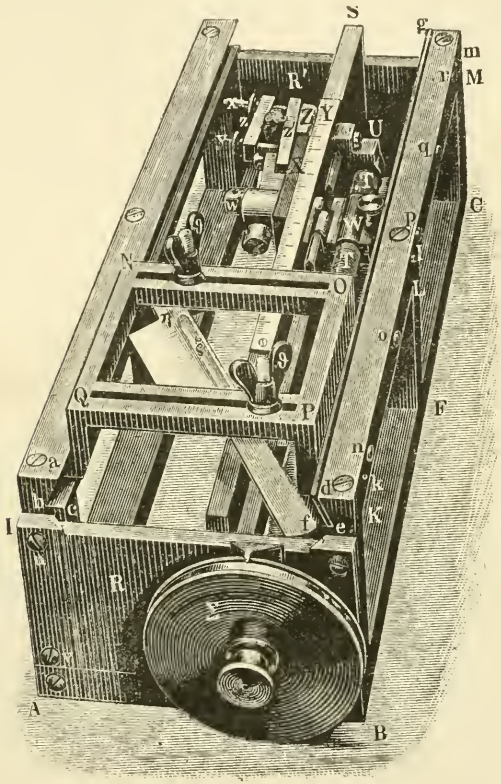
The author states, that with three microtomes which he has had made to this pattern, he has found that one complete turn of the micrometer-screw raises the object 1/500 in. (0·0508 mm.).

Vinassa's Microtome for Pharmacologists.*—The body of this instrument (figs. 184 and 185), invented by Dr. E. Vinassa, is formed by a heavy frame (1½ cm. square) A B C D, 45 cm. long and 18 cm. broad. The two longitudinal bars are joined in the middle and at the ends by three cross-bars A B, E F, D C, while at the corners and in the middle of the long sides are six supports, 12 cm. high, G D, H E,

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 309-20 (4 figs.).

I A, M C, L F, K B. All these parts are cast in one piece. To the supporting pillars two rails are screwed in on the long side, G I and M K, and which seen in transverse section show acute angled grooves *a b c*, in which the knife-carrier fits. One of these grooves *d e f*, *g h i* is planed out 5 to 7 mm. more to render it able to receive the carrier.

Fig. 184.

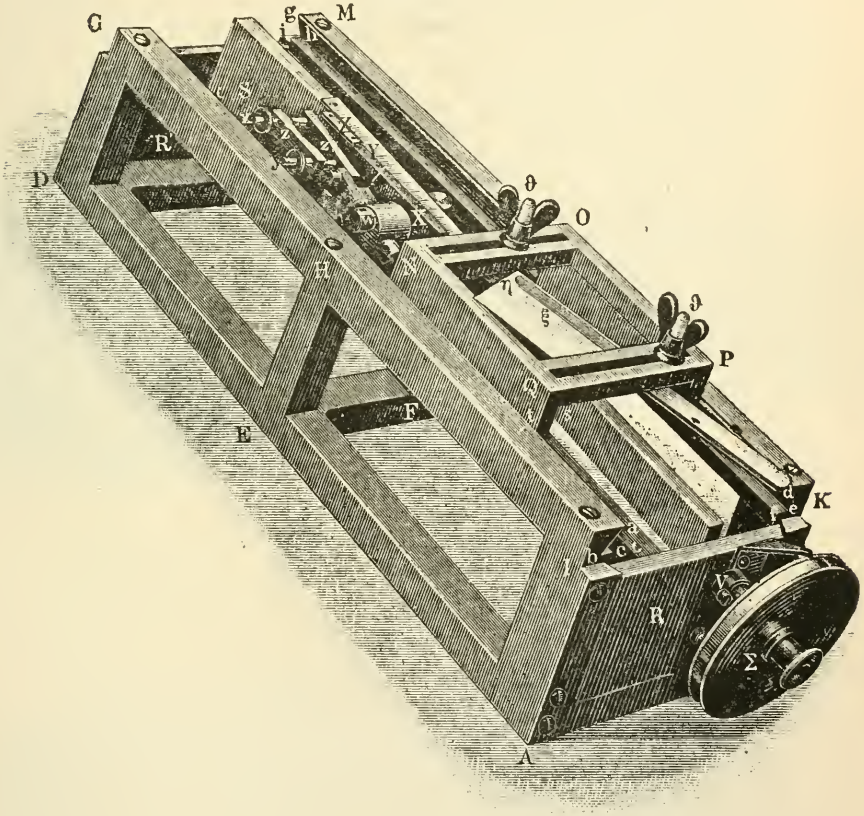


The interspace is filled up with a steel plate *e d g h i*, which, though movable on three pivots *k l m*, is fastened to the groove, and by five screws *n o p q r* on the outside can be fixed more or less tightly to the slide, whereby any irregular movement due to wear is prevented.

The sliding knife-carrier N O P Q is a frame 12 cm. long and 14 cm. broad; in both cross pieces (Q P and N O) is a slit for the binding-screws which clamp the knife to the under side of the carrier; by this arrangement the angle of the knife to the object can be altered at pleasure. To introduce the knife it is necessary that the under side of the carrier, the surface $s\,\alpha\,\beta\,\gamma$, should be 1·3 cm.

higher than the upper part of the slide-ways G T, M K. The lower part of the carrier which runs in the groove (*a b c* and *d e f*) is dove-tailed to fit. The knife is fixed by two thumb-screws, which go through the slits in the cross-bars of the slide, and on its lower end is a clamping plate ϵ with a knob at one end δ. The object of this projection is to prevent the plate from getting broken by over-screwing up the knife. This consists of a strong handle 7 mm.

Fig. 185.

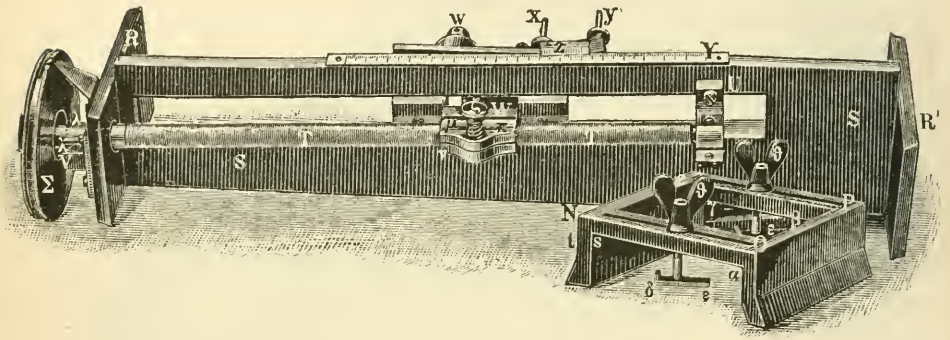


thick, of a broad blade ground like a scalpel, and which for the reception of fluid has a groove ξ near the back. On the upper part of the blade is a kind of second handle η, which, like the first, serves to fasten the knife by means of the clamp, and though of the same thickness, is only 3 cm. long. After raising the two thumb-screws θ, the knife can be easily removed from the carrier and sharpened like an ordinary razor.

At the short ends of the instrument are fitted two plates R and R′, which are connected by a middle vertical plate S, 1 cm. thick, which serves to carry the object-holder. On one side is a wedge-shaped cleft *t*, ascending 5 per cent.; on this the object-carrier or slide X is supported. The object-carrier *x y z z′* somewhat resembles that of Gottschau, but is modified in detail. As a coarse adjustment is of great advantage, Gottschau's clamp arrangement is so modified that the screws themselves act as axes. The screw ω, which allows the pincers to move vertically in a plane parallel to the middle wall, fits into a dovetailed tenon moving upwards and downwards $2\frac{1}{2}$ cm. in a groove in the carrier; turning the screw raises the pincers vertically.

The long microtome-screw T for raising the slide lies parallel to and outside the middle vertical wall. Its supporting points are at U

Fig. 186.



and V. It traverses a middle piece, which is united to the carrier, and is worked by means of two dovetailed parts which through the screw can be pushed up the inclined plane in a slit (ascending 5 per cent.) in the middle piece. Backlash is avoided by a special arrangement of two tightening screws λ λ at V. The screw is turned by a milled head Σ with ten divisions. One turn pushes up the slide 1 mm., raising the object 0·05 mm. A small spring catch clicks for every thickness of 0·005 mm. The middle piece W through which the long micrometer-screw passes, opens by means of a horizontal joint $\mu\ \nu$, and is kept fastened by the screw ζ. Any inequality in the motion of the long lever screw is prevented by means of a spring π, which presses the jointed divisions $\mu\ \nu$ together. A thick screw (14 mm. diameter) is chosen, because it is easier to work and less liable to bend. On the middle wall S a millimetre scale 20 cm. long is screwed on at Y with a vernier Z. Measurements as fine as 0·005 mm. are made by means of a vernier fixed to the carrier.

Weigert's Immersion Microtome for large Sections.*—Prof. C. Weigert has adapted the Gudden microtome for cutting sections

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 326-33 (2 figs.).

FIG. 187.

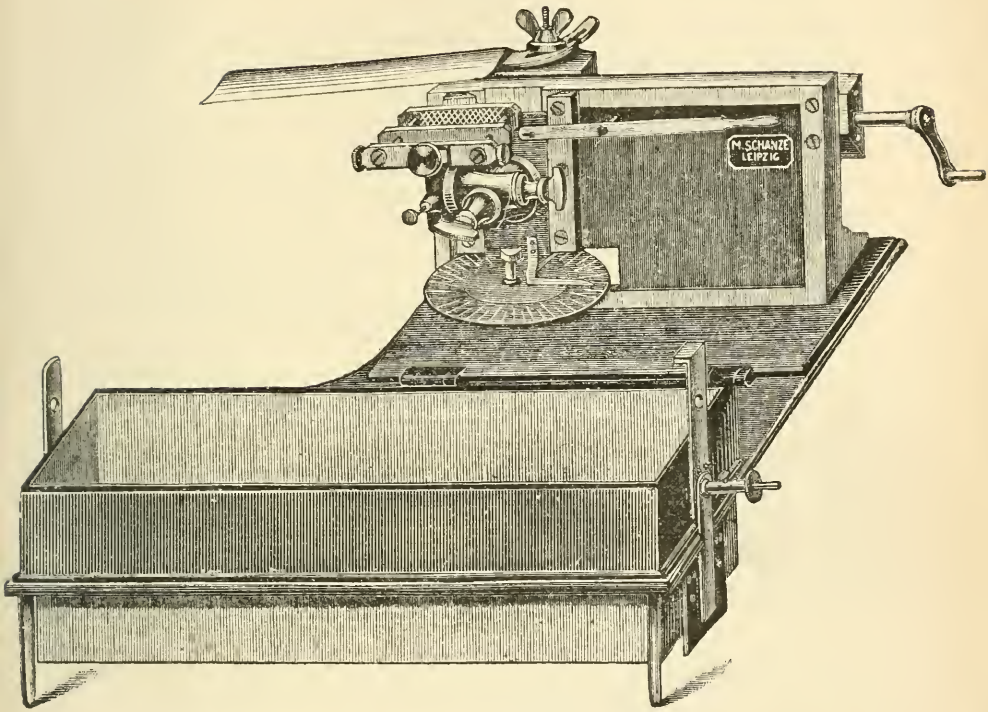
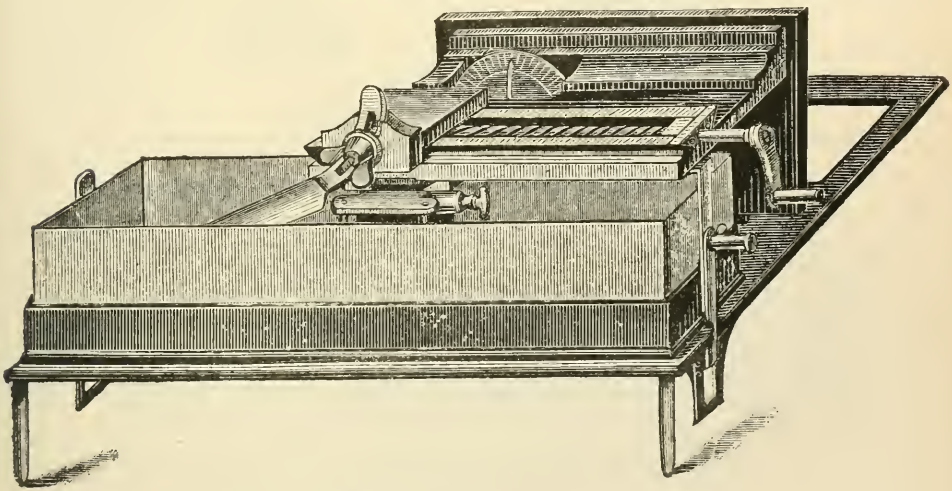


FIG. 188.



WEIGERT'S IMMERSION MICROTOME FOR LARGE SECTIONS.

under alcohol on a principle analogous to that which Prof. Malassez introduced in his modification of the Roy Microtome. That is, the instrument when used for immersion cutting is merely turned over on its side, so that it is at right angles to the position it occupied when used for dry cutting. Figs. 187 and 188, representing the instrument in both the positions in which it is used, are sufficient to explain the way in which the instrument works.

The microtome is chiefly intended for large sections, and is apparently able to produce thinner ones than can be obtained by the Katsch machine, the prototype of immersion microtomes.

Microtome Knives.*—Dr. A. Brass points out that the *sine quâ non* for producing good sections is the knife, for with an indifferent machine and a good and well-sharpened knife, better results will be obtained than with an indifferent knife and a highly complicated instrument such as the Thoma-Jung microtome.

For ordinary purposes the author uses a short knife made of very hard steel. It is quite straight, 14 cm. long (8 cm. blade, 6 cm. handle). The blade is 20 mm. broad and the back 5 mm. thick. The under surface, continued into the handle, is flat and the upper surface hollow-ground. When used it is worked at an angle of about 10° to the surface to be cut. The knife is sharpened by means of a special apparatus, the section of which is represented in fig. 189. The wooden block *h*, made of ash, is prismatic in shape, with a central slit for the reception of the blade *m*, and is so constructed that the cutting edge shall move against the hone *s*, at the same angle

Fig. 189.

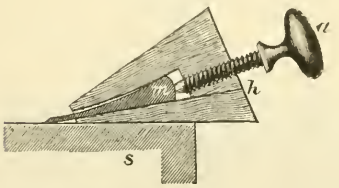
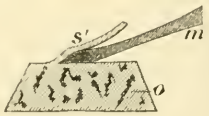


Fig. 190.



as when used for cutting. The blade is fixed in the slit by two screws *a*, 5 cm. apart. By this contrivance the edge is rendered wedge-shaped, and it is this characteristic which, the author thinks, gives it its value.

From fig. 190, giving a view of the knife *m* in operation, may be gathered the relation of the knife to the object *o* and the section *s'*, and also the exact shape of the knife. After sharpening on the hone, the finishing touches are imparted to the edge on the regulator strop, so condemned by Gottschau.

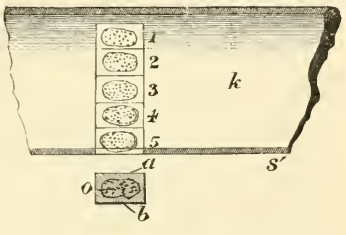
Preparing Adhering Series of Sections.†—For saving time in the preparation of series of sections Dr. A. Brass advises the method

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 305-7 (2 figs.).
† Ibid., pp. 307-8 (1 fig.).

known as riband cutting, in which the sections, while still on the knife, are made to adhere together by their adjacent edges, so that a chain of sections in perfect continuity is produced.

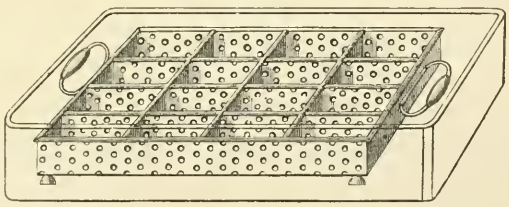
In order to effect this the objects must not be too large ; not more than 3 or 4 mm. long or broad; they must be imbedded in paraffin and the form of the imbedding mass must be rectangular, as shown in *o*, fig. 191. The knife *k* should be placed at right angles to the long axis of the microtome, the same part of the edge *s'* being used throughout; the paraffin mass must be so cut that the two surfaces *a* and *b* lie parallel to the edge of the knife. The more accurately this is carried out the better the sections adhere. A rapid to and fro motion of the knife is recommended as being likely to produce better sections and also cause the edges to adhere better. When a sufficient number of sections have been thus obtained the chain may be laid upon smooth white paper strips and then cut up into any desired length. Schanze's microtomes are said to be more suitable for riband cutting than Jung's, because the preparation always remains in the same position, is raised by a screw, and the knife can be placed over the same surface. With dexterity it is not difficult to make two sections a second.

Fig. 191.



Apparatus for facilitating the preparation of Serial Sections.*— In order to facilitate the manipulation of series of sections, especially of the nervous system, Dr. M. v. Lenhossék has constructed a tray of perforated zinc, fig. 192, and subdivided into a number of compart-

Fig. 192.



ments. Though the number and dimensions of these compartments may be varied, the author's apparatus has sixteen compartments, the diameters of which are 4 cm., and the depth about 1·5 cm. It is also provided with two handles and four knob feet. If required for watery solutions, the zinc may be japanned; if for alcoholic, it is advisable to leave the metal in its natural condition.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 53-5 (1 fig.).

The method of using the apparatus is obvious from the illustration, which shows the tray standing within a glass dish. Water or fluids for staining, &c., are simply poured in until the tray is almost covered, and when any one step is finished, it is merely necessary to lift out the tray, the fluid draining away, while the sections remain within the compartments. Of course, it is not advisable to proceed to the stages of absolute alcohol, oil of cloves, &c., by this method. The tray, when in use, should be covered with a glass plate.

Method for retaining Series of Sections in position.*—Herr H. Gifford records a device which he calls the "book method" for keeping series of sections attached *in situ*. This merely consists in not quite cutting through the celloidin imbedding block, leaving a margin of 6 to 7 mm., so that a number of sections resemble a book, and may be turned over like the leaves. It will be found advantageous to make "books" of ten to twenty leaves. These "parts" or "numbers" may afterwards be bound together properly ticketed, and kept in spirit until required for use. A book or a part may be stained by merely suspending it by its back in the staining fluid. Should the imbedding or the knife be faulty, it sometimes happens that a section or leaf is cut out, i. e. without being attached to the back. In this event, a note should be made of the position of the section on the end of a strip of paper and the section fished out on it.

The great advantage of this method is its rapidity, and it does not require any additional apparatus. It need scarcely be observed that the microtome used should be an "immersion" one.

Heidenhain's Staining Method.†—Prof. R. Heidenhain finds that the following slight modification of his well-known staining method yields the most beautiful results.

Tissues hardened in alcohol, or better in a saturated solution of picric acid first and then in alcohol, are left for 12–24 hours in an aqueous solution of hæmatoxylin (1/3 per cent.), and then placed for 12–24 hours in 1/2 per cent. solution of *simple yellow chromate of potassium* (instead of the red double chromate). The usual dehydration with alcohol, penetration with xylol, and imbedding in paraffin, follow.

"Simplification of Staining."‡—Dr. W. Kükenthal's results with staining solutions in turpentine oil are as follows:—

Ammotrypane binacina Rathke (killed in alcohol) were stained with Grenacher's borax carmine (then absolute alcohol, toluol, paraffin, collodion, oil of cloves, and removal of paraffin with turpentine), and were finally placed in a vessel containing turpentine, to which some methyl-green and some drops of a solution of picric acid in absolute alcohol have been added. Result, nuclei red; plasma-

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 45–7.

† Arch. f. Mikr. Anat., xxvii. (1886) pp. 383–4.

‡ SB. Jenaisch. Gesell. f. Med. u. Naturwiss., 1885. Zool. Anzeig., ix. (1886) pp. 23–5. Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 80–1.

substance green; nervous tissue clearly differentiated. Eosin, gentian-violet, methyl-blue, safranin, fuchsin, tropæolin, malachite-green, and Bismarck brown may be used instead of methyl-green.

If the sections treated with turpentine stains are put in a mixture of pure turpentine oil and absolute alcohol, the colour slowly fades from the plasma. The author used Mayer's carmine solution, the formula for which he communicates as follows:—100 cc. of absolute alcohol are boiled with four grm. carmine and twenty-five drops of hydrochloric acid added. This solution is placed drop by drop in a mixture of turpentine oil and absolute alcohol, and the turpentine oil to be used is mixed with it. Staining is almost instantaneous. Double staining is possible. Hæmatoxylin powder dissolved in absolute alcohol and introduced in turpentine oil gives a nuclear stain. The bright brown nuclei assume a violet colour in ammonia vapour. The absolute alcohol must be pure and free from acid. The turpentine colours are to be kept in glass bottles.

Isolating the Primitive Muscular Bundles and Staining Nerve-endings.*—Dr. G. Sandmann gives a new procedure for isolating the primitive muscular bundles and for staining nerve-endings.

For isolation the author employs a solution of sulphuric acid and distilled water. The muscles are put with the acid in a test-tube, either in toto, or if their size require it, are dissociated in pieces parallel to the fibrillation. Here they remain from one to eight days according to their thickness or richness in connective tissue. The muscles are then washed, and boiled several times in distilled water. Before each boiling it is necessary to allow the water to cool or to replace the hot with cold water, since the glue formed from the connective tissue through the heat and acid loses its coagulability and becomes easily soluble in water. Muscles thus treated are easily dissociated throughout their whole length into their primitive fibrillæ.

In staining, for which purpose Dr. Sandmann uses gold chloride, he departs from the usually accepted view that only fresh muscle-fibre gives good gold preparations, and exposes muscle-fibres treated with sulphuric acid to the influence of the gold chloride. He lays the separated muscle-fibres in a dilute gold solution (one to three drops of a 1 per cent. gold chloride solution to 10 cc. water) until they take on a yellow colour. After having been washed several times in water acidulated with acetic acid, the muscle-fibres are boiled for a few minutes in order to cause the reduction of the gold. The muscle-substance becomes of a red to a deep-blue colour, the nerves are darker, even black.

As in all gold staining, this method has the defect of inconstancy of stain, but from its easy practicability, it permits, without trouble and waste of time, the preparation of a large number of specimens, among which some few will always be found well stained. The method gave very favourable results in the examination of mammalian muscular fibres, which are only dissociated with difficulty, and also in the study of degenerative changes of nerve-end apparatus.

* Arch. f. Anat. u. Physiol.—Physiol. Abth., 1885, p. 240.

Staining black the processes from Ganglion-cells.*—Dr. C. Golgi's method is said to give very excellent results.

Pieces of cerebellum or medulla from 1 to 1½ cm. in size are hardened in a 2 per cent. bichromate of potash solution. The strength of this may afterwards be increased to 3 per cent. Six or eight days suffice (but it is better to wait twenty to thirty days) to obtain the necessary hardness, the bichromate solution being frequently changed. The pieces are then placed in 0·5 or 0·25 to 1 per cent. solution of perchloride of mercury, wherein they may remain for at least two months.

The author further describes successive staining with potassium bichromate or ammonium bichromate and 0·75 per cent. silver nitrate solution, or with a mixture of 8 parts 2–2·5 per cent. bichromate, and 2 parts 1 per cent. hyperosmic acid.

Bizzozero's Picrocarmine.†—Dr. G. Martinotti desires to correct the words in the original notice ‡ (heated in a water-bath) "until one no longer perceives even the slightest ammoniacal odour," for "until a slight but evident ammoniacal odour is perceived."

Methyl-blue.§—Dr. P. Ehrlich, in order to determine the receptivity of animal tissue for oxygen, injected into the veins of rabbits large quantities of a dilute solution of methyl-blue, and found that as with alizarin, the majority of the organs showed more or less strong primary staining, while in some, such as the liver and lungs, the pigment became changed by oxidation to white. Methyl-blue takes a place about half-way between; alizarin and indophenol being more easily reducible than the latter, and with rather more difficulty than the former. Post-mortem reduction takes place extraordinarily quickly, perhaps as rapidly as with indophenol, and it is therefore advisable to inspect the organs as soon as possible, even while the animal is alive.

Anilin-blue-black.‖—Dr. G. Jelgersma in defending anilin-blue-black from the attacks recently made upon it, recommends the English-made dye, from which he has always obtained most satisfactory results.

1. The preparations are permanent; specimens exposed to full daylight for over a year have not deteriorated.

2. Anilin-blue-black is specially adapted for nervous tissue, axis-cylinders, ganglion-cells and their processes. In preparations of the cortex cerebri et cerebelli, Purkinje's cells, with their processes, are seen branching as far as the periphery. Pathological changes in the ganglion-cells are most easily observed in this stain. The axis-cylinders become dark-blue and easiest recognized in vertical section, although in oblique and parallel directions they are very clear.

* Cf. Virchow and Hirsch's Jahresber. Anat. u. Physiol. for 1885 (1886) p. 38.

† Zeitschr. f. Wiss. Mikr., iii. (1886) p. 57.

‡ Ibid., ii. (1885) p. 539. See this Journal, *ante*, p. 350, where the words are, "until every trace of ammonia has disappeared."

§ Centralbl. f. d. Med. Wiss., 1885. pp. 113–7.

‖ Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 39–40.

Ganglion-cells become bright blue; the nuclei and nucleoli dark blue, the processes as well as the cell-body being stained.

3. Anilin-blue-black is of no value for connective tissue and the neuroglia; for these the author uses alum-cochineal, hæmatoxylin, or the Böttcher-Hermann anilin dye method.

4. The staining solutions are very simple. The author uses three watery solutions, 1 in 100, 1 in 800, and 1 in 2000, which stain in four, five, and twelve hours respectively. Then alcohol, oil, and balsam.

5. Anilin-blue-black tires the eyes much less than carmine, an advantage not to be undervalued when a large number of serial sections are to be compared.

Anilin-green.—Dr. P. Schiefferdecker's first communication * on this subject was to the effect that solutions of anilin-green undergo a certain change of composition from exposure to light, in virtue of which alteration they acquire a peculiar susceptibility for staining gland-tissue. This peculiar change cannot be effected in any other way than by age and exposure to light; the addition of alkalies or acids, the aid of gentle heat and various degrees of concentration, make no difference in the capacity of a fresh solution.

Since the first communication, the author has made experiments,† in order to obtain a record of the time the blackish-green reaction takes to develope. In twelve months a solution of anilin-green gave results which were about half-way between those of the seven-year old solution, and of the solution freshly made. Iodine-green, malachite-green, emerald-green, and several methyl-greens, were used in the course of the author's investigations on the salivary glands. But one methyl-green, prepared by the Stuttgart Anilin-Soda-Fabrik, and designated O O, produced in fresh solution results very similar to those from the old solutions. The author thinks the blackish-green reaction of anilin-green to be quite specific and of great value.

Anilin-greens may be mixed with eosin, so as to stain a preparation red and green simultaneously. The double stain is made by allowing some alcoholic eosin solution to dry up in a watchglass and then to add the anilin-green solution. By this method so much eosin is taken up as is necessary to combine with the anilin-green for the production of a double stain. Methyl-green O O gives similar good results.

Modification of the Formula for Alum-Carmine.‡—Dr. Pisenti recommends the following modification of the formula for the alum carmine first introduced by Grenacher. In 100 c.cm. of a hot saturated watery solution of alum (100 parts boiling water dissolve 133 parts crystallized alum) 1·5 to 2 grm. carmine are allowed to boil for a few minutes; 2 grm. of sulphate of soda are then added. This dissolves the small residue of carmine which the alum solution has left undissolved. It is then boiled again for five minutes and filtered while hot. The fluid is then allowed to cool, and as a considerable

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 51-3. † Ibid., iii. (1886) pp. 41-3.
‡ Gazzetta degli Ospitali, 1885, No. 24. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) p. 376.

quantity of alum crystals fall down, it is advisable to decant the solution and preserve in another bottle.

According to the author, this carmine stains microscopical sections in a few minutes, and the nuclei stand out quite conspicuously against the prettily stained protoplasm. It may also be used for staining *en masse* preparations for paraffin imbedding. Staining *en bloc* usually takes from 12 to 24 hours, although the size of the preparation and its histological construction modify these limits considerably. This carmine is said to possess the advantage of keeping for a long time without growing mouldy.

Weigert's Hæmatoxylin Stain.*—Dr. M. Flesch, with the co-operation of Dr. Berliner Blau, has succeeded in reducing the expense of the Weigert process by regenerating the once used staining solution. This is effected by adding 5 to 10 cm. baryta water to about 200 c.cm. of the used solution. The mixture having been shaken up several times is allowed to stand for 24 hours. Carbonic acid gas, made with hydrochloric acid and marble, is then passed through and after 24 hours is filtered. Stainings obtained from this filtered solution cannot be distinguished from those obtained with the original. An attempt was made to recover the pure dye, but this quite failed.

