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

FRANK CRISP, LL.B., B.A.,

One of the Secretaries of the Society
and a Vice-President and Treasurer of the Linnean Society of London ;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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Ser. II.—VOL. V.

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Both before and during the period of ripe fruits, several species of *Saccharomyces* are found, both in flowers (chiefly in the nectaries) and on the bodies of insects; the former being derived no doubt from insects, who have obtained them either from other flowers, from decaying fruits or other substances, or from the soil, which has been proved by Hansen to be an inexhaustible storehouse of these organisms. A comparatively small number are, however, at any time to be found floating in the air. When the fruits are being first formed the flowers have withered and dried up; if these persist round the fruit, the ferments may reach the latter directly; but these organisms are comparatively rare on unripe and uninjured fruits. As soon as the fruit is ripe, it is attacked by various insects which puncture the skin, and thus convey to the cellular tissue of the leaf the ferments of which they are the carriers; the species thus found being chiefly *S. apiculatus* and *Wurtzii*. But, although this explanation suffices for most fruits, it fails in the case of the grape, the ferments of which are almost exclusively *S. ellipsoideus* and *S. conglomeratus*, species not found on insects or flowers. Of this difficulty the author is not able to offer any satisfactory explanation. With regard to fruits in general, it may be stated that in the autumn the ferment is present everywhere on ripe fruits that have been in any way injured; after they have fallen, the organisms are preserved partly on the débris of the fruits, partly in the soil, where they hibernate. From the commencement of spring they are carried by insects to flowers, and finally from them to the ripe fruits.

MICROSCOPY.

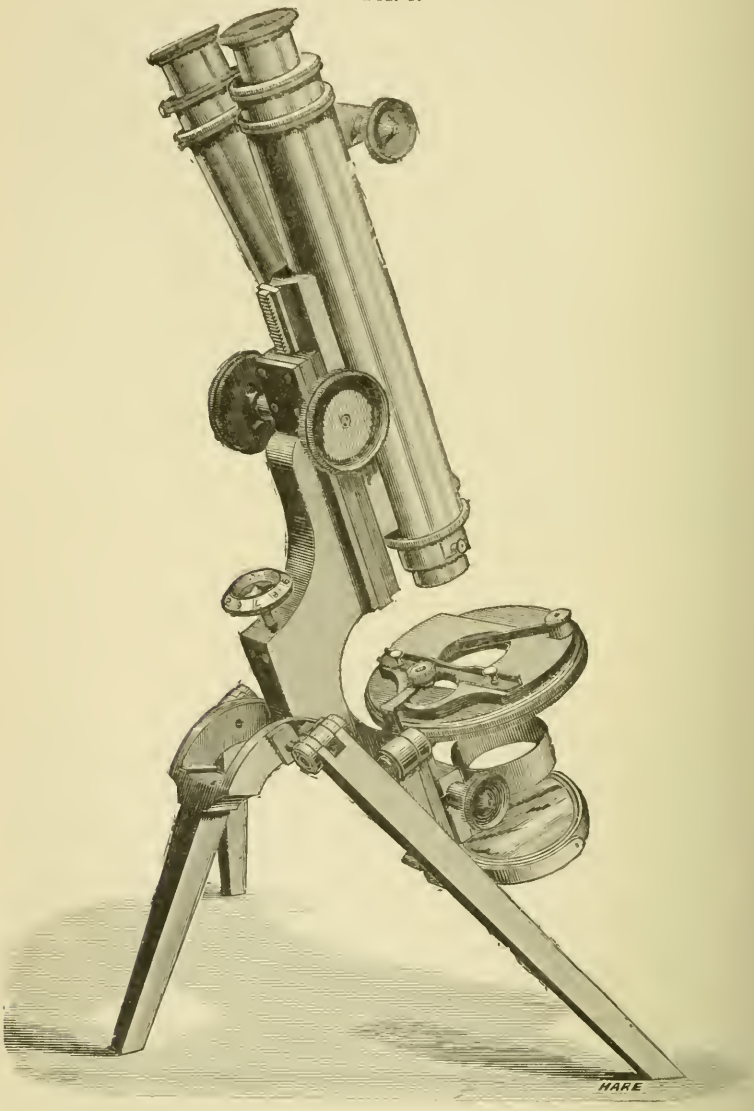
a. Instruments, Accessories, &c.

Beck's Portable National Microscope.—The object of Messrs. Beck in designing this instrument (fig. 1) has been to produce a Microscope which should retain the rigid Jackson-Lister limb, and combine with it great portability. This object has been effected by making the feet of the stand to fold up and the stage to swing on a strong joint, thus enabling the instrument with apparatus to be packed in a case measuring $10\frac{1}{2}$ in. × $7\frac{1}{2}$ in. × $3\frac{1}{2}$ in. A large amount of useful apparatus can be added without increasing the size of the case. The legs, which fold up in the smallest compass, are very firm when spread out. The substage has rack-and-pinion movement, and the stage, which rotates concentrically, can be replaced by one with mechanical movements by rack and pinion if so desired. None of the strength or stability of the instrument is sacrificed for its principal feature of portability.

Beck's Combined Substage Apparatus.—Whilst applicable to other forms of instruments, the combined substage apparatus (fig. 2) has been specially designed by Messrs. Beck for their portable "National"

stand (*supra*, p. 115). It consists of a wide-angle achromatic condenser with double diaphragms, dark-ground illuminator, and polarizing

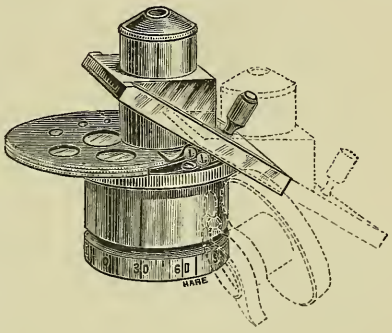
Fig. 1.



apparatus. The condenser has an angle of 180°, that can be varied at will by the diaphragms. It can be drawn away when not in use

(as shown in the figure) by sliding it down the inclined fitting without altering the position of the substage. The front lens is removable for work with low powers, and for dark-ground illumination is replaced by a truncated lens. Below the condenser is placed a revolving polarizing prism which can be thrown out, as shown in fig. 2, when not in use. Between the polarizing prism and condenser are two revolving diaphragm plates; one containing a series of apertures for varying the angle of the condenser, the other containing two selenites and a blue glass disk for moderating the light. It will thus be seen that with this compound substage apparatus the polariscope may be used by itself, or in combination with the achromatic condenser, or with dark-ground illumination; and all the different modes of illumination requisite for general work may be obtained with it.

Fig. 2.



Lehmann's Crystallization Microscope.*—O. Lehmann describes the arrangement which he has devised for examining microscopically small crystals, amorphous deposits, gas bubbles, &c., under different conditions of temperature or pressure and with powers up to 100. The Microscope proper is shown in fig. 3, the work-table to which it is attached in fig. 4.

The body-tube of the Microscope is supported on a stout bar of iron, which is bent at right angles and is fastened at its base to the plate *a a* (fig. 3), which fits into the place marked *a a a a b* in fig. 4. The stage-plate *o* is attached to a revolving plate *p*, rotated by the handle *y*, and showing the extent of rotation by the graduations on the lower plate *z*, seen through an aperture closed with glass at *w*. A lamp and mirror are fixed at *r* and *s* respectively, with a bull's-eye interposed at *t*. A polarizing prism *u* is attached to a movable arm *m*, and an analyser at *n*, the latter supported on a hinge so as to be slipped in and out of the body-tube. For heating the objects a gas-burner *d c x* is introduced into the central aperture of the stage, the heated air passing off between *o* and *p*. The pipe is double, for conveying gas and air. The jet can be removed by the handle at *e*, and the two taps I and II regulate the admission of the gas and air. For cooling the object a pipe is provided at *f* in connection with the tap III, by which a stream of air is admitted. A board for camera lucida drawing is placed at *g*, and a photographic arrangement can be used as with an ordinary Microscope.

The work-table is symmetrical on both sides of the Microscope,

* Zeitschr. f. Instrumentenk., iv. (1884) pp. 369–76 (4 figs.).

only that on the right side being shown in fig. 4. There are four troughs *k k'* (two on each side). Three of these serve for reagents and utensils, while the fourth *k* is for washing slides, &c. At *h* is a contrivance for heating objects previous to their examination (two shown on a larger scale in section in fig. 5). They are placed on the supports at *l* when they are required to cool. The flaps 1, 2, and 3 cover the table when not in use, and can be used separately or together. When all are closed, only the Microscope stands out above the level of the table, but if required this can also be removed and put in a box under the lamp, a board filling up the opening in the top of the table. The table also contains the necessary appa-

Fig. 3.

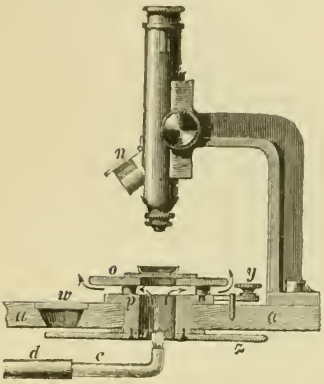
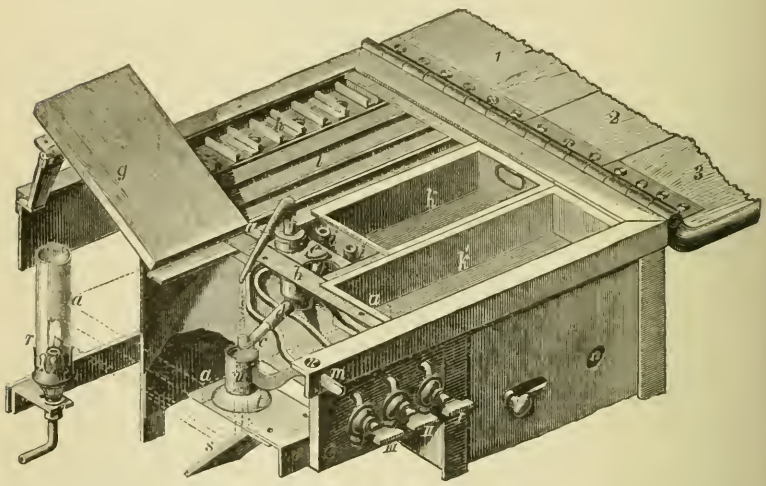


Fig. 4.



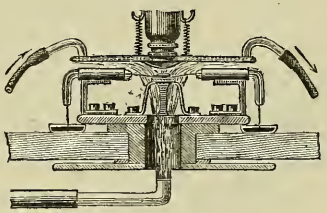
ratus for a hydrostatic blast or other means for obtaining the necessary air currents.

For experiments at very high temperatures a modification of the stage is made use of, shown in fig. 6. The object is placed on a small super-stage, and the objective is protected by a glass screen, through which cold water passes by means of the two tubes which are connected with *i i* in fig. 4. Two electrode holders with quicksilver cups are shown in the fig. for experiments on electrolysis of melted salts.

For experiments on the influence of pressure on physical and chemical combinations the substance to be examined should be inclosed in a very long spiral capillary tube, nearly filled with an

Fig. 5.

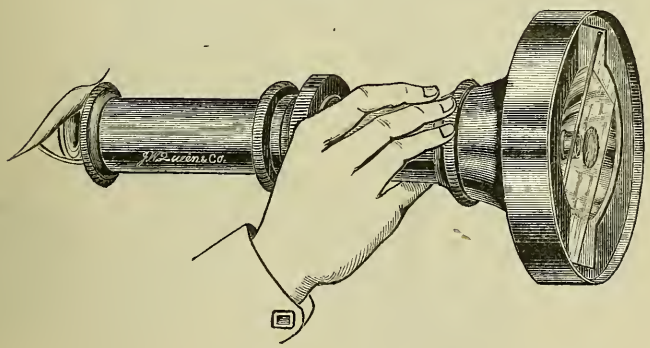
Fig. 6.



indifferent fluid which on being warmed will exert considerable pressure. By using liquefied gases the effect of low temperatures can also be observed.

Queen & Co.'s Class Microscope.* — This (fig. 7) is identical with Waechter's or Engell's instrument already described.† We have had one of the original forms in use for some time, and have found

Fig. 7.



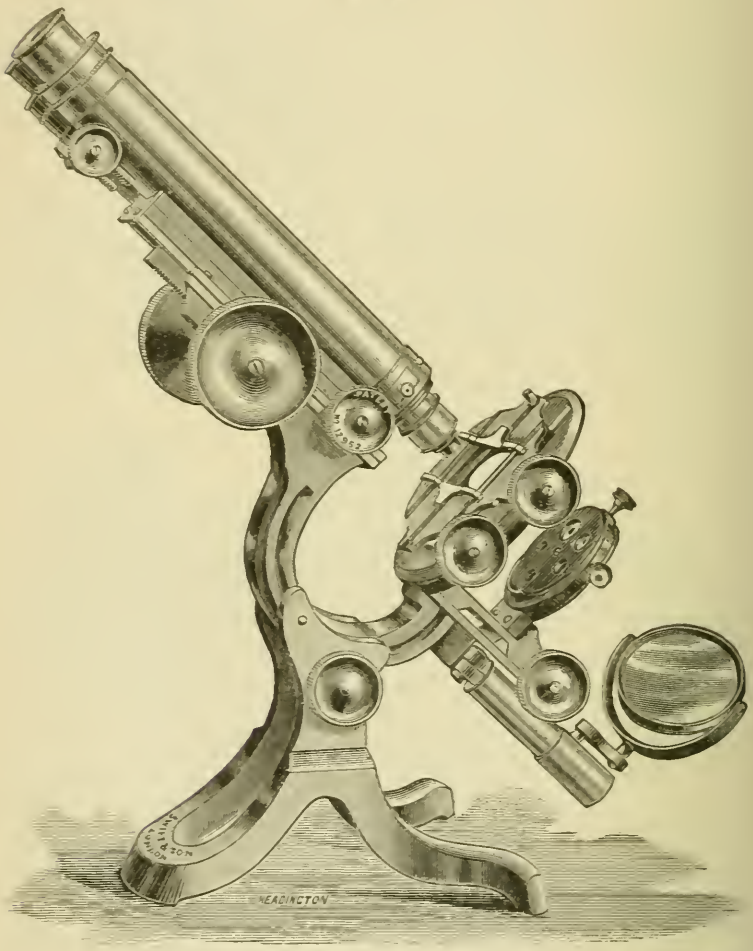
it very convenient for exhibiting objects. By daylight it is simply turned to the sky, and there is no difficulty in at once getting the proper illumination. By artificial light the instrument requires somewhat more adjustment, unless there is a large illuminating surface or the Microscope is brought close to the source of light.

Swift-Wale Microscope.—Messrs. Swift and Son have made further modifications in Wale's model, which is now constructed as shown in fig. 8. The original form was figured in Vol. I. (1881) p. 296.

* Micr. Bulletin, i. (1884) p. 47 (1 fig.).
† See this Journal, ii. (1882) p. 398.

The modifications consist in (1) an increase in the length of the radial inclining limb, so that the body-tube is carried more forward, thus providing space for the *complete* rotation of the ordinary form of mechanical stage; (2) the application of the fine adjustment to a slide

Fig. 8.



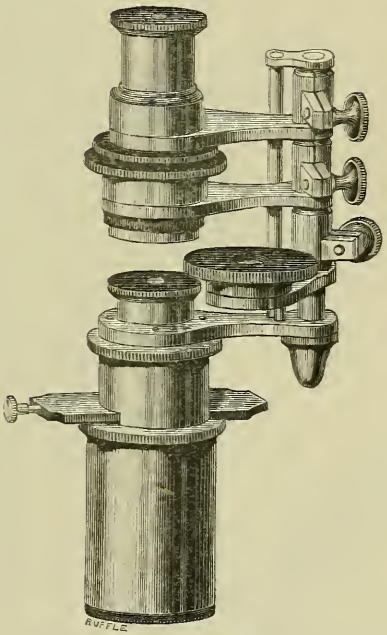
in *front* of the coarse-adjustment slide, so that the whole body-tube is acted upon, and not merely the nose-piece, as in their original form shown in Vol. I. (1881) p. 297, fig. 43; two adjusting screws enabling the movement to be regulated with great delicacy; (3) the application of the double "stepped" diagonal rackwork for the coarse adjustment

as suggested by Mr. J. Mayall, jun.; and (4) an alteration in the form of the tripod, so that when the instrument is vertical the crank-arm of the mirror is allowed free lateral play.

By this system of fine adjustment (which is patented) the binocular prism is brought more than 1/4 inch nearer the posterior surface of the objective-lenses than in any Microscope hitherto constructed by Messrs. Swift.