With regard to the copper modification,† the author now lays the separate sections on cellulose paper, whereon they are placed in the copper solution; from this they are transferred to a 70 per cent. spirit, and thence to the stain.

Dr. Flesch gives the preference to the copper acetate solution over his own chromic acid modification ‡ for fine nerve-fibres, but for nerve-cells, especially in peripheral ganglia, he has entirely given up the copper for chromic acid solution. The medulla of central and peripheral nerves is also much better demonstrated by the latter solution. Where deep staining is required he advises the use of the incubator, and instead of ordinary watchglasses, nests of glasses will be found more handy. For clearing up, he continues to find kreasote to possess advantages over other clarifiers.

Staining in toto the Central Nervous System with Weigert's Hæmatoxylin.§—Dr. C. E. Beever first hardens the preparation in methylated spirit, and then for one to four weeks in 3 per cent. potassium bichromate. He then changes to methylated spirit again, for one or two days, and next treats with hæmatoxylin for four days, raising the temperature every day for three or four hours to 40°–50° C. The hæmatoxylin solution was twice as strong as that used by Weigert (200 parts absolute alcohol, 2 parts hæmatoxylin, and 130 parts water). The pieces, having been washed, were transferred to a solution of potassium ferridcyanide, 2·5 parts; borax, 2 parts; water, 100 parts. The solution was changed until the browning disappeared, the pieces then were treated with water, methylated spirit, absolute alcohol, clove oil, and turpentine oil, imbedded in paraffin, freed from paraffin with xylol, and mounted in Canada balsam.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 50–1.
† See this Journal, *ante*, p. 710. ‡ Ibid., p. 709. § Brain, 1885, pp. 227–42.

New Method of Double-staining.*—Dr. A. Garbini uses two different solutions:—(1) Watery solution of anilin blue, 1 grm.; aq. dest., 100 c.cm.; abs. alcohol, 1–2 c.cm. (2) Safranin, 0·5 grm.; dist. water, 100 c.cm.; abs. alcohol, 50 c.cm. The sections, either free or fixed by Mayer's method to the slide, are immersed from one to four minutes in the first solution, then washed in water, and then laid in a 1 per cent. solution of ammonia until almost all the colour has disappeared. The sections are next placed for five to ten minutes in a 0·5 per cent. solution of hydrochloric acid, are then again washed in a large quantity of water, and are finally placed for four or five minutes in the second solution, from which they are transferred directly to absolute alcohol. Here the sections lose their violet colour to assume a sapphire blue hue. They are then passed through oil of cloves, xylol, and mounted in xylol balsam.

According to the author this method offers the following advantages:—It may be used for any animal or vegetable tissue, imparting to the individual elements their characteristic staining, and even to the different cells of an organ (delomorphous and adelomorphous cells, salivary and mucous cells), the protoplasm staining in various colours.

Merkel's Double Stain with Indigo and Carmine.†—For this safe and excellent stain Dr. M. Flesch uses material hardened in chromic acid or Müller's fluid, followed by immersion in alcohol. The alcohol treatment is proceeded with without previous washing in the dark; much time is thereby saved, and the preparation in no way loses any staining susceptibility. This procedure is especially recommended for nervous tissue, as the brown coloration, which is regarded by Weigert as indispensable for the success of his stain, never fails. The alcohol can be filtered and used over again, so that the cost is not very great. The author has usually experimented on objects imbedded in celloidin, but paraffin preparations previously saturated with turpentine or chloroform take on the stain. Unfortunately the celloidin is stained along with the preparation; the colour, however, with great care and prolonged washing gradually becomes so pale, that this disadvantage need scarcely be considered.

The dye is a mixture of the solutions of carmine (carmine 2, borax 8, H^2O 130) and indigo carmine (indigo-carmine and borax each 8, water 130) in equal parts. This mixture can be kept for a week: if kept longer, a precipitate forms, and the carmine acquires the disadvantage of staining too deeply.

The staining requires a much longer time than Bayerl stated. Textures should be left at least twenty-four hours in the solution at ordinary temperatures; one to two hours in an incubator. The author much prefers the former. After staining, the superfluous pigment is extracted by immersion for half an hour in a saturated solution of oxalic acid. It is always possible to render the water more blue or more red, according as the staining or extraction time are varied.

* Zool. Anzeig, ix. (1886) pp. 26–9.
† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 349-52.

Preparations may be mounted in glycerin or in balsam, and are very permanent. The author has exposed objects frequently to the light in the course of the year, and has not noticed any loss of colour.

This method is especially suitable for nervous tissue and for ossifying cartilage, and may also be recommended for the examination of glands and glandular organs.

Watney's Double Stain with Hæmatoxylin.*—Dr. W. Krause recently reproduced † a procedure introduced by Watney ‡ for double staining by the exclusive use of hæmatoxylin. This is effected by successive staining with a strong red and a weak blue solution. The difference between the two solutions really depends on the quantity and acidity of the alum. An intense blue is obtained by the use of freshly prepared dry alum; the red colour appears when acid has gradually become free in the alum, but best when the quantity of the alum solution is less than three times the quantity of the wood-extract. Connective tissue, the protoplasm of the connective-tissue corpuscles, and the walls of vessels are stained red. Mucus, almost all nuclei, and lymph corpuscles, are stained blue.

A communication from Prof. Langhans to Dr. M. Flesch shows that this double stain takes place more simply if Delafield's hæmatoxylin be used in the ordinary way, and the preparations when mounted in Canada balsam are exposed to the light for a long time. Preparations mounted in glycerin are said to undergo this change.

Silvering Diatoms.§—In an article on "Photography in Belgium," an account is given of Dr. H. van Heurck's method of photographing *Amphipleura pellucida* and other diatoms, with a description of the apparatus ‖ and processes employed. The method of silvering the diatoms, for the purpose of making their details more perceptible, is also described.

The cleansed valves scattered over a disc of cover-glass are silvered, glass and all, with a silvering solution consisting of nitrate of silver 10 parts dissolved in 6·2 parts of strong liquid ammonia; after solution, 50 parts of distilled water are added, and the liquid is filtered; after filtration 800 parts of distilled water are added; this forms solution A. Solution B consists of 2·25 parts of tartaric acid previously exposed for a long time to sunlight; the acid is then dissolved in 8·5 parts of water. These solutions are mixed, drop by drop, with violent shaking, and after sufficient of B has been added to A to tend to produce a permanent precipitate, the silvering solution is made. The pieces of glass and diatoms to be silvered are placed upon the flat cover of a vessel containing boiling water, which water is kept at that temperature during the silvering operation,

* Zeitschr. f. Wiss. Mikr., ii. (1885) p. 353.

† Internat. Zeitschr. Anat. u. Histol., i. (1884) p. 154. *Infra*, p. 906.

‡ Phil. Trans., iii. (1882) p. 1075.

§ Engl. Mech., xlii. (1886) pp. 548–9, from Brit. Journ. of Photography.

‖ Swan incandescent electric lamp; Wenham's radial arm Microscope, and Nachet's large inverted Microscope with silvered mirror (principally); Zeiss's objectives; Powell's oil condenser.

which lasts for thirty minutes; some fresh silvering solution is then applied and allowed to act at the same temperature for another thirty minutes; by this means a somewhat thick coating is given.

Smith's new High-refractive Media.*—Prof. H. L. Smith writes as follows :—

"The results of experiments made subsequently to the discovery of the boro-glyceride and antimony bromide medium, described in a preceding paper,† are of importance, and demand a brief notice. The antimony compound works very pleasantly, and still appears to be the best when high refractive power is required; but unless all excess is completely removed from outside the cover, it stains the protecting ring. The litharge and gold size ring and the zinc white ring are merely darkened; but the black asphalte ring is softened. Thoroughly cleaning off the excess around the cover remedies this difficulty.

The chief improvement I would make in the formula given, I now think, is the substituting of stannous chloride for antimony bromide, and of arsenious acid for boracic acid.

I find that a compound of stannous chloride, arsenious acid, and glycerin is so very slightly deliquescent, that the mounts may be left for weeks without cleaning off the excess, and that very little if any softening of the material ensues. The mounts are easily cleaned, as the cover is very firmly attached.

The medium is not so liable to turn when heat is applied, as when boro-glyceride or gelatin and glycerin are used; the latter, indeed, for that reason, is quite objectionable. The refractive power of the mixture is not quite so high as when antimony bromide is employed; but the refractive power is quite high enough for anything except the most hyaline tests; and as a little excess of material outside the cover does not discolour the ring, and does not seem to alter by quite long standing without a ring, I now prefer this compound.

This medium is prepared as follows:—Weigh out 6 parts of stannous chloride, and 2 to 2½ parts of pure arsenious acid. Melt the stannous chloride in a test-tube, and boil it for a little while; add while hot an amount of glycerin equal to the bulk of the melted stannous chloride, not more; heat and shake until it forms a perfectly clear solution. Add now, little by little, the arsenious acid, constantly shaking and heating until all is dissolved. This mixture when cold should be very viscid.

In making a preparation with this medium, at first, on heating, a great number of small bubbles may appear under the cover. A little more heating enlarges these to steam-bubbles; then, by allowing the slide to cool a little, the cover will settle down, and most of the bubbles will disappear; but if any are still present, another application of the heat of a small flame under the slide at the edge of the cover, where the bubbles are most abundant, will remove them.

* Journ. New York Micr. Soc., ii. (1886) pp. 75-7.

† See this Journal, *ante*, p. 356.

Towards the completion of the preparation, the slide may be inverted, if necessary, and the small flame allowed to play directly on the edge of the cover; thus, careful treatment will dispose of all bubbles. When cold, the excess is easily removed with a moistened roll of tissue paper; and finally, after the cleansing, the slide should be warmed just sufficiently to expel any moisture that may have found its way under the cover. If, after the ring is applied, and the preparation otherwise completed, any metallic stain should show on the cover or slide, it can be removed with a roll of tissue paper moistened with hydrochloric acid.

The arsenious acid also makes an excellent compound with the antimony bromide; and the highest-refractive-power white medium that I have yet seen is made as follows:—Melt antimony bromide and add to it while hot half its bulk of glycerin; in this put arsenious acid, little by little, shaking and heating at the same time, until by its solution the bulk is increased three-fourths of one part, so that the final mixture will be: antimony bromide 2 parts, glycerin 1 part, arsenious acid 3/4 part, all in bulk. This compound is solid, or very nearly so, when cold, and will require slight warming to take out a drop on the dipping-rod. It does not soften much, if at all, on exposure, and its refractive index is well on towards 2. The mounts made with this material are very satisfactory.

Finally, I think that the yellow medium, the compound of 'realgar' and bromide of arsenic, can be made permanent and easy to use by the addition of a small excess of sulphur. The realgar is broken up and dissolved by the aid of heat, in the bromide of arsenic. The solution is evaporated until, when cold, it becomes so viscid as to flow with difficulty; enough sulphur is now added to increase its bulk about one-sixth (I have not been able to determine the exact proportions yet), and thoroughly dissolved; it becomes now somewhat more limpid, and is used as one would use balsam. It requires a very light heat to boil, so the slide must be heated cautiously; but there is no difficulty in boiling, and this should be continued for a little while, when the cover will settle down entirely free from bubbles, and, if the user is careful not to slide it, may be gently pressed down. When cold, the deep colour will disappear and the cover will be very firmly fixed. To use this medium, the best polished slides must be obtained, as all the pits and scratches of ordinary slides show up very disagreeably. The cover also must be well cleaned. I have preparations which were made with this material more than three months ago, that show no symptoms of change.

Too much sulphur, however, will, in time, crystallize. I cannot now state what proportions can be safely used, but the amount named above, thus far appears within limits."

At the meeting of the Microscopical Section of the Royal Society of New South Wales on June 2nd,* specimens of *Amphipleura pellucida* were exhibited mounted in piperine, picric acid, chlorides of tin and thallium and sulphur in combination with disulphide of

* Cf. Nature, xxxiv. (1886) p. 355.

arsenic. "These slides were exhaustively tested against the American methods, viz. Dr. Chase's metallic silver and realgar, also Prof. Smith's specimen slide. . . . The slide of Dr. Morris's sulphur and arsenic combination gave the best results."

Wax for Cells.*—Mr. C. M. Vorce recently found that while a considerable number of cells in his collection had gone wrong, not one of the wax cells or wax-bottomed eurtain ring cells (described Amer. Mon. Micr. Journ., i. (1880) p. 208) was found loose.

Acting on the hint gathered from the durability of the wax cell mounts the damaged slides were repaired in the following manner:— The Atwood cells, and other loose cells having their covers still attached, were cleaned of the old cement and the slip cleaned anew, and placing the cell on a sheet of coloured wax, it was cut round with a penknife, and, with the disc of wax adhering, transferred to the slip and centered on the turntable, and slightly pressed to fix it in place. The slip was then placed on the warming table and gently heated till the wax slowly melted, when the excess exuded as a coloured ring around the cell. The slide was then returned to the turntable, and a ring of transparent cement spun around it over the wax. Gold size, Bell's cement, liquid marine glue, Brown's rubber cement, or Folsom's finishing cement, are all good for this purpose, and when dry the slide is complete.

In the case of loose covers, the top of the cell was cleaned of cement by means of knife and turntable, a cover was selected or cut of a size slightly smaller than the outer diameter of the cell, and placed on the cell; warm (not melted) wax was then filled into the space between cover and outer edge of cell by means of a knife-blade, and finally smoothed by the same means on the turntable. Finishing cement was then applied over the wax from inner edge of cell down to and upon the slide, and the mount was complete.

Mr. Vorce also writes, "My own experience leads me to conclude that the condemnation of wax cells and the use of wax on account of the sweating so common when it is used was premature. A wax cell with a covering layer of cement, if used when freshly made, will frequently sweat; but if well seasoned will scarcely ever sweat, according to my experience. The wax appears to soften some cements, probably because they contain some solvent of the wax, and these will sweat no matter how old, unless years be allowed for seasoning; hence, cements containing turpentine or oil should not be used for covering wax cells; but benzole being so volatile will wholly leave the wax in a few weeks, hence, as well as on account of its colour, I generally employ Brunswick black.

"The cells made as advocated in the article referred to have this advantage, that the slide may be left (and freely used) with no other cement than the primary wax filling around the edge of cover for months or years, until it is seen whether any sweating will occur. If it does occur, by placing the slide on a turntable the wax filling can be instantly turned out with a sharp-pointed knife-blade, the cover

* Amer. Mon. Micr. Journ., vii. (1886) pp. 123-4.

freed, object removed, and cell recoated, or the cover simply cleaned and replaced as before in a minute or two, and thus objects too hastily mounted may be remounted or recovered with the least loss of time, which cannot be done so well or so quickly where covers have been cemented down with any of the cements ordinarily used."

Mr. R. Hitchcock has found, however, that since he has been in Washington a great change has taken place in his slides, and that the covers are now quite generally coated with the deposit complained of. It should be remembered that in this case the mounts remained in a perfect condition certainly four or five years, and then the change took place.

The Microscope in Mineralogy.*—Prof. J. W. Judd writes as follows :—

The recognition of certain characters in the rock-forming minerals as being original and essential, and the distinction of such from other characters which are secondary and accidental, is of the highest importance to the petrographer and geologist, and not less so to the mineralogist. Rightly studied, these minerals are capable of furnishing the geologist with evidence not only concerning the mode of origin of the rocks of which they form a part, but also of the changes which they have undergone since their first formation. The study of the minerals included in the crystalline rocks is not less important than that of fossils in the sedimentary rocks. And to the mineralogist the study of the secondary characters of minerals, and of the causes which have produced them, is equally necessary. Researches of this kind, indeed, can scarcely fail in the end to reduce many so-called mineral species to the rank of accidental, though still highly interesting varieties.

But of still greater importance is the recognition of the fact that the investigation by the aid of the Microscope of the processes by which minerals have acquired their several characters, and the consequent tracing of the evolution of mineral species and varieties, is calculated to raise mineralogy from its present rank as a merely classificatory science, to infuse it with new life, to open out to it new realms of research, and to invest it with a higher importance than is at present accorded to it in the family of sciences.

Amphipleura pellucida in various mounting media. [*Supra*, p. 902.]
Nature, XXIV. (1886) p. 355 (Proceedings of R. Soc. N. S. Wales, June 2nd, 1886.)

Bachmann, E.—**Mikrochemische Reactionen auf Flechtenstoffe als Hülfsmittel zum Bestimmen von Flechten.** (Micro-chemical reactions of Lichen-substance as an aid to the determination of the Lichens.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 216–9.

[Beck, J. D.]—**New Methods and Mailing-boxes.**
["This method of double-staining vegetable sections consists in employing such means whereby it is possible after staining to dehydrate the sections in absolute alcohol without having the colour in the least removed by the alcohol. Mr. Beck 'does not feel able to give the process to the public,

* Quart. Journ. Geol. Soc., xli. (1885) p. 411.

but will sell the same to private parties, including one slide, for 75 cents.'" The box consists of a block of wood the length of a slide and any width desired. Grooves are sawn lengthwise nearly through the block for the reception of the slides. A semicircular or U-shaped groove is cut through the centre of the block transversely to the grooves above-mentioned. It leaves a clear place for the mount on the slide. The box is easily made, and its cost is nominal.]

The Microscope, VI. (1886) pp. 177-8.

Becker, A.—**Neuerung an Mikrotomen.** (Improvement in microtomes.)

[Same as *supra*, p. 884.]

German patent, No. 34,683, 20th September, 1885.

See *Zeitschr. f. Instrumentenk.*, VI. (1886) pp. 218-9 (2 figs.).

,, ,, See also Huber, K.

Benda, C.—**Ueber eine neue Färbemethode des Centralnervensystems, und Theoretisches über Hæmatoxylinfärbungen.** (On a new method of staining the central nervous system, and theoretical remarks on hæmatoxylin staining.)

[Original of *ante*, p. 728. *Post.*]

Arch. f. Anat. u. Physiol.—Physiol. Abtheil., 1886, pp. 562–4.

Benecke, F.—**Anleitung zur mikroskopischen Untersuchung der Kraftfuttermittel auf Verfälschungen und Verunreinigungen.** Für die Praxis bearbeitet. (Guide to the microscopical investigation of adulterations and impurities of oil, flour, bran, &c.). [*Post.*] vi. and 117 pp., 44 figs. (8yo, Berlin, 1886).

Braun, M.—**Zur Behandlung der Anthozoen.** (On the treatment of Anthozoa.) [*Post.*]

Zool. Anzeig., IX. (1886) pp. 458–9.

Brevoort, H. L.—**[Microscopical Examination of Cotton Fibre.]**

Journ. New York Micr. Soc., II. (1886) p. 81 (2 figs.).

Brock, J.—**Technische Notizen.** (Technical Notes.)

[Recommends the dorsal spine of the male Triton as a suitable object for demonstrating cell-division.—Double staining of the pallial wall of Pulmonata with borax-carmine and hæmatoxylin; pigment glands red, mucous glands red, epithelium, muscle, connective tissue, violet of various shades.—As a maceration medium for the isolation of nervous elements of marine molluscs; bichromate of potash in 10 per cent. solution and diluted with an equal volume of the fluid from the somatic cavity of the animal (12 hours).

Internat. Monatsschr. f. Anat. u. Histol., I. (1884) p. 349.

Buffham, T. H.—**[Preserving Marine Algæ.]**

[Wash well in sea-water and put in best glycerin, or, as in the case of *Polysiphonia* and allied species, in a saturated solution of common salt. Mount in Deane's gelatin.]

Journ. Quek. Micr. Club, II. (1886) pp. 342–3.

Castellarnau y de Lleopart, J. M. de.—**Procédés pour l'examen microscopique et la conservation des animaux à la station zoologique de Naples.** (Methods for the microscopical examination and preservation of animals at the Naples Zoological Station.) (*Continued.*)

[Transl. by Dr. J. Pelletan of the second part of the report noted Vol. V., 1885, p. 746.]

Journ. de Microgr., X. (1886) p. 69–75, 178–84, 274–9, 368–72.

Cole, A. C.—**Studies in Microscopical Science.** Vol. IV. Nos. 1 and 2 (each 4 pp.).

Sect I. Botanical Histology. No. 1. I. The Vegetable Cell. Plate I. Trans. Sec. through growing point of Fig. × 250. No. 2. II. The Cell-wall Plate II.

Sect. II. Animal Histology. No. 1. The Mammalian Testis. Plate I. Testicle of Cat. Trans. Section × 200. No. 2. Spermatozoa of Vertebrata. Plate II.

Sect. III. Pathologieal Histology. Nos. 1 and 2. Normal Kidney. Plate I. Kidney. Plate II. Congestion of Kidney.

Sect. IV. Popular Histology. Nos. 1 and 2. The Sea Fans. Plate I. Spicula of *Gorgonia flabellata* × 200. Plate II. Spicula of *Thyone papillosa* × 250.

DEBY, J.—**On the Microscopical Structure of the Diatom Valve.**
[Imbedding media, *supra* p. 883. See also *post.*]
Journ. Quek. Micr. Club, II. (1886) pp. 308–18, 339–40.

EHRLICH, P.—**Zur Biologische Verwerthung des Methylenblau.** (On the biological value of methylen blue.)
[*Post.*] *Centralbl. Med. Wiss.*, 1885, pp. 113–7.
„ „ **Beiträge zur Theorie der Bacillen-färbung.** (Contributions to the theory of staining Bacilli.) 17 pp. (8vo, Berlin, 1886).

ÉTERNOD, A.—**Guide technique du Laboratoire d'Histologie normale et Eléments d'Histologie Générale.** (Guide to the technique of the laboratory of normal histology and elements of general histology.)
viii. and 246 pp., 53 figs. (8vo, Genève, 1886).

FIELD, A. G.—**Microscopy in Medicine.** *The Microscope*, VI. (1886) pp. 145–9.

FLEMMING, W.—**Surrogate für Knochenschliffe.** (Substitute for bone-grinding.)
[*Supra*, p. 876.] *Zeitschr. f. Wiss. Mikr.*, III. (1886) pp. 47–9.

GAGE, S. H.—**The Microscope in Jurisprudence.**
["While an *entire* human body may be distinguished as such with certainty, histological knowledge is not, in my opinion, sufficiently advanced at the present day to enable one to say that any microscopical structure is absolutely characteristic of and peculiar to a human being."]
Journ. New York Micr. Soc., II. (1886) p. 68, from *Notes on Histological Methods.*

Gierke, H.—**Staining Tissues in Microscopy. XI.**
[Transl. from *Zeitschr. f. Wiss. Mikr.*]
Amer. Mon. Micr. Journ., VII. (1886) p. 150–2.

GILES, G. W. M.—See Bibliography *a.*

HAUSHOFER, K.—**Ueber einige mikroskopisch-chemische Reactionen.** (On some micro-chemical reactions.)
[Tellurium. Selenium. Bismuth. Sulphates of Barium and Strontium. Sulphate and Chloride of Lead.]
SB. K. Bayr. Akad. Wiss. München, 1886, pp. 70–83.

HEINRICHER, E.—**Verwendbarkeit des Eau de Javelle zum Nachweis kleinster Stärkemengen.** (Use of Eau de Javelle for demonstrating small quantities of starch.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 213–5.

Heurck's (H. van) Method of Silvering Diatoms. [*Supra*, p. 900.]
Engl. Mech., XIII. (1886) pp. 548–9, from *Brit. Journ. of Phot.*

[HITCHCOCK, R.]—**Detection of Fats in Butter.** [*Post.*]
Amer. Mon. Micr. Journ., VII. (1886) pp. 135–7.
„ „. **On Mounting certain Diatoms.** [*Post.*] *Ibid.*, pp. 148–9.

HUBER, K., and BECKER, A.—**Die Pathologisch-Histologischen und Bacteriologischen Untersuchungs-Methoden mit einer Darstellung der wichtigsten Bacterien.** (The pathologico-histological, and bacteriological methods of investigation, with figures of the most important Bacteria.)
viii. and 122 pp., 13 figs., and 2 pls. (8vo, Leipzig, 1886).

Koch, R.—**Method of Staining Tubercle Bacilli.** Translated by *B. Persh* (*concld.*).
Micr. Bull. (*Queen's*), III. (1886) pp. 25–6, from *M. T. K. Gesundheitsamte*, II.

KRAUSE, W.—**Untersuchungsmethoden.** (Methods of investigation.)
[Recommends a 10 per cent. aqueous solution of chloral hydrate for the retina instead of osmic acid—5 per cent. ammonium molybdenate—Zinc chloride for hardening brain according to Raltoni—The way to produce Watney's red and blue hæmatoxylin stains, and the different ways in which they may be applied—Martinotti's double stain with hæmatoxylin and eosin—Weigert's method with ferridcyanide of potassium.]
Internat. Monatsschr. f. Anat. u. Histol., I. (1884) pp. 152–7.

LIST, J. H.—**Beiträge zur Mikroskopischen Technik. II. Zur Verwendung der Javelle'schen Lauge.** (Contribution to microscopical technique. II. On the use of Eau de Javelle.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) p. 212.

LONG, J. H.—**On the Microscopic Examination of Butter.** [*Post.*]
Bull. Illinois State Micr. Soc., May 14th, 1886, 5 pp. and 1 pl.

MANTON, W. P.—**What to work with.**
["It is often a matter of question with the beginner, what objects shall be examined with the Microscope. The answer, roughly speaking, would be, *Everything.*"]
The Microscope, VI. (1886) pp. 161–3.

MINOT, C. S.—**A Staining-Dish.**
[A convenient form of staining-dish has hitherto been a desideratum. The new dish is made of clear glass with polished surfaces, and is sufficiently deep to hold a considerable quantity of fluid, while the curves inside are such that, although large sections lie nearly flat, yet when little fluid is used it gathers into the centre. The dishes, owing to their vertical sides, are readily stacked, while the bevel is wide enough for a label, which can be easily seen both when the dishes are stacked and as they are set upon the table singly.]
Amer. Natural., XX. (1886) pp. 675–6 (1 fig.).

MINOT, C. S.—**Notes on Histological Technique.** [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 173–8.

MOLISCH, H.—**Berichtigung.** (A correction.)
[Dr. A. Ihl (see this Journal, V., 1885, p. 897) claimed to have found that in addition to the phlorglucin, specially made by Wiesner, other phenols stain wood-fibre in a characteristic manner, and Dr. Molisch remarks that Wiesner in 1878 called attention to the fact.]
Zeitschr. f. Wiss. Mikr., II. (1885) p. 359.

MORLAND, H.—**On Diatom Structure.**
[Contains directions for making very thin sections of "Cementstein," and separating and isolating the diatom sections. See also *post.*]
Journ. Quek. Micr. Club, II. (1886) pp. 297–307, 338–9.

NÖRNER, C.—**Zur Behandlung mikroskopischer Präparate.** (On the treatment of microscopical preparations.)
[Contains a variety of recommendations for hardening, staining, mounting, &c., including a description and figure of a lifter for removing sections from various fluids, consisting of a handle terminated at each end by a blade of German silver; the larger of these blades is triangular, and the smaller oblong and quadrangular.]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 19–23 (1 fig.).

OBRZUT, A.—**Prof. Spina's neue Färbungs-methode der Faülnissorganismen und ihre Beziehung zu den Tuberkelbacillen.** (Prof. Spina's new staining method for schizomycetes, and its relation to tubercle bacilli.) [*Post.*]
Deutsch. Med. Woch., 1885, No. 12.

PINCKNEY, E.—**Making Cells.**
[Wax cells covered with King's amber cement. Brass ring cells secured with same cement.]
Amer. Mon. Micr. Journ., VII. (1886) p. 152.

[QUEEN, J. W.]—**The Whitney Section-Instrument Improved.** [*Post.*]
Micr. Bulletin (*Queen's*), III. (1886) p. 30 (1 fig.).

" " **Grip Cement.**
[Recommended for fastening the Peirce cells to glass slides, and uniting glass and metal, or two metal surfaces, wood, &c. Also as a protective finish for slides against oil used for immersion objectives, and as a cell cement in cases where oils are used as mounting media.]
Micr. Bulletin (*Queen's*), III. (1886) p. 32.

ROGERS, W. A.—**Sweating.**
["I *think* I have overcome absolutely the difficulty of sweating by a form of mounting, which is simply one ring fitting loosely to an inner ring fastened securely to the slide."]
Micr. Bulletin (*Queen's*), III. (1886) p. 32.

SCHÄLLIBAUM, H.—**Beiträge zur mikroskopischen Technik.** (Contributions to microscopical technique.)
[Improvements in the process of fixing sections on the slide for subsequent staining, *post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 209–11.

Schiefferdecker, P.—**Ueber ein neues Mikrotom.** (On a new microtome.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, III. (1886) pp. 151-64 (4 figs.).

Schimper, A. F. W.—**Anleitung zur mikroskopischen Untersuchung der Nahrungs- und Genussmittel.** (Guide to the microscopical examination of provisions.) viii. and 140 pp., 79 figs. (8vo, Jena, 1886).

Simmons, W. J.—**A Method of using Bismarck Brown.**

[Carbolic acid, 15 minims; distilled water, 1/2 fluid oz.; dissolve. Add saturated solution of Bismarck brown 3/4 fluid dram; filter, and keep in a corked or stoppered phial. The carbolic acid must be the strongest crystallized, and must be diluted in the usual proportion of one part distilled water to twenty parts of the crystallized acid. This method is an adaptation of a solution of fuchsin recommended by Gradle, Bismarck brown taking the place of fuchsin. It is well adapted for bacilli and gives excellent results with cells both animal and vegetable. The epithelial cells from the mouth stain in three or four minutes, the nucleus being well brought out. Sections of leaves and stems take a red stain for the nucleus; the chlorophyll granules at first retain their green colour, producing a very nice effect with the 1/4 or 1/8 objectives.]

Sci.-Gossip, 1886, p. 186.

Smith, H. L.—**High-refractive Media.** [*Supra*, p. 901.]

Journ. New York Micr. Soc., II. (1886) pp. 75–7 and 80.

Smith, T.—**A few simple Methods for obtaining pure Cultures of Bacteria for Microscopical Examination.**

[Hay Bacillus. Isolation by gelatin plates. Sterilizing potato. Agar-agar, &c.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 124-5.

Stowell, C. H.—**Studies in Histology.**

[Methods of examining: mucous white fibres, yellow elastic and adipose tissue, cartilage and pigment-cells.]

The Microscope, VI. (1886) pp. 150-5 (6 figs.).

Strasser, H.—**Ueber das Studium der Schnittserien und über die Hülfsmittel, welche die Reconstruction der zerlegten Form erleichtern.** (On the study of series of sections, and on the means of facilitating the reconstruction of the original form.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) pp. 179–95 (2 figs.).

Upton, C.—**Mounting Chalk Organisms.—Mounting Coccoliths from Chalk.**

Sci.-Gossip, 1886, p. 212.

Vorce, C. M.—**Wax as a Material for Microscopical Mounting.** [*Post.*]

Amer. Mon. Micr. Jour., VII. (1886) pp. 123-4.

" " **Detection of Fat in Butter.** [*Post.*]

Amer. Mon. Micr. Jour., VII. (1886) pp. 156-7.

Wilbur, C. L.—**Desmid Fishing.** [*Post.*]

The Microscope, VI. (1886) pp. 169-71.

Williams, C. F. W. T.—**Preparation of Epidermis. Mounting Pollen, &c.**

[Place the leaf in distilled water in a test-tube and boil. Remove the epidermis and place in equal parts methyl-spirit, glycerin, water; mix. After an hour or two mount in glycerin jelly. Mount pollen dry, or if too opaque use glycerin jelly. Mount sections of stems in glycerin jelly, first soaking in above solution. As a rule avoid damar or balsam in mounting botanical specimens.]

Sci.-Gossip, 1886, p. 113.

Witt, O. N.—**Untersuchungen über einige zur mikroskopischen Zwecken verwandte Harze.** (Investigations on some resins suitable for microscopical purposes.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, III. (1886) pp. 196–206.

Woodward, A. L.—**Remounting Balsamed Objects in Fluid.**

[Algæ with adhering diatoms remounted in a solution of salicylic acid in water. "Upon putting the mount under the Microscope it was found to have undergone a remarkable change. The alga stood out sharply defined, and with all its structural details visible."]

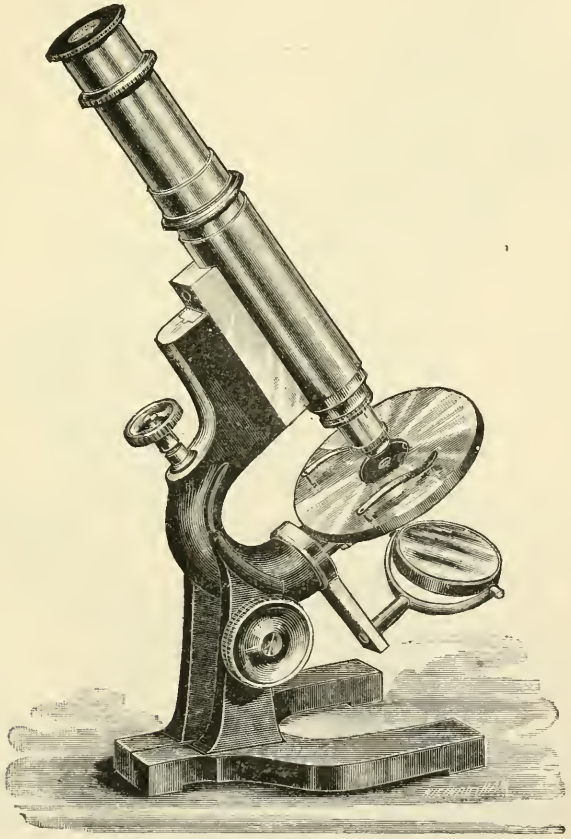
Scientif. Enquirer, I. (1886) pp. 124-5.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Bausch & Lomb Optical Co.'s New Student Microscope.†—The Bausch & Lomb Optical Co. have issued the low-priced Microscope for students shown in fig. 201. It is constructed on the Wale principle

Fig. 201.

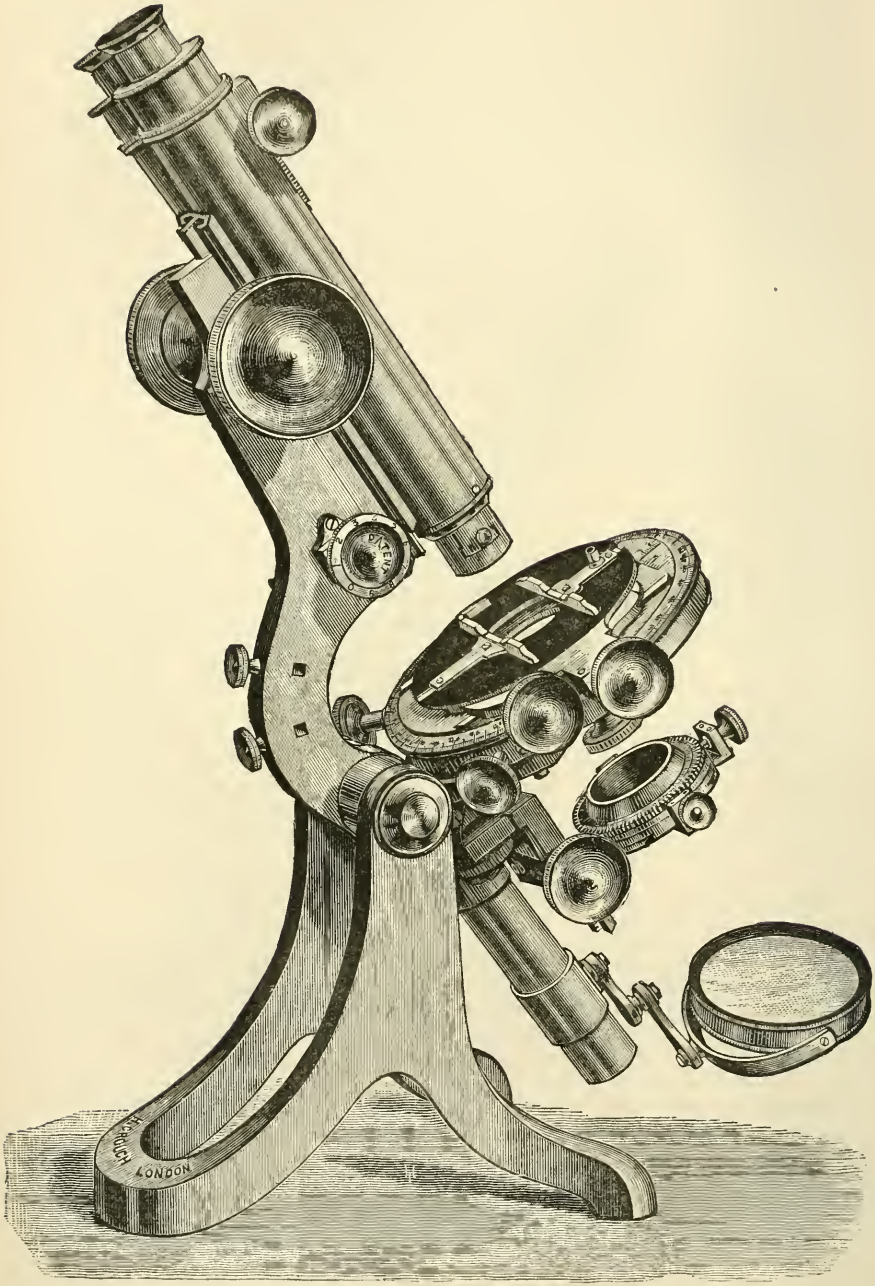


of concentric inclination of the arm, by which the instrument becomes more firm the further it is inclined. It also has a new roller

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

† The Microscope, vi. (1886) p. 199 (1 fig.).

FIG. 202.



CROUCH'S GRAND MODEL MICROSCOPE.

motion for the fine-adjustment, and a revolving diaphragm fixed to a separate arm so that it can be swung out of the optic axis. The concave mirror is attached to a bar, the axis of which lies in the plane of the stage, so that illumination may be directed on the object from any point below or above the stage. The base and arm are japanned, the latter being fastened at any desired angle by means of milled heads in the pillars.

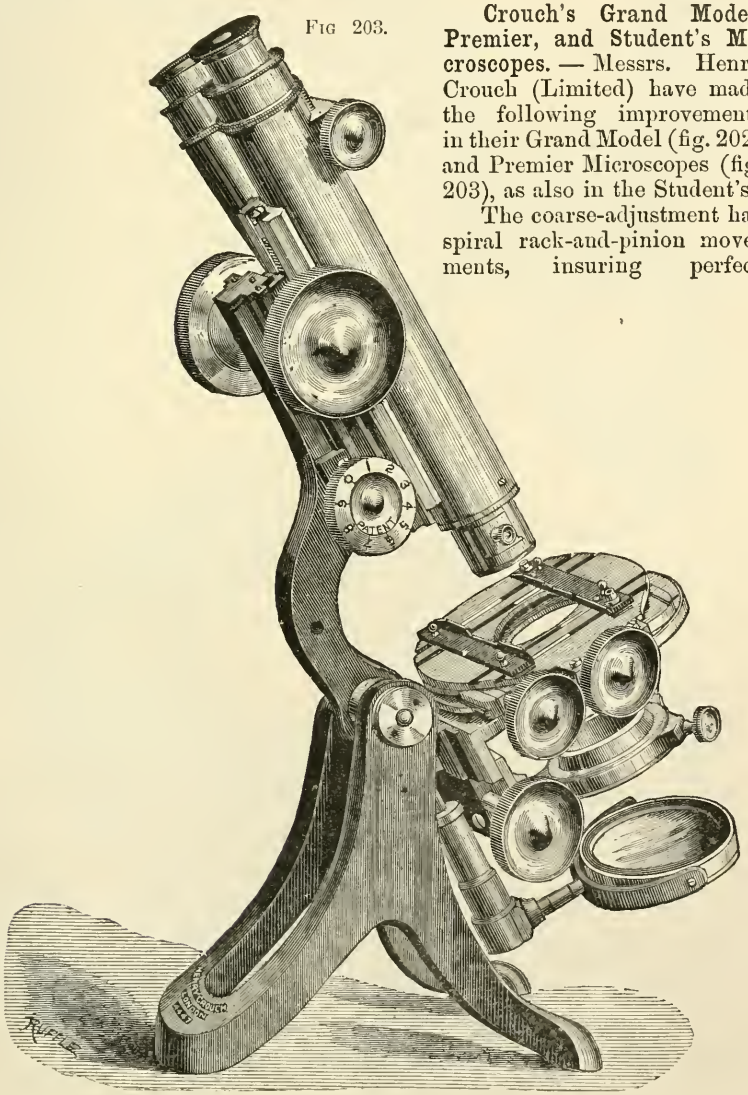


Fig 203.

Crouch's Grand Model, Premier, and Student's Microscopes. — Messrs. Henry Crouch (Limited) have made the following improvements in their Grand Model (fig. 202) and Premier Microscopes (fig. 203), as also in the Student's.

The coarse-adjustment has spiral rack-and-pinion movements, insuring perfect

Fig. 204.

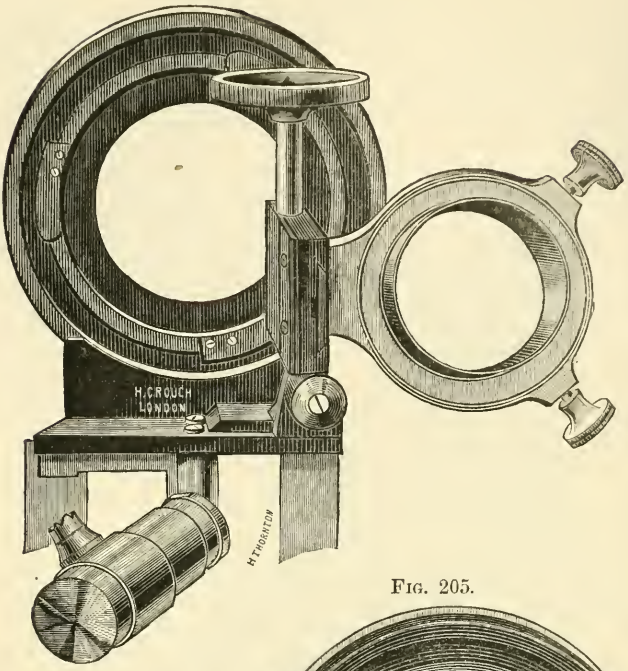
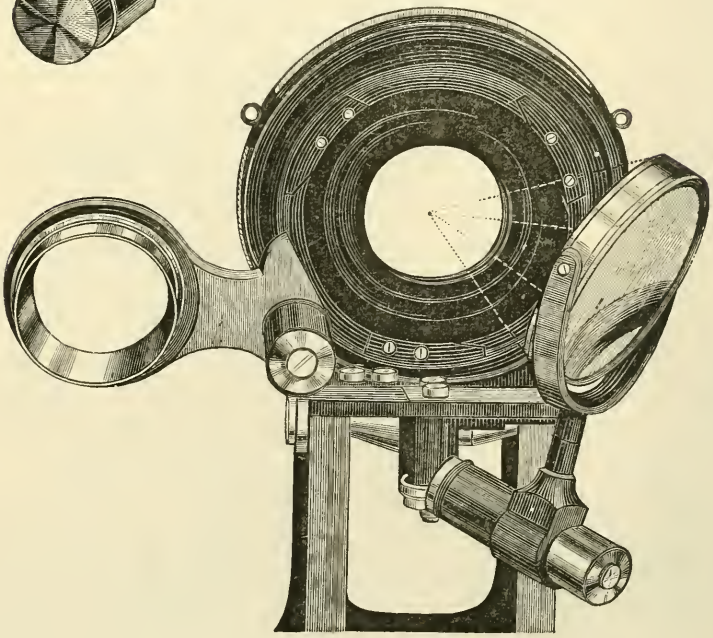


Fig. 205.



smoothness and steadiness of focusing, and can be used alone for focusing all powers up to 1/6 in., while the fine-adjustment is claimed to be of the "greatest possible delicacy and stability, the most perfect arrangement yet applied to the Jackson model form of Microscope."

The substage (figs. 202, 203, and 204) is hinged so as to give increased facility for inserting and removing illuminating accessories. It can also be entirely removed by a lateral slide when required.

The mirror-stem in the Premier and Student's Microscopes (figs. 203, 204, and 205) is pivoted from the attachment to the limb, so that it can be brought up level with or above the stage in a more convenient manner for oblique illumination than with the crank arm.

Cutter's Cam Fine Adjustment.*—Dr. E. Cutter has for years "sought to simplify the mechanism of the compound Microscope so that a really good instrument might be had for less money—not for the sake of doing away with the magnificent mechanisms now extant, but for paving the way for them by making Microscopes as plentiful and popular as pianos and organs." This contribution is one effort in this direction.

"Two ideas are involved: (1) To have a cam or cams at the distal end of the stage, which is a steel or brass plate fastened to the proximal end of the bed-plate of the stage; (2) To have four cams, one at each angle of the quadrangular stage, which is drawn down to the bed-plate by springs beneath, suggested by the late Dr. Elsberg.

The advantages of the cam fine-adjustment are:—

1. *Simplicity*, as compared with the screw fine-adjustment. A screw adjustment is a double-faced, projecting, spiral, inclined plane wound on a shaft. This plane runs on another re-entrant double spiral inclined groove winding around the inside periphery of a hole or shaft, usually fixed. For use on the stage the screw adjustment must not wabble, yet it must move readily and have no loss of motion upwards or downwards, inwards or outwards. Experience has taught that it takes a skilled mechanic to make a good fine screw adjustment. For ordinary screw threads the requirement is to bind in one direction, but not in the other direction. Such screw threads ill answer for moving backwards and forwards with the accurate delicacy of such an instrument of precision as the compound Microscope. It is expensive to make a fine screw adjustment, and there are few workmen that can make them.

On the other hand the cam adjustment is easily made by centering a metallic disc, outside of the true centre, on an axis of steel wire. It is simple to mount. Even an unskilled artisan can make and mount it.

2. *Cheapness.*

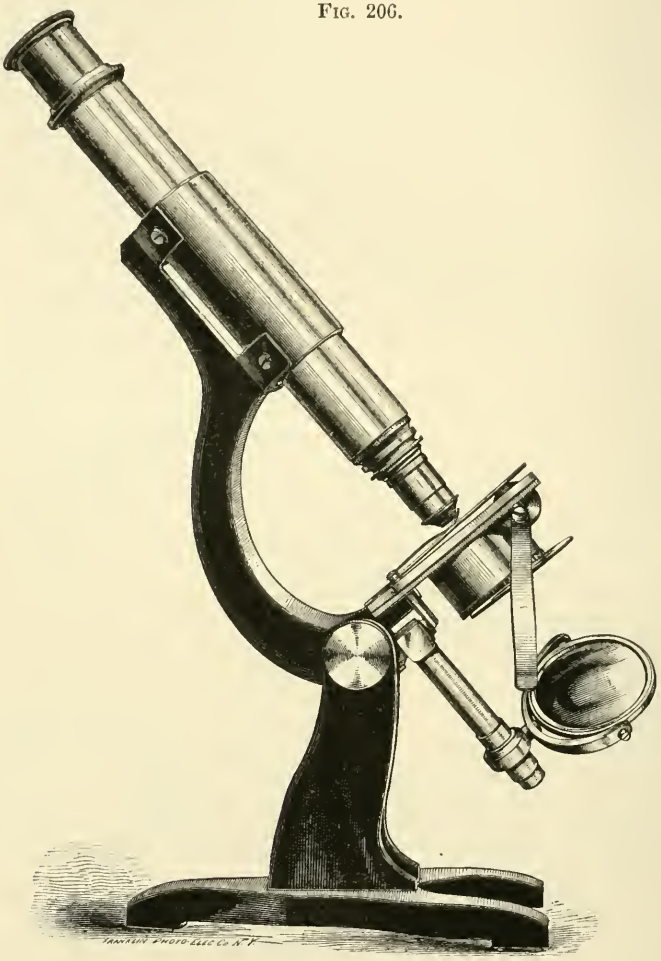
3. *Effectiveness.* No mechanical motion is so sure and effective. A short lever attached to the axis of the cam gives the means of applying required motions with ease and certainty. The amount of motion can be regulated exactly. It is rapid and sensitive.

4. *Not liable to get out of order*, as the spring or springs holding the

* The Microscope, vi. (1886) pp. 101–4 (1 fig.).

stage to the stage-plate keep the parts in contact together, and compensate for the loss by wear, which is on one surface in one direction, to wit, downwards, while the wear of the screw is on two surfaces in

FIG. 206.



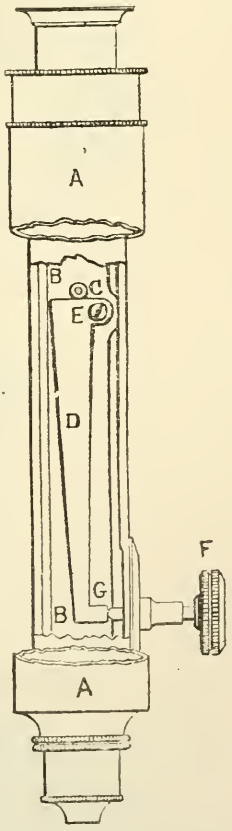
two directions, to wit, upwards and downwards. In the hands of an active worker this wear of a screw makes an unpleasant loss of motion in two directions, and which it is not easy to remove in the case of a screw. The cam gives the minimum of trouble for wear and loss of motion thereupon.

In fig. 206 the stage is represented as arranged for use, so that it can be elevated or depressed. When not in use the cam lever is turned so as to lie parallel with the stage, and the stage is not put on a stretch.

The author then discusses the objection that the inclination of the stage is a "barbarous" device, and says that he has used it successfully with objectives as high as a 1/10 in., but to obviate all annoyance from this objection, he has adopted Dr. Elsberg's idea of multiple cams, one at each corner of the stage; the two distal cams being on the same axis, and the two proximal cams on the same axis. A rod or rods connect the arm levers, and springs hold down the stage on the bed stage plate. The combined action of these cams gives horizontal motion.

Swift's Paragon Microscope (Wale's form).—In this Microscope (fig. 208) Messrs. Swift have adopted the form of inclining limb devised by Mr. George Wale, of the United States, which we have repeatedly described. The increased curve of the limb allows complete rotation of the mechanical stage. The centering and rotating substage is furnished with rack movement, on which it is applied by a dovetailed slide. The mirror, with gimbal, two arms, and rotating socket, slides on the tail-piece, which is hinged to swing laterally on the end of the limb.

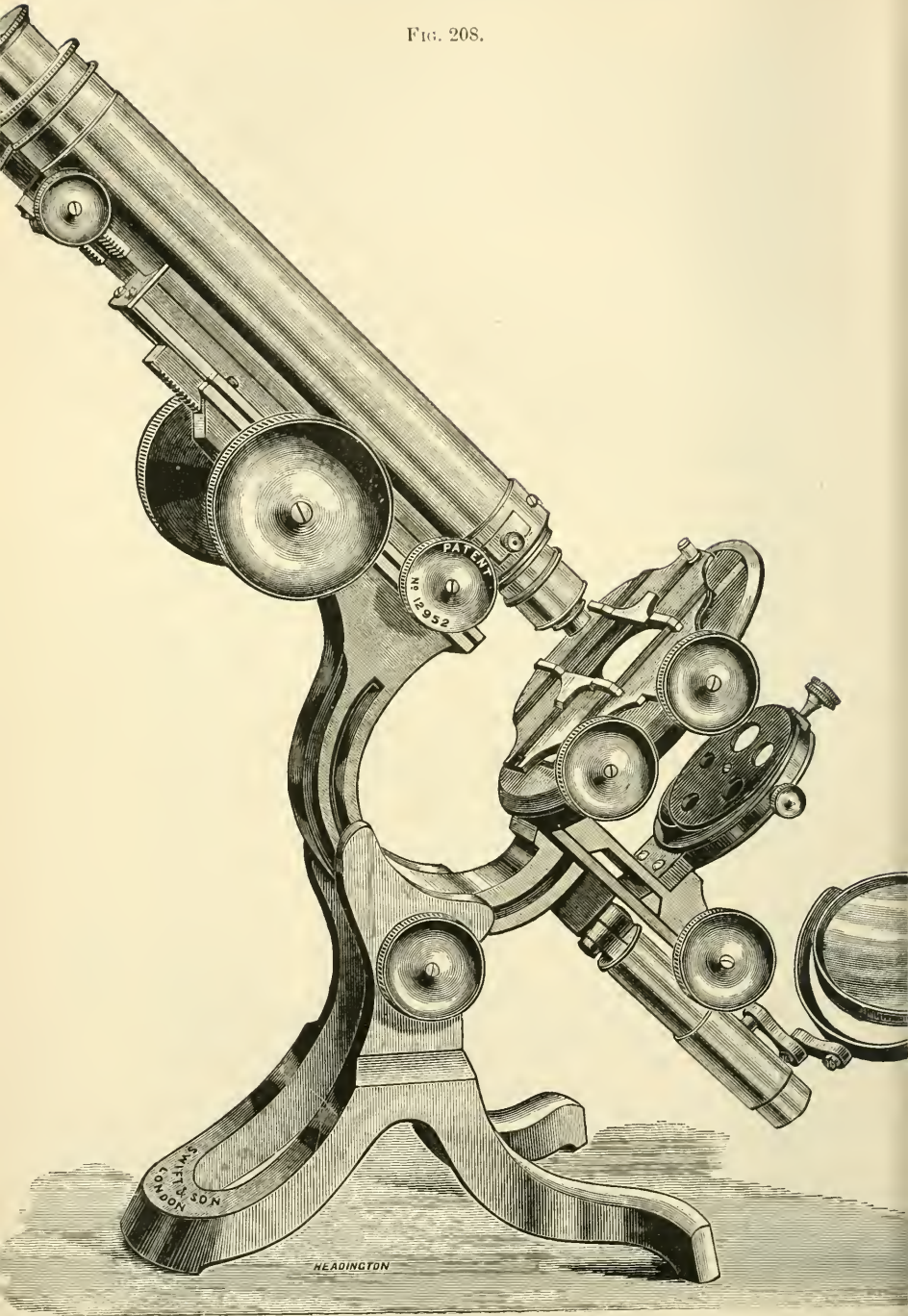
Fig. 207.



To this instrument Messrs. Swift have applied a new arrangement of fine-adjustment which they have patented. The mechanism is shown in fig. 207, where A A is the body-tube (the middle part cut away to show the action). This is connected at either end at the back with a chamfered slide, fitted to move accurately and lightly on the front of the coarse-adjustment slide B B of the usual "Jackson" form, a spiral spring above and at the back pressing it downwards. A long lever D is attached to the plate B B, to pivot at E; by the action of the milled head F, on the lower end G of the lever, the lifting stud C, connected with the chamfered slide behind the body-tube B B, is raised very slowly through a focusing range of about 1/10 in.; the reverse action of the screw allows the spiral spring above to press the slide downwards.

By this very simple mechanism the fine-adjustment is applied to the front of the coarse-adjustment, and acts on the whole body-tube, and not merely on the nose-piece, so that the magnification is not altered by changes in the focal adjustment. It is obvious that the slowness of the motion is here controlled by three factors: (1) the length of the lever D, (2) the distance of the lifting-stud C from the pivot or fulcrum E, and (3) the pitch of the screw-thread on F. We understand that Messrs. Swift anticipate being able to adapt this system of focusing to all their better class of instruments.

FIG. 208.



SWIFT'S PARAGON MICROSCOPE.

Fig. 209

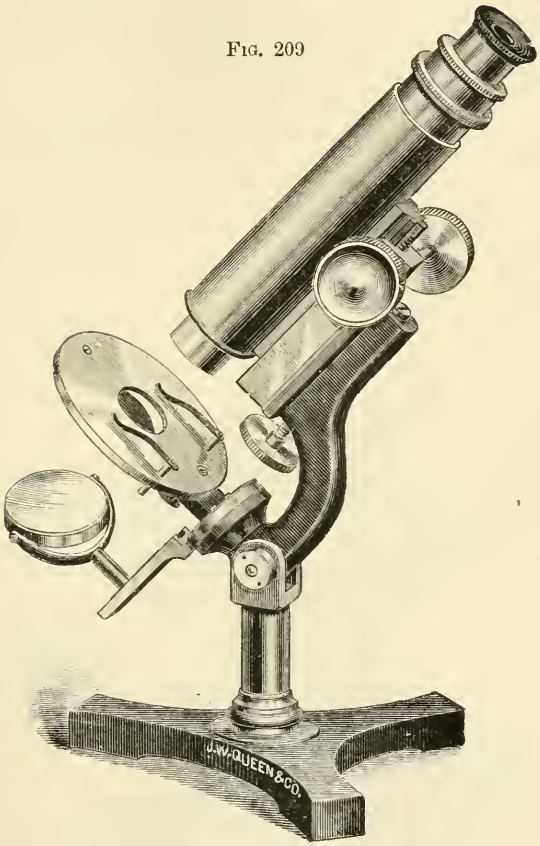
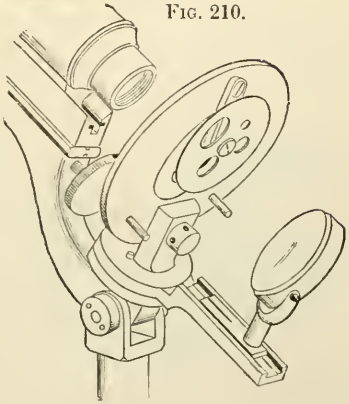


Fig. 210.