Sorby's Dichroiscope.—Dr. H. C. Sorby's dichroiscope (fig. 9), as made by Messrs. Beck, consists of four parts:—(1) An A eye-piece, between the two lenses of which slides a blackened brass plate with a circular aperture and a slit. The width of the latter can be varied by the small milled head acting on a spring. (2) A double-image prism. (3) An analyser; and (4) a direct-image prism. As the whole apparatus is somewhat heavy, the tube of the eye-piece does not terminate just below the field lens, but is continued for an inch further, so as to insure a firm hold in the body-tube. The field lens is attached to a separate inner tube, which slides (with a bayonet catch) in the outer, so that it may be readily removed for cleaning.

Fig. 9.



The method of using the apparatus is thus described by Dr. Sorby (extracted from letters from himself):—

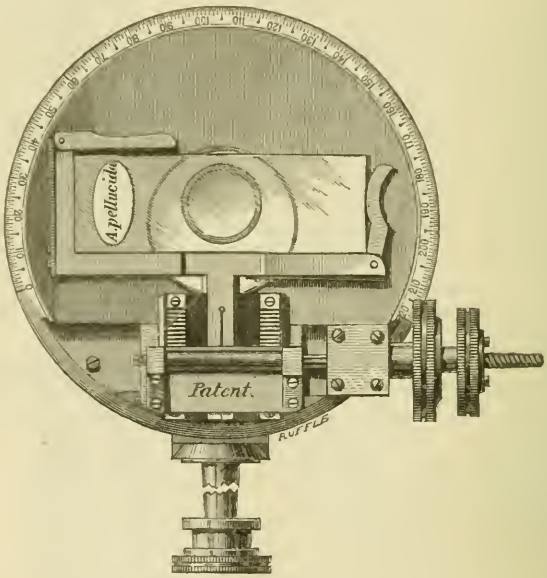
"In the examination of sections of granite and other minerals with polarized light, if the sliding plate be inserted in the eye-piece and the double-image prism placed over the eye-piece under the analyser, two images of the hole or slit are seen, of different colours if the object on the stage is dichroic, or if the colour is due to chemical change only one image will be coloured. If now the direct-image prism of a spectroscope be placed over the double-image prism and the analyser removed, the two spectra can be seen side by side.

The most useful application of the instrument is in studying small crystals or sections of rocks. We can then tell whether difference in colour is due to mere difference in position of the same crystal or not; for example, in many granites we see yellowish and orange crystals mixed up with the black. By means of the dichroiscope we can see at once that these are the same mineral in different

positions. If the crystal is doubly refracting and is strongly dichroic we may be sure that the colouring matter was formed along with the crystal, but if it is not dichroic we must conclude that the colour was due to a change which took place after the formation of the crystal. We may thus infer that the colour of the spiculæ of *Gorgonia* was formed at the same time and was not introduced afterwards."

Mayall's Mechanical Stage.—Mr. J. Mayall, jun., has improved Wenham's single-plate mechanical stage, by dispensing with the plate which from its thinness is liable to flexure. The slide is made to lie on the surface of the rotating stage-plate, being held in a hinged frame connected, by a sliding fitting, with the mechanical movements. The object-carrier is shown in fig. 10 as applied to the stage; the

Fig. 10.



curved arm on the right and the straight arm on the left are hinged with sprung fittings and open like the blades of a pocket-knife, to admit the slide. The inner edges of the frame are bevelled inwards so that the sprung arms press the slide in close contact with the rotating stage-plate.

To obviate the inconvenience due to any unevenness of surface of the glass slides, a narrow strip of paper may be gummed near the ends of their under surface.

The use of this carrier is equivalent to a corresponding reduction in the thickness of the stage, and as the slide lies in contact with the surface of the rotating stage-plate, the flexure that is found more or less in every form of mechanical stage, acting by one or more superposed plates, is obviated.

Abbe's Condenser.—We are indebted to Dr. Zeiss for the accompanying woodcuts of this apparatus, which although of somewhat

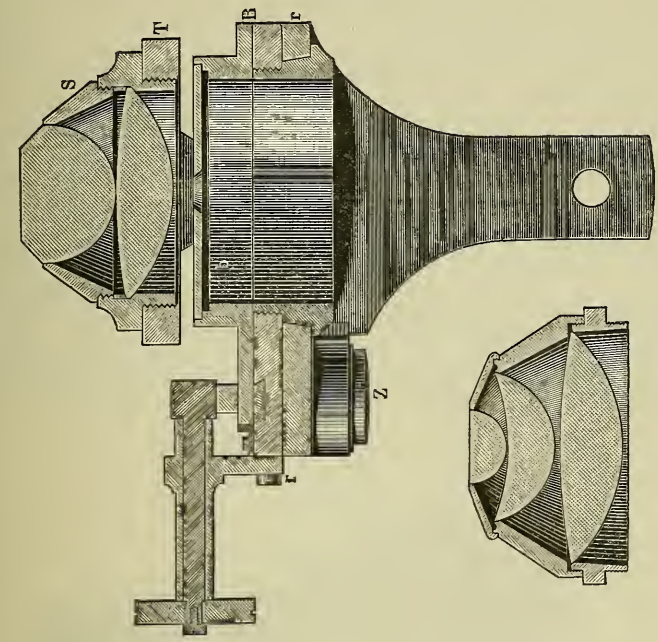


FIG. 12.

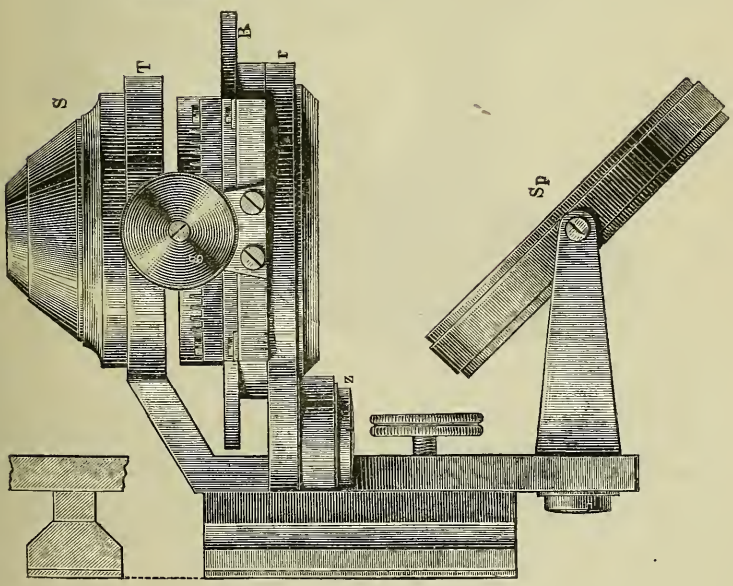


FIG. 11.

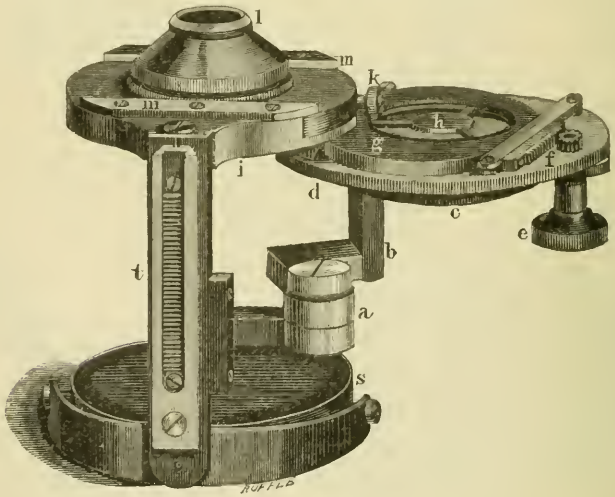
large scale (natural size) illustrate the construction of the illuminator better than any previously given.

Figs. 11 and 12 show the illuminator in side view and section as intended for application to the large Zeiss stand, Sp being the mirror, *z* the pin on which the outer diaphragm-carrier *r* turns, B the inner carrier for the diaphragm disks (*b*) moved by the milled head *q*, and T the holder for the optical combination S. The double combination is for use with objectives of aperture not exceeding 1·20 N.A., whilst the triple combination has an aperture of 1·40 N.A.

Modification of the Abbe Condenser.—W. Behrens * modifies the mechanical part of this condenser in the manner shown in fig. 13, to correct principally two inconveniences; 1st, that the focus of the optical combination cannot be brought much below the object, and 2ndly, that the lenses cannot be removed and an ordinary cylinder-diaphragm substituted.

The bar *t* has at the lower end the mirror *s*, and at the upper end the carrier *i* for the lenses *l*. The bar is provided with rackwork, and

Fig. 13.



is raised or lowered in a vertical direction by a pinion and milled head beneath the stage. The two sets of lenses for use with high and low powers are each attached to a plate which slides (by the milled

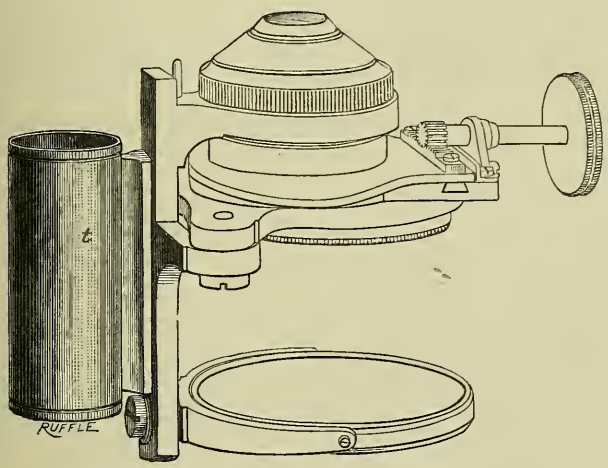
* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 409–12 (1 fig.).

head *k*) between the guides *m m*. A third plate carries a cylinder for the ordinary cylinder-diaphragm. The diaphragm holder *c d g* is attached to the bar *t* by the double elbow-piece *b* turning on *a*, so that it can be brought out from under *i*, and the diaphragms (*h*) readily changed. When in its place there is nothing to prevent a complete revolution of the diaphragm-carrier by its milled rim, the elbow-piece allowing the milled head *e* of the pinion *f* to pass without obstruction. This is a third advantage claimed by the designer, as the original form will not allow of this complete rotation. The mirror by the addition of a simple contrivance could be made to move obliquely.

Either central or oblique illumination can therefore be used without, as heretofore, having to remove the whole apparatus from the Microscope and substitute a second form.

Mr. T. Curties informs us that he has for some time constructed the Abbe condenser so that it can be moved vertically beneath the stage. This he accomplishes by attaching to the bar a tube-fitting *t* (fig. 14) by means of which the condenser slides on the tail-piece of the Micro-

Fig. 14.



scope. A pin secures it in the optic axis. By this arrangement, moreover, the condenser is readily applied to the simplest forms of stands, which has long been a great desideratum.

For the larger stands with rackwork substages he has been in the habit of applying the same form of condenser, but without the tube-fitting, rackwork being added to the bar.

Some microscopists prefer Dr. Zeiss's modification for large English

stands with substages,* shown in figs. 15 and 16 (for 1·40 N.A.). Here the condenser slides into the substage, and can be accurately centered by the substage adjusting screws. It is, however, very heavy.

Fig. 15.

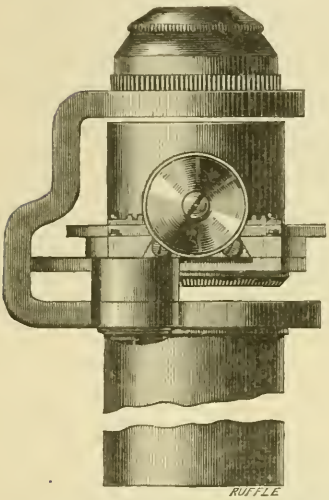
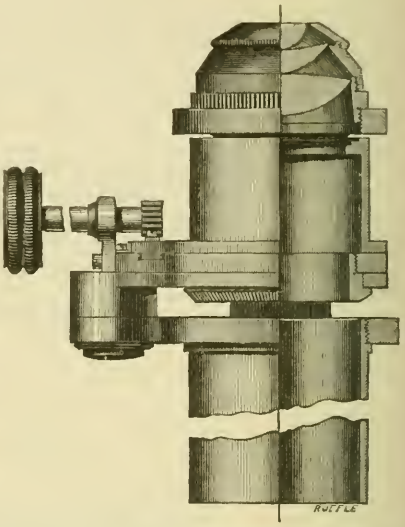


Fig. 16.



Swift's Cone and Achromatized Immersion Paraboloid Condenser.—Mr. J. Swift, referring to Dr. Wallich's condenser described

Fig. 17.

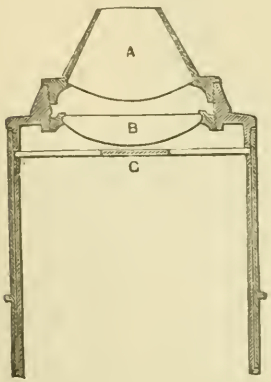
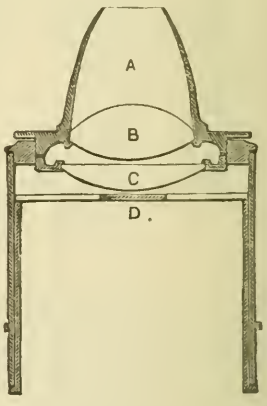


Fig. 18.



at p. 963 of Vol. IV. of this Journal, claims priority in the construction of such a condenser, and sends us the diagram, fig. 17, of the

* See also this Journal, ii. (1882) p. 411.

one which he made in 1883. A similar condenser was supplied to a Fellow of the Society in January of that year. As will be seen from the figure, there is a cone A with convex under-surface; the lens B is however nearly in contact with the convex surface, whilst Dr. Wallich separates them somewhat.

Mr. Swift further says that finding the cone gave confused pencils of light instead of convergent rays, he (in 1884) substituted for it an achromatized paraboloid, with a flat top for immersion. This is shown in fig. 18. A lens B is cemented to the lower surface of the paraboloid A, with a second lens at C. It screws on the same form of substage-fitting as the cone.

In each form an annular diaphragm (C and D) slides inside the adapter so as to be in contact with the lower lens.

Wallich's Condenser.*—Dr. G. C. Wallich more fully describes the advantages of his condenser as follows:—

"The principle I have kept in view in the production of the condenser is that for the illumination of transparent objects in the Microscope, the conditions as regards light should as closely as possible be assimilated to those under which we are accustomed to look at transparent objects with our unaided eyesight—that is to say, by an 'all round' light, in which, however, the rays proceeding from any selected azimuth are partially, or, if need be, wholly, cut off. This end is attained by a very simple and well-known mechanical contrivance, inasmuch as the condenser itself (when fitted, as it can quite easily be, to the substage of any Microscope) hardly ever requires to be moved out of the axis of the instrument. Hence, it may be regarded as supplying the very opposite mode of illumination to that usually implied by the term 'oblique.'

Again, instead of seeking to bring the whole of the utilized rays to a focus in a point at the centre of the object under examination, or, in other words, instead of securing only a single brilliantly illuminated focal plane extending circumferentially and horizontally outwards from one focal point, it has been my aim to produce (both in the monocular and binocular Microscope) a succession of brilliantly and nearly equally illuminated horizontal planes extending to the very margin of the field, and yet allowing the formation of just sufficient shadow to secure the desired results.

What these results are I will now briefly describe, premising, however, that I expect no one to accept my statement without having an opportunity of testing its accuracy by ocular demonstration. I consider this proviso as all the more essential, inasmuch as, if my statement bears the test, two or three important dogmas in the theoretical optics in relation to the Microscope will, undoubtedly, have to undergo a certain amount of revision.

In the first place, I claim that the condenser increases to a very great extent the range of *penetration* at our command; and that through its means we are enabled to see a transparent object, or any number of transparent objects, at a single focusing, very nearly as distinctly as

* Engl. Mech., xl. (1884) p. 320.

we should be able to see a similar object or objects if they could be presented to our unaided vision, of the same size as the microscopic images, at the ordinary visual distance, and mounted in equivalent depths and thicknesses of mounting material. In short, that we see the objects suspended, as it were, in their true relative positions to each other in the mounting medium, those nearest to the eyes or lying in the plane to which the focus has been most perfectly adjusted being, of course, best defined, whilst those situated below or above that plane are seen very nearly, if not quite, as distinctly as they would be in ordinary vision were the conditions assimilated to the extent already indicated. Of course, I do *not* assert that any condenser can impart to any objective additional penetrative power to that already implanted in it. What I claim is that the new mode of illumination supplies those conditions which allow any objective to 'put its best leg foremost.'