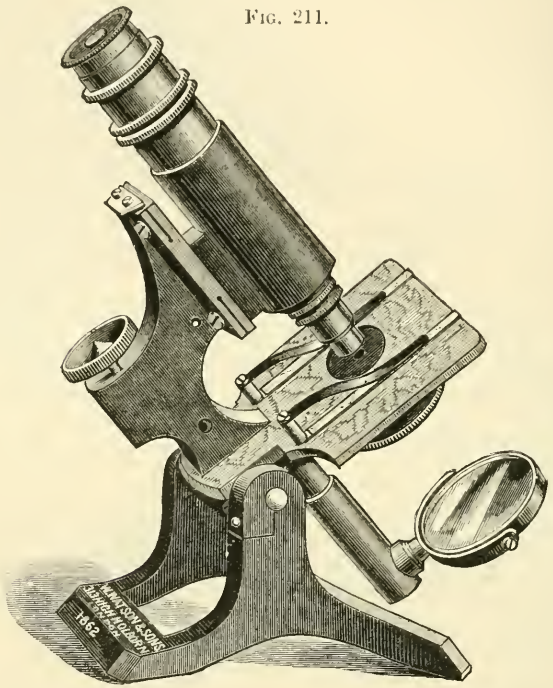
Queen's Acme No. 4 Microscope.*—Messrs. J. W. Queen & Co's. "Acme No. 4" Microscope (figs. 209 and 210) differs from the previous "Acme" models in having the fine-adjustment at the lower end of the straight part of the limb. The diaphragm is also on a hinged arm which may be readily swung aside when oblique light is required. The mirror arm slides in a groove in the swinging tail-piece.

* Micr. Bulletin (Queen's), iii. (1886) p. 17 (1 pl. and 1 fig.).

Watson's New Histological Microscope.—Messrs. W. Watson and Sons have designed this instrument for the use of class students, and it is sold at a very moderate price.

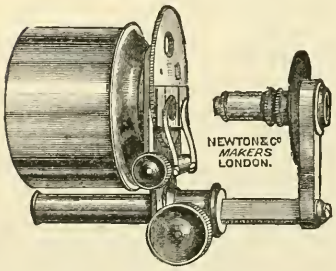
It has the fine-adjustment introduced by Messrs. Watson, and hitherto confined to the larger instruments, and also a novel featuro

Fig. 211.



in connection with the stage which is so simple that it is a little remarkable that it has not been suggested before. This consists in adding to the stage two raised parallel ribs on which the object rests, and on which it can be readily moved about. The surface of the stage is thus kept free from scratches and, what is more important, friction is reduced to a minimum.

Fig. 212.



Newton's Microscopic Attachment for Lantern Projection.—This is a simple apparatus to screw on to the nozzle of any lantern in place of the front lens, and with the limelight it is claimed that it will show an ordinary microscopic slide on the screen 8 feet in diameter far more brilliantly and better defined

than the old forms of lantern Microscopes. It has a large rotating diaphragm forming an entirely open stage, which greatly facilitates the manipulation and gives a clean sharp edge to the disc. By a prism the image can be thrown down on paper for drawing. Any good Microscope objectives can be used.

For high power work it cannot of course compare with the Wright and Newton lantern Microscope.

Leeuwenhoek's Microscopes.—Leeuwenhoek, it will be remembered, published nearly the whole of his microscopical investigations through the medium of the Royal Society, and yet, beyond the occasional statement by himself that his observations were made with simple Microscopes, nothing appears to have been definitely known by his contemporaries regarding their actual construction. The

Fig. 213.

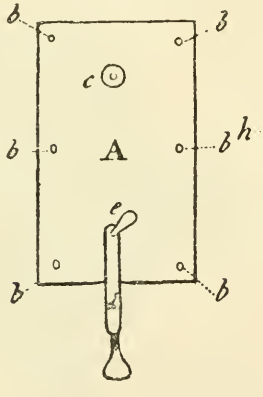
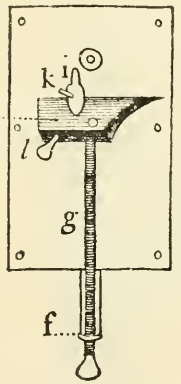


Fig. 214.



general impression during his lifetime seems to have been that he utilized lenses consisting of spherules of blown-glass. At his death (1723) he bequeathed to the Royal Society a cabinet containing twenty-six of his Microscopes (now lost), and these were reported upon * somewhat vaguely by Martin Folkes, Vice-President of the Royal Society, who appears not to have directed his attention minutely to their construction.

In 1740 these Microscopes were examined and described † to the Royal Society by Henry Baker, F.R.S., whence it appears that the magnifiers were not spherules of blown-glass, but bi-convex lenses having worked surfaces, and that they ranged in power from 1/5 in. to 1/20 in., magnifying from 40 to 160 diameters. No figure of any of the instruments was however published until 1753, when Baker ‡ issued two outline drawings representing both sides of one of them

* Phil. Trans., xxii. (1723) pp. 446–63. † Ibid., xli. (1740) pp. 503–19.
‡ 'Employment for the Microscope,' 1st ed., 1753, pp. 434–6, pl. xvii. figs. 7 and 8.

constructed of silver. These drawings are reproduced in figs. 213 and 214; but they do not give at all a clear idea of the construction of the instruments. It was therefore with much interest that we learnt that Prof. A. W. Hübrecht, of Utrecht, the eminent zoologist, was coming to London, bringing one of Leeuwenhoek's Microscopes, belonging to the Zoological Laboratory of the University of Utrecht. Unfortunately Prof. Hübrecht's visit was during the recess, so that there was no opportunity of exhibiting it to the Society, but by his courtesy we were enabled to make careful drawings and models of the instrument, the two sides of which are accurately shown in figs. 215 and 216, full size.

The lens is bi-convex, of about 1/4 in. focus, and is mounted between two concavities, provided with minute apertures, made in two corresponding thin plates of brass, which are held together by three

Fig. 215.

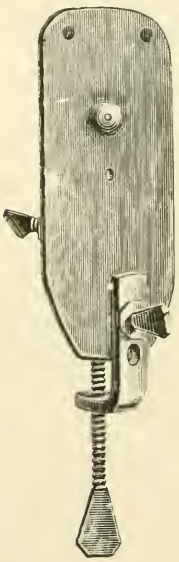
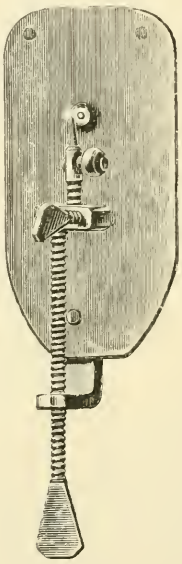


Fig. 216.



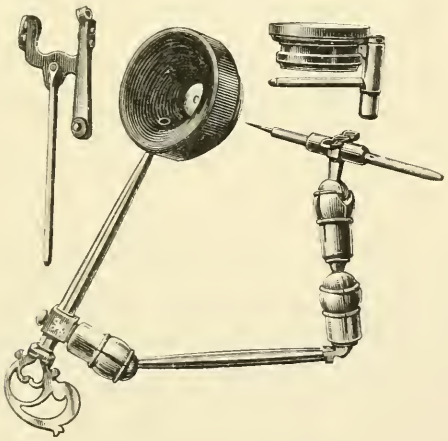
rivets, two at the upper end, and one at the lower. The object is held in front of the lens on the point of a short rod, the other end of which screws into a small block or stage of brass, which is riveted somewhat loosely on the smoothed cylindrical end of a long coarse-threaded screw, acting through a socket angle-piece attached behind the lower end of the plates by a small thumb-screw. The long screw serves to adjust the object in the axis of the lens in the vertical direction, whilst the pivoting of the socket angle-piece on its thumb-screw gives lateral motion. The object-carrier can be turned on its axis, as required, by screwing the rod into the stage. For focusing, a

thumb-screw passes through the stage near one end, and presses vertically against the plates, causing the stage to tilt up at that end; the fitting of the long screw carrier (angle-piece) is such that the stage at the end is sprung down somewhat forcibly on the brass plates, and it is against this pressure that the focusing screw acts. The metal knob on the object-carrier has a small projection, which appears to have been intended by Leeuwenhoek to fit in the hole in the brass plates beneath it, and thus retain the object opposite the lens.

It is evident from the extreme simplicity of the construction of this Microscope that the success of Leeuwenhoek's investigations did not depend essentially on the excellence of the instruments he employed, and as has been before remarked, it is simply wonderful that he was able to do such work with them as is recorded in his publications.

Musschenbroek's Microscope.—Prof. Hübrecht also brought with him the Musschenbroek Microscope shown in fig. 217 (about 2/3 size), which is only second in interest to that of Leeuwenhoek. It was

Fig. 217.



devised by J. van Musschenbroek (about 1695), the brother of P. van Musschenbroek, who became Professor of Mathematics and Physics at the University of Utrecht. The first representation of this form of instrument was given by Zahn, in his 'Oculus Artificialis,' 2nd ed., 1702, p. 781.

The object-lens is a simple bi-convex lens, mounted between two plates of brass, having minute central apertures forming diaphragms fitting in a horn cell, pierced laterally so as to be adjustable on the end of a metal rod-support, which is connected, by a second rod and three ball-and-socket joints, with a slide-socket in which various object-carriers are placed. The objects were held on the end of a

pin, shown in the fig. There is also a small wooden stage on which materials, &c., can be placed, or a bottle or test-tube can be stood upon it and held in place by being tied to a rod which slides vertically in the brass socket supporting the stage. The carrier on the left is provided with a long spring, under which rods of various shapes for holding objects can be slid and rotated in notches and holes made on either side of the fork-support.

This is the first application known to us of ball-and-socket movements to a simple Microscope.

Beeldsnyder's Achromatic Objective.—Another object of interest brought by Prof. Hübrecht, was the objective shown in fig. 218, which is of special interest in the history of the evolution of the Microscope from the fact that the late Prof. P. Harting * assigned its construction to about the year 1791, by François Beeldsnyder, of Amsterdam.

Fig. 218.

The combination consists of two bi-convex (green) crown lenses of 22 mm. and 19 mm. focus respectively, with an interposed bi-concave flint lens, the combined focus being 21 mm., and the diameters 6·5 mm. The lenses fit somewhat loosely in a brass cell screwing into the brass mount. The surfaces are somewhat imperfectly polished. The image obtained by the objective when used with an eye-piece, is but little better than that given by an ordinary non-achromatic simple object-lens diaphragmed as was usual before the application of achromatism. The increase of light due to the greater aperture hardly compensates for the loss due to the greyness of the polish.

Queen's "Parfocal Eye-pieces."—Messrs. J. W. Queen and Co. announce † that they are prepared to furnish eye-pieces (parfocal = of equal focus) which can be "changed without altering focus," or, in other words, eye-pieces with which the amplification of the Microscope is in exact inverse proportion to their focal length. This is accomplished by so adjusting the mounting of the eye-pieces that their anterior principal focus always lies at the same place in the body-tube.

The position of the anterior principal focus is readily calculated for every eye-piece. If a is the distance of the diaphragm from the field lens, and x the focal length of the latter, the distance of the anterior focus above the diaphragm will be

$$\underbrace{\beta = \frac{a^2}{x-a}}_{\text{strictly}} = \underbrace{\frac{a^2}{x}\left(1+\frac{a}{x}\right)}_{\text{approximately}}.$$

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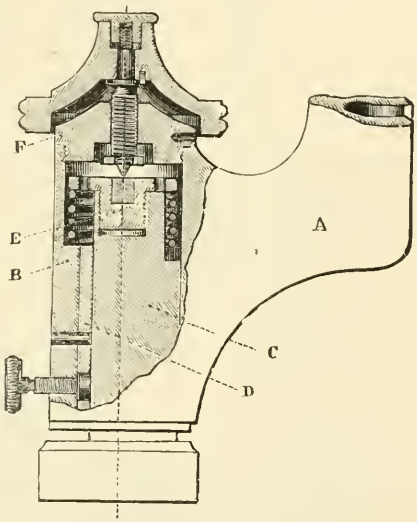
* 'Das Mikroskop' (German trans.), 2nd ed., 1866, iii. pp. 132–3.

† Micr. Bulletin (Queen's), iii. (1886) p. 31.

Fine-Adjustment to the New Zeiss Stands.* — Dr. S. Czapski gives a short account of the simplified construction of the fine-adjustment as now adopted for the Zeiss Microscopes.

The triangular bar C, fig. 219, is screwed firmly to the stage. On it moves a hollow piece B, which is connected inseparably with the arm A carrying the tube. The accuracy of the fitting of B and C is insured by the brass plate D, which is fastened to B by a pin. At its upper end C is cut away for about 15 mm. and B hollowed out at the corresponding place so that space is obtained for a spiral spring. This spring bears below against the hollowed out part of B, its upper end being connected with the projections of a piece E, screwed into C. The piece B is closed above by the brass cap F, in which is the female screw. To the top of the micrometer screw is fitted a bell-shaped head, and at its lower end is a small nut for preventing inadvertent extraction of the screw. The lower end of the screw is rounded off and bears against the flat surface of a hard steel cylinder let into E. The space allowed for the play of the screw is only 5 mm., but this is sufficient for all practical purposes.

Fig. 219.



Notwithstanding the relatively long female screw (which guarantees safety of movement and slight wear and tear), the fine-adjustment screw is on the whole rather short and correspondingly firm. The binding screw at the back of B serves to fix B in any desired position (during transport, &c.), and thus to prevent the screw mechanism from injury.

How the apparatus works is evident from the fig. When turned the micrometer screw remains in the same place, bearing against C. The female screw on the other hand moves over it, raising or lowering the tube-carrier B A connected with it. By its own weight A B counteracts the rise, and thus supplies the place of the strong spiral spring formerly employed. The weak spring here adopted acts in the same direction as the weight of A B, and serves to assist the latter when the upper part of the Microscope is placed horizontally. The micrometer screw is a left-handed one, in order that when the screw head is turned to the right the tube, as is usual, may sink.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 207–9 (1 fig.).

Wenham's Frictionless Fine-Adjustment.—Messrs. Ross have applied to Mr. F. H. Wenham's Radial Microscope the form of fine-adjustment shown in fig. 220.

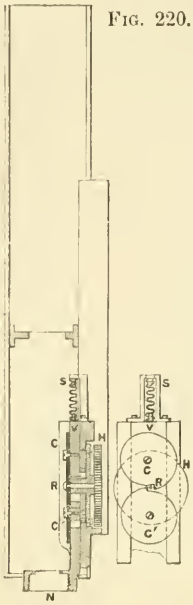


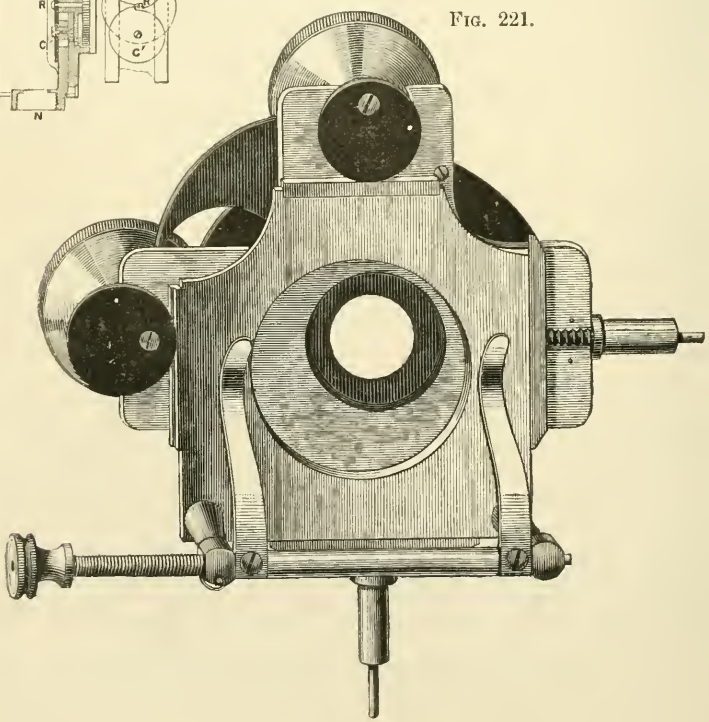
Fig. 220.

A V-slide is fitted within the body-tube, carrying at its lower end the nose-piece N, and is pressed downwards by a spiral spring S. It is moved against the spring by the revolution of two "snail" cams C C', between the edges of which revolves a steel roller R forming the axis of, and actuated by a large milled head H, passing longitudinally through the slide of the coarse adjustment and projecting slightly on either side, in a convenient position for work.

By this system an extremely sensitive focusing is obtained, though a difficulty has to be overcome in the tendency of the roller to slip between the cams.

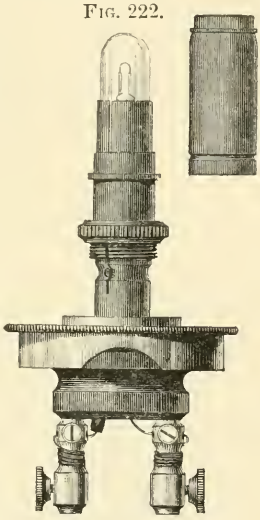
Swift's Cam Mechanical Stage.—Mr. J. Swift, in 1884, utilized the cam for a mechanical stage in the manner shown in fig. 221. There

Fig. 221.



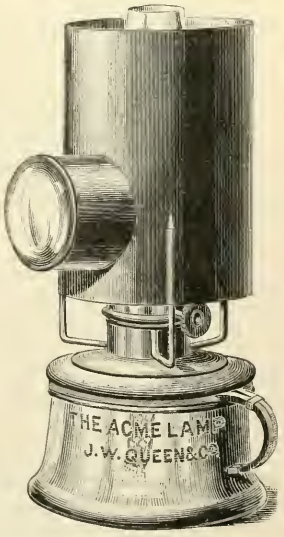
are two cams, one on the left and the other in front, and they are actuated by large milled heads beneath the stage. Two spiral springs on the projecting rods press the stage plates against the cams. A very smooth motion is thus obtained. The spring clips are raised by the milled head on the left against the action of a spiral spring which is wound on the axis, and they provide an unusual depth of space for cells or other thick objects. The stage was more especially intended for use with a photo-micrographic camera.

Fig. 222.



Electric Incandescence Lamp.—This, fig. 222 (received anonymously from America), is a very convenient form of incandescence lamp for use in the sub-stage. The glass receiver with the carbon filament and the wires for connecting with the battery are screwed into the sub-stage adapter shown in the fig., from which they are, however, insulated by ebonite. Over the glass receiver fits a piece of tubing (shown at the side), which carries either a condensing lens, a disc of blue glass, or a pin-hole diaphragm. A milled ring working in a screw-thread, tightens or loosens the setting of the lamp, so as to allow of its renewal in case of breakage.

Fig. 223.



Queen's Acme Lamp.*—Mr. J. W. Queen in designing this lamp (fig. 223), has followed out his belief that a Microscope lamp attaining the highest efficiency could be produced at a low cost.

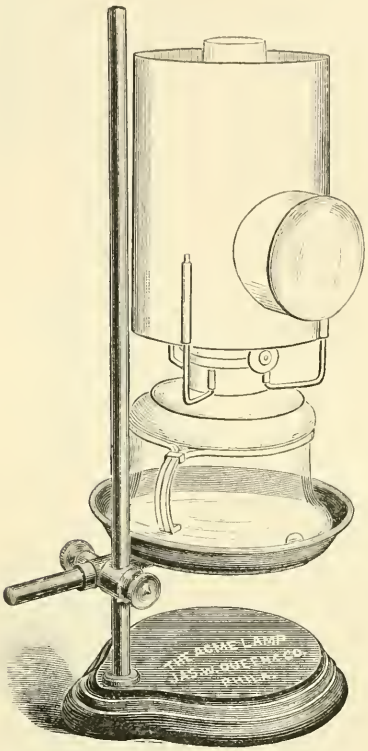
The careful and exact application of a finely figured, ground, and polished bull's-eye lens permits the use of a very small flame and wick. This feature will, it is anticipated, prove a valuable one for summer work, where the heat of most lamps is very objectionable. The bull's-eye gives sufficient light for a 1/12 in. objective, using only the usual substage condenser when the lamp is at the distance of 3 feet from the mirror.

The lens can be set higher or lower, the flame placed flat or edgewise towards the lens. The shade is japanned outside, but bright inside, in order that it may become but little heated by

* Micr. Bulletin (Queen's), iii. (1886) p 27 (1 fig.).

absorption from the radiation of the flame. The handle, being of brass, obviates the danger from breakage incident to glass handles. If a larger flame is desired, a larger burner and chimney may be readily applied. The adjustable stand (fig. 224), since issued,* enables the lamp to be set and clamped at any height. The lamp may also be inclined by means of the horizontal axis, so as to throw the beam of light downward or upward, as may be necessary, and there clamped.

Fig. 224.



Thompson's Modification of the Nicol Prism, giving wider angle of field.†—In the ordinary Nicol prism the available polarized field is limited, on the one side by the intrusion of the ordinary ray, and on the other by the vanishing of the extraordinary ray by total reflection. Of the various methods suggested from time to time for widening the available angular aperture, some have affected one side of the field, some the other, some both. For example, the suggestion made by Prof. S. P. Thompson in 1881 (and by Mr. Glazebrook in 1882) to alter the prism in such a way as to make the balsam-film a principal plane of section, has the effect (irrespective of the external shape of the prism, which we may suppose given) of throwing back to its furthest possible limit (for any given cement) the point at which the extraordinary ray vanishes by total reflection. The obliquity of the end-face, other things being given, affects the limit of intrusion of the ordinary ray to a much greater degree than it affects the extraordinary ray, hence by increasing the slope of the end-faces we may add to the available width of field, but this involves increased distortion of the field as well as loss of light. The use of a more highly refringent cement than Canada balsam causes a gain on the side of the extraordinary ray—it thrusts the blue iris further back—but

* Micr. Bulletin (Queen's), iii. (1886) p. 35 (1 fig.).
† Phil. Mag., 1886, pp. 478–80 (1 pl.).

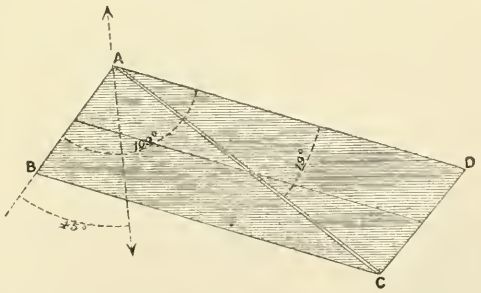
causes a slight loss on the side of the ordinary ray, which intrudes a little more than before.

Now, taking the Nicol prism as it is ordinarily made, there would be a real gain, if it could, without additional labour or cost, be so cut as either to widen the field (using the same length of prism as before) or to shorten the length of the prism (if obtaining the same angular aperture as before). The method of cutting adopted by Hartnack, and that suggested in 1881 by Prof. Thompson, both add to the cost of spar and to the labour of cutting. In Hartnack's construction the width of field is gained partly by employing linseed oil, partly by the device of making the plane of the film lie at right angles to the crystallographic axis of the spar. In Prof. Thompson's construction of 1881 the balsam-film was made to lie in a principal plane of section, whilst the principal axis of vision through the prism was made to lie at right angles to the crystallographic axis. A gain of about 9° in the width of the field over that of a Nicol of the same external form was the result; being a little less for flattened prisms, a little more for oblique-ended prisms.

Prof. Thompson has now devised a simple modification of the mode of cutting the Nicol prism, which possesses several of the advantages of these costlier methods of construction, but without adding appreciably to the cost.

Fig. 225 shows the ordinary Nicol prism as usually cut, the end-faces A B and C D being natural faces of the crystal polished up. The books assert that makers of Nicol prisms cut down these faces, making them still more oblique by 3°, but the author has not found any constructor who does this. The natural angle between the face A B and the arrête A D is about 109°. The crystallographic axis

Fig. 225.

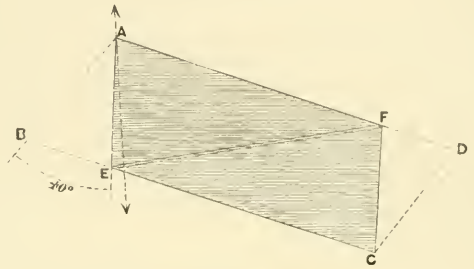


makes about 45° with the end-face A B. The balsam-section is at about 90° to the plane of the end-face. The consequence of this is that there are about 45° between the plane of the balsam-film and the crystallographic axis. This limits the field: those rays which traverse the prism at small angles to the film, and which would traverse the film if the crystallographic axis were at right angles to it (as in the

Hartnack prism) are totally reflected out, because the crystallographic axis slopes at 45°.

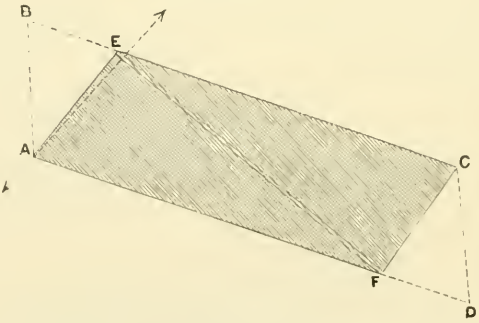
To remedy this the crystal is cut in the manner shown in fig. 226 or fig. 227. Fig. 226 represents a piece of spar of the same size as fig. 225. The end-faces are first cut away about 40° each, making the ends of the prism A E and F C reversed in position, but inclined at

Fig. 226.



about 69° instead of 71° to the long edges. The prism is then cut across E F, which makes about 89° with the end-faces. The result is a shortened and "reversed" nicol, in which the crystallographic

Fig. 227.



axis lies very nearly in the plane of the end-face, and in which the balsam-film is very nearly at right angles to the crystallographic axis. Or, comparing the two,—

	Ordinary Nicol. °	Reversed shortened Nicol. °
Obliquity of end-face	71	69
Angle between end-face and crystallographic axis	45	5
Angle between balsam-film and crystallographic axis	45	94

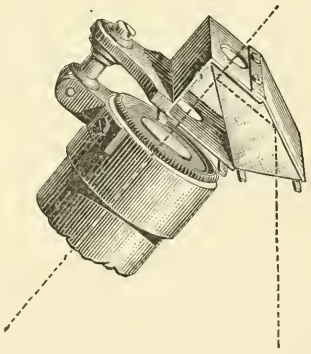
The result is that the blue-iris limit is thrown right back, and a shorter prism is obtained, having an equally wide field or wider.

Fig. 227 shows the same method applied to a slightly longer piece of spar, producing a "reversed" prism of precisely the same external form as the ordinary nicol, and having indeed everything the same, save the direction of the crystallographic axis, as a comparison of figs. 225 and 227 will show.

The method of "reversing" the section is of course equally applicable to flat-ended nicols. If a piece of spar is first cut so that the terminators are orthogonal to the long edges of the prism, it is obviously just as easy to slice the prism with a section that is very nearly perpendicular to the crystallographic axis as to slice it with one that makes only 45° with it.

This new method of construction may be regarded as a compromise, for the sake of cheapness, between the method of Hartnack and the older method of Nicol.

Fig. 228.

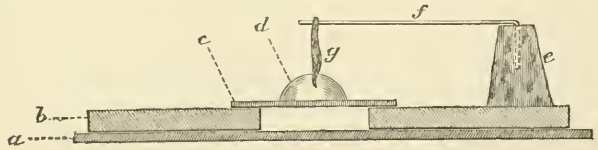


Nachet's Camera Lucida.—This is now made by M. A. Nachet for use with an inclining Microscope, when it takes the form of fig. 228. The difference between this and the camera for a vertical Microscope is principally that the surfaces of the prism have been cut to the angles necessary to produce an exact coalescence of the images when the body-tube is inclined 45°.

Instead of the small central prism of the older forms, M. Nachet uses with all his cameras the thin coating of gold suggested by Prof. G. Govi, the reflecting power of which is sufficient to give a clear image of the pencil, while its translucidity allows the object to be seen at the same time.

Apparatus for cultivating Plasmodia.*—In his observations on an aquatic *Myxomycete*, Mr. H. Marshall Ward found that the plasmodia

Fig. 229.



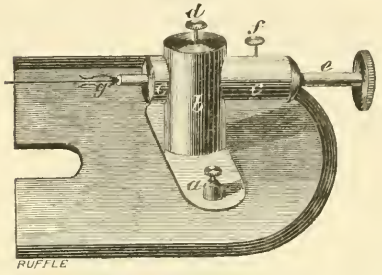
tended to the upper parts of the culture drop, and he therefore used the apparatus shown in fig. 229, in which the drop *d*, containing

* Stud. Biol. Laborat. Owens College, i. (1886) pp. 64–85 (2 pls.).

myxamœbæ and plasmodia, is inverted, instead of hanging down from the under side of the cover-glass *c* into the cavity of the bibulous paper cell *b* (fixed to the slide *a*). A piece of hyacinth root *g* passes into the drop, being suspended by a glass filament *f* supported by a cork *e*. The whole is placed in a larger damp chamber, and the root kept thoroughly wet.

Apparatus for the microscopic detection of Rhombic Pyroxene.* —Dr. R. Küch uses the contrivance shown in fig. 230 to determine hypersthene where this mineral is present in a rock with a larger proportion of monoclinic augite.

Fig. 230.



The cylindrical brass pillar *b* (2–3 cm. in height) is fixed on a brass plate *a*, 1 cm. broad and 1 mm. thick; a hole is bored at the upper end, and through this passes a hollow cylinder which can be rotated, but cannot be shifted to right or left on account of the collars *c c*. The screw *d* serves to fix the cylinder to *b*; through the cylinder passes the rod *e*, which can be moved to right or left and is fixed by the screw *f*. This rod terminates at one end in the clamp *g*. The apparatus is fixed on the stage by two screws, so that the prolongation of *e* passes through the axis of the Microscope.

To use the apparatus the pyroxenic constituent is isolated and fixed with Canada balsam between two cover-glasses, which are then placed in the clamp *g*; by moving *e* and the slide itself one crystal after another is so placed that its crystallographic vertical axis coincides with the axis of *e*; *f* is then clamped, and each crystal may then be turned about its vertical axis and the extinction tested in different positions, care being taken to clamp the screw *d* when the stage is rotated.

Sahli's Automatic Regulator for an Incubator heated by Petroleum.†—Dr. H. Sahli's apparatus, the general appearance of which is shown in fig. 231, consists of an iron vessel A B C (fig. 232) divided into (1) a hot-air chamber A C, (2) the incubator proper, and (3) a space filled with water surrounding the latter. From the air-chamber descends a pipe D, into the lower extremity of which the chimney of the lamp fits. On one side is a shaft K, to which at its junction with D is attached a valve H J moving on a hinge at H. H G is a lever raised by the needle W.

The lamp is provided with two chimneys; the smaller used for incubations, the larger for sterilizing. The regulator apparatus

* Neues Jahrb. f. Mineral., Geol. u. Palæont., i. (1886) pp. 35–48 (2 figs.).
† Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 165–73 (3 figs.).

consists of a broad glass tube M, into which is blown a thin tube L. M L, placed in the water-tank, communicates through a hole in the lid with the caoutchouc tube P L. The lower part of this glass

FIG. 231

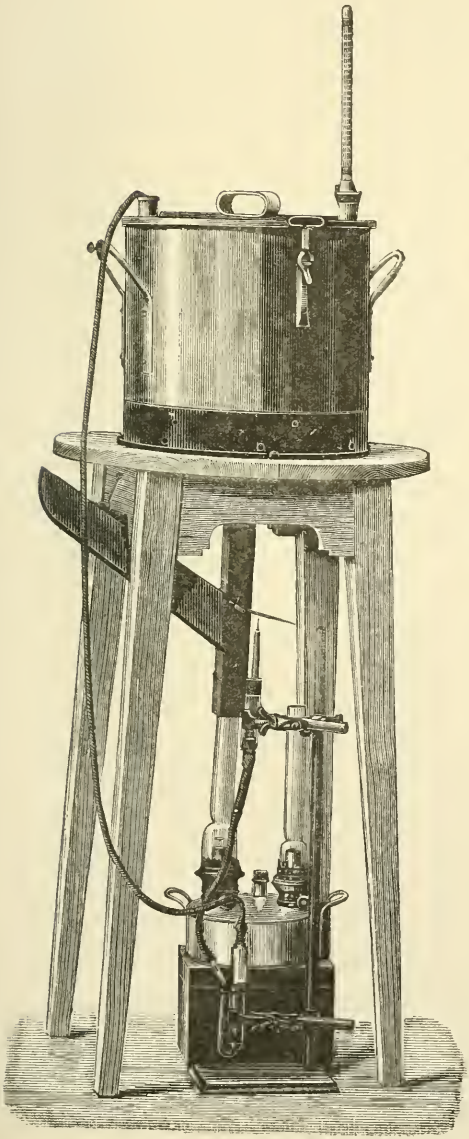
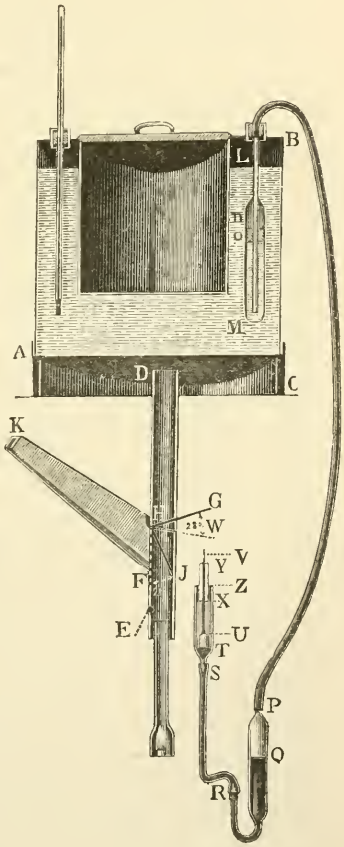


FIG. 232.



vessel, as well as its tubes as far as P, is filled with water, while above it is a layer *n o* of ether for temperatures about 40° C., or of petroleum-ether for temperatures of 56°. P R is another glass vessel, with an ascending limb, which contains mercury, and is connected by means of a rubber tube with the cylinder Z S. Herein is a float T, from which proceeds the wooden rod V U, terminated by the needle W. The rod passes through a tube X Y inserted in a cork which closes the end of the cylinder at Z. The tube X Y in addition to acting as a guide-bearing for the rod V U, has also the further object of preventing, in case the pressure of the ether should rise too high, the overflow of the mercury or the bursting of the vessel. The upper end of the float T U is so shaped that if it is pressed against the tube X Y, the latter does not close but permits the mercury to ascend the tube, after flowing over the float. If the tube is only a few centimetres high an overflow of the mercury is hardly conceivable, for such an ascent would correspond to a temperature difference of some degrees Celsius in the incubator, and this, in consequence of the regulator, never happens. The two glass tubes P R and S Z are clipped to an iron burette-holder (fig. 231).

The action of the apparatus is sufficiently simple. As the water in the iron vessel gets hot, the ether expands and drives the water in the glass bulb from M to C onwards, so that the mercury rises up the tube R S and so presses on the float T, which in its turn raises the needle W. The needle, as already mentioned, presses against the lever, which if in the position W before, now rises to G, and by this means moves the valve H J from F to J, thereby cutting off the ascent of the hot air, all of which now passes out through K. As the temperature falls, so do the needle and the lever, the valves consequently returning towards F.

The temperature depends partly on the boiling point of the fluid *n o*, and partly on the difference between the levels of O and T. The higher P R is placed the sooner the mercury reaches the float, and the sooner therefore the heating process is interrupted. A bulbed pipette is described which is used for filling M, N.

Tursini's Photomicrographic Apparatus.*—In place of the small dark chamber of the ordinary apparatus for photomicrography, Signor Tursini proposes a camera obscura which is large enough to receive the operator as well as the necessary instruments and reagents. The Microscope and the preparation to be photographed are outside the chamber, the image is projected into the interior. Near the Microscope is an oblique aperture through which the operator, without leaving the chamber, can regulate the position of the mirror, the preparation, the fine-adjustment, &c. In this way the operations are better watched, and therefore the results are better.

Phototypic Process applicable to the Reproduction of Photomicrographs.†—This method, which is the invention of M. A. Denaeyer, depends on the insolubility of bichromate-gelatin produced by the

* Il Morgagni, 1886, p. 90.

† Bull. Soc. Belge Micr., xii. (1886) pp. 92-6.

action of the luminous rays proportional to the "photovaleur" of the different whites of the image it traverses. The preparation of the glass plates requires the successive employment of the following products:—

Mixture A. Whites of two eggs beaten to a froth; solution of silicate of soda, 60 parts; distilled water, 120 parts. This solution having been introduced into a florentine flask is allowed to stand for twelve hours. It is the lower limpid layer which is poured on the glass plates.

Mixture B. Very hard white gelatin, 20 parts; distilled water, 200 parts. To this solution, made in a water-bath at a temperature of 45°–50° C., is added bichromate of ammonia 4 parts, dissolved in distilled water, 40 parts; ammonia, 15 drops. The mixture is filtered at a temperature of about 45° through white filter paper.

In order to obtain a uniform layer, the glass is placed on three wooden cylinders, provided with adjusting screws; and then some of the mixture having been poured on, the glass slide is gently tilted with the hand, and then a white thread rendered tense by being stretched from the points of an iron arc, serves to carry along the viscid fluid without loss of continuity and production of bubbles. The glass is next dried in the air, and afterwards washed in cold water for five minutes. It is next placed in a heating apparatus and carefully levelled in the horizontal position. Here it is left for two hours at a temperature of 57° C., and while still warm it is coated with a layer of mixture B, the same procedure being adopted as for mixture A. The glass is then again transferred to the heating stove, where it is allowed to dry thoroughly at a temperature of 57° C. (about two hours).

When dry, the glass is sensitive to luminous rays. After cooling it is placed in the press-frame above and in contact with the negative, care being taken to cover all parts of the glass which are not to receive the luminous action with black paper. Exposure is then made to diffuse light. The duration of the exposure varies from one hour to five minutes, according to the greater or less intensity of the negative. The image is shown in relief on the layer of bichromated gelatin.

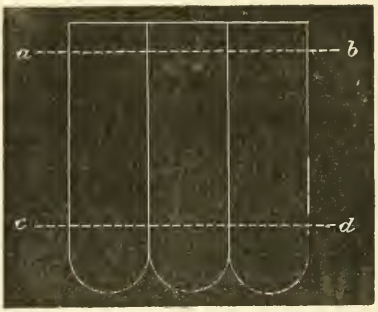
Before proceeding to print, the glass must be well washed to remove any excess of bichromate, or better, it may be left for five or six hours in running water. It is next dried in a dark place. To obtain the positive the glass is moistened with the following mixture: Glycerin, 100 parts; ammonia, 5 parts; hyposulphite of soda, 2½ parts. After ten minutes the excess of the "Moistener" is removed, first with a sponge, and next with a piece of clean linen; the latter must be dabbed, and not rubbed on.

The plate is to be inked with two special phototypic inks, laid on with rollers. It is necessary to remoisten with the glycerin mixture after every dozen copies. From four to eight hundred copies may be obtained from one plate.

It is not necessary to perform the operations in an absolutely dark room; it is almost sufficient to draw down the blinds.

Cylinders which act as Lenses, and give an Optical Image.*—Prof. S. Exner having previously found,† in examining the eye of *Hydrophilus piceus* with his micro-refractometer, that each facet of the cornea is a cylinder of continually increasing refractive power from the circumference to the axis, has been led to study the optical action of such a cylinder. That the images produced by the facets are not only due to their spherical terminations was shown by removing the

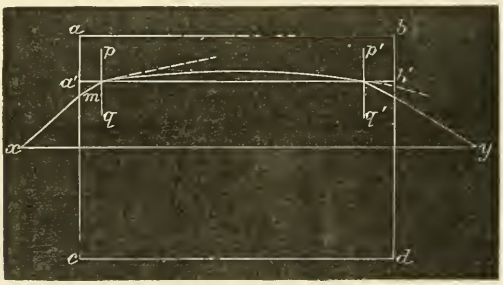
Fig. 233.



latter, when an inverted image was produced by the section between *a b*, *c d* (fig. 233), and this must be due to the fact that each cylinder acts as a lens by reason of its varying optical density. The subject is mathematically treated by Prof. Karl Exner, but the general results are suggested by the following simple considerations:—

Let *x y* (fig. 234) be the axis of the cylinder of which *a c*, *b d*, are

Fig. 234.



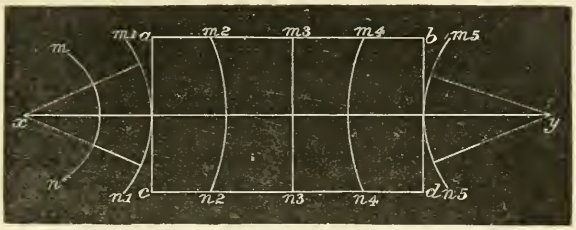
the plane terminations perpendicular to *x y*, and suppose the refractive index to be a maximum along the axis, and to diminish regularly towards the circumference. Then the course of a ray *x m* incident at *m* is shown by the curved line *x m y*, since the ray on encountering successive strata of varying density will be continually refracted

* Pflüger's Arch. f. d. gesammt. Physiol., xxxviii. (1886) pp. 274–90 (10 figs.).

† See this Journal, *ante*, p. 328.

towards the axis, and is at one part of its path parallel to the axis. Consider next a spherical wave $m\,n$ (fig. 235) proceeding from x; after entering the cylinder, as at $m_1\,n_1$, it will be gradually altered in shape,

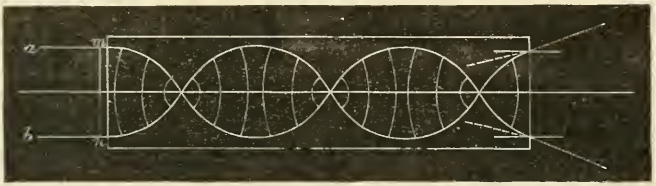
Fig. 235.



as shown by $m_2\,n_2$, $m_3\,n_3$, $m_4\,n_4$, successively (the velocity being least along the axis), and will emerge as a concave wave at $m_5\,n_5$, so that rays diverging from x will converge to y. The figure also indicates that if the cylinder be cut through at $m_3\,n_3$, where the wave-front is plane, the beam will emerge parallel to the axis; in other words, x is the focus of the cylinder $a\,c\,m_3\,n_3$, and y is the focus of the cylinder $b\,d\,n_3\,m_3$. The form of the curve $m_5\,n_5$ will depend upon the law by which the index varies, but in any case it will be a surface of revolution about the axis, and consequently the portion in close proximity to the axis may be replaced by its sphere of curvature; hence, if central pencils only be taken into account, it is clear that an image of x will be produced at y.

It may be proved that the focal length is inversely proportional to the length of the cylinder; this, however, is only true within certain limits, since with a long cylinder the course of a beam of parallel rays $a\,b$ may be periodically re-entrant, as shown in fig. 236,

Fig. 236.



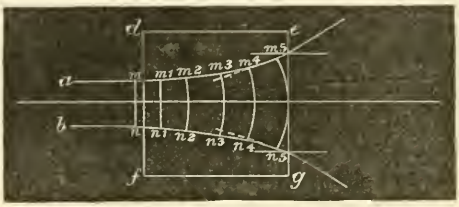
and there will be a succession of foci within the cylinder; the latter should therefore be shorter than the distance between two consecutive foci.

It may be shown also that the ordinary lens formula $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ is equally true for the cylinder, u and v being the distances of the object and image respectively, and f the focal length. Such a

cylinder behaves, therefore, like a convex lens, and can be treated in a similar way as regards the calculation of the sizes and positions of images, &c. Precisely similar considerations will show that a cylinder in which the index *increases* from the axis towards the circumference will behave as a concave lens (fig. 237).

It might be supposed that if at any point a ray is travelling

Fig. 237.



parallel to the axis it will continue to do so, since it is travelling along strata of constant index; but if we consider the elementary waves which constitute the ray, it will be seen that those which are nearer the axis are propagated with diminished velocity, so that the ray as a whole will have a curved path.

Two points of interest proved in the mathematical investigation are: (1) Whatever be the law according to which the index varies, in the immediate neighbourhood of the axis it will be a parabolic law; in other words, if from all points of the base lines be drawn parallel to the axis and proportional to the index of refraction at those points, their extremities will form a surface of revolution which is in all cases a paraboloid near the axis. (2) If all the rays diverging from a point in the axis are to converge to a point after refraction through the cylinder, the law of the index must be a parabolic law.

To put the theory to the test of experiment, Professor Exner, following the example of Matthiessen, prepared cylinders of varying optical density from celloidin and gelatin. The celloidin was for this purpose cut from a plate with a cork-borer into cylinders 5–10 mm. in length and breadth, placed between glass plates to protect the ends, and then immersed for some hours or days in a mixture of alcohol and ether. Gelatin cylinders were prepared by filling a glass tube with a gelatin solution, treated with salicylic or carbolic acid; this is allowed to harden, and then extracted by warming the tube for a few seconds. A cylinder cut from such a column is then fixed between glass plates, and immersed for a day in water. Cylinders of celloidin and gelatin treated in this way are found to act as lenses in accordance with the theory. Thus Exner was able to manufacture some of two inches focal length, which gave fairly good images, and could be used as rough magnifying lenses, enabling him to verify approximately the formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$. Cylinders which act as concave lenses may be made by exposing the rod of gelatin to the air for

some days or weeks after it has been taken out of the glass tube, and by combining a convergent and a dispersive cylinder it was possible to construct a small Galilean telescope.

The path of rays through cylinders formed by coaxial shells of varying index is also investigated by Dr. L. Matthiessen, with special reference to the eyes of different insects,* who agrees with Professor Exner that the spherical ends of the facet cylinders have very little to do with their action as lenses, which is to be attributed solely to the variation in optical density. He is, however, of opinion that the cylindrical lenses of the cornea are not composed of coaxial cylinders, but of successive shells, like the chambers of *Orthoceratites*, the refractive index diminishing from one to another in the direction of their convexity.

In a subsequent note † Professor Exner says that the cylinders of varying density which were at first made of gelatin have now been constructed of glass at the Jena Glastechnisches Laboratorium. At present their optical density can only be made to diminish from the circumference towards the axis. They act as dispersive lenses, and give clear images when they are free from cavities. The only marked defect is the double refraction which duplicates the image near the borders of the field of view, and indicates that the variation of density is not quite regular along the radii of the cylinder.

Definition of Hairs, "Test Rings."‡ — In articles on "Microscopical Advances, Ancient and Modern," Dr. G. W. Royston-Pigott says that, he considers the "advances of the accuracy and power of the Microscope is well shown in the well-developed structure of hairs. A favourite object figured in antiquated books is the hair of the Indian bat. Quekett represents it as frilled with a kind of coronet of small hairs, ringed at regular intervals, leaving the intermediate transparent quill exposed." With an "oil-immersion 1/12th, and a large angle in the oil condenser, instead of frilled hairs, which are purely imaginary, a beautifully *serrated cup*, with concave notches, is seen, and edges as black as jet, ornamenting the whole of the stem at equal intervals. After so many years of observation of this object, this result is perfectly startling, and throws a strong doubt upon innumerable accepted appearances. The black boundary edges are very nearly 100,000th thick."

As to "test rings" he says that "when a brilliant white disc in diatoms can be detected, it is generally accompanied by a jet black marginal ring all round the spherule; and in brilliant spherules 1/40,000 in. in diameter, this black ring has been frequently estimated at 1/6th of the disc, or 1/240,000 in. thick. This ring plays so important a part in the definition of diatoms, cells, and molecules, that I shall ask leave to call it the *spherule test ring*, or, shortly, the *test ring*; for, if a glass giving 800 diameters will not show it in a minute spherule (1/90,000th), it cannot be rated as of the finest quality."

* Exner's Repert. d. Physik, xxii. (1886) pp. 333–53 (10 figs.).
† Arch. f. d. gesammt. Physiol. (Pflüger), xxxix. (1886) pp. 244–5.
‡ Eng. Mech., xlii. (1885) pp. 331–2 (14 figs.).

Allman, G. J.—**Obituary of G. Busk, Hon. F.R.M.S.**
Nature, XXXIV. (1886) pp. 387–9.

American Society of Microscopists.—Ninth Annual Meeting.
Amer. Mon. Micr. Journ., VII. (1886) pp. 161–3.
The Microscope, VI. (1886) pp. 200–1, 202, 202–6 (Abstract of President's Address), 212.

Bausch and Lomb Optical Co.'s New Student Microscope. [*Supra*, p. 1037.]
The Microscope, VI. (1886) p. 199 (1 fig.).

Beck, J. D.—**[Working Distance of High-power Objectives.]**
[" I am no expert in optics, but I do firmly believe that the form, the construction, the arrangement and combination of lenses for objectives can be modified so as to give a working distance between the objective lens and cover-glass of 1/4 in. for a 1/6 in. objective, and 1/32 in. for 1/50 in. objective. I may be looked on with apparently good reason as a crank for entering the field so boldly with such an idea. Things have been accomplished (successfully) apparently as difficult as this enthusiastic idea of mine. For example, high angles of aperture of objectives. It appears that 90° was at one time considered the highest limit of angle of aperture for objectives, and the man who predicted it possible to construct an objective with an angle of 180° aperture certainly would have been called a crank, but it has been successfully accomplished 'just the same.' *How much higher the angle can be applied to objectives I do not know. It may be the limit.* Is it not possible or even probable that the working distance may be increased to the limit mentioned?"! (Italics ours.)]
The Microscope, VI. (1886) p. 215.

Behrens, W. J.—See Unna, P. G.

Bostwick, A. E.—**On a Means of Determining the Limits of Distinct Vision.**
[*Post.*] *Science*, VIII. (1886) p. 232 (1 fig.).

Czapski, S.—**Mitteilungen über das glastechnische Laboratorium in Jena und die von ihm hergestellten neuen optischen Gläser.** (On the Jena Glass Laboratory and the new kinds of optical glass made there.)
[Cf. this Journal, *ante*, pp. 316 and 849.]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 293–9 (in part).

Delage, Y.—**Compresseur nouveau, à pressure régulière et à retournement.** (New Compressor with regular pressure and reversible.)
[*Ante*, p. 862.] *Arch. Zool. Exper. et Gén.*, IV. (1886) xix.–xxi. (2 figs.).

Exner, S.—**Nachtrag zu der Abhandlung "Ueber Cylinder, welche optische Bilder entwerfen.** (Supplement to the article "On Cylinders which form optical images.") [*Supra*, p. 1062.]
Arch. f. d. gesammt. Physiol., XXXIX. (1886) pp. 244–5.

Francotte, P.—**Descriptions des Objectifs construits avec les verres nouveaux.** (Description of the Objectives constructed of the new kinds of glass.)
[Cf. *ante*, pp. 316 and 849.] *Bull. Soc. Belge Micr.*, XII. (1886) pp. 100–8.
Journ. de Microgr., X. (1886) pp. 467–70.

Gänge, C.—**Lehrbuch der Angewandten Optik** in der Chemie, Spectralanalyse, Mikroskopie, Polarisation. Praktische Anleitung zu wissenschaftlichen und technischen Untersuchungen mit Hülfe optischer Instrumente nebst theoretischer Erklärung der beobachteten Erscheinungen. (Compendium of Optics as applied in Chemistry, Spectral Analysis, Microscopy, Polarisation. Practical instruction in scientific and technical investigations with the aid of Optical Instruments and theoretical explanations of the phenomena observed.)
['The Microscope,' pp. 58–60 (2 figs.), 67–84 (7 figs.), 106–8, 173–82, 197–8, &c.]
xi. and 463 pp., 24 pls., and 162 figs., 8vo., Braunschweig, 1886.

Glass, the new Optical.
[Cf. *ante*, pp. 316 and 849.] *Nature*, XXXIV. (1886) pp. 622–3.
See also *Engl. Mech.*, XLIV. (1886) p. 286.

H.—**The Benefits of Improvements in Objectives.**

[Review of the President's Address (R.M.S.) 1886. "No one can read Dr. Dallinger's contributions without a feeling of respect and admiration for those qualities of mind and industry that have enabled him to carry on such difficult observations so long and successfully."]

Amer. Mon. Micr. Journ., VII. (1886) pp. 172–3.

Haeckel, E.—**[Use of both Eyes with the Microscope.]**

["According to the same law of divergent adaptation, both eyes also frequently develop differently. If, for example, a naturalist accustoms himself always to use one eye for the Microscope (it is better to use the left), then that eye will acquire a power different from that of the other, and this division of labour is of great advantage. The one eye will become more short-sighted, and better suited for seeing things near at hand; the other eye becomes, on the contrary, more long-sighted, more acute for looking at an object in the distance. If, on the other hand, the naturalist alternately uses both eyes for the Microscope, he will not acquire the short-sightedness of the one eye and the compensatory degree of long-sight in the other, which is attained by a wide distribution of these different functions of sight between the two eyes. Here, then, again the function, that is the activity, of originally equally-formed organs can become divergent by habit; the function reacts again upon the form of the organ, and thus we find, after a long duration of such an influence, a change in the more delicate parts and the relative growth of the different organs, which in the end becomes apparent even in the coarser outlines."]

Amer. Mon. Micr. Journ., VII. (1886) p. 176.

Hénocque.—**L'Hématoscopie, méthode nouvelle d'analyse du sang, basée sur l'emploi du Spectroscope.** (Hæmatoscopy; a new method of blood analysis based on the employment of the Spectroscope.) [*Post.*]

Comptes Rendus, CIII. (1886) pp. 817–20 (3 figs.).

Hitchcock, R.—**Recent Improvements in Microscope Objectives.**

[Summarized statement of the modern theory of aperture.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 190–3.

Jörgensen, A.—**Die Mikroorganismen der Gärungsindustrie.** (The microorganisms of the fermentation-trades [brewers, distillers, &c.].)

[Chap. i., pp. 1–24 (6 figs.) Microscopical and Physiological Investigation.]

viii. and 138 pp., 36 figs., 8vo, Berlin, 1886.

Lehmann, O.—**Ueber Mikroskope für physikalische und chemische Untersuchungen.** (On Microscopes for physical and chemical investigations.)

[*Post.*] *Zeitschr. f. Instrumentenk.*, VI. (1886) pp. 325–34 (4 figs.).

N., W. J.—**The Two Mirrors.** (*In part.*)

[On Illumination by Plane and Concave Mirrors.]

Sci.-Gossip, 1886, pp. 217–8, 248–51 (7 figs.).

Objectives, the New.

[Cf. *ante*, pp. 316 and 849.] *Science*, VIII. (1886) pp. 335–6.

Pelletan, J.—**Microscope spécial de MM. Bézu, Hausser et Cie. pour l'étude des Bactéries.** (Bézu, Hausser and Co.'s special Microscope for the study of bacteria.)

[Hartnack stand with circular rotating stage and glass plate. Abbe condenser. The objectives are the subject of the following Pelletanian puff. "Every one knows the reputation of the objectives of this house (!). We need not therefore eulogise them here, but we may add that the 1/12 homogeneous immersion of MM. Bézu and Hausser is absolutely of a superior quality. We have several times had occasion to compare it with similar objectives, German, English, or even American, and under all circumstances it showed itself superior by the delicacy and purity of the image, as well as by the absence of colour and distortion of the field. We do not hesitate, therefore, to recommend it in preference to all others."]

Journ. de Microgr., X. (1886) pp. 412–5 (1 fig.).

Pfeifer's (A.) Embryograph for use with Zeiss Microscopes. [*Post.*]
Stud. Biol. Laborat. Johns Hopkins Univ., III. (1886) pp. 480–1 (1 fig.).

Photography, advance of Pathological.
["In an editorial on the 'Advance of Pathological Photography,' the 'British Medical Journal' says that a perfect system of representing pathological specimens, as seen under the Microscope, by photography, is much to be desired, and it seems that such a system will very shortly be perfected."]
The Microscope, VI. (1886) pp. 201–2, from *Brit. Med. Journ.*

Power of a Microscope.
["The magnifying power of a Microscope centres in the lens," &c.!]
Scientif. Enquirer, I. (1886) pp. 190–1.

PROCTOR, R. A.—**Minute Writing.**
[As to minute writing of the Lord's Prayer. The 'Newcastle Weekly Chronicle' says that Mr. Proctor has sent three specimens of his skill in microscopic writing. "One of them is the Lord's Prayer written in less than a half-ring marked by a penholder smaller than an ordinary pencil-ring. Another is the same prayer occupying a space slightly over the half-ring. A few touches of the pen have given the latter specimen the appearance of the sun rising out of the sea. The third specimen is in some respects the most striking and curious of the three. It is the Lord's Prayer written three times over on three straight lines a shade over 2½ in. long. The writing in this case is so straight and minute that the three lines look to the naked eye like three ruled lines. And yet, when placed under a magnifying glass, every word is seen to be perfectly distinct."]
Knowledge, IX. (1886) p. 361.

Queen's (J. W.) Acme Lamp-stand. [*Supra*, p. 1054.]
Micr. Bulletin (*Queen's*), III. (1886) p. 35 (1 fig.).

Robin (C.), Sa Vie et son Œuvre. (Life and work of Prof. C. Robin, Hon F.R.M.S.) (*In part.*)
Journ. de l'Anat. et de la Physiol., XXII. (1886) pp. i.–xlviii. (portrait).