In the second place, I claim that this method of illumination proves that there are such things in microscopic vision as *orthostereoscopic* projection and perspective." Dr. Wallich then goes to say that the existence of both of these "attributes has, as we all know, been "emphatically and unconditionally denied by more than one of our "most accomplished and deservedly renowned theoretical opticians." Dr. Wallich, however, in making this statement, has misapprehended the views to which he refers, which are not in conflict, as he supposes, with any results obtained by him.* The further statement that "Dr. Carpenter has for many years stood alone in contending that true stereoscopic vision does not take place in the Microscope," contains, we presume, a misprint, in that the "not" should have been omitted.

Osborne's Diatomescope. Modified Wenham Disk Illuminator.†—W. F., whilst having no doubt that the diatomescope will give a pencil of light sufficiently oblique for the various objectives used, considers that the same result can be got in a much simpler and cheaper way. Mr. Wenham's disk illuminator serves the object in view very well; but it has one serious defect—there is no provision for a shutter in front to narrow the band of light. He prefers to take a hemispherical lens about 1/4 or 3/8 in. in diameter, and after burnishing it into a setting, cut the setting almost entirely away at one side, leaving only sufficient to hold the lens. Slip this lens so mounted into the top of a tube of the proper size, and slit the tube at one side below the lens downwards for 1/2 in. or so with a fine saw. The cut sides of the tube chemically blacken. When the tube is mounted beneath the stages so as to almost touch the object slide, and with a provision for turning it slightly round, the lamp being placed in front of the slit in the tube, it will be seen that the band of light transmitted by the lens may be made any breadth from the width of the cut in the tube

* See this Journal, iv. (1884) pp. 496–7.
† Engl. Mech., xl. (1884) p. 321.

to a hair's breadth by turning the tube, and any obliquity of the pencil may be got either by inclining the Microscope or raising the lamp. There is in this way no necessity for converting the lens into a disk. The hemisphere sent out by Zeiss with his oil-immersion lenses is, he thinks, too large.

Dr. H. Van Heurck,* in a note in commendation of the diatomescope as an oblique condenser, says, "It has been said that oblique condensers were of no utility through giving false images. I am not of that opinion; certainly, if object-glasses could be constructed so as to resolve everything with an axial illumination (there are diatoms much more difficult to resolve than *Amphipleura pellucida*), and if these object-glasses could be supplied at so moderate a price that every one could have them, then I should say that oblique condensers could be done away with. But, unfortunately, such is not the case—at least, nowadays; yet we may foresee that by discovery of new media, our means of investigation may be considerably improved.

Meanwhile, the oblique condensers render notable services; in cases where it is not allowed us to *see*, we may *conceive*. We know that the valve of the diatoms is provided in most cases with alveoles, and in others with fine punctuations. The striæ, then, by the oblique condensers are the solid and thickened parts of the valve, and the distance between them allows us to judge of the size of the alveoles; also the direction of the striæ shows whether the alveoles are disposed in opposite series which produce longitudinal and transversal striæ, such as in *Pleurosigma balticum*, or in alternate series which produce oblique striæ, such as in *P. angulatum*."

Oblique Illuminators.—The value of oblique illuminators has recently been the subject of some controversy. Mr. E. M. Nelson† considers that "oblique illuminators, be they diatomescopes, reflex illuminators, revolver prisms, or what not, should, in the interest of microscopical science, be consigned to the dust-bin. I am confident that by their use only false images can be obtained. In former days microscopists used this kind of illumination, and in consequence talked of the striæ on *Pleurosigma*, *N. rhomboides*, &c. Now, we know there are no striæ at all on these diatoms; the marks being isolated dots, the striæ owing their origin solely to the running together of these dots by improper illumination. In the case of *A. pellucida*, we have to content ourselves with the appearance of striæ, simply because it is beyond the powers of our widest angled objectives. I have not the slightest doubt that if an objective were made capable of completely resolving it, it would appear similar to *N. cuspidata*, having more dots to the inch transversely than longitudinally. Few have worked with oblique illuminators more than I have; my experience leads me to say that an oblique illuminator for the Microscope is *not* wanted."

* Engl. Mech., xl. (1884) p. 365.
† Ibid., p. 242.

"F.R.M.S." thinks * that in the interest of the *history* of microscopical science, Mr. Nelson should consider the service hitherto rendered by "oblique illuminators" towards the improvement of the Microscope. The category of oblique illuminators includes every condenser devised, from the days of Descartes' gigantic parabolic reflector applied at the nose-piece, down to the days of Powell and Lealand's achromatic condenser. The former was afterwards modified to its present form by Lieberkühn, and is now termed the "Lieberkühn," and Mr. Nelson gave it unqualified praise in his "demonstration" at the "Quekett"; the latter, on the same occasion, he extolled enthusiastically as "*the* finest condenser in the world." Every form of condenser deals with oblique rays, and is, therefore, an oblique illuminator, and *as such* has contributed its quota towards the improvement of the Microscope. Nothing since the invention of the Microscope has done more to cultivate the critical eye for excellence in the optical construction than the striving to devise and utilise condensers. Without condensers the importance of increasing the apertures of the objectives might never have been discovered.

"Mr. Nelson says that a new oblique illuminator of nearly 1·5 N.A. is '*not* wanted.' I will endeavour briefly to show the use it may be put to, bringing him in as a witness.

Mr. Nelson has repeatedly admitted that the finest 'resolving' power of any objective is reached just before the obliquity of the illumination is so great as to be *beyond* the aperture of the objective, i. e. just before the dark field is reached. This is matter of common experience, and I assume it to be agreed upon. Moreover, I refer only to objectives of the best construction, which work accurately to the limit of their aperture. It would appear, then, that Mr. Nelson himself has not yet seen the finest resolving power of objectives of 1·43, 1·47, or 1·5 N.A. (the limit reached by Powell and Lealand in the 1/6ths made for the President and one of the Vice-Presidents of the R.M.S.), because, if I am rightly informed, he has never had the use of any oblique illuminator of higher N.A. than 1·4 (i. e. Powell and Lealand's truncated oil-immersion condenser referred to by Mr. Nelson on p. 240 of the current 'English Mechanic,' whence I quote its numerical aperture). In order to obtain the finest 'resolving' power of such objectives, an oblique illuminator of 1·5 N.A. *is* therefore required in spite of Mr. Nelson's negation, for with such a condenser alone can we approximate to the 'dark field'—the condition of 'finest resolution.'

When Powell and Lealand issue their achromatic immersion condenser of 1·5 N.A., which has been on the way for many months past, we shall, doubtless, be enabled to run through our present range of apertures in a manner worthy of the splendid optical skill of these opticians. But achromatism with such an aperture must necessarily be costly. At present we are in the position of having objectives with apertures beyond the reach of any recognized form of condenser. We can, it is true, illuminate very near the limit of the apertures of

* Engl. Mech., xl. (1884) p. 264.

our finest objectives by means of Abbe's immersion condenser, Powell and Lealand's truncated ditto, using the mirror in the axis, or by means of Tolles's transverse lens or equivalent means, using complex reflecting prisms to reach the required obliquity of incidence, or by swinging the mirror from the axis. But I want to see our illumination brought conveniently on a par with or beyond the apertures of our finest objectives, so that we may readily test the value of the last zone of working aperture. We have been told by Prof. Abbe what is the *theoretical* resolving power of a numerical aperture of 1·5. I want to *see* the matter demonstrated practically by means of a convenient and inexpensive condenser—one that will not require an infinitesimally thin stage, or other elaboration of the mechanism of our Microscopes.

As to Mr. Nelson's observations on the 'true' structure of certain diatoms, I should have expected his rout on that point by 'Monachus' would at least have taught him that no amount of devotion to the inspection of the surface of *Amphipleura pellucida* would enable him to decide the question of its 'true' structure. If we really know anything of the true structure of the finer diatoms, our knowledge has been derived mainly from the comparison with coarser and coarser forms, of which the structure has been made out, more or less satisfactorily, by the examination of fractures or sections, and carefully tracing the correspondence with surface views—certainly not by mere examination of the surface. As Mr. Nelson still clings to his empirical views on the question of the determination of 'true' structure, I must counsel him to read more closely 'Monachus's' refutation of his views.

Oblique light is the most potent means we have of arriving at the *minimum visibile* with the Microscope. I do not say that by it alone can we arrive at *true* interpretations of minute structure; nor, on the other hand, can I agree with Mr. Nelson that we owe to its use all our erroneous interpretations. It appears to me that errors of interpretation are matters personal to the observer. If the observer will insist on pledging himself to this or that view, regardless of the fact that the *whole* of the necessary data may not be within his reach, then, as I take it, he alone is responsible for the blunders he may make; and he should not blame oblique illumination, for, with sufficient knowledge of the complexity of the conditions involved in accurately diagnosing the structure of fine diatoms and of the means at command towards the solution of the problem, he would give due weight to every mode of illumination, and no more than its due weight. Under such circumstances an oblique illuminator would be an important factor, and I think it probable that Mr. Nelson's dust-bin, if not already emptied, would yield up an odd contrivance or two which the 'scientific microscopist' would be glad to possess."

Mr. Nelson rejoined * that "F.R.M.S." is mistaken "if he thinks

* Engl. Mech., xl. (1884) p. 282.

that I do not value oblique illuminators as matters of history in the development of the Microscope. It was merely in their use as instruments of modern scientific research that I condemned them. Condensers and Lieberkühns cannot be justly called oblique illuminators, though they may be used as such. I cannot agree with the statement that 'oblique light is the most potent means we have of arriving at the *minimum visibile* with the Microscope.' So far as I know, the smallest object which has been publicly exhibited is the flagellum of a *Micrococcus* which I showed at the Q.M.C., and by invitation at the soirée of the R.M.S. The length of the double micro-organism was only 1/12,000 in., the flagellum was barely half that length. Now if we take as a *maximum* estimate $\frac{\text{breadth}}{\text{length}} = 1/6$, we shall have 1/144,000 in. as the thickness of the filament. This ratio is probably greatly in excess of the truth. This object is only visible with *direct* light: *oblique* light completely obliterates it."

"F.R.M.S." in reply * considers that Mr. Nelson "has involved himself in the following paradox:—He considers that the diatomescope, which provides oblique rays in *one* azimuth, *is* an oblique illuminator; whereas the Lieberkühn or a condenser which provides oblique rays in *all* azimuths, is *not* an oblique illuminator. In other phrase: Light incident in one azimuth is oblique; in *all* azimuths, *not* oblique! I will leave him to explain the paradox.

He does not agree with my remark that 'oblique light is the most potent means we have of arriving at the *minimum visibile* with the Microscope,' and as an example of what he regards as the *minimum visibile*, he cites a flagellum of a *Micrococcus* estimated at 1/144,000 in. in thickness, 'which is only visible with *direct* light; *oblique* light completely obliterates it.'

On this I remark, firstly, that I think his *direct* light, if critically examined, will be found to consist chiefly of oblique light.

Secondly, by way of parallel example embodying the opposite view, I cite one of the most prominent items of what is generally admitted to be 'modern scientific research,' the original discovery of the flagellum of *B. termo* by the eminent microscopist Dr. Dallinger.† This discovery was made by the use of the most oblique light obtainable by the recognized condensers of that date, a method of research utterly condemned by Mr. Nelson. That in Mr. Nelson's hands the flagellum should be 'obliterated' by the same kind of illumination by which Dr. Dallinger first discovered a similar flagellum, is another paradox, which I leave for his consideration. I note, in passing, that Dr. Dallinger, in referring to the oblique illuminator he employed, wrote that it had 'the advantage of throwing the light in only from one direction [in azimuth].' Now, singular as it may appear, Mr. Nelson *condemns* the diatomescope for possessing the qualification commended by Dr. Dallinger.

* Engl. Mech., xl. (1884) p. 299.
† Mon. Micr. Journ., xiv. (1875) pp. 105–8.

Thirdly, the flagellum of *Micrococcus*, though but 1/144,000 in. in diameter, does not come within the range of what I should regard as the *minimum visibile* with the Microscope. During the past fifteen years we have known of the resolution of lines 112,000 to the English inch. Assuming the lines and the interspaces to be equal (*vide* Dr. Woodward's photographs of Nobert's 19-band test plate), then they each represent 1/224,000 in. Now, if we have already succeeded in resolving with the Microscope spaces of this degree of proximity, the mere perception or recognition of one single object of 1/144,000 in. is no feat in microscopical manipulation in the direction of the *minimum visibile*. It would seem that Mr. Nelson, having found a difficulty in exhibiting the flagellum of *Micrococcus*, has made a random shot at an explanation of his difficulty, and has dropped upon the minuteness as the *vera causa*, strangely ignoring the conditions of visibility by which the object is easily or with difficulty differentiated from the medium in which it is placed."

Bertrand's Polarizing Prism.—Dr. H. Schröder writes us that the first form of this prism * was devised as long ago as 1869 by Jamin and himself, and later by Feussner.†

The second form is an impracticable one as no glass is known of the refractive index 1·65 and which has a perfectly white colour and will not tarnish in the air. The angle of field 98° 41′ given by Bertrand can only be obtained by moving the eye about from side to side. If the eye is fixed the field is only 47° 27′. If the prism were made of calc spar and cemented with linseed-oil the above angles would be 83° 6′ and 42° 10′. ‡

Bulloch's New Lamp.§—W. H. Bulloch's new lamp is shown in fig. 19. The reservoir and base are similar to those of the "Beck Complete Lamp," but the burner, instead of being in the middle of the reservoir, is placed on one side. This gives room for a brass upright on the other side, which supports the bar carrying the bull's-eye. The latter is focused by sliding the bar in either direction, and the light is directed either upward or downward by swinging the arm as required, and clamping it in any position by the milled head shown. Only one side of the chimney is open, and the rectangular aperture is covered with a plane glass slip 3 × 1, outside of which may be slipped in a blue slide or one with a ground surface to modify the light. There is also a brass slit, adjustable in width, which fits outside of all. This is intended to give a narrow line of light. The chimney turns about the burner, so that the broad face of the flame or the edge can be used at pleasure. The reservoir,

* See this Journal, iv. (1884) p. 965.

† Ibid., p. 456.

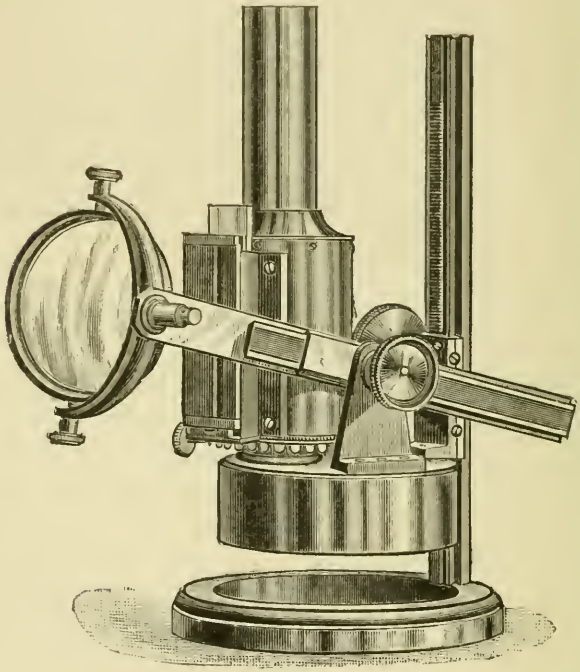
‡ See also Zeitschr. f. Instrumentenk., v. (1885) p. 30, from which part of Dr. Schröder's remarks are taken.

§ Amer. Mon. Micr. Journ., v. (1884) p. 205 (1 fig.).

‖ See this Journal, iv. (1884) p. 628.

carrying everything upon it, moves up and down, by a rack and pinion, on the upright bar from the base, as shown in the fig. The

Fig. 19.



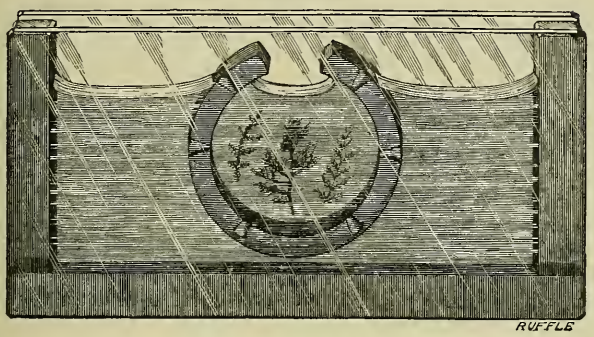
chimney and reservoir are nickel plated and the other parts of brass.

Live-Cell.—This cell (fig. 20) is of unknown authorship, but is claimed to be convenient when it is desired to keep the water cool in which any living objects are being examined. It dispenses with the alum cell, which is an objectionable adjunct, affecting as it does both illumination and definition. The inner circular cell (open at the top for the reception of the objects) is distinct from the outer rectangular cell, but has six minute holes in its circumference. These allow of a constant interchange between the water in the inner and outer cells, and that in the latter can of course be supplied at any desired temperature. Unless the holes are very small, there will of course be a danger of the minuter organisms making their escape into the outer cell.

The cell would seem to be likely to be more useful for lantern

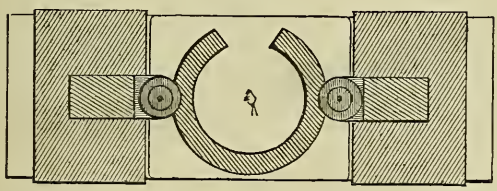
demonstration (where the heat is often great) than for any other purpose.

Fig. 20.



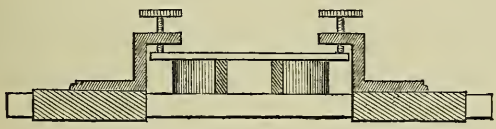
Giles' Live-Cell.*—G. M. Giles finds that the main drawbacks of most cells for the observation of living objects are that they either leak or are very difficult to clean, and suggests the following form (figs. 21 and 22) to obviate these defects. Take a stout ground-edged

Fig. 21.



glass slip, and have fitted to it two sheaths of thin brass, about 3/4 in. wide. These should be made to fit closely, but not so tightly as to prevent the glass slip from sliding easily through them. To the middle

Fig. 22.



of one end of each sheath is soldered a small brass arm (shaped as in fig. 22), carrying a fine screw on one arm, which, when secured in position, projects about 1/4 in. beyond the end of the sheath. A piece about $1\frac{1}{4}$ in. long, cut off a thin glass slide, and a thick indiarubber

* Sci.-Gossip, 1885, pp. 7–9 (2 figs.).

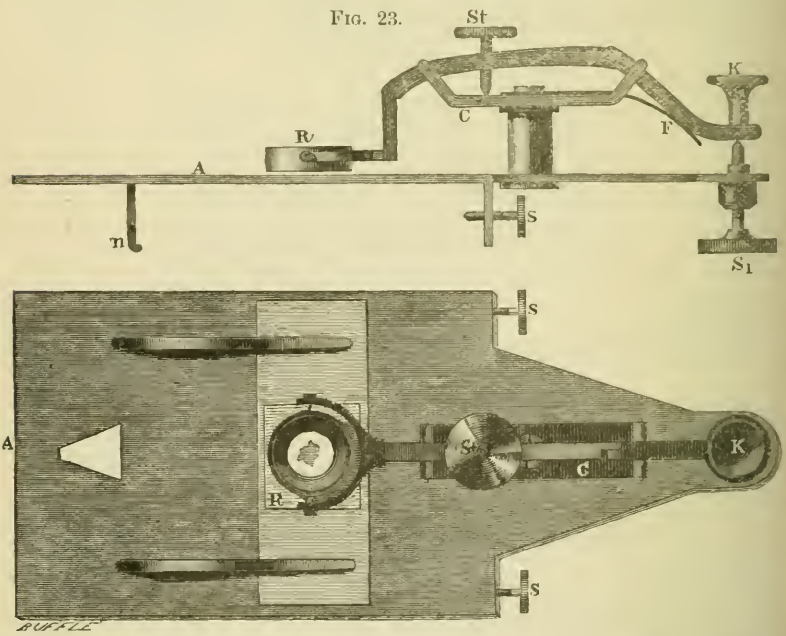
ring (those used for Cod's patent soda-water bottles serve excellently) complete the requirements.

To put the parts together, slip the sheaths, one on to each end of the glass slide, with their two little screw arms projecting towards each other. Now cut a small piece out of the circumference of the indiarubber ring, and place it on the slide between the sheaths, with the opening towards one of the long sides of the slide. Place on the top of the ring the short piece of glass, and slide the sheaths towards each other, till the small screws project over its ends. Then, by turning down the screws, the ring is compressed between the two pieces of glass, and a perfectly water-tight cell results. By using rings of different thickness, cells of every convenient depth may be obtained.

When finished working, the whole can be taken to pieces in an instant and cleaned. If a well-polished piece of glass, free from flaws, be chosen for the upper plate, its thickness will not be found to interfere very materially with the performance of any power below 1/2 in.

Jung's Compressorium.*—During some histological investigations on *Hydra*, &c., H. Jung was often obliged, in order to isolate the

Fig. 23.



cells, tissues, &c., to adopt the process of "beating." This, however, he found an exceedingly tiresome process, especially when it has to be

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 248–50 (1 fig.).

carried on for hours with perhaps the handle of a dissecting needle, and the ordinary compressors being unsuitable for the purpose, he therefore devised the form shown in fig. 23.

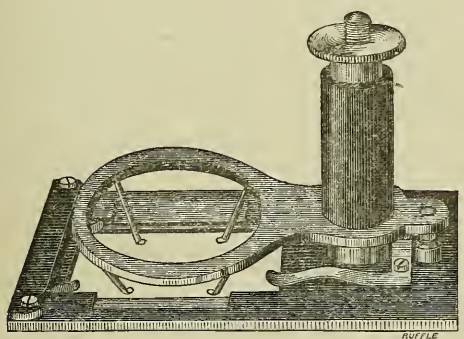
The plate A is attached to the stage by the catch *n* and two screws S S. On this plate is a double lever, one arm of which has a movable ring R and adjusting screw St, and the other the knob K. The two levers are so connected with the bent piece C that when K is pressed down the ring R is also pressed towards the stage-plate. Conversely an upward movement of the knob, produced by the spring F, raises the ring again. The screw S_1 regulates the extent of movement of the end of the lever.

To use the apparatus the screw St is adjusted so that the ring lies nearly close to the large and thick cover-glass of the preparation, and S_1 is turned so that the lever can move but very slightly. The object is then focused, and by quick and continuous movement of the knob and the changing pressure on the cover-glass thus produced, tissues (after maceration) can be easily disassociated without danger of being destroyed. The object can also be continually watched with powers up to 600, and all the changes noted. When the cells are isolated they can be seen (by a slower movement of the lever) to move about in all directions, so that they can be observed from all sides.

If it is desired to press the object, S_1 is loosened and St screwed down as far as necessary, and the apparatus can then be used as an ordinary compressor.

Viguier's Compressorium.*—C. Viguier points out that whilst the compressors in common use enable us to study objects under favourable conditions, which it would be very difficult, if not im-

Fig. 24.



possible, to do without them, yet, on the other hand, the objects are almost always destroyed, it being but very exceptionally that a compressed object can be preserved as a permanent preparation, so as to resemble what has been seen in the compressor, and the evil is

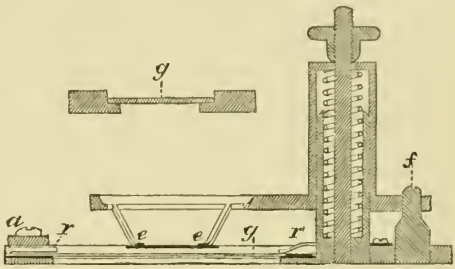
* Arch. Zool. Expér. et Gén., ii. (1884) pp. xii.–xvi. (5 figs.).

still greater when there is only a very limited number or even only one specimen of an object.

Dr. Viguier's new form is intended to remove this inconvenience. It has no fixed glass plates, the ordinary slide and cover-glass being used. When the observation is over, the preparation is withdrawn just as it has been seen, and drawn or photographed or subjected to reagents, and definitively preserved. The management of the instrument is, moreover, very simple.

The compressor is shown in figs. 24 and 25, and it will be seen that for the motion of the upper plate the slow-movement screw is

Fig. 25.

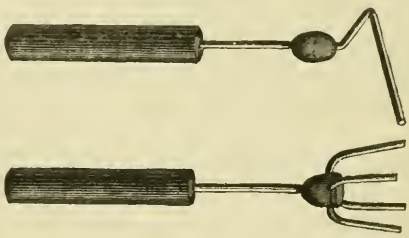


used which is found in so many Continental Microscopes and in Moulinié's compressor, the directing pivot *f* of the latter being, however, much longer, and placed on the side furthest from the glasses. The important point claimed by the author is the adjustment and removal of the glasses.

The bar which turns on *a* is opened, and the slide *g* is introduced (resting in a deep groove of the lower plate), its upper surface being entirely free except at the ends, where are four springs *r* and *r'* to keep it in its place. Two of these are attached to the movable bar *a*, which is closed after the introduction of the slide.

To fix the cover-glass, take the copper wire which has a little ball

Fig. 26.



as a reservoir of heat (fig. 26), and slightly warm it over the spirit-lamp, and place a very little drop of paraffin under the four arms *e* of the

upper plate, which will take cover-glasses of 18–22 mm. The arms are flattened underneath and well adjusted in one plane. The thin glass is then put exactly in its place, which is indicated by two marks. By the screw the upper plate is lowered until the four drops of paraffin are in contact with the cover-glass and even press a little on it. The four-pronged wire (fig. 26) is then heated slightly and put on the ends of the four arms, which are thus all heated simultaneously; the paraffin melts, and as soon as the wire is raised the thin glass is found to be firmly attached by its four corners. The oblique position of the arms *e* enables the strongest objectives to be focused over almost the whole surface of the cover-glass.

When the observation is completed it is important to keep the cover-glass exactly in the position which it occupied relative to the slide and to free it from the arms *e*. Owing to its double curve the bent wire enables some warm paraffin to be conveyed along the edges of the cover-glass corresponding with the long sides of the slide, and the cover-glass is thus firmly fixed. To free the points, the four-pronged wire has only to be again heated and applied to them whilst releasing the screw. There is then nothing further to be done, to withdraw the preparation, than to open *a*. The preparation is still open on two sides, and the necessary reagents can be applied.

" Akakia."—The Diatomescope.
[Objects to the non-coincidence of the axes of the two lenses and the want of coning of the settings, and questions the necessity of the diaphragm. And see *post.*]
Engl. Mech., XL. (1884) pp. 281–2.

American Society of Microscopists, photograph of members of, taken at Rochester, N.Y. *Amer. Mon. Micr. Journ.*, V. (1884) p. 219.

" " " Rochester meeting of.
[Comments by the 'National Druggist' on the remarks of the 'Amer. Mon. Micr. Journ.' and 'The Microscope.']
The Microscope, IV. (1884) p. 273.

" " "
[Commendation of the " working-session " at the Rochester Meeting.]
Micr. Bulletin, I. (1884) p. 52.

B.Sc.—Microscopic.
[Recommendation, on the authority of Waldeger and Recklinghausen, to "always stick to the A eye-piece, otherwise you will hurt your sight."]
Engl. Mech., XL. (1885) p. 414.

Beck's and Bulloch's Microscope Lamps.
[Beck's, cf. Vol. IV. (1884) p. 628; Bulloch's, *supra*, p. 133.]
Amer. Mon. Micr. Journ., IV. (1884) pp. 203–5 (2 figs.).

Blackburn, W.—See Dippel, L.

Bradbury, W.—The Achromatic Object-glass. XXXVII.–XLIII.
Engl. Mech., XL. (1884–5) pp. 277–8, 294–5 (3 figs.), 314–5 (13 figs.), 334–5, 358–60 (7 figs.), 401–2, 445 (2 figs.).

Brunn, A. v.—Der Westien'sche Universalloupenhalter. (The Westien Universal Lens-holder.) [*Post.*]
Arch. f. Mikr. Anat., XXIV. (1884) pp. 470–1 (1 fig.).

Bulloch's Microscope Lamp, see Beck's.

Chester Society of Natural Science.—A Short Handbook of Natural History for use at the Annual Conversaziones and other Meetings of the Society.
[Useful for the scientific arrangement of Zoological and Botanical objects at soirées, &c.]
28 pp., 8vo, Chester, 1884.

Chiusoli, V.—Die Vergrösserung der dioptrischen Apparate. (The Amplification of Dioptric Apparatus.) Translated, and with a note, by G. Fischer. [*Post.*]
Zeitschr. f. Wiss. Mikr., I. (1884) pp. 558–60.
from *Rev. Scientifique*, IV. (1884) p. 62.

Compton, B.—Microscopic Illumination.
[Inquiry for a gradually adjustable *stop* for the condenser, like the iris diaphragm.]
Engl. Mech., XL. (1885) p. 475.

Curties, T.—[Remarks on the R. Microscopical Society and its Journal.]
Journ. of Microscopy, IV. (1885) pp. 51–2.

D., E. T.—Graphic Microscopy. XII. Eggs of Mottled Umber Moth (*Hybernia defoliaria*). XIII. The Red Water-Mite (*Eylais extendens?*).
Sci.-Gossip, 1884, p. 265 (1 pl.), 1885, pp. 1–2 (1 pl.).

[Davis, G. E.]—Our suspended publication.
["No sooner is one month's number out than the worry of the next commences. Few people are aware of the vast amount of work required to keep even a small journal like this in motion." In our own case, we should be very well contented if the "worry of the next number" only commenced when the preceding number was out.—Ed. J.R.M.S.]
Micr. News, IV. (1884) p. 304.

Davison, J.—*Navicula cuspidata* as a test-object.
[Transverse striæ can be shown by a good 1/4 in. object-glass, but a good 1/8 fails to show any longitudinal striæ. With a good 1/16 and careful illumination, however, both sets of striæ can be seen. The double set of striæ is much easier shown when the frustules are mounted dry or in media less transparent than balsam, such as styrax.]
Sci.-Gossip, 1884, p. 276.

Dippel, L.—Grundzüge der allgemeinen Mikroskopie. (Outlines of General Microscopy.)
[Abridgment of his "Handbook."]
xiv. and 524 pp. (245 figs. and 1 pl.), 8vo, Braunschweig, 1885.
„ „ Endomersions-Objective. (Endomersion Objectives.) [*Post.*]
Zeitschr. f. Wiss. Mikr., I. (1884) pp. 485–90 (2 figs.).

Dippel, L.—The use of polarized light in vegetable histology.
[Transl. by W. Blackburn of article noted Vol. IV. (1884) p. 482. *Post.*]
Micr. News, IV. (1884) pp. 291–7 (5 figs.)

Elsner, F.—Mikroskopischer Atlas. (Microscopical Atlas.) Part V. 6 pp. and 2 pls. of 30 photo-micrographs.
[Contains Flour and Starch preparations.] 4to, Halle a. S. 1885.

Ermengem, E. van.—
[Observations on Dr. van Heurck's note on *Amphipleura pellucida*. *Infra.*]
Bull. Soc. Belg. Micr., XI. (1884) pp. 67–71.

Errera, L.—Deux questions de terminologie. (Two questions of terminology.)
[Proposal (1) to substitute *lame* and *lamelle* for *porte-objet* and *couvre-objet*; (2) to use *micron* in place of *micromillimetre*. The second adopted but the first not adopted by the Society for the present.]
Bull. Soc. Belg. Micr., X. (1884) pp. 217–20; XI. (1884) pp. 36–8.

Ewell, M. D.—Identification of Blood Corpuscles.
[Suggestion that writers should state what objectives, eye-pieces, length of tubes, stage or eye-piece micrometers they use.]
The Microscope, IV. (1884) pp. 241–2.

F., W.—The Diatomescope.
[Calls attention to Nachet's "Eclairage à fond noir." Also gives the note *supra*, p. 128.] *Engl. Mech.*, XL. (1884) p. 321.

F.R.M.S.—Illumination for a Microscope. [*Supra*, p. 132.]
Engl. Mech., XL. (1884) p. 299.

Fischer, G.—See Chiusoli, V.
„ „ See Guébhardt, A.

Flesch, M.—Ueber einige Versuche mit elektrischem Glüh- und Bogen-Licht. (On some experiments with incandescent and arc electric lights.) [*Post.*]
Zeitschr. f. Wiss. Mikr., I. (1884) pp. 561–3.

Fol, H.—Lehrbuch der vergleichenden mikroskopischen Anatomie mit Einschluss der vergleichenden Histologie und Histogenie. (Compendium of comparative microscopical Anatomy, including comparative Histology and Histogeny.) Part I. Microscopical-Anatomical Technics.
208 pp. (84 figs.), 8vo, Leipzig, 1884.

Francotte, P.—Marqueur traçant un cercle sur la lamelle pour retrouver facilement un lieu déterminé à une préparation. Finder. (Marker for making a circle on the cover-glass to readily find a given place in a preparation. Finder.) [*Post.*] *Bull. Soc. Belg. Micr.*, XI. (1884) pp. 48–50.

Fritsch.—Optical Phenomena. [*Post.*] *Nature*, XXXI. (1885) p. 212.

Garbini, A.—Manuale per la Technica moderna del Microscopio nelle Osservazioni zoologiche, istologiche ed anatomiche. (Manual of the modern technic of the Microscope in zoological, histological, and anatomical observations.)
[Same as Vol. IV. (1884) p. 993. Contains a chapter on the Microscope and mode of using it, pp. 15–28 (9 figs.).]
208 pp. and 9 pls., 8vo, Verona, 1885.