ROYSTON-PIGOTT, G. W.—**Microscopical Advances. XIII., XIV.**
[Minute Coloured Imagery.—First Order of Interstitial Colouring. Second Order: Transmitted Colours. Solar Spectra emitted by small lenses. On the circular solar spectrum.]
Engl. Mech., XLIV. (1886) pp. 165–6 (2 figs.), 207–8.

SCHRÖDER, H.—**Ahrens' neues Polarisationsprisma.** (Ahrens' new polarizing prism.) [*Post.*]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 310–1

SCHULTZE, E. A.—**Five species of Triceratium.**
[Two artotype plates with 8 figs., from photo-micrographs with Wale's 1/12 in. and Spencer 1/16 in.]
Journ. New York Micr. Soc., II. (1886) p. 110 (2 pls.).

SCHULZE, A.—**The new Apochromatic Micro-objectives and Compensating Oculars of Carl Zeiss in Jena.**
[Cf. this Journal, *ante*, pp. 316 and 849.]
Engl. Mech., XLIV. (1886) pp. 126–7, 155.

SCRIBNER, F. L.—**Method of making Drawings of minute portions of Plants.**
[The apparatus used consists of a Zentmayer dissecting Microscope, with the metal base replaced by a wooden one, which slides in a frame hinged to a heavy base-board. When in use, the frame is placed vertically and the focal distance adjusted as desired. A Wollaston camera and an adapter for lenses are attached; drawings are made on tracing paper and transferred by means of a steel point to Bristol board. The final lines are inked with Keuffel and Esser's pen No. 1459.]
Bull. Torrey Bot. Club, XIII. (1886) p. 170.

Sonnet—The Microscope.
["But here, in thee, frail instrument, we hold,
A more than fairy-fashioned key of gold,
That opes the boundless world Infinity;
And helps us trace, from its recondite source,
The first lace weavings of Life's dawning Now,
Down thro' its swiftly circling, onward course,
Till Man appears, with thought-enshrouded brow;" &c., &c.]
The Microscope, VI. (1886) p. 198.

Spencer Objectives and Quekett.

[Various letters as to the omission from the 2nd ed. of Quekett's 'Treatise on the Use of the Microscope' of the reference to Spencer's objectives inserted in the 1st.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 197, 198.

Tursini.—**Apparecchio microfotografico.** (Photo-micrographic apparatus.)

[*Supra*, p. 1060.] *Il Morgagni*, 1886, p. 90.

Tyrrell, P.—**A 1/25 in. Objective.**

[Commendation of a Spencer 1/25 in., balsam angle 125°.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 178–9.

Unna, P. G.—**Zur Histotechnik—Zerstreuende Diaphragmen.** (On Histotechnique. Dispersing Diaphragms.)

[Suggests for use with artificial light a ground-glass plate in the diaphragm-carrier. Dr. W. J. Behrens adds in a note (*Zeitschr. f. Wiss. Mikr.*, III., 1886, p. 230) that he prefers to use discs of dead blue cobalt glass, 2 mm. thick, ground on one side, placed with the ground side up, and illuminated with the concave mirror.]

Monatschr. f. prakt. Dermatol., V. (1886) No. 4.

Van Allen, J. F. C.—**200,000 to the Inch.**

["Many dispute the possibility of resolving lines ruled so finely as 200,000 to the inch. I can only say I have broken this reputable law repeatedly, and so have a dozen other reliable gentlemen"!]

Micr. Bulletin (*Queen's*) III. (1886) pp. 39–40.

Ward, H. M.—**The Morphology and Physiology of an Aquatic Myxomycete.**

[Contains a description, p. 73, of a moist chamber formed out of thick cardboard or several thicknesses of filter paper kept wet, a drop being suspended in a central cavity from the under side of a cover-glass. Also of the apparatus, *supra*, p. 1057.]

Stud. Biol. Laborat. Owens College, I. (1886) pp. 64–86 (2 pls.).

Westien, H.—**Doppel Objectiv-linsen mit gemeinschaftlichen Sehfelde.** (Double objective lenses with common field of view.)

Title of German Patent, Kl. 42, No. 4191.

White, T. C.—**On a simple method of Photographing Biological Subjects.**

[*Post.*]

Sep. repr. from *Journ. Brit. Dental Assoc.*, 1886, October, 8 pp. and 1 fig.

β. Collecting, Mounting and Examining Objects, &c.*

Cytodieresis of the Egg.†—M. J. B. Carnoy's paper on this subject is divisible into three sections, the germinal vesicle, the first polar globule, and the second polar globule, and accordingly the methods of examination fall under two heads.

In the study of the germinal vesicle and the nucleolus, the two following methods were employed—(1) Methyl-green in combination with 2 to 3 per cent. acetic acid, if possible on fresh objects, or on objects which had been fixed by a reagent which neither deteriorates the effect of the staining medium nor the constitution of the nuclein elements. (2) The use of solvents for the nuclein and also for the albumen corpuscles. Methyl-green is a specific reagent for the nuclein of the nucleus for the following reasons: methyl-green only stains the

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† 'La Cellule,' ii. (1886) p. 76 (4 pls.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 244–6.

nuclein within the nucleus; it leaves the membrane, the karyoplasma, and the plasmatic nucleoli unstained; whereas carmine, logwood, anilin violet, safranin, &c., are only uncertain reagents, for these stain all nuclear elements indifferently, the plasmatic nucleoli, perhaps, even more intensely than the nuclein. The solvent used for the albuminoids, as vitellin and myosin, were 0·001 per cent. hydrochloric acid, and 0·1 per cent. salt solution. The micro-chemical characters of nuclein given are: the nuclein substances are almost insoluble in water, insoluble in dilute mineral acids (partially soluble in strong acids), but easily soluble in very dilute alkalies. In a solution of sea-salt they swell up, forming a gelatinous mass. They present, with iodine, nitric acid, and Millon's reagent, the reactions of the protein substances. All these properties enable the nuclein substances to be easily distinguished from lecithin and albuminoids. It is, perhaps, owing to the nuclein that nuclei stain with picrocarmine.

For the study of the polar globules, fresh and preserved material was employed. (1) A small piece of an ovary was placed in a drop of methyl-green on a slide. The egg was then fixed (*a*) with 3 per cent. nitric acid, 50 and 70 per cent. alcohol, after Van Beneden's method. Instead of leaving the eggs two hours in 50 per cent. alcohol in order to obtain karyokinetic figures, the author merely washed with 50 per cent. alcohol until all the acid was removed, and then treated with 70 per cent. alcohol; (*b*) with absolute alcohol, to which a quantity of sulphuric acid was added. A large drop of this spirit is then run over the eggs on the slide until the methyl-green is quite decolorized; then the acid is carefully washed away; next glycerin or Ripart's fluid plus a little glycerin is added to the preparation. (2) For fixing and hardening ovaries intended for later use, these were treated (*a*) with 3 per cent. nitric acid; (*b*) with sulphuric acid alcohol, in which the objects are left for one to eight hours, according to the thickness of their membrane; after having been well soaked the objects are transferred to strong spirit; (*c*) The solution of mercury perchloride according to Gilson's formula may be used. The ovaries remain herein for 20 minutes to an hour, are then well washed in water and preserved in alcohol. In any case the eggs are stained with methyl-green. Of all the reagents sulphuric acid alcohol gave the best results.

Preparing Spermatozoa.*—For making permanent preparations of spermatozoa Mr. A. C. Cole says that no method succeeds better than receiving the perfectly fresh seminal fluid into a watchglass containing glycerin diluted with its own bulk of water, and a single drop of osmic acid solution. After mixing gently by means of a needle, drops of this fluid may be taken up by means of a pipette, deposited on slides, covered, and secured with gold size. By this method spermatozoa are mounted in a fluid of about the same refractive power as the natural seminal fluid, and appear as in life. The whole cell is preserved unaltered, except that its contour is slightly sharpened and the nucleus brought into greater prominence.

* Cole's 'Studies in Microscopical Science,' iv. (1886), Sec. 2, p. 6.

Another useful method of preservation is to receive the fresh semen on a slide, and spread out a thin layer by drawing another slide through it, over the glass. This film is then set aside for ten minutes, or until perfectly dry. A solution of eosin is then applied and left on the slide five or ten minutes, after which the excess of staining reagent is washed away by gentle agitation of the slide in clean water. It is again allowed to dry perfectly. A drop of Canada balsam is then applied, and covered as usual. This is a very simple method, and may advantageously be had resort to when it is desired to photograph the spermatozoa, the red stain giving the needed photographic opacity. But the cells are of course shrunken and distorted by this method, and only their coarser features can be preserved.

Demonstrating the mucous secretion of the skin of the Trout Embryo.*—Dr. L. Merk recommends for the study of the secretion of goblet cells, the embryo of the brook trout in which the epithelium on the body and on the yolk-sac is crowded with these forms. The embryos are available from the time when the eye-points appear. The smaller animals can be examined in water in a hollow ground slide, but the author preferred to cut the yolk-sac and isolate the investing membrane by waving it to and fro. The separation of the yolk-sac was undertaken in 0·75 per cent. salt solution because the issuing yolk is not precipitated therein, while in water an albuminous body (ichthin) is deposited. The membrane is carefully spread on a slide and examined in 0·5 per cent. salt solution or in water.

Preparing Cells of the Vitreous in Cyprinoids.†—Dr. H. Virchow gives the following directions for demonstrating the branched cells found on the surface of the vitreous in Cyprinoids:—(1) Hardening. Chromic acid, 2 per cent., Müller's fluid or 1 per cent. sublimate solution. The latter to be warmed to 30° C., and while cooling the preparations freed from sclerotic and choroid, should remain therein for about seven hours. After-treatment with alcohol is not requisite. Gold treatment is inapplicable as it renders the retina inseparable. (2) Staining. Slow staining with hæmatoxylin (followed by immersion in 1/2 per cent. alum solution) and eosin (eosin 1, alcohol 60, water 160) for twelve hours or more; transfer to absolute alcohol. (3) Mounting. After hardening in sublimate the preparation is spread on a slide and a cover-glass imposed; it is then transferred to alcohol and removed along with the cover-glass for further treatment.

Preparing Elastic Tissue of the Skin.‡—Dr. P. G. Unna demonstrates the elastic tissue of the skin by combining osmium-hardening with staining in an acid solution of dahlia or iodine violet. The solution is as follows:—dahlia, 0·2; aq. dest. and spirit (95 per cent.), āā, 10·0. Mix and add acid nitric, 2·0; aq. dest., 18·0; spirit 95 per cent., 10·0. The osmium sections are over-stained

* SB. K. K. Akad. Wiss. Wien, xciii. (1886) p. 28 (2 pls.).
† Arch. f. Mikr. Anat., xxiv. (1884) pp. 99–113.
‡ Monatschr. f. Prakt. Dermatol., v. (1886) No. 6.

in this solution for 12 to 24 hours, and according to its intensity the colour is extracted by acetic acid, or water acidulated with acetic acid. The sections are then to be washed and examined in glycerin, but permanent preparations are mounted in balsam. Over-staining with osmic acid is removed with peroxide of hydrogen.

Preparing the Iris.*—Dr. O. Eversbusch employs the following contrivance for examining the muscular tissue of the iris in Mammalia.

Liver, amyloid for choice, is hardened for five weeks in Müller's fluid, and after careful and prolonged dehydration in alcohols (up to absolute) is passed through, seriatim, the alcohol-clove-oil mixture, oil of cloves, turpentine, paraffin mixture, and lastly Merck's paraffin. Then a piece about 0·5 cm. thick is imbedded in a composition of hard and soft paraffin, and having been placed on a microtome (Katsch) is planed smooth. On this smooth surface the iris soaked in paraffin is placed and covered with fluid paraffin.

The author recommends that the iris should be stained *in toto*, and advises picrocarmine, hæmatoxylin and Grenacher's alum-carmine, giving preference to the last. If the preparation be too highly coloured the nervous elements are liable to be confounded with the muscular; therefore the tint should not exceed a light rose.

Preparing Spinal Ganglia of the Frog.†—Dr. M. von Lenhossék recommends the ganglia, of which the seventh, eighth, and ninth are easiest of access, to be placed in a 1 to 1·5 per cent. osmic acid solution, wherein they remain for three-quarters of an hour. Preparations were made both by section and teasing out. The hardened objects were imbedded either in Flemming's transparent soap or in Schiefferdecker's celloidin. Dissociation of the ganglia exposed merely to the influence of osmic acid did not produce satisfactory results. The author recommends objects treated with osmic acid to be placed afterwards in a mixture of equal parts of acetic acid and glycerin. The action of the acetic acid on the interstitial tissue may be increased by exposing the fluid with the ganglia for a day to a constant temperature of 35°–40° C.

Preparing Eyes of Heteropoda.‡—Dr. H. Grenacher recommends for the preservation of the eyes of Heteropoda, when intended for after examination, the use of Kleinenberg's picro-sulphuric acid mixture. A mixture of picro-sulphuric acid with sublimate, which had been so useful in the examination of retina of Cephalopoda, was here useless. The employment of the former medium with consecutive extraction with alcohol, led through irregular crumpling to destruction of opposing layers of single parts, occasionally to loss of continuity.

For the removal of pigment, Grenacher uses the hydrochloric acid which rendered good service in the Cephalopoda (2 or 3 parts to 100

* Deutsche Zeitschr. f. Thiermed. u. Vergl. Pathol., xi. Zeitschr. f. Vergl. Augenheilk., iii. (1885) pp. 25–32. Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 251–2.

† Arch. f. Mikr. Anat., xxvi. (1886) pp. 370–453 (2 pls.).

‡ Abh. Naturf. Gesell. Halle, xvii. (1886) 64 pp. (2 pls.).

of a mixture of 1 part glycerin and 2 parts 80 per cent. alcohol). Both the quantity and the time are greater than is required for the Cephalopods. For the isolation of the membrana limitans and the recognition of the connection of the nerve-fibres and the retina cells a strong action of the bleaching mixture is required. The sharpness of the contours of the retina cells is said to be retained by mounting the preparations in castor oil, and the isolation of the membrana limitans is accelerated by transferring the bulb from the acid to weak spirit (about 50 per cent.). By this treatment the vitreous body and the lens swell up, while the membrana limitans remains unaffected.

Preparing Spermatic Elements of Cockroach.*—Prof. v. la Valette St. George recommends for the examination of the spermatic elements of the small cockroach (*Blatta germanica*) a fluid which unites the properties of not being harmful to cells, and that of staining certain cell-parts deeply. This is iodized serum, rubbed in with dahlia and filtered. The amniotic fluid can thus be replaced by another indifferent fluid. Dilution of pure nuclear-staining media with iodized serum did not give favourable results. For fixing the tissues the author used the mixtures recommended by Gilson and Carnoy, and with the same result, and also Flemming's fluid.

Preparing Acœlous Rhabdocœla.†—M. Y. Delage, as reported *ante*, p. 790, has demonstrated the presence of a distinct nervous system in acœlous Rhabdocœla, the absence of which has hitherto been considered as characteristic. His methods are as follows:—

1. Staining with gold chloride. (*a*) Examination of the whole animal. Fresh *Convoluta* are placed in a watchglass filled with sea-water. The greater part of the latter is removed and replaced by one-third formic acid. After two minutes the formic acid is displaced by a copious quantity of a 1 per cent. solution of gold chloride acting for 10 to 12 minutes. From the gold solution the *Convoluta* are transferred to a 2 per cent. solution of formic acid in which they remain in the dark for one to three days. The progress of the reduction of the gold must be watched. The author considers it to be advantageous to allow the staining to proceed to complete violet or even non-transparency and to decolorize slowly by means of a 1/2 per cent. solution of cyanide of potash (2 to 24 hours). The effect of the last reagent is interrupted by a 2 per cent. solution of formic acid. By this treatment all the tissues are stained violet, the nervous system first, as it is the last to be decolorized. Mount in glycerin or balsam.

(*b*) If the author intended to cut the animals, he crushed them gently on a slide and allowed some one-third formic acid to run under the cover-glass. This altered the form of the *Convoluta* as little as possible and kept them extended. Further treatment was as above. From the 2 per cent. formic acid, the author passed them into 60 or

* Arch. f. Mikr. Anat., xxvii. (1886) pp. 1–12 (2 pls.). See this Journal, *ante*, p. 590.

† Arch. Zool. Expér. et Gén., iv. (1886) pp. 109–60 (2 pls.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 239–41, and this Journal, *ante*, p. 796.

70 per cent. alcohol for a quarter of an hour; half an hour in 90 per cent. alcohol, and three to four hours in absolute.

Imbedding in paraffin. Unfortunately this method is uncertain, and does not allow the finer structure of the nervous system to be studied. The zoochlorella retain, and this is a great advantage, their green colour.

2. After the author had convinced himself of the existence of a nervous system, he tried many dyes without result, but attained his object by the simultaneous action of osmic acid and carmine. For this purpose he heated a strong solution of carmine in ammoniated water in a water-bath until red clouds on the surface of the purple fluid arose. This shows that the excess of ammonia has disappeared. After cooling, an equal volume of a 1 per cent. osmic acid was added to the carmine solution, and filtered under a bell-jar. A red fluid, smelling strongly of osmic acid, was obtained, and this served at once as a fixative and staining agent. The animals, placed alive in the fluid, remain there for a half to twelve hours, and are then transferred to 90 per cent. and finally to absolute alcohol. After some days the osmic acid odour disappears and along with it the fixative power, but the staining capacity of the fluid remains undiminished. It is then necessary to fix objects to be examined in a 1 per cent. osmic acid for two to ten minutes. The staining is as follows:—The cell plasma is but slightly stained; the cell membrane stands out sharply, the nuclei and nucleoli appear red or rose. Fat-drops are black or grey; the cilia a pale red. The zoochlorella retain their greenish hue.

The author found iron sulphate to be an excellent fixative. In a concentrated solution the animals die extended without change of form. In order to save time, six to twelve *Convoluta* were cut at once. With this intent the *Convoluta* are taken from the paraffin dissolved in chloroform, to a glass plate coated with a thin layer of oil, and arranged as desired. The plate is then placed carefully in a bath of tepid paraffin, and after cooling, the whole are cut together.

Preparing Rotatoria.*—Dr. L. Plate, in his researches on the natural history of the Rotatoria,† used the following methods:—

The animals are immersed for 10 to 15 minutes in a 1 per cent. solution of osmic acid; they are then washed and transferred for a day to a 2 per cent. solution of chromate of potash, after having been well washed they are stained for 2 to 24 hours in borax or picrocarmine. Then alcohol with hydrochloric acid, and finally 60 per cent. alcohol.

To obtain the animals with extended wheel apparatus, the author used (1) a saturated solution of picro-sulphate of potash, 1 part, and water 40 parts. They are then placed in a watchglass filled with the fluid, which (2) is heated until bubbles appear. A few unfolded examples will always be obtained.

Mounting Spicules of Gorgonia.‡—Mr. A. C. Cole states that to make nice slides of spicules of *Gorgonia* a portion of the *Gorgonia*

* Jen. Zeitschr. f. Naturwiss., xix. (1885) pp. 1–120 (3 pls.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) p. 239.

† See this Journal, *ante*, p. 76.

‡ Cole's 'Studies in Microscopical Science,' iv. (1886) Sec. 4, p. 7.

must be boiled in liquor potassæ. When the axis of the skeleton is left bare the detached and clean spicula are to be poured off into a large test-tube and washed over and over again in distilled water until all debris is got rid of; they are then to be dried and put into perfectly clean dry bottles. A thin glass cover is to be cleaned, and a solution of 12 to 15 drops of strong gum-water in 1 oz. of distilled water (filtered) is to be prepared, and a drop of this spread carefully over the cover and *allowed to dry* (not dried by heat), put away under a glass shade, or in a case impervious to dust. When the gum solution is dry it is to be breathed upon until the surface is quite moist, and a piece of fine muslin, which will just allow the spicula to pass through its texture, being strained lightly over the neck of the bottle the spicula are to be scattered evenly (as from a pepper-castor) over the adhesive surface; after a minute the cover is to be taken up by means of forceps and tapped upon a sheet of paper until all non-adherent spicula are shaken off, when balsam is to be applied.

"Dry" mounts of spicula may, of course, be made in the same way; the cover, with the spicula attached to it, being secured to the bottom of the cell. The advantage of this method is that the spicula are firmly attached to the cover, and all lie upon one plane.

Preparation of Anthozoa.*—Prof. M. Braun has made some experiments on *Alcyonium palmatum*, *Caryophyllia cyathus*, and other Anthozoa; he treats them with a concentrated solution of corrosive sublimate in sea-water, which he boils, and to which he then adds four or five drops of a 1 per cent. solution of osmic acid to 20–25 c.cm. of the solution; this is suddenly poured over the Anthozoa. After five minutes the fluid is drawn off, and the specimens washed with sea-water, and then gradually treated with alcohol, beginning with 30 per cent., and ending with alcohol of 96 per cent. solution. *Hydra*, rotifers, and Polyzoa may be treated in the same way, and then preserved in Canada balsam, or be imbedded in paraffin and cut into sections; the preservation of the tissues will be found to be perfect.

Prevention of browning in Plant Preparations.†—Dr. H. de Vries finds that the browning of vegetable preparations depends on the reduction of certain colourless substances (chromogens) by the oxygen of the air. In order to prevent the appearance of this brown staining the air and chromogenous substances are removed, the former in boiling alcohol, the latter by extraction in acidified solutions of spirit in water. The latter solution is preferable for most leaves and stalks, the former for thin delicate leaves and for flowering parts. The acids used are sulphuric or hydrochloric in 2 per cent. solution, and the treatment lasts for some hours to several days.

To remove the brown stain from vegetable preparations the author employed the following solution:—100 c.cm. spirit, 0·2–0·5 strong

* Zool. Anzeig., ix. (1886) pp. 458–9.

† Maandbl. voor Natuurwetensch., 1886, No. 1 (7 pp.). Cf. Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 280–1.

sulphuric acid, and a few crystals of chlorate of potash. Stronger solutions had no greater effect.

Preparing Fucus vesiculosus.*—For the demonstration and fixation of the cells of the filaments on which the spermatozoid cells exist as end-cells, Dr. J. Behrens used osmic and picro-sulphuric acid, also iodine water and bromide vapour, and for staining, Schneider's acetic-carmine. For the observation of nuclear fission in the antheridium cells, carmine staining is not especially favourable. The processes in the spores and perispores must be studied in fixed material; picro-sulphuric acid, bromide vapour, iodine water, boiling water, chrom-osmic-acetic acid serve as fixative media, and in rare cases alcohol and 1 per cent. acetic acid. Bromide vapour and boiling water are the most convenient agents as they do not necessitate any washing out afterwards. After staining, the objects are placed in dilute and finally in absolute alcohol. When perfectly dehydrated, they are cleared in clove or turpentine oil, and mounted in balsam or dammar.

In order to render visible what had happened in the spore after the penetration of the spermatozoids (occurrences hitherto unobserved and invisible in the living spore by reason of its opacity), the author mixed fresh spores with spermatozoids in a hollow ground slide, and after some moments the spores were killed, usually with iodine solution, and then stained and cleared up.

Separating Desmids, Diatoms, and other minute objects.†—Mr. C. L. Wilbur uses for separating desmids and similar objects from the foreign matter with which they are associated in nature, a set of suction-tubes, five in number, increasing and decreasing in fineness from No. 3, which is large enough to comfortably admit a *Cosmarium tetraophthalmum*. These are ranged on a small wooden rack placed on a box of convenient size at the right of the Microscope and are fitted in, as needed, to a small flexible white rubber tube; this fits over one of two glass tubes put tightly through the stopper of a 1-oz. wide-mouthed bottle, and to the other tube is fitted a second one of rubber which is held in the mouth while at work or fitted to a convenient mouth-piece. The tubes are filled with water on beginning work to a height sufficient to satisfy capillary attraction. Then, working e.g. under a 1 in. objective and B eye-piece, the point is brought nearly to the surface of the pool on the slides and moved to and fro horizontally till shadow is seen in the field, thence quickly brought with the point close to the object. After a little practice the proper point can be inserted and instantly brought to the object without taking the eye from the field. It can now be sucked in and transferred to little pools of 50 per cent. glycerin on a collecting slide, parcelling off like forms, different sizes, &c., or, by alternately expelling and drawing in the breath, the object can be rolled over and over by the current from the tube, thus showing all sides.

The author ordinarily takes samples with a small pipette, places

* Ber. Deutsch. Bot. Gesell., iv. (1886) pp. 92–103.

† The Microscope, vi. (1886) pp. 169–71.

them on the slide and spreads out and breaks up foreign gelatinous masses with a curved glass needle set in a match-stick as a handle. It is useful to give a preliminary running over with 50–100 diameters for larger forms, and then, taking care that the pool is shallow enough to avoid contact with the objective, and occasionally replacing water lost by evaporation, run down with 1/4 in. or 1/8 in. objective and take out the smaller species. Finding, for example, a *Pediastrum tetrus* or small *Cosmarium* under the higher power, turn on the 1 inch (a nose-piece is indispensable), run back, remove the small speck and place him in the little pool containing his brethren that have gone before him. *Docidium* and long strings of filamentous desmids are safely taken up by holding the tube in the direction of their length and expelling them with the tube held nearly horizontal to avoid injury from flexure. A very little experience will enable the beginner to transfer with certainty, ease, and rapidity any object he can make out under 250–500 diameters.

This method is of course equally applicable to separating diatoms or any minute objects which it may be desirable to preserve. Mosses, &c., too large to enter the tubes can be sucked against their ends and there held while being transferred. Further, in microchemistry, minute crystals can be taken up from plant sections, moved to a clean portion of the slide (or better, to a piece of thin cover-glass held in a match-stick handle which admits the application of heat when needed) and then treated with solvents, &c. For the use of reagents, in order to avoid the undue multiplication of tubes and the contamination which would result from using the same tube for more than one reagent, the author uses little *test-points*—formed by drawing out small glass tubing—with bulging body and short tapering shank, which is inserted in a small hole passing through a cork stopper, which closes a glass tube (3 in. × 5/16), the other end of which is drawn out and cut off to admit of substitution for a fishing tube. The points are kept on a convenient tray or large watchglass, and being charged with various liquids, permit the ready and perfectly controllable application of any test or stain to very small quantities of matter. Precipitates can be formed, redissolved, &c.

The desmid tubes, test-points, &c., can be fashioned by any one after a few minutes' practice from small glass tubing by aid of the blow-pipe. A common kerosene lamp furnishes a good enough flame for the purpose. To prevent blackening of the tubing (containing lead) it must be kept out of the inner, luminous reducing flame.

Collection and Treatment of Living Diatoms.*—Herr E. Debes recommends the following articles as the necessary equipment when in search of diatoms :—A bag or travelling satchel ; a number of wide-necked glass bottles, with glass, cork, or caoutchouc stoppers. These should be of two sizes, the larger, 1/3–1/2 litre, the smaller 1/6–1/4 litre ; a flat 4–6 in. net of thick gauze, fine book muslin, or any other not too coarse tissue ; a tin spoon fitted with a screw, as well as a telescope-stick, if possible, to which both can be screwed on. Also

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 27-38.

an ordinary metal spoon, and most important of all, a Thum's "Algen-sucher" pocket Microscope, which has a magnifying power of 150–180 times, with the necessary glass plates and some linen rags for cleaning them. Parchment-paper and guttapercha will also be found useful for packing up things. It is scarcely necessary to say that owing to the habitat of diatoms waders may be needful.

Collection should be made, if possible, on a summer day. Water plants, stones, and any other substances seen lying in water, especially in early spring, are to be carefully scrutinized for a brownish-coloured coating. If the Microscope reveal their yellow cell contents, the brownish layer may be removed with the finger to the collecting bottle. When the diatoms are found as a soft brownish or blackish scum on the water bottom, this is scooped up with the net, and after draining, is removed with the spoon to the collecting bottle.

The coarser impurities are removed from the material thus collected by straining through a hair sieve into flat ve sels, so as to produce a layer of $1\frac{1}{2}$ to 2 cm. This is set aside in a cool, shady place and covered over with about 1 cm. of water. In one or two days the surface of the muddy layer will be found covered with living diatoms, while the dead and certain varieties unaffected by light, remain buried in the mud. This characteristic may be taken advantage of to procure a pure cultivation of diatoms by merely placing the vessel in the sunshine, when in a short time the diatoms struggle to the surface, forming a delicate scum, which is easily removed for examination or for preservation in alcohol. If the residue is required for further cultivation it is supplied with fresh water, and then placed aside in a cool and shady place. Those forms which do not rise to the surface, but are disseminated throughout the mud, are to be obtained for examination by boiling the residue with clean water and decanting off the fluid.