George, C. F.—Presidential Address to Postal Microscopical Society. [Mites.] *Journ. of Microscopy*, IV. (1885) pp. 1–5.

Giles, G. M.—Description of a convenient form of live-cell for observation with the Microscope, and of an inexpensive Microtome. [*Supra*, p. 135.] *Sci.-Gossip* (1885) pp. 7–9 (4 figs.).

Giltaij, E.—Inleiding tot het Gebruik van den Microscop. (Introduction to the use of the Microscope.) xii. and 254 pp. (2 pls.), 8vo, Leiden, 1885.

Giltay, E.—Ueber die Lage des Brennpunktes resp. der Brennlinie der Doppelkugel oder des Hohlcylinders. (On the position of the focal point or line of the double sphere or hollow cylinder.) *Zeitschr. f. Wiss. Mikr.*, I. (1884) pp. 479–85 (1 fig.).

Griffin, F. W.—Microscopic Objectives.
[General remarks.] *Lancet*, 22nd November, 1884, p. 942.

Griffith, E. H.—The Working Department [of the American Society of Microscopists. Reasons for refusing to accept the Directorship].
The Microscope, IV. (1884), pp. 242–3 and 253.

Guébhardt, A.—Elementare Erklärung der Untersuchungen von Gauss und Listing über die Kardinalpunkte der centrirten dioptrischen Systeme. (Elementary explanation of the investigations of Gauss and Listing on the cardinal points of centered dioptric systems.) Translated by G. Fischer from 'Ann. d'Oculistique,' lxxxi.
Central. Ztg. f. Opt. u. Mech., VI. (1885) pp. 4–9, 13–6 (6 figs.).

Gundlach, E.—Magnifying power. [*Post.*] *Amer. Mon. Micr. Journ.*, V. (1884) pp. 205–6.

" " Aperture and Working Distance. [*Post.*] *The Microscope*, IV. (1884) pp. 246–8.

Hepworth, T. C.—The Magic Lantern and its Management.
[Contains a chapter on the Lantern Microscope, pp. 61–6.]
viii. and 75 pp. (9 figs.), 8vo, London, 1885.

Heurck, H. van.—Note sur la résolution en perles de l'*Amphipleura pellucida* Kutz. et sur la nature réelle des stries des Diatomées. (Note on the resolution of *Amphipleura pellucida* Kutz. into "beads," and on the true nature of the striæ of the Diatomaceæ.)
[Nearly the same as given in this Journal, IV. (1884) p. 971.] *Bull. Soc. Belg. Micr.*, XI. (1884) pp. 63–7.

" " The Diatomescope. True nature of the striæ of diatoms. [*Supra*, p. 129.] *Engl. Mech.*, XL. (1884) p. 365.

" " The Diatomescope.
[Reply to E. M. Nelson, *infra*. It will, he considers, render much service with Continental small Microscopes to which a condenser cannot be adapted and which have mirrors with insufficient movements.] *Engl. Mech.*, XL. (1885) pp. 452–3.

Hirst, G. D.—Increase of augular aperture obtained by screwing the collar of Zeiss's 1/8 water-immersion objective to its utmost, and using 1 of glycerin to 2 of water for the immersion fluid.
Journ. and Proc. Roy. Soc. N. S. Wales, XVII. (for 1883) p. 262.

[Hitchcock, R.]—Some general remarks.
Amer. Mon. Micr. Journ., V. (1884) pp. 212–3.

„ „ Choosing objectives. [*Post.*] *Ibid.*, p. 214.

„ „ Microscopical Societies. [*Post.*] *Ibid.*, pp. 215–7, 237–8.

„ „ Schröder's Camera Lucida.
["While commending this instrument in the highest terms, it is but fair to say that owing to the considerable distance the light has to travel through it from the eye-lens, it can only be used with oculars of low power, having a long focus back of the eye-lens. Otherwise the rays come to a focus within the prism or at least do not reach the point K far enough above the prism to afford a sufficiently large field of view." "No such objection applies to the camera lucida of Grunow, which is the only one comparable with it."]
Ibid., p. 221 (1 fig.).

„ „ Postal Club Boxes.
[Remarks on J. Kruttschnitt's theory of the fertilization of the ovule.]
Ibid., pp. 234–5.

„ „ Concerning Microscopes.
[Criticism of J. S. Kingsley's article, cf. this Journal, IV. p. 975. His list of names is too small and far from comprehensive.]
Ibid., pp. 236–7.

„ „ Discontinuance of the 'Microscopical News.' *Ibid.*, p. 239.

[*Hitchcock, R.*]—Electric light for the Microscope.
[Abstract of S. T. Stein's paper, *supra*, p. 466.] *Ibid.*, pp. 222–4 (4 figs.).

"Invicta."—Microscope.
[Reply to inquiry for internal diameter and standard length of a full-sized English Microscope body-tube, and recommendation not to use a 10 in. tube. "A very well known and respected maker . . . . most kindly and liberally gave me advice that was simply invaluable. . . . 'Don't make your tube more than 8½ in. long, and shorter than that preferably.'"]
Engl. Mech., XL. (1885) p. 392.

Jannettaz, E.—Les Roches, description et analyse au Microscope de leurs éléments minéralogiques et de leur structure. (Rocks, description and microscopical analysis of their mineralogical elements and structure.)
[Contains a section on Polarizing Microscopes, pp. 112–7 (2 figs.)]
2nd ed., xii. and 486 pp., 215 figs. and 2 maps, 8vo, Paris, 1884.

Joseph, R. E.—Incandescent Lamps for Surgical and Microscopical purposes.
[Quotes Mr. Stearn's paper, III. (1883) p. 29.]
Trans. and Proc. Roy. Soc. Victoria, XX. (1884) pp. 84–7.

K.—The Phenomenon of Multiple Image.
[Has observed multiple images in diatoms, *Tricceratium favus*. This phenomenon is well known in England. See this Journal, I. (1881) p. 555.]
The Microscope, IV. (1884) p. 272.

L., R.—Paul Müller's Insectenfänger mit Lupe. (Paul Müller's insect-catcher with lens.)
[See this Journal, IV. (1884) p. 632, and *post.*]
Entomol. Nachr., X. (1884) p. 52.

Landolt, T.—Natriumlampe für Polarisationsapparate. (Sodium lamp for polarisation apparatus.)
Zeitschr. f. Instrumentenk., IV. (1884) p. 390 (1 fig.).

Latham, V. A.—The Microscope and how to use it. I.
[Gives "some of the best methods for the preparation and mounting of microscopic objects," preceded by brief remarks on the Microscope and accessories.]
Journ. of Microscopy, IV. (1885) pp. 22–34.

LEHMANN, O.—Ueber eine vereinfachte Construction des Krystallisations-Mikroskops. (On a simplified construction of the Crystallisation Microscope.) [*Supra*, p. 117.]
Zeitschr. f. Instrumentenk., IV. (1884) pp. 369–76) (4 figs.).

MALLEY, A. C.—Illumination for a Microscope. [*Post.*]
Engl. Mech., XL. (1884) p. 299.

Manchester Microscopical Society, presentation of Microscopes to, by Members.
Micr. News, IV. (1884) p. 303.

MANTON, W. P.—Beginnings with the Microscope: a working handbook containing simple instructions in the art and method of using the Microscope and preparing objects for examination. 73 pp. 8vo, Boston, 1884.

Microscope is always ready.
["A consideration that greatly recommends the use of the Microscope is the fact that it is never too cold or hot, too dry or wet, too cloudy or bright for work."]
The Microscope, IV. (1884) p. 279.

Möller, J.—C. Reichert's Neues Präparirmikroskop.
[Abstract of note, IV. (1884) p. 613.]
Zeitschr. f. Instrumentenk., V. (1885) p. 30.

NELSON, E. M.—Microscopic.
[Reply to five questions by "Al. Fard," p. 198.]
Engl. Mech., XL. (1884) pp. 239-40.

" " The Diatomescope. *Ibid.*, p. 282.

" " Illumination for the Microscope. IV. [*Post.*]
Ibid., p. 282 (6 figs.).

" " Beetle's eye as a lens.
[Directions for seeing the images of objects in beetle's eyes.] *Ibid.*, p. 327.

" " Optical Records.
["It is a well-known fact that the great strides taken in the improvement of the Microscope during the past twenty years have been in a great measure due to diatom maniacs, who by purchasing glasses warranted to resolve such and such diatoms, stimulated the makers not only to increase the aperture of their lenses, but also to improve the instrument, apparatus, and mounting material. . . . . Believing, as I do, that the literature of the resolution of test objects has had a material influence in the improvement of the Microscope, I see no reason why a similar kind of literature should not also prove beneficial to the telescope."]
Ibid. (1885) pp. 383–4.

" " The Diatomescope.
[Challenges the validity of Dr. Van Heurck's statement, *supra*, p. 129, that it has "answered very well as an oblique condenser," and considers that the result he obtained "is eminently unfavourable to the Diatomescope."]
Ibid., p. 410 (1 fig.).

Obituary.
[Discontinuance of 'Science Record' and 'Microscopical News.']
Micr. Bulletin, I. (1884) p. 49.

OSBORNE, LORD S. G.—The Diatomescope.
[Reply to "Akakia," *supra*, that he found it better practically not to adjust the two lenses in the same axis.]
Engl. Mech., XL. (1884) p. 299.

Osborne's Diatomescope.
[Cf. Vol. IV. (1884) p. 961.] *Sci.-Gossip* (1884) p. 276–7.

P., T.—Beetle's eye.
[Directions for seeing the images of objects in beetles' eyes.]
Engl. Mech., XL. (1884) pp. 327–8 (1 fig.).

PENNY, W. G.—On the correction of colour aberration when lenses are in contact. *Engl. Mech.*, XL. (1885) pp. 474–5.

RAYLEIGH, LORD.—Optics, Geometrical.
[Contains a note on the "resolving power of optical instruments."]
Ency. Britannica, 9th ed., XVII. (1884) pp. 798–807 (16 figs.).

Richmond Athenæum, opening of Microscopical Section in connection with.
Engl. Mech., XL. (1884) p. 297.

S., J. T.—Beetle's eye as a lens.
[Directions for exhibiting the image through a beetle's eye.]
Engl. Mech., XL. (1884) p. 372.

Slack, H. J.—Pleasant Hours with the Microscope.
[On the selection of a Microscope.]
Knowledge, VI. (1884) pp. 476-7 (1 fig.).

Slingo, W.—Photographic Recreations.
[Contains a note on taking photo-micrographs and exhibiting them with a Lantern Microscope.]
Knowledge, VI. (1884) pp. 485–7 (4 figs.).

Stowell, C. H.—The Student's Manual of Histology.
3rd ed., 370 pp., 178 figs., 8vo, Ann Arbor, 1884.

Stowell, C. H. and L. R.—Our Journal for 1885.
The Microscope, IV. (1884) p. 278 (and p. 279).

Strasburger, E.—Das kleine Botanische Practicum für Anfänger. (The small 'Botanisches Practicum' for beginners.)
[Abridged edition of the larger work, see IV. (1884) p. 633.]
viii. and 285 pp., 114 figs., 8vo, Jena, 1884.

Thompson, W. J.—The Microscope for Class-room Demonstration. [*Post.*]
Science, IV. (1884) pp. 540–1 (1 fig.).

Vogel, J.—Das Mikroskop und die wissenschaftlichen Methoden der Mikroskopischen Untersuchung in ihrer verschiedenen Anwendung. (The Microscope and the scientific methods of microscopical investigation in their different applications.) 4th ed. by O. Zacharias.
8vo, Leipzig, 1884.

Vorce, C. M.—Multiplying drawings. [*Post.*]
Amer. Mon. Micr. Journ., V. (1884) pp. 207–8.

Waldeyer [W.]—
[Exhibition to Berlin Physiological Society of a "Microscope-stand which he found very practicable, both for the ease and security with which it enabled a Microscope to be turned in every direction, and for the way in which it allowed the use of any system of lenses. (Apparently the Westien Universal Lens-holder, *supra*.)]
Nature, XXXI. (1885) p. 212.

Wallich, G. C.—A new form of Condenser for the Microscope.
[Statement of the advantages of his condenser. Cf. IV. (1884) p. 962 and *supra*, p. 127.]
Engl. Mech., XL. (1884) p. 320.
" " Dr. Wallich's Condenser.
[Statement as to Mr. Swift's Cone Condenser.] *Ibid.* (1885) p. 474.

Ward, P.—Illumination for a Microscope.
[Preliminary announcement of his "Anti-thermic Illuminator."]
Engl. Mech., XL. (1884) p. 299.

Weyenbergh, H.—Catálogo del laboratorio y gabinete de histologia de la Universidad Nacional en Córdoba. (Catalogue of the laboratory and cabinet of histology of the National University at Cordova.)
60 pp., 8vo, Cordoba, 1883.

Wilkie, F. B.—The Great Inventions: their history, from the earliest period to the present. Their influence on civilization, accompanied by sketches of lives of the principal Inventors; their labors, their hardships, and their triumphs.
[Chap. XI. The Microscope and the Telescope, pp. 143–73.]
687 pp. (figs.), 8vo, Philadelphia and Chicago, 1883.

Wright, L.—The Lantern Microscope.
[As to his exhibition of it at the R. Micr. Soc. and Quekett Micr. Club. Also as to a 1/4 or 1/5 in. for it, and as to showing diatoms.]
Engl. Mech., XL. (1884) pp. 299–300.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, giving an account of their origin, constitution, and working. Compiled from official sources. With appendix comprising a list of the leading Scientific Societies throughout the World. 1st Annual Issue.
[R. Micr. Soc. p. 67.] vi. and 226 pp., 8vo, London, 1884.

Z.—Neues Polarisations-Prisma von E. Bertrand.
[Abstract (with remarks) of note, Vol. IV. (1884) p. 965. Cf. also *supra*, p. 133.]
Zeitschr. f. Instrumentenk., V. (1885) pp. 30–1.

Zacharias, O.—See Vogel, J.

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

Hardy's Collecting-bottle.—Mr. T. Curties has improved this bottle by replacing the indiarubber strips forming the sides of the bottle by glass, it being difficult to cement the indiarubber with sufficient firmness to the glass.

Salmon's Culture-tube.*—The culture-tube of Dr. D. E. Salmon consists of a test-tube-like body or reservoir, of rather heavy glass, about 4 to 5 in. in length and 3/4 in. in internal diameter. Over the top of this reservoir a second hollow piece or cap is fitted. Its internal surface is ground to fit snugly over the ground external surface of the upper end of the reservoir, thus forming a ground-joint union. This cap, about 2½ in. long, abruptly contracts near its middle into a narrow tube with an internal diameter of about 3/8 in. The third piece, or ventilating tube, is like an inverted U, one limb being about 3 in. long, and 1½ in. longer than the limb, which fits by means of a ground joint over the narrow tube of the cap. The longer, free limb of the ventilating tube lodges a plug of glass-wool from 1½ to 2 in. long. The limbs of the ventilating tube are about 1 in. apart.

The culture-liquid is introduced by removing the cap, which brings with it the ventilating tube, and it is sterilized in the tube. The liquid is inoculated by removing the ventilating tube only. To prevent the ground joints from sticking too firmly, a little sublimated vaseline is introduced between the surfaces of the joint.

The pipette, used to introduce a drop of fluid containing bacteria, consists of an ordinary glass tube about 1/4 in. in diameter and 2 to 3 in. long, one end of which is drawn out into a very fine, almost capillary tube, which must be long enough to easily reach the bottom of the reservoir when introduced through the narrow tube of the cap. A plug of glass-wool occupies the other end, which is closed by a rubber ball.

The method of inoculating the culture-liquid is briefly as follows:—

The pipette is first thoroughly sterilized by flaming every portion of it from the tip of the capillary tube to near the rubber bulb, until the contained air is subjected to a temperature of at least 150° C. It is usual to bring it to a dull red heat, avoiding the contingency of melting the capillary tube. It is hung with the rubber bulb up to avoid its capillary portion coming in contact with anything while

* Amer. Mon. Micr. Journ., v. (1884) pp. 185–7.

cooling. When sufficiently cool the capillary portion is again drawn once or twice through the flame to destroy any particles that may have become attached meanwhile. The ventilator of the culture-tube, containing the bacteria to be sown, is flamed and removed and the narrow tube of the cap flamed, the rubber bulb slightly compressed, and the pipette introduced, a few drops drawn up, the pipette slowly withdrawn, the cap flamed again, and the ventilator replaced. The cap of the fresh tube is now flamed before and after removing the ventilator, the pipette introduced, a drop allowed to fall into the culture-liquid, the pipette removed, the narrow tube of the cap again flamed, and the ventilator replaced. When the source of the bacteria is an exudate, or the flow of the animal body, various methods are in use. The method above given may, however, be employed in most cases.

The reservoir may be variously modified. A flask-shaped body may be used for cultures that require an abundance of air, but the test-tube form will serve nearly all purposes. It enables the nature of the opacity in the liquid to be readily determined, while the earliest traces of a membrane or a deposit are more easily detected than with a broad body and a flat bottom.

The culture-tube recommends itself as a simple, very neat apparatus, readily filled, sterilized, and inoculated. It dispenses with the troublesome and dangerous expedients of disturbing cotton plugs, and of tying down various air-filtering materials. It is easily cleaned, and hence may be used over and over again, the original cost of the tube being in this way reduced to a minimum in the end. It does not break readily, nor are there any sharp or jagged edges to be feared in the manipulation of dangerous cultures. It is very compact, and occupies but very little space in a thermostat. Finally, the chances of contamination through the air during the process of inoculation are practically of no account.

Collecting Microscopic Algæ.*—An anonymous correspondent, referring to a suggestion for placing slides back to back and then suspending them from hoops in ponds, proposes a modification of this plan by taking waxed paper (from cakes of soap) and punching holes slightly smaller than the largest covers, then wrapping the paper about the slides in such a way as to bring the holes in the middle on each side. On suspending the slides, growths are secured on a space a little smaller than the covers, and good mounts can be obtained. Another suggestion is to take a slide with a spot of growing forms upon it, surround it with a cleft ring, as in Hardy's vivarium, bind on another slip, and the little world is ready for observation.

Preparations of the Central Nervous System for Projection.†—L. Edinger points out how much preferable actual sections of the central nervous system are for students as compared with diagrams. Hitherto, however, it has been very difficult to show them, for being

* Amer. Mon. Micr. Journ., v. (1884) p. 200.
† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 250–1.

mostly very large preparations a small diaphragm cannot be used and hence there is too much light, which drowns the images. Stained preparations in balsam are for the most part unsuitable, and glycerin preparations must be very thin, and are therefore difficult to make of the necessary size. The difficulty may, however, be got rid of by placing the sections direct from the microtome in a solution of nitric acid 1 part, water 15 parts, and there leaving them until they are a dazzling white. They should then be mounted in glycerin without previous washing. Thus prepared the sections, even though not very thin, are not only in an admirable condition for the Sciopticon, but in the case of microscopic or low-power examinations, will be found to give sharper images than by any process hitherto known.

The author has also found the Sciopticon useful as a means of drawing large sections under low powers. For this purpose the nitric acid preparations are very suitable, as all the details are thrown on the drawing-paper with marvellous clearness.

Treatment of the Ova and Embryos of the Aphides.*—E. Witlaczil publishes a lengthy paper on the development of the Aphides, and gives the following information on methods :—

The embryos of the viviparous aphides were examined in a weak salt solution (1½ per cent.), in which they live for about an hour. The ovaries contain embryos in different stages of development, and have to be isolated for study.

The early stages in the development of the ova may be studied to advantage after treatment with hydrochloric acid (3 per cent.) or acetic acid, as these reagents partially dissolve the yolk elements and thus render the preparation more transparent. The later stages, on the contrary, are rendered more opaque by the same treatment.

Preparing Echinorhynchi.—In the paper by A. Säfftigen already noted,† the following methods of preparation are described :—

It is a very difficult matter to kill *Echinorhynchi* instantly. This cannot be done either with corrosive sublimate or strong osmic acid, even after preliminary treatment with tobacco smoke or chloroform. Thus treated, they contract strongly, and remain so after death.

Much the best results are obtained by killing gradually with 0·1 per cent. osmic acid, in which they contract during the first hours, but stretch out again and die fully extended. This method causes slight swelling, but does not seriously injure the object for histological investigation. In specimens left for twenty-four hours in the osmic acid, it is easy to isolate under the dissecting Microscope the subcuticula and the two layers of muscle-fibres (circular and longitudinal). For the study of the internal organs, the *Echinorhynchi* should be cut open immediately after death and transferred to a 0·01 per cent. solution of osmic acid. The preservation of specimens thus treated may be accomplished in the following manner :—After carefully

* Zeitschr. f. Wiss. Zool., xl. (1884) pp. 559–696 (7 pls.). Abstract, *supra*, p. 53.

† Morphol. Jahrbuch, x. (1884) pp. 120–71 (4 pls.). See this Journal, iv. (1884) p. 897.

washing away the osmic acid, place the objects in a very dilute solution of potassic acetate in an open vessel, and leave them for two or three days, during which much of the solution evaporates. Finally, transfer to a saturated solution in order to clarify so far as possible. Very beautiful preparations are said to be thus obtained.

The course of the nerves may be easily traced in specimens that have lain several days in 1 per cent. formic acid. The tissues swell up strongly and become quite transparent, so that the nerves can be seen. If the muscular layers be separated from the subcuticula in specimens thus treated, and then stained in gold chloride, the lateral nerve-trunks may be clearly shown. For the histological study of the nerves, the *Echinorhynchi* should be treated with chromic acid and then stained deeply with borax-carmine.

Chromic acid preparations are also best for the study of the subcuticula. *Echinorhynchi* live for days in a 0·1 per cent. solution of chromic acid, but eventually die in a fully extended condition. Such preparations, after treatment with alcohol, may be coloured at once; or, after washing a day or more in running water, exposed to the action of osmic acid, and then coloured in borax-carmine.

For the study of the sexual organs, a very dilute picro-sulphuric carmine, which according to Säfftigen is the best staining fluid, must be allowed to act a long time (often one or more days); after a deep stain has been taken the preparation should be partially discoloured by the use of hydrochloric acid in the ordinary way.*

Action of Light on Objects hardened in Chromic Acid.†—Dr. H. Virchow shows that in tissues hardened in chromic acid, if subsequently placed in alcohol, a precipitation takes place, in the presence of light, of destructive secondary products of chemico-physical action. Part of the tissues is dissolved and thrown down as a fine brown granulation. In the dark, this result is avoided, as also when the tissue is first dehydrated before placing it in (absolute) alcohol in the presence of light.

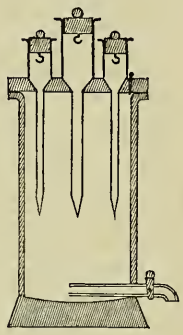
Haacke's Dehydrating Apparatus.‡—Dr. W. Haacke has devised the apparatus shown in fig. 27 for dehydrating objects so as to avoid the tedious process of placing them first in weak and afterwards in stronger and stronger alcohol.

It consists of a glass vessel 50 cm. high and 25 cm. in diameter, with a tap at the bottom and a top fitting air-tight, having one central and eight (smaller) peripheral apertures. These are closed by the tubes shown in the figure, also fitting air-tight (but easily removable), the lower end being drawn into a capillary point and the upper widened out to 5 cm. in diameter, and having a closely-fitting glass stopper. The tubes extend 25 cm. into the glass vessel and stand up 10 cm. above it. They should be thick and have a lumen of at least 1/2 cm. The central one should hold 100 c.cm. and the

* See Amer. Naturalist, xviii. (1884) p. 1291.
† Arch. f. Mikr. Anat., xxiv. (1884) pp. 117–19.
‡ Zool. Anzeig., vii. (1884) pp. 252–6 (1 fig.).

others 50 c.cm. The large vessel is to be filled with absolute alcohol and the tubes with distilled water (or alcohol of different strengths) and the preparation dropped in the latter (or attached to the hooks on the stoppers). An exchange then takes place between the alcohol and the water, the latter falling to the bottom of the vessel and absolute alcohol replacing it in the tubes. From time to time the dilute alcohol at the bottom of the vessel can be drawn off through the tap, first taking out the stopper in the cover. When the alcohol has sunk to the level of the points of the tubes the vessel should be filled up again through a funnel reaching half-way down and having a bent point. By regulating the sizes of the apertures at the bottom of the tubes the time required for the exchange of the alcohol and the water can be varied—from several days to a few hours—so as to suit all requirements. The tubes should be numbered and a table made showing their different periods.

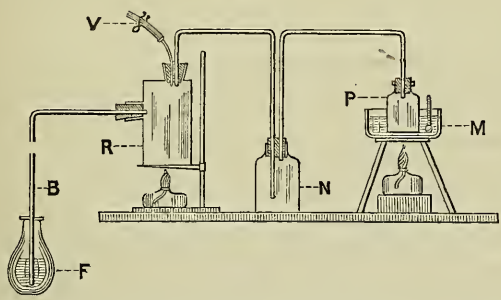
Fig. 27.



Imbedding in Paraffin by means of a Vacuum.*—P. Francotte has improved on Hoffmann's apparatus described Vol. IV. (1884) p. 820, which requires for producing the vacuum either a pressure of water or a very long aspirator. The former is often wanting and the latter very inconvenient.

Dr. Francotte at first attempted to obviate these inconveniences by boiling and then cooling ether (which requires only a temperature of 40°), but he now uses by preference steam. The vessel R (fig. 28)

Fig. 28.



holding about half a litre, has a barometer tube B, which passes into a vessel of mercury F, and another communicating with the flask P, containing the melted paraffin, heated by a water bath M. It is useful though not necessary to interpose a flask N to collect the steam if it is formed in too great quantity.

The water is boiled by a spirit-lamp and the air escapes by the

* Bull. Soc. Belg. Micr., xi. (1884) pp. 45–8 (1 pl.).

tube, which is provided with a pinchcock V. When the steam passes out in a jet, the lamp is removed, V is closed, and the vessel R cooled slowly by a wet sponge, by which means a vacuum is produced, and the mercury rises above 70 cm. The air is thus drawn out of the preparation and the paraffin penetrates. In half an hour the air may be readmitted.

Rapid Imbedding.*—In his studies on *Limulus* J. S. Kingsley adopted the following method of imbedding large numbers of specimens at once, thus effecting a considerable saving of time. The same method is applicable to any easily oriented object.

The embryos were taken from absolute alcohol and transferred to chloroform and then impregnated with paraffin in the normal way. When at last they were in pure paraffin they were transferred with a quantity of paraffin to a flat-bottomed watch-glass, and, the paraffin being kept in a melted condition, the embryos were arranged in a symmetrical position, the heads all pointing the same way and considerable space left between them. When arranged, the whole was allowed to cool, and then each embryo was cut out, together with a parallelogram of the surrounding paraffin, the longer axis of which corresponded with the axis of the embryo. The head end was marked, and then the crystal was slightly warmed, which allowed the little strips of paraffin to be readily removed. When it was desired to cut one of the specimens, it was a comparatively easy operation to place it in any desired position and fasten it by means of a hot needle on the end of a larger piece which fitted the clamp of the microtome.

The author tried various killing and hardening reagents (Kleinenberg's fluid, Perenyi's fluid, Müller's fluid, chromic acid, Merkel's fluid, corrosive sublimate, and osmic acid), but for sections he had the best results with the use of alcohol of various grades, beginning with 50 per cent. and ending with absolute. For surface views nothing excels osmic acid used for about ten minutes in a 0·1 per cent. solution.

Caldwell's Automatic Microtome.—Mr. W. H. Caldwell's very novel and ingenious instrument has effected a revolution in the art of section-cutting, especially where it is desired to cut a very large number of sections of equal thickness in a very short time, and to insure their arrangement in their proper consecutive order and with the same side upwards. It may be easily made to deliver in one continuous ribbon sections at the rate of 100 per minute, and when driven by means of a motor, such as the water-motor used for it at Cambridge, more than double this number can be obtained.

The general form of the instrument, which is supported on a heavy iron frame 36 in. long, 8 in. wide, and 11 in. high, resting on four feet, is shown in fig. 29, the object-holder with its carrier (in enlarged view) at fig. 30, and the top plate of the microtome, with object, knife, and belt, at fig. 31.

The carrier, with the object, moves backwards and forwards beneath the razor (any ordinary razor does), which remains stationary

* Science Record, ii. (1884) p. 269.

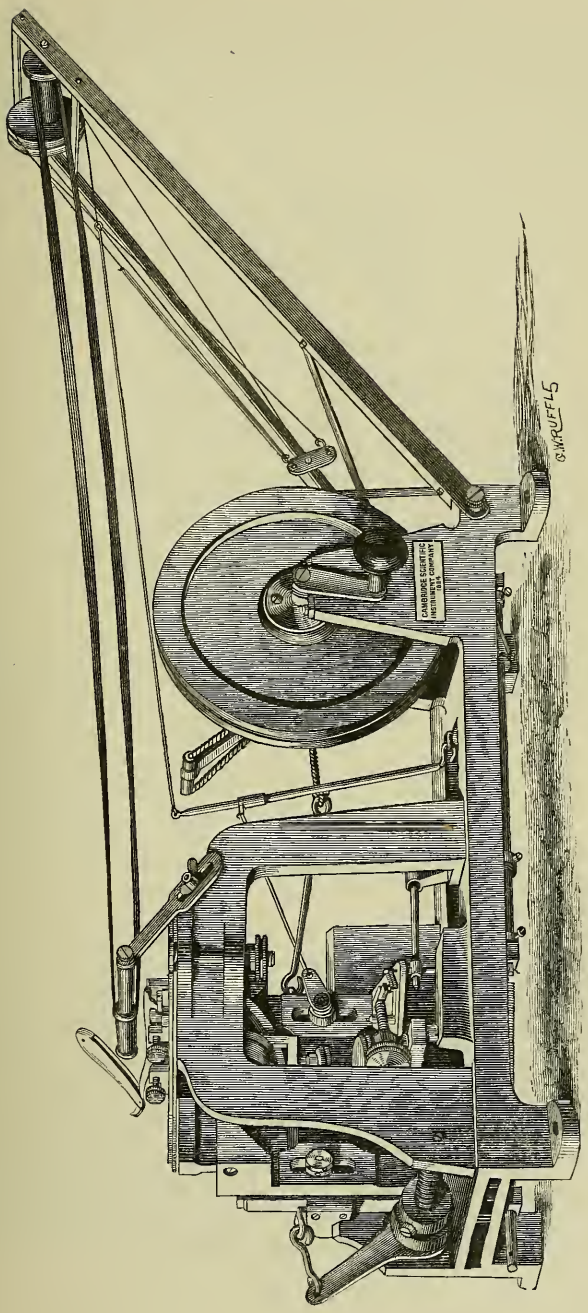
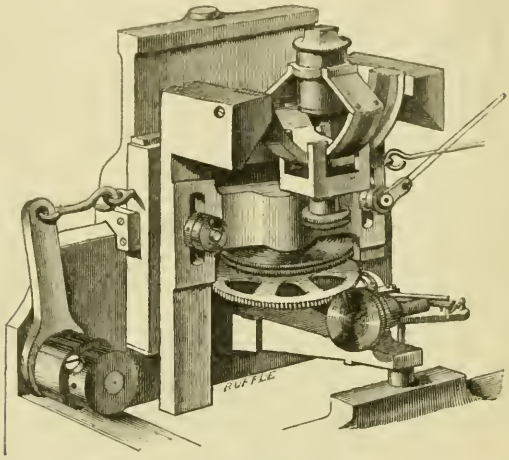


FIG. 29.

CALDWELL'S AUTOMATIC MICROTOME.

in the clamp in which it is fixed (figs. 29 and 31). The carrier is pulled forwards by the action of a roller fixed eccentrically to the axis of the large fly-wheel, and connected with it by the link and cords shown in fig. 29. It is drawn back again by the strong spring shown on the left. The extent of its motion is regulated so that the

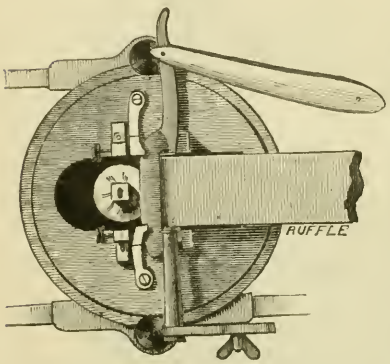
Fig. 30.



surface of the imbedding mass just clears the razor when the carrier is at its maximum and minimum distance from either end of the frame.

The cylindrical vessel which holds the imbedding mass and object is slipped into a tube or socket, in a cross-piece attached to two quadrants, arranged so that the socket may be set at any angle desired, and clamped by the vertical screw underneath (see fig. 30). This arrangement is for use when the object has not been symmetrically imbedded. For a rough adjustment of the object to the level of the knife the socket can be slipped up or down in the cross-piece. For more accurate, yet still rapid, adjustment the entire object-holder may be raised and lowered by the large micrometer screw. To this screw is attached a ratchet wheel with clicks, which are controlled by the lower, horizontal, screw (fig. 30), and by means of which the object is raised automatically. When the clicks

Fig. 31.



engage half a tooth the sections will be 2·5 μ (or 1/10,000 in.) in thickness, a whole tooth 5 μ, and so on.