Another method, which gives better results, but which requires more time, is, after the sifting and the development of the diatoms, to decant off the water, and then keep the mud surface moist by spraying. In four to six days the mud layer has become so consistent that the diatoms may easily be stripped off the surface with a brush. Certain species adhering to water plants, stones, &c., are obtained by sifting from larger impurities, and allowing the water to settle, only brushing the diatoms off. These are preserved either with the objects on which they are found, or the whole collection may be boiled with dilute nitric or hydrochloric acid, and then filtered off to be preserved in the usual way.

For the cultivation of diatoms it is only required to place the mud collections in flattish vessels in a cool airy place, sheltered from the sun, and covered with a thin layer of water. A constant change of water, the stream of which must not be too strong lest the diatoms be washed away, and kept at a level of 1 cm. high, is extremely useful to the cultivations, which, with care and attention, will last for an indefinite period. About every 14 days it is necessary to stir up the mud layer thoroughly, in order to bring the diatoms into contact with

fresh layers, and it must be always kept in mind that once allowed to dry the whole cultivation is ruined.

In most cultivations a constant change of the varieties takes place, one form driving out another, and this in its turn being supplanted by a new variety. As a rule the more motile forms spread over the less mobile, and the former may therefore be easily removed by means of a brush.

Mounting Diatoms.*—Señor A. Truarn y Luard gives, in his work on the diatoms of the Asturias, a new and original method for mounting.

Egg-albumen is mixed with its own weight of distilled water, and with 5 grms. of pure ammonia. The mixture having been beaten to frothing, is allowed to stand for 12 hours. The clear fluid is then decanted, filtered, and preserved. The addition of ammonia prevents decomposition for a period of one or two months. Coating the cover-glass with the fluid, arranging the diatoms, and fixing them by breathing over them, is performed with exactitude by the use of this gelatin solution. To close the preparation, the cover-glass is placed on a metal plate, and heated to a degree sufficient to coagulate the albumen. Preparations obtained by this method are extremely clear and brilliant.

Mounting Isthmia.†—Mr. R. Hitchcock, in reference to a remarkably pure gathering of *Isthmia nervosa* attached to seaweed, points out that by the exercise of some skill and patience their natural beauty may be brought out far better than is often seen; and he remarks that there is "a fine art in mounting microscopic objects that many of the more stolid investigators affect to despise; but so long as the specimens are not distorted, misshapen, or crushed out of their natural condition, they lose nothing for purposes of study by being skilfully prepared for exhibition."

The usual method of mounting *Isthmia* is by drying the frustules, either on the seaweed or, freed by shaking, on an opaque ground. In this way, exercising some care in selecting the most showy groups, very attractive specimens can be obtained. A dry mount of the free frustules can be greatly improved by previously clearing them, or rather removing the dried endochrome. The best way to do this is to place them for a few minutes in a bleaching solution which may be chlorine water, Labarraque solution, or any such active agent. No acid is required. In the course of fifteen minutes the frustules will probably be quite white, and, owing to the air contained in them, they will form a perfectly pure layer floating at the top of the fluid. It is then only necessary to remove the solution below by means of a pipette or siphon, wash several times with water, drawing it off in the same way, and finally collecting the diatoms in a bottle with some alcohol for preservation. They are now perfectly clean, and white as snow.

To prepare a dry mount select a clean cover-glass and place a

* An. Soc. Españ. Hist. Nat., xiii. (1884) pp. 307–64 (4 pls.).
† Amer. Mon. Micr. Journal, vii. (1886) pp. 148–9.

sufficient number of the cleaned diatoms with water upon it to form a perfectly even layer of the diatoms over the central part of the cover. As the water evaporates the frustules will gather close together and form a compact mass in a single, uniform layer, perfectly adapted for a display slide. An exceedingly thin and clear solution of gum may be used in this operation to attach the frustules more securely. When thoroughly dry, cement the cover-glass over a ring, just deep enough to protect the diatoms, preferably with a dead black bottom.

This particular diatom, however, is a far more brilliant object when mounted in balsam and viewed with a dark field. It is likewise one of the most difficult to mount in balsam, owing to the persistence with which the air is retained within the frustules. A mount in balsam of the diatoms attached to the seaweed as they grow can be made by the method devised by the late Charles Stodder. Selecting a perfectly dry specimen, place it in chloroform for a short time, and, if necessary in order to remove all the air, heat the latter gently. In this way the frustules become filled with the liquid. Then place some drops of chloroform on a slide, transfer the specimen selected for mounting to this, and keep it covered with the liquid. It is well to put on a cover-glass to prevent rapid evaporation of the liquid. Then add chloroform balsam and let it run under the cover and follow the chloroform as it evaporates from the frustules, aiding the operation with gentle heat. In this way the hollow frustules can be completely filled with balsam without difficulty, and the mounts thus obtained are very fine.

In mounting the free frustules in balsam we have adopted a plan somewhat different in detail, in order to obtain a perfectly flat and even layer of frustules against the cover-glass. The cleaned specimens in considerable abundance were first placed in chloroform in a small vial, and raw, hard balsam added until a not very thick solution was obtained, which thoroughly permeated the cells. The solution was poured upon a cover-glass resting on a mounting table, with a spirit-lamp beneath. In a short time the frustules settled down upon the cover-glass and formed an even layer. The closer they are the more effective the result. Heating now, very gently indeed, the balsam becomes slowly hardened without distributing the diatoms. If necessary, more balsam can be added, but if possible, a sufficient quantity should be put on at first, as the addition of more is likely to disarrange the specimens. The balsam must be thoroughly hardened, without heating enough to discolour it. We now have the frustules nicely mounted in the balsam on the cover-glass, and the latter may now be turned over and attached to a ring on a slide, and the mount thus finished. It will be greatly improved, however, by the well-known process of backing with black varnish. First put on a layer of shellac over the balsam to protect it from the action of turpentine, and then apply an opaque layer of black varnish. When this is thoroughly dry, mount the cover-glass on a ring, and it will make one of the finest objects in any cabinet.

Micro-chemical reactions of Lichens.*—Dr. E. Bachmann has made some preliminary micro-chemical experiments on lichens for the purpose of obtaining from the pigmented parts reactions which may be applied as tests for determining the position of these cryptogams.

The black apothecia of many crustaceous lichens he finds is due, not to one black pigment, but rather to four different pigments, one brown and three blue or green-blue. These are distinguished by certain characteristics which are epitomized thus:—

A. If the addition of potash solution causes little or no change in the pigment, but (*a*) when nitric acid is added to excess a copper-red coloration, confined to the surface, results, this shows the presence of Blue i. (*b*) If, however, on the addition of the nitric acid a violet hue penetrating as far as the colourless hymenium results, then Blue ii. is indicated.

B. If the addition of the potash solution is followed by the appearance of a deep violet colour, then Blue iii. is present.

The author's method consists merely in treating sections of the apothecium with a potash solution or some other strong base, then over-saturating with nitric acid, and lastly, allowing a solution of calcium chloride to flow under the cover-glass (strength of solution not given). The reaction is also obtainable from crushed preparations, provided that the sub-hymenial tissue is not pigmented.

Demonstrating Glycogen in the Basidiomycetes.†—Dr. L. Errera states that not only can the presence or absence of glycogen in Basidiomycetes be determined, but that by iodine staining the approximate quantity is also ascertainable.

The solution used is composed of H^2O, 45 grm.; iodide of potassium, 0·3 grm.; iodine, 0·1 grm. After placing a section in a large drop of this solution the cover-glass is imposed, a little water added, and then the slide heated until it feels rather hot to the hand. If glycogen be present in extremely small quantity, the coloration is rather orange than brown, and a somewhat more concentrated iodine solution may be used.

Demonstrating the Nucleus in Yeast Cells.‡—Dr. A. Zalewski demonstrates the nucleus by keeping the cells in water for some hours, and then treating with hæmatoxylin and alum solution. In ripe spores the nucleus is also easily shown. In budding and spore-forming cells the nucleus is not discoverable.

Imbedding Fish Eggs.§—Mr. J. A. Ryder's method of imbedding fish eggs which have been coloured *in toto* with borax carmine, or borax picrocarmine, is as follows:—

a. After dehydration with about forty times their own volume of

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 216-9.

† Mém. Acad. R. Sci. Belg., xxxvii. (1885) 50 pp.

‡ Verh. u. Ber. d. Krakauer Akad. d. Wiss., xiii. (1885). Cf. Bot. Centralbl., xxv. (1886) p. 2.

§ Ryder, J. A., 'On the preservation of Embryonic Materials, &c.,' 1884, p. 15. Cf. Whitman's 'Methods of Research in Microscopical Anatomy and Embryology,' 1885, pp. 101-2.

strong commercial or 97 per cent. alcohol, and afterwards saturated with oil of cloves, the embryos are placed in a watchglass containing a melted mixture of chloroform and paraffin in equal parts, in which they may remain twenty or thirty minutes at a temperature not above 150° Fahr. When saturation is complete, the eggs have the same appearance in the melted mixture as in alcohol.

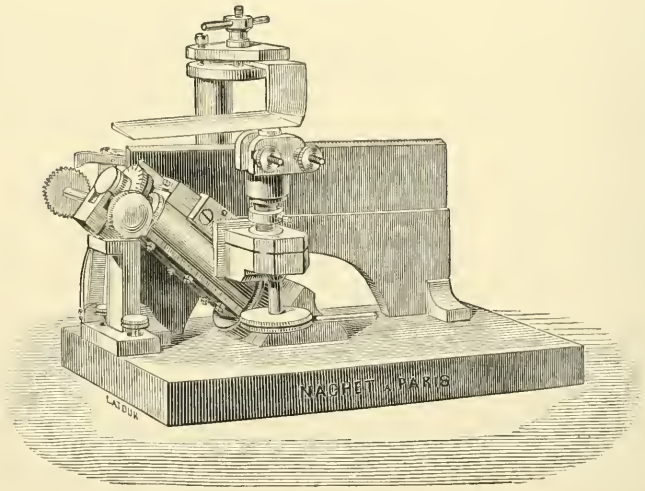
b. From the above they are transferred to another larger dish, containing pure paraffin, which melts at 158° Fahr., but which must on no account be allowed to boil. Here they remain for twenty to thirty minutes more.

c. The embryos are then transferred, one or two at a time, to a common slide, such as is used for mounting objects. The slide may be warmed over an alcohol lamp. A brass ring, 5 to 8 mm. deep, and 24 mm. in diameter, is then placed on the slide around the object. This ring is then filled with melted paraffin, and the object arranged in it in the desired position, with a hot needle, when the whole is left to cool.

d. After cooling, the paraffin contracts within the ring, when the latter may be removed, and the discoidal block may then easily be loosened from the slide. The block may then be trimmed down with a scalpel, into a shape suitable for fastening into the well in the carriage of a sledge microtome, or the block may be marked and laid away until it is wanted for use.

Nachet's Microtome.—This microtome (fig. 238) is distinguished

Fig. 238.



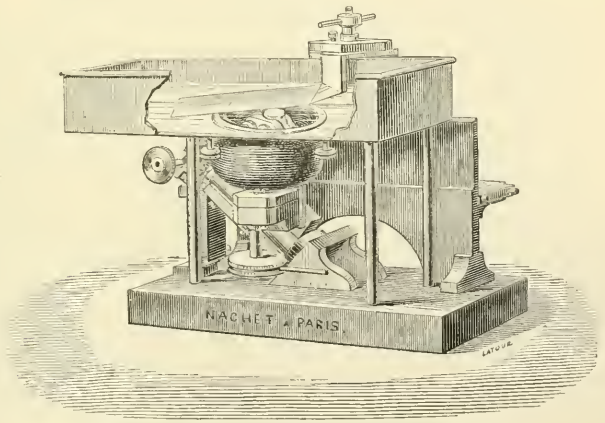
from previous models by several innovations. The knife-carrier slides on an agate plate and is provided with four points of agate to

reduce the friction; two fine rollers under the agate plate assure the perfect contact of the carrier with the sliding plane.

The object-carrier is attached to an elevator which is raised and lowered by the same mechanism as the slow motion of Continental Microscopes. This is inclined so as to reduce the elevation and allow of sections being made as fine as the knife will cut or the nature of the tissues will permit. Special mechanism prevents loss of time in the screw, and the thickness of the section is exactly indicated by graduations on the milled head. At each traverse of the knife the object is raised automatically as the knife-carrier strikes against the end of a lever-arm which catches in the teeth of the wheel shown in the figure, and which by means of a tangent screw at the other end of its axis turns the micrometer screw and raises the object 0·002 mm. If it is desired to raise the object to a greater extent the knife-carrier must be made to strike the end of the lever a second or third time, according to the height required.

The microtome can also be used to cut sections in alcohol by a very simple and entirely novel addition. A metal tray having an aperture in the centre, over which a piece of indiarubber is stretched, is placed on supports, as shown in fig. 239. The indiarubber is pierced

Fig. 239.



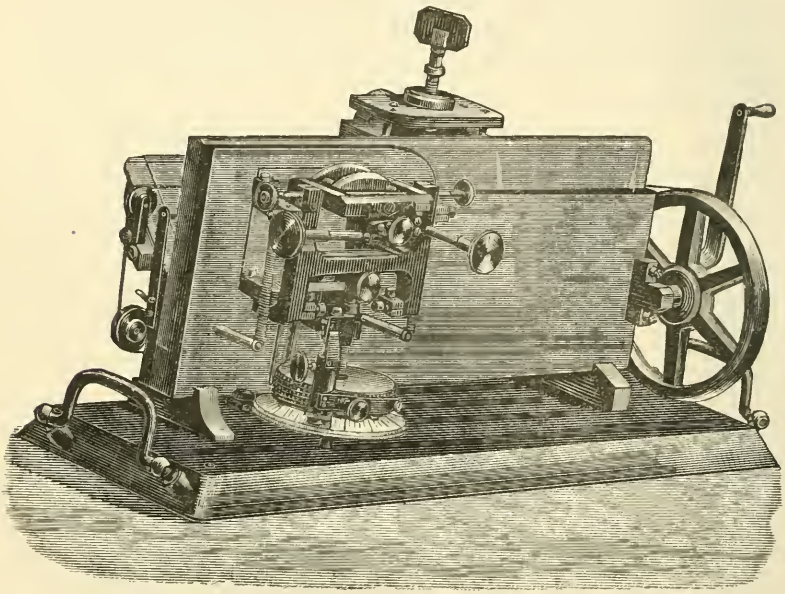
with a small aperture in which the vertical rod is applied which supports the object-carrier, the edge of the rubber is then clamped by a special arrangement which forms a kind of annular drumhead of it and prevents leakage of the fluid. The object does not project above the bottom of the tray which is filled with alcohol.

In order that the knife may work easily in the tray, the blade is set on an angle-piece so that it is 3 cm. below the handle. The movements are thus left quite free; the tray is in contact with the

elevator only by means of the piece of indiarubber, which is sufficiently elastic to allow of the few millimetres of play required by the slow motion. The object-carrier is a simple double screw vice; it is mounted on a ball-and-socket joint of diameter sufficient to provide an active surface of 12 square cm., by means of a tightening screw with lever, by which it can be rigidly fixed; and when the object to be cut is inclined, it remains always close to the axis of the clamping mechanism. The object-carrier may be readily replaced by a freezing-stage.

Schiefferdecker's New Microtome.*—Dr. P. Schiefferdecker's instrument, of which a general view is given in fig. 240, consists of a heavy stand A (fig. 241), upon which are two blocks B, supporting the plates D and C. The upper part of the latter forms part of the slide-way. Between C and D is interposed a thick glass plate E,

Fig. 240.



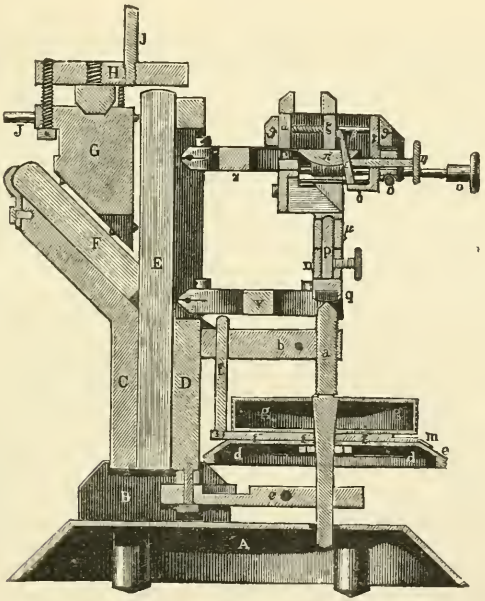
while on the oblique part of C is fixed a similar glass plate F. In the angle (45°) between E and F runs the body of the knife-carrier G, which is separated from the glass plates by ivory knobs, four to each surface. Above the body G is the knife-plate H, connected by three screws with G. This plate and the body are separated by a block for giving an inclination to the knife. The upper surface of the

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 151–64 (4 figs.).

plate H is seen (fig. 242) to be perforated by holes, the larger of which are intended for fixing the knife in different positions. The rods J J are for the purpose of supporting extra weights, to be attached when additional weight is required for the carrier, and the holes J′ in the plate (fig. 242) are for altering the position of the rods in case they interfere with the knife.

The apparatus for the object-carrier and its motor is somewhat

Fig. 241.

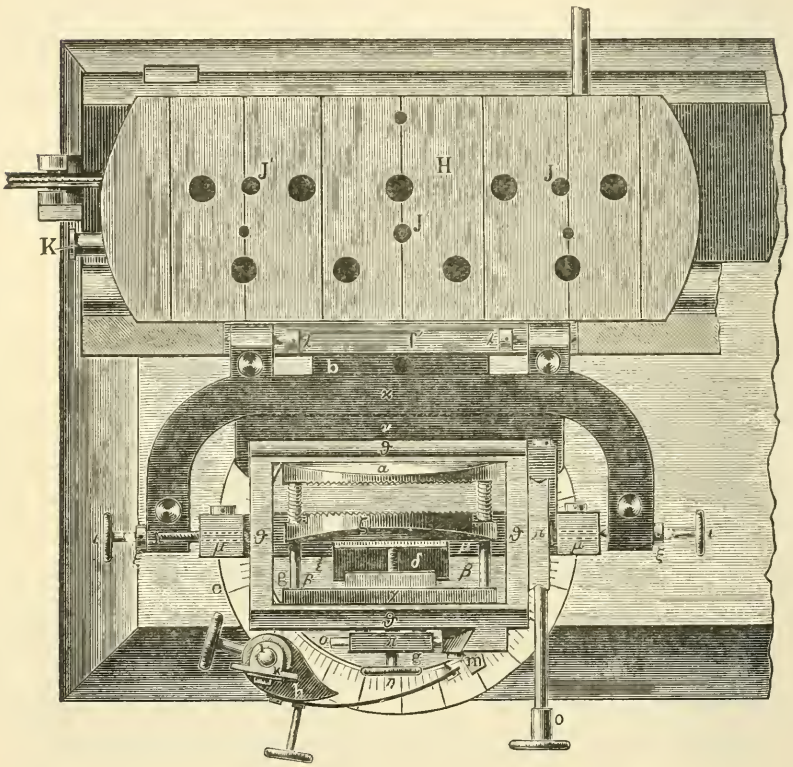


complicated. The section-holder $\alpha\,\zeta\,\gamma$ (fig. 242) consists of a clamp with two jaws $\alpha\,\zeta$, the serrations of which point to the left, in order to oppose the course of the knife. The bars β are fitted with spiral springs, and their action is opposed by the screw η working against the plate ϵ, which in its turn presses against ζ. The clamp is fitted within a quadrilateral frame θ, and the latter swings between the upper arms of an H-shaped piece μ through the intervention of the screws ι (fig. 242). The lower arms of μ are fitted to the front ends of a similar shaped piece ν, the hinder ends of which fit into a rectangular excavation of the middle plate D. Both these hinder arms are perforated by screws, the ends of which work against the sides of the excavation in D. The front ends of ν are screwed to the lower ends of μ. The C-shaped piece x is fixed to the upper arms of μ by screws at ξ, while through its prolongations posteriorly the screws λ work against the sides of the excavation in D.

Now though the object-carrier can of course only move vertically, the clamp frame is provided with motion in two directions, viz. from side to side and from before backwards. These movements are effected through the mediation of the endless screws o working against a thread on the half-circles π (figs. 241, 242).

The micrometer-screw a, capable of moving 30 mm., is turned by

Fig. 242.



the large milled head d. This head is marked by 100 radial lines, and as one turn of the screw raises the object 0·5 mm., one division corresponds to 0·005 mm.

The pointed upper end of the micrometer-screw pushes against an agate plate q fixed to the lower end of a rod p, let into the cross-bar of μ; below the latter is a metal case n and a fixing screw. The lower end of a is in connection with the bars b and c, which in their turn are in apposition with D.

The drum g through which the micrometer-screw passes is marked by six lines of holes. A spring-catch supported by a vertical rod fixed to f snaps as the drum revolves.

Fixed to the extremities of x by one end, and by the other to a rod projecting from D, are two spiral springs for the purpose of keeping up the tension of the carrier on the micrometer-screw.

If desired, an arrangement for fitting the instrument for cutting under spirit can be applied, and also for raising the preparation automatically.

Efficiency of the Micrometer Screw.*—Prof. M. Gottschau in reply to Herr Ost's paper,† repeats his previous conviction that micrometers constructed with an inclined plane are not inferior, nay, are superior, to those in which the motion is vertical or lateral; the chief points in favour of the latter are that the knife can be used in its whole length, and that this construction is more convenient than one which necessitates the constant whetting of the knife. With these and other details, Prof. Gottschau does not agree. Dr. A. Brass, who recently made some remarks ‡ on the microtome knife and how to manage it, also shares in the author's strictures. The result of the matter simply is, that the one authority strops, and the other hones. In this connection we may remark that nearly all microtomists seem to differ on the treatment of knives, some advising soft stones, some hard, and with or without the use of the strop.

Use of Methylene-Iodide for Petrographical and Optical Purposes.§—Herr R. Brauns directs attention to the value of this substance both as a liquid for the separation of minerals of different specific gravities, and as a convenient medium for the determination of refractive indices by the method of total reflection. For the former purpose it is well adapted by reason of its high specific gravity (3·33), which is greater than that of Thoulet's solution, and almost equal to that of Klein's solution. The author finds the specific gravity to be 3·3485 at 5° C., and 3·3045 at 25° C., the variation being uniform. For the successive separation of lighter minerals the liquid must be diluted, not with water, but with benzole; it may be readily concentrated again by distilling off the benzole, and is purified by shaking with diluted potash water.

For optical purposes it is particularly fitted by its high index and by the fact that it is not decomposed or diluted by exposure; in these respects having a considerable advantage over Rohrbach's solution. The index of refraction for sodium light is 1·74873 at 5°, and decreases uniformly to 1·73453 at 25°, while the decrease in the index for each ray is equal for equal increments of temperature, but different for different rays, the dispersion (which is considerable) becoming less as the temperature increases.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 14–8.
† See this Journal, *ante*, p. 538.
‡ Ibid., p. 706.
§ Neues Jahrb. f. Mineral., Geol. u. Palaeont., ii. (1886) pp. 72–8.

Improved Whitney Section-Instrument.*—Mr. J. W. Queen has improved the simple section-instrument of Mr. J. E. Whitney, described *ante*, p. 539.

A block of walnut with a V-shaped cut or recess (fig. 243) is faced at one end of this recess with strips of plate glass of uniform thickness. It may be used thus without any screw, by holding the stem (or other object to be cut) in the recess with thumb or finger, and advancing it carefully by hand as the end is cut. For nicer work a screw with large milled head is added, which is clamped to the under side of the block in such a way that it may be shifted to set opposite to the centre of the object to be cut, whether large or small, and setting more or less deeply into the groove. There is a cap to fit over the end of the screw to give a broader bearing, and so prevent the screw from sinking into the tissue.

Fig. 243.

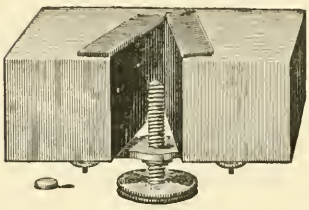
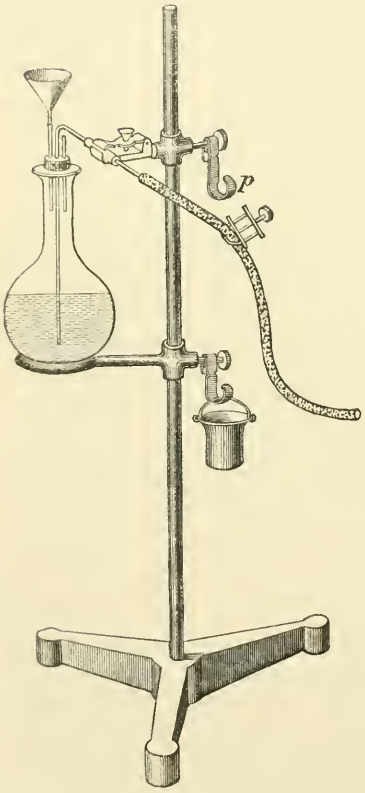


Fig. 244.



Alcoholic Drip for the Thoma-Jung Microtome.†—Mr. W. T. Sedgwick, in conjunction with Mr. G. E. Stone, has devised a very neat siphon drip for the Thoma-Jung microtome.

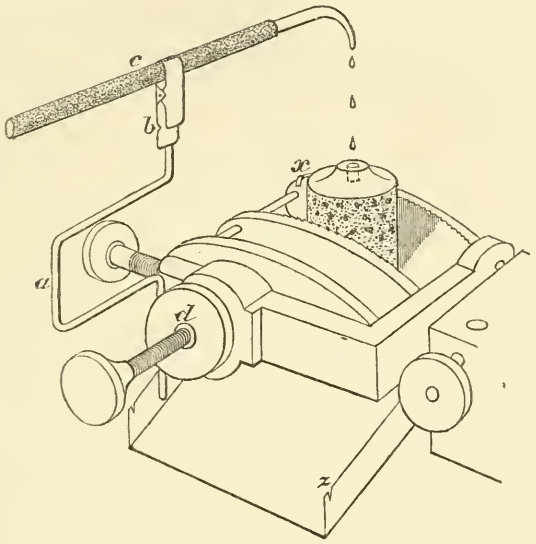
Constant pressure and flow are obtained by the apparatus shown in fig. 244. Fig. 245 shows the end of the flexible siphon tube *c*, fixed by a clip *b* to a stiff wire *a*. The wire is attached to the object-holder by the collar *d*, which is firmly screwed down. The overflow of spirit is carried off by a trough, which is suspended by a hook *x*. The trough fits underneath and behind the object-holder. The notches *z z* are to secure a wire from which a vessel is suspended beneath the trough to catch the overflow. When not in use the tube and wire are hung upon the hook *p* (fig. 244).

* Mier. Bulletin (Queen's), 1886, p. 30 (1 fig.).

† Amer. Natural., xx. (1886) pp. 488–90 (3 figs.).

The convenience of the drip consists in the fact that, being attached to the object-holder, a constant flow of spirit is poured over the object.

Fig. 245.



Schällibaum's Fixation Method.*—Dr. H. Schällibaum has made some improvements in his method for fixing sections to the slide for the purpose of subsequent staining. The alteration occurs after the ethereal oil has been driven off. Then if the object has been imbedded in paraffin, a few drops of xylol are poured over the slide, held obliquely, until the paraffin is completely removed. The xylol in its turn is replaced by 95 per cent. alcohol, and the slide and section are carefully dried. They are then placed in a water-bath in order to completely remove the alcohol.

If the sections have been imbedded in soap, gelatin, gum, albumen, celloidin, or any other alcoholic or watery medium, the slide, after the ethereal oil has been evaporated, is placed for 15 minutes in a 95 per cent. alcohol bath and thence into water, where it remains until all the alcohol is driven off. (An intermediate step between the water and alcohol is advised both for the above and for the paraffin imbedding. It consists in breathing over the dried section several times.)

Staining is always carried out in the same way. After the section has been dried, some drops of the staining fluid are poured on and left until the desired colour is attained. The slide is then placed in a moist chamber to prevent precipitation of the fluid from evaporation. All the ordinary stains, except picro-carmine, may be used, but the

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 209-11.

best is Grenacher's hæmatoxylin. After having been stained the sections are carefully washed and mounted in glycerin or some watery medium.

If it be desired to mount in a resin, the slide is placed in 95 per cent. alcohol for 15 minutes, the section is then dried as quickly as possible, and some drops of origanum oil passed over it. The sections clear in five minutes and then some more origanum oil is applied, or better, some xylol, and these having been displaced, the sections are mounted in resin.

Ehrlich's Hæmatoxylin Solution.*—Prof. P. Ehrlich gives the formula for the hæmatoxylin solution invented by him:—H^2O, 100 c.cm.; absolute alcohol, 100 c.cm.; glycerin, 100 c.cm.; acetic acid, 10 c.cm.; hæmatoxylin, 2 grm.; alum in excess. The mixture is exposed to light until it assumes a deep red colour. The staining power is retained for years. No precipitate ever occurs, provided the vessel is properly corked. If need be, the solution may be employed for double staining.