The great novelty of the instrument, however, consists in the use of an endless band, 2 in. wide, to receive the sections as they come from the razor. With proper imbedding material the sections will adhere to one another and come off the razor in the form of a ribbon, and as soon as a sufficient length has been cut the end is picked up by a needle or scalpel and placed on the band which is just above the razor (see fig. 31). By the arrangement of cords and rods, shown in fig. 29, the band is adjusted so that at each "throw" of the object-carrier (or turn of the fly-wheel) it is moved forward through a distance equal to the breadth of the surface which is being cut. The ribbon of sections consequently travels up the band until the top is reached, when the sections can be cut off in convenient lengths for mounting.

The directions for using the instrument issued by its manufacturers, the Cambridge Scientific Instrument Co., have been republished,* and need not be repeated here. The most important points insisted upon are the sharpness of the razor and the accurate parallelism of the sides of the imbedding material from which the sections are cut, so that the ribbon of sections may be quite straight for convenient mounting. The Company supply special imbedding material, so that sections may be satisfactorily cut within a very considerable range of temperature, obviating the necessity of exactly adjusting the temperature of the room to the specimen of paraffin in use, or, as an alternative, of providing a number of specimens of paraffin with different melting points.

The ordinary 3 × 1 slides are not of course large enough for the ribbons, and slides of double the size (6 in. × 2 in.) are found the most convenient, with cover-glasses 5 in. × $1\frac{1}{2}$ in. On such a slide five or six rows of the ribbons may be placed, each row containing from fifty to one hundred sections or more.

Beck's Automatic Microtome.—At the January meeting of the Society, Messrs. Beck exhibited a simplified form of the Caldwell microtome, the cost of which is a little over a third only of that of the original.

The new form has an automatic movement and clamp arrangement similar to that of the Schanze (*post*), but to this is added the Caldwell endless band, which is driven by a very simple mechanism, and which has the special feature of being very readily detached from the microtome, so as to leave the latter free to be used for ordinary purposes other than the cutting of series of sections.

The new microtome will, we think, be found a great desideratum by those who are desirous of having a smaller and less elaborate instrument, and it will be illustrated in the April part of the Journal.

Thoma's Microtome.—Prof. R. Thoma sends us some further notes on this subject, and Herr Jung of Heidelberg the woodcuts.

It often occurs, he says, that in using the microtome, sections of

* Quart. Journ. Micr. Sci., xxiv. (1884) pp. 648–54.

hardened substances (aorta, eyes, cartilage, substances imbedded in paraffin, &c.) instead of being even are thicker at one point than at another, or the sections appear striped, their thickness varying in steps. He has found that the cause lies in the fact that hard substances bend the edge of the ordinary knife and that this can be prevented by using knives with stronger edges and shorter blade like E Z in figs. 32–4, which at the same time are cheaper. For convenience in sharpening the knife a movable handle F is attached to the blade by the screw *r*.

The knives should moreover be attached to the microtome in a different way to that ordinarily adopted. The new holder is also shown in figs. 32–4. This has two forks O and O′ by which it can be fastened

Fig. 32.

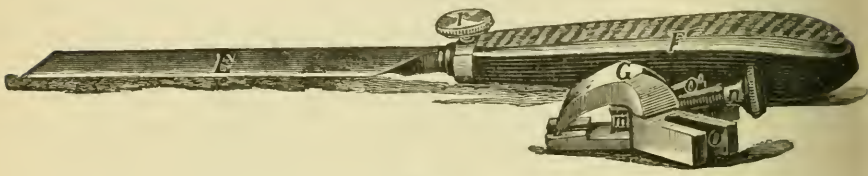


Fig. 33.

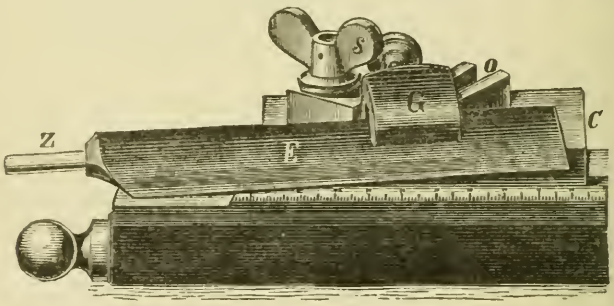
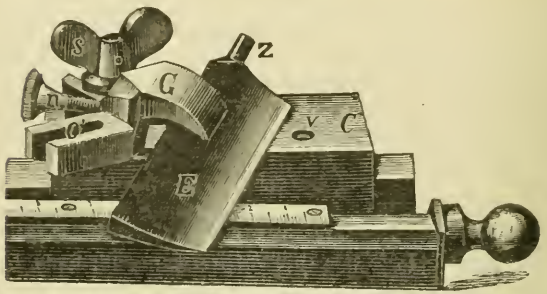


Fig. 34.

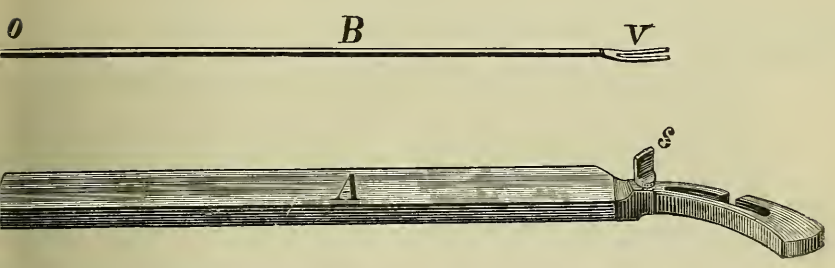


to the carrier V C of the microtome and clamped by S, the knife being clamped by *n* acting on the piece G. Fig. 33 shows the position

of the holder when the knife is intended to work with the whole length of its edge (fastened by the fork O′), for objects of moderate hardness, and fig. 34 when it stands more transversely to the long axis of the microtome (fastened by the fork O), for paraffin-imbedded objects.

For the purpose of stropping the original knives with plane-concave surfaces, a small rod B (fig. 35) is recommended. This rod has a projection at O which is inserted in a hole near *t* on the triangular end

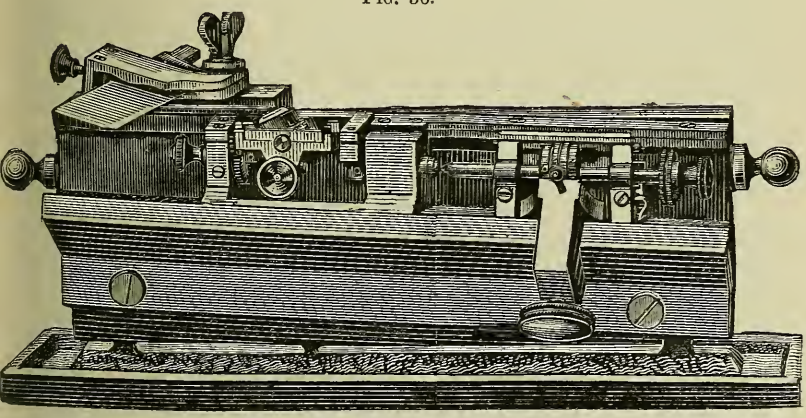
Fig. 35.



face of the knife A. The other end V of the rod is forked and is fixed to the handle of the knife by the screw *s*. The rod and screw are removed before cutting.

The construction of the carriers for the objects has also been varied according to different requests made by investigators. Fig. 36

Fig. 36.



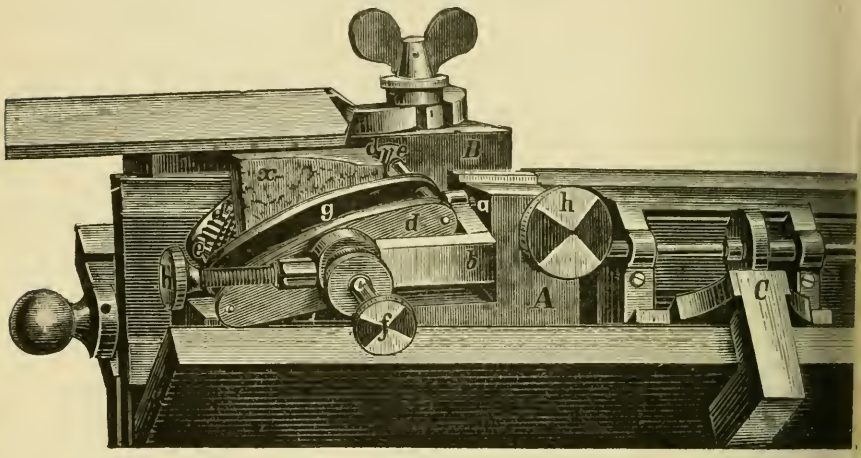
shows one of the new carriers with a clamp somewhat different from the original form.* This gives a few advantages of a secondary

* See this Journal, iii. (1883) p. 302.

character over the older form, particularly in avoiding the difficult working of the screw *d* in the latter.

A more perfect clamp is that shown in fig. 37, permanently attached to the sliding carrier. It is also made to fit the ordinary carrier. Rotation of the specimen on two horizontal axes can be per-

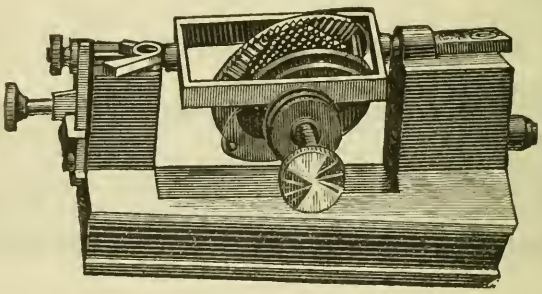
Fig. 37.



formed as in the clamp fig. 36. The axis which is parallel to the long diameter of the microtome is fixed by *h*. And in the same way *h'* will free the axis which works vertical to the former. The screw *f* moves the jaws *g* of the clamp, to fix the specimen. A is a part of the carrier and C the micrometer screw which moves it.

Fig. 38 represents a clamp devised by Dr. Meyer, of Naples.

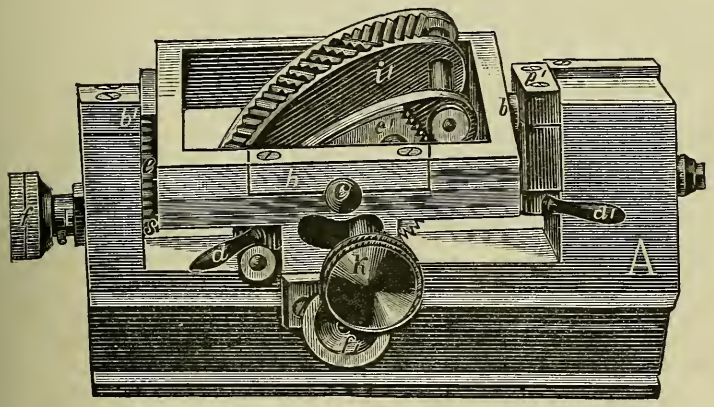
Fig. 38.



It can be turned round two horizontal axes, and the clamp can be easily removed from the carrier. The axes of rotation are very near to the cutting surface, which has certain advantages in adjusting

the object. Still more exact is the working of the clamp shown in fig. 39. There is rotation round two horizontal axes, as before, the position of the clamp being fixed at any given point by the two

Fig. 39.



handles *d* and *d'*. The milled heads *f* and *f'* produce the rotation by means of toothed wheels. The jaws *i'* are moved by K to fix the specimen to be cut.

This clamp has received some more recent improvements, which allow also of a vertical movement of the specimen in the clamp, and rotation round a vertical axis. It also allows of the use of imbedding boxes.

The microtome is now made of non-oxidizable bronze.

Herr Jung also provides * a strop of large size for the knives. The edges of the leather are carried round beneath to obviate the wrinkling which the tension of the blade usually produces on the sides.

The placing of the knife in a transverse position is found to prevent to a great extent the curling up of the sections. It also enables the successive sections to adhere to one another, to form a continuous ribbon.

Cutting Ribbons of Sections.—M. A. Gravis enumerates † several conditions which are necessary to the success of this delicate process. The object must not be too large nor too friable; the melting-point of the paraffin must be chosen with great precision, and the temperature of the room must be in a certain relation to that of the melting-point of the paraffin. A hard paraffin is favourable for the thinnest sections; and a soft paraffin facilitates the adherence of the sections in ribbons. Mr. Harmer reconciles these two opposite advantages by using as hard a paraffin as the nature of the object permits; cutting out of the block of paraffin a small cube containing the object, then

* Bull. Soc. Belg. Micr., x. (1884) pp. 151–2.
† Ibid., pp. 117–9.

covering one of the vertical faces of this cube (the one turned in the direction of the knife) with a thin coat of soft paraffin, which insures the adherence of the sections to one another by their edges.

Dr. C. O. Whitman also points out * that it is important to use a moderately soft paraffin, which may be obtained by mixing in proper proportions soft and hard paraffin, and further to give the piece of paraffin to be cut a rectangular form. The piece must then be so placed in the holder that the side next to the knife is exactly parallel with the cutting edge. Thus placed, every section lies flat on the blade. The second section pushes on the first, adhering to its adjoining side; the third pushes on the first two, adhering to the second. A whole ribbon of sections may be cut in this way in a few moments without danger of losing their serial order. Thus three very important points are gained: the sections remain perfectly flat, the cutting may be as rapid as the hand can move, and the order of the sections is preserved without trouble to the manipulator. Care must be taken only that the opposite sides of the paraffin are parallel, otherwise the ribbon will curve to the right or left and the arrangement of the sections on the slide be less easily accomplished.

New Application of Hæmatoxylin.†—R. Heidenhain describes a process which gives an entirely different stain to that of the ordinary fluid. The ingredients are a 1/2–1 per cent. *aqueous* solution of hæmatoxylin and a 1/2–1½ per cent. solution of bichromate of potash. Small pieces of tissue well hardened in alcohol are first placed in 8–10 c.cm. of the former fluid, and after 8–10 hours for the same time in a nearly equal quantity of the second solution. After they have taken a black colour throughout, the excess of bichromate of potash is removed by water. Then follows dehydration by alcohol, imbedding, &c. The sections must be cut extremely thin.

The nuclei are mostly black, and the tissue-elements a more or less dark grey or also black, but so that different elements take an entirely different shade of grey and are readily distinguished as if in an artistically finished woodcut. In epithelial tissue the outlines of the cells are extremely sharp. In the separate cells the protoplasm is darker than the other contents, so that the richness of different cells in protoplasm and its distribution in the separate cells is admirably shown. The markings of the primitive bundles and fibrillæ in muscle are much clearer than in the fresh tissue. Nerve-fibres are also well shown.

A blue stain is obtained if instead of treating the tissue with bichromate of potash, a 1 per cent. alum solution is used.

Weigert's Staining Method for the Central Nervous System.—C. Weigert, in 1882, described‡ a method of staining the central nervous system in which *acid* fuchsin was used, and which left the

* Amer. Natural., xviii. (1884) pp. 106–7.
† Arch. f. Mikr. Anat., xxiv. (1884) pp. 468–70.
‡ Centralbl. f. d. Med. Wiss., xx. (1882) pp. 753, 772, and 819.

nerve-fibres of the white and grey matter a brilliant red, the other parts varying in tint to blue. This was much praised by all who used it as an exceptionally excellent method, but is now superseded by a new stain, which Prof. Weigert * considers to be still better, and which, according to all accounts, is specially valuable as being extremely simple and easy, and, above all, unfailing.

The first solution used consists of hæmatoxylin 0·75 to 1·0, alcohol 10·0, and water 90·0, the mixture being boiled and left to stand several days before being used.

In this solution sections, cut with alcohol and not water, and hardened in Müller's or Erlicki's † fluid, are allowed to remain for 1–2 hours at a temperature of 35°–45° C. The sections are now coal black.

After washing with water they are placed in a solution of borax 2·0, potassium ferricyanide 2·5, and water 100·0, until the white is differentiated from the grey matter, the latter becoming indistinctly yellow, while the former remains black. They can then be washed, treated with alcohol, xylol, and Canada balsam in the usual way.

W. T. Councilman,‡ writing of this process, says that any one using it for the first time will be struck with the richness of the network of nerve-fibres in the grey matter of the cord. What was formerly spoken of as gelatinous substance or neuroglia will be found to be mostly nerve-fibres. They are not visible under ordinary circumstances, because the intermediate substance stains as intensely as the axis-cylinders. At first sight it will appear that the axis-cylinders are stained, but closer inspection with high powers will show that these are really unstained, and the white substance of Schwann has taken on the colour. In the middle of the bright red or purple spots which represent the cross sections of nerve-fibres, the unstained axis cylinder can be seen. It is in all respects just the opposite to the ordinary staining of carmine and hæmatoxylin. The method is also invaluable in the pathology of the cord in tracing degenerated nerve-tracts.