The author omits to state that sections stained with this preparation should be placed in ordinary (tap) water which is slightly alkaline, not H^2O, in order to bring out the blue colour.

New Staining Method for the Central Nervous System.†—Herr C. Benda hardens small pieces of fresh material in cold saturated picric acid. Hardening is usually completed in two or three days, but longer immersion in the picric acid is not at all harmful. When thus soaked the preparations are hardened again in alcohol. Celloidin appears to have an unfavourable influence on the sections, and paraffin is to be preferred as a saturative medium. Sections, made as thin as possible, are placed for some hours in a solution of an iron salt (the author employed a concentrated solution of iron sulphate), and these after careful and repeated washing in water are transferred to a 1 per cent. watery solution of hæmatoxylin until they become a deep black colour (about 10 minutes). They are next bleached for about five minutes in chromic acid (1 to 2000), washed well in water, dehydrated, and mounted in balsam. This method is stated to give results equal to those of the best carmine and nigrosin stainings; not only are the coarser fibres and their communications with the ganglion cells clearly shown, but the intimate structure of the ganglion cells themselves is made evident.

Action of Methyl-blue on Living Nervous-tissue.‡—Dr. P. Ehrlich has, since his experiments with alizarin blue, investigated the action of methyl-blue on living nervous matter. This staining substance was found to possess an extraordinary affinity for the axis-cylinders, even to the finest ramifications of nerves in the larynx, the eye, and the diaphragm, but not in other parts of the body. Saturation with oxygen and an alkaline reaction of the fibres are the two conditions on which this reaction is dependent.

* Zeitschr. f. Wiss. Mikr., iii. (1886) p. 150.
† Arch. f. Anat. u. Physiol. (Physiol. Abth.), 1886, pp. 562–4.
‡ Deutsch. Med. Wochenschr., 1886, No. 4.

Gold Chloride for Sclerosis of Nervous Tissue.*—Dr. A. Wittig, after hardening in Müller's fluid and in alcohol, transfers the spinal cord to a 2 per cent. solution of gold chloride in alcohol of 47 per cent., wherein the preparations remain from six to eight hours, and are afterwards transferred to a 20 per cent. soda solution. After three or four minutes they are removed from this fluid, drained on blotting-paper, and thereupon are immersed in a 10 per cent. solution of iodide of potassium. In this the sections remain 15–30–45 minutes, and are then washed in water. Clearing up is effected by means of bergamot oil or turpentine-creosote and the preparations are mounted in Canada balsam. In this manner were obtained images in no way inferior to those from Weigert's hæmatoxylin. The medullated nerve-fibres appear dark blue on a reddish ground; the ganglion cells, somewhat less darkly stained, showed clearly the nucleus, together with nucleoli, and numerous processes.

Fixing and Staining Flagellata.†—Dr. J. Künstler did not use, in his researches on Flagellata, alcohol and chromic acid, as these fluids gave indifferent results (except in some special cases, e. g. trichocysts). The best reagent is osmic acid in a very concentrated form; weak solutions and the vapour are unsuitable. The author takes 1 grm. of the pure acid and dissolves it in some cubic centimetres of water. The fluid should have a citron-yellow colour. At the bottom of the vessel is usually some undissolved osmic acid. A drop of the fluid containing the Infusoria to be examined is placed on a slide, and then a drop of the osmic acid solution immediately added. The animals are thereby fixed at once. Before staining the acid is allowed to evaporate to prevent over-blackening. A small drop of the staining fluid (the author used methylen green and a concentrated solution of cyanin) is added to the fluid on the slide, a cover-glass imposed, and then closed with paraffin and wax; or the preparation may be left for 24 hours in a moist chamber in contact with a drop of the stain. Then dilute glycerin is added very sparingly, and the preparation closed as before.

The internal protoplasmic substance of the Flagellata is stained and contracted, but the hyaline sheath remains to show the original form of the animal.

Double-staining Botanical Preparations. ‡ — The following method "B.Sc." has found very successful in showing clear differentiation, besides producing slides of great beauty (he is indebted to Prof. Rothrock for the process).

Immerse the section in a *very, very weak* solution of anilin-green for twenty-four hours (at the end of twelve hours the section will most likely have absorbed all the green, in which case add two drops more of the mother solution). Then take a middling strong solution of Beale's carmine, and dip the section in it for from *one* to *five* minutes only; then prepare with alcohol and clove-oil in the usual way, bedding in dammar, lac, or Canada balsam.

* 34 pp., 8vo, Breslau, 1885.
† Journ. de Microgr., x. (1886) pp. 17–25, 58–63 (1 pl.).
‡ Scientif. Enquirer, i. (1886) p. 33.

Double Staining Vegetable Sections.*—It is found that on lifting thin vegetable sections from one fluid to another, so many times as it it is necessary to do in double staining them, they are liable to get broken, and Mr. F. Beddow suggests the following method as a means of avoiding the difficulty:—

After the sections have been cut and the paraffin removed from them, they should be put in specimen tubes (1 in. long and 7/8 in. wide), and a piece of muslin tied over the mouth of each tube. To bleach the sections the tubes are put in chlorinated soda, or in a bottle containing water, through which chlorine is passed. After bleaching, the tubes (still keeping the muslin over the mouths) should be put in a large basin of water, and the water changed several times, then the different stains can be poured into the tubes and poured out again. The sections can be bleached, washed, put in a mordant, stained with carmine, put in an acidulated water to fix the carmine, stained with anilin green, and cleared in benzol or oil of cloves, without once handling them.

Congo Red as a reagent for free acid.†—According to Dr. H. Scholz, Congo red, a dye easily soluble in water, appears to have no action, even in strong solutions, on the lower organisms. It may therefore be employed to demonstrate free acids which occur as the result of the tissue changes of living microscopical organisms. If Rotatoria be examined in the coloured solution they are seen at first unstained in the red-yellow field of view; afterwards, while the investment, tail, and wheel-organs are unstained, the jaws appear a dark rusty red; the stomach walls assume a blue colour, as also, transitorily, the part between the oral cavity and stomach and the upper part of the exit gut. In *Vorticella* and Infusoria reliable results were not obtained. As the blue colour of the acidly reacting parts could not be elicited by transmission of carbonic acid through the solution it was concluded that some other acid was the cause.

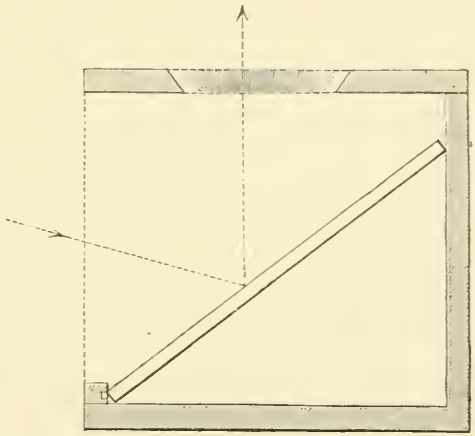
Decoloration of stained Nuclei and Micro-organisms by salt solutions.‡—Dr. A. Gottstein finds that in addition to silver nitrate and potassium bichromate, the decolorizing property is possessed by other salts, such as iodide of potassium, chloride of sodium, the carbonates and sulphates of soda and magnesia, alum, &c. The degree of decoloration depends on the concentration of the salts, and the duration of their action. As well as nuclei, typhoid, pneumonia, gonorrhœa, and putrefaction Bacteria are unstained by these salt solutions. The bacilli of tubercle, lepra, and syphilis are less susceptible than the preceding, and are only deprived of their colour by concentrated solutions. Fuchsin is more sensitive to the decolorizing influence than the violet stains. The reason for the decolorizing action is to be sought in the insolubility of the anilins in the solutions of these salts.

* Sci.-Gossip, 1886, p. 233. † Centralbl. f. d. Med. Wiss., 1886, p. 449.
‡ Fortschr. d. Med., iii. (1885) p. 627.

Obersteiner's Section-finder.*—Prof. H. Obersteiner's instrument (fig. 246) is intended to remove the difficulty often experienced in finding a section which is being stained in a dark-coloured fluid.

The apparatus consists of a simple wooden box about 12 cm. high, 12 cm. broad, and 18 cm. long. One of the long sides, the front, is wanting: in the top of the box is a round hole somewhat smaller than the watchglasses in ordinary use, and cut out in such a way that its upper opening is larger than the lower one. Within the box a quadrangular mirror of about the same length, and of somewhat larger breadth, is placed at an angle of 30° to 40°, so that it looks towards the open side. A small filleting in front serves to keep the

Fig. 246.



mirror in its place. To obtain greater stability, a wood block or any other weight may be fixed within the triangular space behind the mirror.

When used, the apparatus is so placed that the open side faces the window: the watchglass with its contents is placed in the round opening, and by this means sections are easily detected, no matter how dark the staining fluid may be. Under such circumstances much less damage is likely to happen to delicate sections than when fished for in the ordinary way.

Washing Sections.†—Dr. P. G. Unna uses, for washing sections or pieces of tissue, a funnel the spout of which is plugged with cotton wool rammed down tight so that water passes through very slowly. The sections, either alone or tied up in a piece of muslin, are put in the filter and covered over with another layer of cotton wool. Water is then passed through and the filter placed over an empty flask.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 55–7 (1 fig.).
† Monatschr. f. Prakt. Dermatol., v. (1886) No. 3.

The process is improved by means of any apparatus which will supply a continuous current of fluid. It is scarcely necessary to state that other fluids than water may be used for this contrivance.

Histological Technique.*—In "Notes" under this heading, Mr. C. S. Minot makes some very useful and interesting observations, the most important of which refers to the clearing up of celloidin sections.

A mixture of 3 parts of white oil of thyme and 1 part of oil of cloves "clarifies sections very readily and softens the celloidin just enough to prevent the puckering which is so annoying with thyme alone." The author thinks that this process, which is the discovery of Dr. E. K. Dunham, may be improved if the proportions be 4 to 1.

For hardening purposes the author found the use of warmth with Müller's fluid to be inferior to the use of cold. Nitric acid in cases where the specimen is of small size, and especially when it has begun to deteriorate, is said to be very valuable. One part commercial nitric acid (strong) diluted with 9 parts of water, forms the solution in which the specimen is placed for 3 to 5 minutes. It is then transferred to running water for 15 to 20 minutes; 30 per cent. alcohol for 10 minutes; 50 per cent. for 1 hour, and kept in 70 per cent. which is changed daily until it no longer takes on a brownish discoloration due to the acid.

In staining, after giving a formula for a neutral carmine solution, and for an alcoholic eosin solution, with a note on Weigert's hæmatoxylin, the author recommends a picrocarmine made by boiling 1 grm. powdered carmine, with 200 c.cm. of water plus an excess of picric acid for half an hour; allow to stand and cool; decant the clear fluid, add fresh water, and if necessary picric acid, boil, cool and decant, repeat this operation until all the carmine is dissolved. Place the decanted fluid in an evaporating dish, add about 1 grm. thyme oil and stand in a warm place until the volume is reduced to 25 c.cm., let the solution cool, filter, wash out the residue which should be on the filter with 25 c.cm. water, dilute the filtrate with 50 c.cm. water. The solution keeps indefinitely, and gives a stronger differential colouring of the tissues than Ranvier's picrocarmine, but the contrast between the nucleus and the protoplasm is less. "It is, however, made equal and equivalent to the latter (Ranvier's) by adding very dilute ammonia to the picric acid solution until it *begins* to assume a rich wine-red shade which is quite distinct from that of the acid solution."

The article also contain notes (1) on alcohol, in which it is stated that absolute alcohol is an unnecessary extravagance, 96 per cent. being entirely sufficient for all manipulations; (2) on benzole which can be used to replace the much dearer xylol, and (3) on imbedding in celloidin (cf. *ante*, p. 164).

Eau de Javelle.†—Dr. J. H. List, on making serial sections of *Orthezia cataphracta* West., experienced unusual difficulties owing to the brittleness and inequalities of the chitinous investment. To

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 173–8. † Ibid., p. 212.

partially remedy this he tried Eau de Javelle diluted with four times its volume of water. The animals, hardened in Frenzel's or in List's sublimate and picric acid mixtures or in 90 per cent. alcohol, were left in the fluid for 18 to 24 hours. After being well washed they were gradually hardened in alcohol and then imbedded in paraffin.

Thus diluted Eau de Javelle permits good staining (alum carmine and picrocarmine) even though five or six days may be required. Secondly, the chitin loses its great brittleness, and good sections are obtained. Thirdly, no alteration of the delicate structures was observable. In order to render the animals transparent for examination of the parts about the gullet, the author boiled them in the undiluted fluid, but prefers a 10 per cent. potash solution on account of its more speedy action.

Eau de Javelle as a test for very minute Starch particles.*—Dr. E. Heinricher, in commenting on the resisting power of starch to Eau de Javelle, remarks that after acting for four days on the leaves of *Argemone grandiflora* no starch granules were to be found in the cells but that the iodine reaction gave evidence of a starchy paste therein. So, too, leaves of *Crambe cordifolia* showed starch after 24 hours' immersion in Eau de Javelle though all the rest of the cell-constituents were destroyed. If, however, a glass stoppered bottle instead of open vessels be used and put in a dark place, the action ensues more quickly. Hence from destroying the plasmatic substances and the relatively late solution of the starch Eau de Javelle may be considered suitable for the demonstration of the smallest quantities of starch, and the author finds this test, when combined with iodine, to be more sensitive than that recently advocated by Schimper who advised a combination of chloral and iodine.

Resins used for Microscopical Purposes.†—1. *Shellac.*—Dr. O. N. Witt remarks that the conflicting views on the value of shellac are due probably to impurities, although the purest shellac is a complex mixture of different substances, and he endeavours to show that only a part of these constituents possess properties useful to the microscopist.

There are two varieties of shellac, the raw or unbleached, and the bleached. The latter is obtained by removing the colouring matter from the former variety by means of Eau de Javelle and hydrochloric acid. Apart from the colouring matter the two kinds are alike, being composed of three constituents, wax, resin, and a body chemically allied to fat, being the glyceride of an acid, for on dry distillation it produces acrolein. It is the resin, however, which gives shellac its microscopical value, and this the auther obtained by first removing the wax by acting on powdered bleached shellac with petroleum-benzin in the cold. When some of the solution, allowed to evaporate in a watchglass, does not leave a residue of wax the treatment is suspended. The powder, spread on filter-paper, is dried in the air, and the resin obtained therefrom by dissolving it in a *large* quantity of alcohol.

* Zeitschr. f. Wiss. Mikr., iii. (1886) pp. 213–5. † Ibid., pp. 196–206.

The further treatment of the resinous solution varies with the intended application. If a very pure resin be desired it is advisable to let the solution stand in a cool place for weeks, in order to allow any fatty matter to separate out. The solution is then filtered and concentrated by distillation. If only required as a sealing varnish, concentration may be proceeded with at once. According to the author, the resin thus obtained possesses every quality desirable in a mounting or inclosing medium; in toughness, hardness, and permanency it is unequalled, and while quite colourless and transparent, easily takes up anilin dyes of any desired colour.

When used for mounting the shellac resin is dissolved in iso-butyric-alcohol, as ordinary spirit is found in practice to be too hygroscopic.

2. *Storax.*—Fluid storax as it occurs in commerce is a thick, viscid opaque mass, with an agreeable smell and a mouse-grey colour. The opacity is due to numerous drops of water and solid impurities which are removed by dissolving the balsam in three or four times its weight of ether, and leaving the solution in contact with calcium chloride for some days. By filtration and distillation over a water-bath pure fluid storax is obtained. The following bodies are found therein:—(1) styrol; (2) cinnamic acid; (3) ethyl-vanillin; (4) styracin; (5) cinnamic methylate; (6) cinnamic ethyl-propylate; (7) two bodies of unknown constitution, α and β storesin; (8) a resin. The last five bodies may be considered the actual constituents, as the first three only appear in very small quantities, and after being kept for a long time, constituents 5 and 6 disappear; but this disappearance is unaccompanied by any diminution in volume or weight. The reason of this the author afterwards explains. In order to separate the fluid from the solid constituents, the storax is treated with petroleum-ether (boiling point 45°–50° C.). The solid residuum is placed in glass bulbs, and petroleum-benzin poured over. After being well shaken up it is allowed to stand until the solution separates into two layers, when the colourless solution is poured off. This treatment is repeated thrice, and then by distilling off the petroleum-benzin, a colourless oil of a high refractive index is obtained.

When dry the resin becomes quite hard, but is still brown, and to deprive it of this colour it is treated with about five times its weight of pure benzol, and then petroleum-benzin added slowly until the fluid becomes the colour of hock. Having settled, it is filtered, and the solvent distilled off from the filtrate. As an imbedding medium the resulting substance is faultless. Its refractive coefficient is that given by Van Heurck. It is of a dark yellow colour in bulk, but colourless in thin layers. When cold it is perfectly solid, and although its melting-point is lower than that of Canada balsam, it is quite brittle when exposed to the hottest sun.

This medium, for which the name of styresin is proposed, is dissolved for use in turpentine oil and treated exactly like Canada balsam.

The cause of the spontaneous hardening of storax after standing for many years, is associated with the presence of the pure cinnamic

ethylate. This body can also be prepared synthetically by treating a solution of cinnamic acid in ethylic alcohol with hydrochloric acid gas. After standing for months this fluid, at first as clear as water, begins to grow cloudy from the presence of amorphous particles, which by their increase, render the fluid quite thick in the course of years. This appearance is due to polymerism, a condition to which all the derivatives of cinnamic acid are liable. Consequently, after long standing, the quantity of the solid constituents of storax increases at the expense of the fluid.

Carbolated Glycerin-gelatin.*—Señor Lázaro é Ibiza, who has been experimenting with carbolated glycerin-gelatin as a substitute for Canada balsam, remarks that gelatin being much more soluble hot than cold, it is possible to obtain solutions which, saturated at 50°, 60°, 70°, or higher, are solid at the ordinary temperature of museums and laboratories. A piece of this gelatin, slightly warmed on a slide, melts and allows the object to become immersed in it, and after putting on a cover-glass, the gelatin solution solidifies, thus keeping the object in position and firmly fixing the two glasses.

The use of this substance offers two advantages. (1) The point of concentration of the substance is obtained on preparing the solution. (2) Cleaning the preparation is effected by merely washing the edges with a brush and water. The author uses Kaiser's formula:† gelatin 1 part; water 6 parts; glycerin 7 parts. The gelatin is macerated in water for two hours; the glycerin is then added and also pure carbolic acid, in the proportion of 0·01 of the mixture. It is then boiled for ten minutes and filtered while warm.

Apart from its general advantages, carbolated glycerin-gelatin may be recommended for those substances which are dry or but little juicy. The author has found it excellent for the preservation of diatoms, pollen, epidermis, and wood-sections. Moreover, it offers great facilities when preparations are only required for a few days or months, as the slides are easily cleaned by merely washing in water. If the preparation is to be kept indefinitely the edge of the cover-glass should be cemented down, for if not, the gelatin becomes slightly coloured, probably from the volatilization of the antiseptic, and hence the author suggests the substitution of salicylic acid. It is not advisable to use this gelatin mixture for mounting soft objects, the juices of which are easily alterable.

The possibility of obtaining preservative media which are liquefiable at very low temperatures (30·5°) affords the opportunity of preserving algæ and delicate fungi which are unable to resist the disorganizing action required for mounting objects in balsam.

Mounting in Glycerin-jelly.‡—Mr. W. T. Suffolk, a member of the committee appointed to examine the cabinet of the Society, found that whilst in all cases slides properly mounted in balsam were unaltered, the objects mounted in glycerin-jelly had been affected by

* Anal. Soc. Española Hist. Nat., xiv. (1885), Actas, pp. 12–5.
† See this Journal, iii. (1880) p. 502.
‡ 15th Ann. Rep. South London Micr. and Nat. Hist. Club, 1886, p. 13.

shrinkage. If care, however, is exercised, satisfactory results can be obtained with glycerin-jelly. The object should be first soaked in diluted glycerin, and properly deposited in its cell. After the cover is put on, a ring of balsam and benzole should be applied and allowed to harden; the slide is then to be well washed under the tap, and a ring of shellac varnish added. Another washing and another coating of shellac follows, and then the object is to be more permanently varnished with successive coats of gold size laid on as thinly as possible. Slides so prepared will last upwards of 25 years.

Needle for manipulating objects immersed in Canada Balsam.—Mr. J. Joly (B.E. Trinity College, Dublin) writes:—The accompanying sketch (fig. 247) depicts an easily made contrivance, which has been of much service to me in arranging minute crystals in Canada balsam. A warm needle is essential for this kind of work

Fig. 247.

unless the balsam be rendered very thin with a solvent, but the latter plan is inconvenient with lumpy objects, which will soon be left protruding by the very thin balsam, and the addition of more balsam subsequently is very likely to disturb the arranged objects. I found it necessary to work in thick balsam, keeping the needle hot by inserting it frequently in a spirit flame, taking care to withdraw it from the balsam before it had fallen to the solidifying or *thickening* point of the balsam. This was an arduous way of proceeding, and led me to devise a needle which would stay hot without any attention from the manipulator, and the temperature of which would be adjustable.

To this end the needle is so mounted that the current from a small bichromate cell may be passed through a portion of its length, the point becoming warm by conducting heat from the portion traversed by the current. The arrangement will, I hope, be understood from the figure. A wooden or ivory pen-handle is drilled axially to receive a brass wire, one end of which is connected with one of the binding screws affixed at the end of the handle, the other end is split to receive the head of the needle at *d* in the figure. A barrel, with a spring forceps, clips the needle at *c*; this barrel is electrically connected with the second binding screw on the handle by a fine copper wire *a b* let into the handle along its whole length. A current entering at one binding screw traverses the length *c d* of the needle and leaves by the second binding screw.

I find that with this arrangement a needle one-half larger than that figured may be kept sufficiently hot when the plates of a one pint bichromate cell are about one-half immersed; the temperature is adjustable to a nicety by letting down the plates more or less. Very fine spirally coiled wires do for connections and do not interfere with

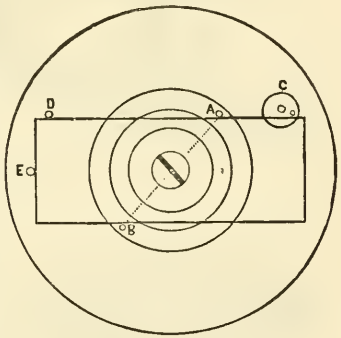
freedom of manipulation. Work may be carried on rapidly, the balsam yielding at once to the sustained temperature of the needle, which moves freely through it, and imparting its heat to the tiny crystals enables them to be turned and examined with much ease.

Griffith Turntables.*—Mr. E. H. Griffith describes two more of his turntables.

The first was described Vol. IV. (1884) p. 826, but has now been improved, and as improved is thus described by Mr. Griffith (figs. 248 and 249):—

The centre of the table, marked with the circles, has a straight spring attached to it beneath. The slide being placed between the two pins A and B in this centre, is partially rotated against the spring and pushed forward, when the spring keys it between the two pins and a third fixed pin D at the upper side of the slide, centering it perfectly for width. The fourth pin E at the left end, 1½ in. from the centre, is for length, and allows the slide to be always placed in the same relative position. The recent improvements add much to the value of the table. One of them is a countersunk decentering wheel and pin C, which may be seen at the upper right-hand side of the slide. The axle of the wheel passes through the table and is furnished underneath with a short bar with which the decentering wheel may be turned, forcing the pin against the slide, pushing it as far out of centre as may be desired. Another improvement is in making the end-pin a screw, which may be turned down out of the way if desired.

Fig. 248.



The second (fig. 250) presents the peculiarity that the spindle is hollow, for illuminating the centre of the slide for mounting purposes.

The table has two grooves A and B, milled across the upper surface, equidistant from the centre F and tending towards a common point beyond. To these grooves are fitted two followers, and to the followers are fastened two thin narrow brass plates C and D, parallel to each other, and which are the slide-holders. The pin E is a small screw, which may be turned back out of the way or used as an end-pin, it being 1½ in. from the centre of the table. The slide may be placed between the two plates C and D and made to abut against the end-pin E. Then if C and D are pushed the same distance in the direction of E they will clamp the slide firmly and centre it perfectly for width. If it be desired to decentre the slide, one of the plates must be pushed farther than the other.

Some years ago General William Humphrey, of Jackson, Mich.,

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 112-3 (2 figs.).

an expert preparer of slides, suggested that an arrangement for illuminating the centre of slides would be of great convenience, and the hollow spindle in this turn-table is the result of the suggested

Fig. 249.

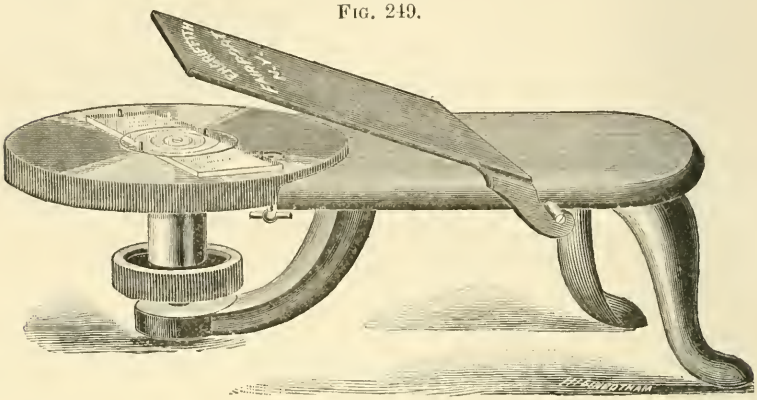
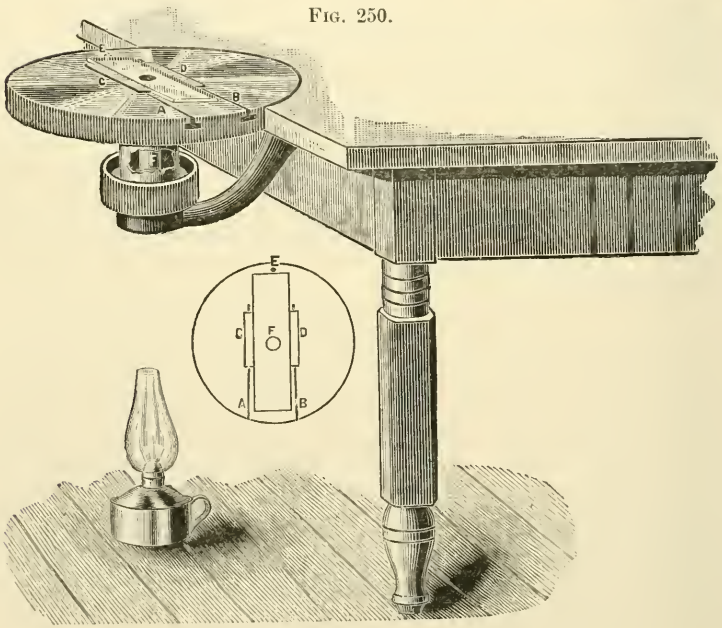


Fig. 250.



need. A small mirror may be placed underneath and the light be reflected through the spindle, or a lamp may be used for the same purpose.

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[Part II. of 'The Microscopical Fresh-water Vegetable and Animal World.']
iv. and 122 pp., 7 pls., 4to, Braunschweig, 1886.

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Sect. II. Animal Histology. No. 3. The Human Penis. Plate III. Penis of Infant, at term × 11.—No. 4. The Penis in the lower Animals. Plate IV. Penis of Dog. Trans. Section × 14.
Sect. III. Pathological Histology. Nos. 3 and 4. Normal Kidney (*contd.*) Plate III. Acute Congestion of Kidney. [Plate IV. ?]
Sect. IV. Popular Microscopical Studies. Nos. 3 and 4. The Sea Fans (*contd.*). Plate III. Spines and Plate of *Palmipes membranaceus*. Plate IV. Marine Alga, *Ptilota elegans*.

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["An interesting and instructive paper, in which he calls the attention of the profession to the great service which the Microscope is rendering in the field of medicine. He also offers several pleasant bits of advice and practical suggestions."]
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[Defence of shellac cement, which is "the only cement that has come into our hands (and we have tried many) that never fails."
"There is another reason why we have so persistently urged its use in these columns, until we doubt not many of our readers are tired of it, and are inclined to regard us as a crank on the subject. The reason is that so many of the best observers and students do not mount specimens for preservation because they have not the time to spare. There is just reason for this if the ordinary methods of mounting in fluids are followed, while Canada balsam is not the proper medium. But by using shellac, a permanent mount, dry, in water, or in glycerin, can be made on a plain slide in five minutes, and it will keep perfect for years."]
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[Describes the methods used by the author.]
Gazeta Lekarska, IV. (1884) pp. 67–72, 87–96, 107–15.

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