Method for Displaying the Course of the Fibres in the Central Nervous System.§—S. Freud proposes the following method for this purpose:—

Thin sections of brain hardened in bichromate of potash, after washing to free them from the alcohol with which the razor has been moistened, are placed in a watch-glass with 1 per cent. solution of gold chloride and left for 3–5 hours. They are then removed with a clean fragment of wood, washed in distilled water, and placed in a solution of caustic potash (1 part potash to 5 or 6 water) for about three minutes. The superfluous potash is removed by placing the sections on filter paper, and they are then placed in 10–12 per cent. sodium potash, where they acquire a red colour; in 5–15 minutes the staining is complete.

* Fortschr. d. Med., 1884, pp. 113, 190.
† Potassium bichromate 2·5; copper sulphate 0·5; distilled water 100·0.
‡ Amer. Mon. Micr. Journ., v. (1884) pp. 201–3.
§ Arch. f. Anat. u. Phys., 1884, pp. 453–60.

Such preparations show the fibres dark reddish brown on a light red, bluish, and even unstained ground. The most convenient hardening fluid is 2½ parts bichromate of potash, 1/2 sulphuric acid, to 100 parts of water.

Method for the Silver Staining of Marine Objects.*—The principle of this method was suggested to Mr. S. F. Harmer by Dr. W. H. Ransom, and consists in the replacement of distilled water in the ordinary process of silver staining by a solution of a neutral salt not precipitable by silver nitrate, and of the same specific gravity as sea-water. *Loxosoma* and *Pedicellina* were the first objects investigated, and these animals are not killed by an exposure of as much as half an hour to a 5 per cent. solution of potassic nitrate in distilled water. It is thus quite easy to free the tissues from the greater part of their chlorides by washing with the above-mentioned solution of potassic nitrate; from this the objects are transferred (naturally without the formation of any precipitate) for four or five minutes to a solution of silver nitrate (1/8 to 1 per cent. according to circumstances). After reduction of the silver during exposure to light in the nitrate solution, the tissues may be mounted permanently either in glycerin or in Canada balsam. Very beautiful preparations of *Loxosoma* were easily obtained by the use of osmic acid and picro-carmine after treatment with silver nitrate. The animal may either be transferred directly from the silver solution to osmic acid (1/2 per cent.) and thence to picro-carmine, reduction taking place during the process, or the osmic acid may be added after the silver has been already reduced in the potassic nitrate. In successful preparations made in the above manner, the limits of all the cells of the epidermis and of the alimentary canal are exceedingly sharply marked out, the nuclei of these cells as well as of the muscle cells, connective-tissue corpuscles, and other tissue elements, being very distinctly stained.

Few animals seem to resist the action of potassic nitrate to so great an extent as *Loxosoma* and *Pedicellina*, most forms being either immediately or after a few minutes killed by an immersion in a 5 per cent. solution of this substance. Even in many of these cases, the tissues suffer very little histological change, and can be easily stained by silver nitrate. It is possible that many other salts may be used more advantageously than potassic nitrate in washing the chlorides from the tissues without killing the animal. A 4½ per cent. solution of sodic sulphate may be used instead of the potassic nitrate, over which, however, in most cases it has no obvious advantages.

Balsam of Tolu for Mounting.—Dr. W. J. Gray informs us that some years ago he tried this substance for mounting, but found that it was open to the great objection of the formation of crystals. Since Mr. C. H. Kain's recommendation of it† he has tried it again, and the slides are already full of crystals.

* MT. Zool. Stat. Neapel, v. (1884) pp. 44-56.

† See this Journal, iv. (1884) p. 985.

Zenger's Mounting for Diatoms, to view them on both sides.—Dr. C. V. Zenger writes us as follows :—"It is of the utmost importance for the study of diatoms and their structure, to view the preparations from opposite sides, and I have found very useful a simple and expeditious mode of obtaining a double-sided cell.

I use two circular covers just fitting on the plane surface of the Abbe condenser. After well rinsing with pure alcohol or benzine and drying, a circular disk of tin-foil is cut of exactly the diameter of the covers. A concentric hole is punched out, and the tin-foil ring thus obtained glued to one of the covers. After drying over a small gas-burner, the shallow cell thus formed is warmed and filled with a solution of tolu balsam in benzine; and the other cover with the diatoms burned on its surface is placed on the cell, squeezing out with the nail the superfluous imbedding liquid on blotting-paper, so that it will immediately suck away the liquid pressed out. Wool or cotton dipped in benzine or pure alcohol may be used to wipe the borders and surface of the cell to clean it, turning it round on the blotting-paper, so that the other side is equally cleaned. It is then dried over a small gas-burner very cautiously to get rid of air-bubbles, and to fasten the covers. Both covers having the same thickness and diameter, there is no fear of separating them. In order not to confound the different views, the tin-foil is painted with red lacquer on one side, so that the particular side under the object-glass can be readily distinguished. Immersion can be used on both sides, on that turned to the condenser or to the object-glass, or both sides at once."

Ady, J. E.—The Microscopic Study of Rocks. I.
[Includes methods of preparing.] *Sci. Monthly*, III. (1885) pp. 1–4.

Almqvist, E.—Die besten Methoden Bacterien rein zu cultiviren. (The best Methods for the pure cultivation of Bacteria.)
[(1) Pasteur, (2) Koch, (3) in a moist chamber. The last for observations on the development of an individual from spore to spore.]
Bot. Centralbl., XIV. (1883) pp. 286–7. Also *Hygiæa*, 1883.

Arnold, C.—See Turntable.

B.Sc.—See Turntable.

Baldwin, L. A.—Staining and Mounting Casts, &c.
[Inquiry for satisfactory process and reply by R. Hitchcock.]
Amer. Mon. Micr. Journ., V. (1884) p. 240.

Barrett, J. W.—A new Method of Cutting Sections for Microscopical Examination.
[Describes the "Celloidin Method."—See Vol. IV. (1884) p. 822.]
Journ. Anat. and Physiol., XIX. (1884) pp. 94–6.

Becke, F.—Ueber die Unterscheidung von Augit und Bronzit in Dünnschliffen. (On the Discrimination of Augite and Bronzite in thin Sections). [*Post.*]
Tschermak's Mineralog. und Petrogr. Mitthlg., V. (1883) p. 527.

Braun, M.—Die thierischen Parasiten des Menschen, nebst einer Anleitung zur praktischen Beschäftigung mit der Helminthologie für Studirende und Aerzte. (The Animal Parasites of Man, with instructions in practical Helminthology for Students and Physicians.) [*Post.*]
223 pp., 72 figs., 8vo, Würzburg, 1884.

Brown, G. D.—Mounting dry opaque objects without cover-glass.
[His collection of Polyzoa is mostly so mounted. Objects are thus better seen by reflected light, there is no condensation of moisture on the cover-glass, and no fungi.]
Journ. of Microscopy, IV. (1885) p. 42.

Cement for Glass, Porcelain, &c.

[" Take soft cheese, grind and wash it in hot water, and when freed from all soft matter, and nothing remains but pure caseine, press in a fine cloth so as to squeeze out all the liquid. The white matter is dried, reduced to powder, and preserved in a wide-mouthed bottle, or well-fitting box. To use it, grind it up with a small quantity of water, which makes a very adhesive paste. Use immediately, and in the cold. It sets rapidly, and when once dry, it cannot be redissolved, either by moisture or heat. It is suggested that the dry caseine should be ground up, not in water, but in ammonia, solution of borax, or in lime-water, and preferably to obtain the caseine from butter-milk, which is precipitated with acetic acid, using as little as possible. The precipitate to be repeatedly stirred up in hot water, and thus washed by decantation, until all the fatty matter is removed."]

Journ. of Microscopy, IV. (1885) pp. 63–4, from 'Moniteur des Produits Chimiques,' through the 'Chemical Review.'

Councilman, W. T.—The Microscopic Investigation of the Brain and Spinal Cord. [*Supra*, p. 159.] *Amer. Mon. Micr. Journ.*, V. (1884) pp. 201–3, 212.

Davies, T.—The Preparation and Mounting of Microscopic Objects. Edited by John Matthews. New ed.

[Not a new ed.—title-page redated.] 222 pp., 12mo, London, 1884.

Dekhuijzen, M. C.—Het Onderzoek van dierlijke Weefsels, voornamelijk van het Kraakbeen, in het gepolariseerde licht. (The investigation of animal tissues, especially cartilage, in polarised light.)

viii. and 108 pp. (1 pl.), 8vo, Leiden, 1884.

Delogne.—Instrument pour opérer le triage des diatomées sous des grossissements assez forts tels que ceux fournis par les objectifs Nos. 3 et 4 de Hartnack. (Instrument for sorting diatoms under powers as high as the Nos. 3 and 4 Hartnack objectives.)

[On the same principle as that of J. Chalon, Assoc. Franc. Av. Sci., 1881 (See Vol. I., 1881, p. 847), but the movements are restricted to two rectangular planes.]

Bull. Soc. Belg. Micr., XI. (1884) p. 38.

Dietzsch, O.—Die wichtigsten Nahrungsmittel und Getränke, deren Verunreinigungen und Verfalschungen. (The most important Foods and Drinks, their impurities and adulterations.) 4th ed., 352 pp., 8vo, Zurich, 1883.

Flesch, M.—Zur Weigert'schen Hämatoxylinfärbung der centralen Nervensystems. (On Weigert's hæmatoxylin staining for the central nervous system.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, I. (1884) pp. 564–6.

Francotte, F.—Moyen d'accélérer l'inclusion dans la paraffine à l'aide du vide. (Method of accelerating imbedding in paraffin by means of a vacuum.)

[*Supra*, p. 149.] *Bull. Soc. Belg. Micr.*, XI. (1884) pp. 45–8.

Fränkel, B.—Ueber die Färbung der Koch'schen Bacillus und seine semiotische Bedeutung für die Krankheiten der Respirationsorgane. (On the staining of Koch's *Bacillus* and its semiotic importance in diseases of the respiratory organs.) [*Post.*] *Berl. Klin. Wochenschr.*, 1884, No. 13.

Garbini, A.—See Bibliography *a*.

Giacomini, C.—Sezioni microscopiche dell' intero Encefalo umano adulto. (Microscopical sections of the entire human adult brain.)

Sep. repr. from *Giorn. R. Accad. Med. Torino*, 1882, Fasc. 12, pp. 3–18.

„ „ Modificazione al processo classico di induramento dei centri nervosi. (Modification of the classical process for hardening the central nervous system.) [*Post.*] Torino, 1883, pp. 66–7.

Gierke, H.—Färberei zu mikroskopischen Zwecken. (Staining for microscopic purposes.) (*Concld.*) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, I. (1884) pp. 497–557.

Giles, G. M.—Description . . . . of an inexpensive Microtome.

[Describes "a form of microtome which can be made by any one with a slight mechanical turn for about 1*s.* 6*d.* In many essential points it is almost identical with that of Mr. A. B. Chapman, described" Vol. IV. (1884) p. 642, though made more than ten years ago.]

Sci.-Gossip, 1885, pp. 7–9 (2 figs.).

Gosse, P. H.—Evenings at the Microscope. [*Post.*]
New ed., vi. and 412 pp., 112 figs., 8vo, London, 1884.

Gram, C.—Untersuchungen über die Grösse der rothen Blutkörperchen im Normalzustande und bei verschiedenen Krankheiten. (Researches on the size of the red blood-corpuscles in the normal condition and in different diseases.)
[On the methods used, pp. 33–6.] *Fortschr. d. Med.*, II. (1884) p. 33.

Griffith, E. H.—A beautiful slide.
["Heat a slide until it will melt a small portion of a menthol pencil as it is drawn evenly back and forth over a perfectly clean surface. Do not use more heat than necessary to melt the material evenly. Then as it commences to crystallize, arrest its progress frequently by passing the slide quickly over the flame of your spirit-lamp. Soon the crystallization will be completed, a little at a time, and a very desirable slide will be the result."]
The Microscope, IV. (1884) p. 241.

Hanaman, C. E.—White Zinc for mounting.
[Warning against its use. Of "27 slides 21 required re-cementing, and in every case the cement was so brittle that it needed but a touch of the knife-blade to cause the fragments which remained to leave the glass."]
Amer. Mon. Micr. Journ., V. (1884) p. 220.

Harmer, S. F.—On a method for the silver staining of marine objects.
[*Supra*, p. 160.] *MT. Zool. Stat. Neapel*, V. (1884) pp. 445–6.

Haswell, W. A.—On methods of studying the Annelida. [*Post.*]
N. Zealand Journ. Sci., I. (1883) p. 305.

Heidenhain, R.—Eine neue Verwendung des Hämatoxylin. (A new use of hæmatoxylin.) [*Supra*, p. 158.]
Arch. f. Mikr. Anat., XXIV. (1884) pp. 468–70.

Henking, H.—Neue Construction des Objecthalters am Schlittenmikrotom, eine genaue Einstellung des Objectes bezweckend. (New construction of the object-holder to the slide-microtome, allowing of an exact adjustment of the object.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, I. (1884) pp. 491–6 (2 figs.).

Heurck, H. van.—Structure microscopique de la valve des Diatomées. (Microscopic structure of the valve of the Diatomaceæ.) [*Post.*]
Bull. Soc. Belg. Micr., XI. (1884) pp. 71–3,
from 'Synopsis des Diatomées de Belgique,' pp. 35–7.

Hitchcock, R.—Microscopical Technic. VIII. Concluding remarks on Mounting.
Amer. Mon. Micr. Journ., V. (1884) pp. 210–1.

" " Zinc White Cement again.
["What we have said and still maintain as the result of practical experience is that zinc white cement cannot be depended upon. It may do as a finish, but not for the practical purposes of a cement."]
Ibid., p. 218.

" " Chromogene Bacteria.
[Contains directions for obtaining pure cultures of bacteria, simple culture-chamber ("glass tumbler inverted over a sauce-dish containing water with a salt-cellar projecting above the water to support the specimen"), directions for staining and mounting, and for preparing the culture-medium.]
Ibid., pp. 224–6.

" " Material for Mounting for Distribution. *Ibid.*, pp. 235–6.

" " W. C. Walker's preparations of Diatoms.
["These slides are unique from the ornamental mounting which must involve considerable expenditure of time."]
Ibid., p. 239.

" " J. L. Zabriskie's wood sections, transverse, radial, and tangential. *Ibid.*, p. 239.

" " See Baldwin, L. A.

" " Pillsbury Cabinet for Slides.
[Commendation of it. Cf. this Journal, IV. (1884) p. 320.] *Ibid.*, p. 239.

Israel, O.—Ueber die Cultivirbarkeit des Actinomyces. (On the capacity for cultivation of Actinomyces.) [*Post.*]
Virchow's Arch. f. Pathol. Anat. u. Physiol., XCV. (1884) p. 140.

James, F. L.—The Microscope as an instrument for physical diagnosis.
[Discovery of *Sporotrichum dermatodes* as the cause of a disease to which French workmen manipulating reeds (*Arundo donax*) are subject.]
National Druggist (St. Louis), V. (1884) p. 216.

„ „ Preparing Slides with Shellac.
[The slide should be put away to dry, cell side downward, or the heaped-up shellac will again spread over the glass.]
Ibid., p. 216.

Kalchbrenner, K.
[Describes a discovery of F. v. Müller, who has found in methylized alcohol a means by which fungi and other plants can be so dried that they retain their natural colours.]
Bot. Centralbl., XX. (1884) p. 391,
from 'Mathem. és Term. tud. Értesitö,' II. (1884) pp. 97–8.

Kerremans.—[Sur la méthode de Wickersheimer.] (On the method of Wickersheimer.) *Comptes Rendus Soc. Entomol. Belg.*, No. 51 (1884) pp. cccxxxiv.-v.

Klebs, G.—Organisation einiger Flagellatengrüppen und ihre Beziehung zu Algen und Infusorien. (Organisation of some Flagellata and their relationship to Algæ and Infusoria.)
[See Vol. IV. p. 68, and for methods, *post.*]
Unters. Bot. Institt. Tübingen, I. (1883) pp. 233–62 (2 pls.).

Koestler, M.—Ueber das Eingeweidenervensystem von *Periplaneta orientalis*. (On the intestinal nervous system of *Periplaneta orientalis*.) [*Post.*]
Zeitschr. f. Wiss. Zool., XXXIX. (1883) pp. 572–95.

Latham, V. A.—Staining Sections. *Sci.-Gossip*, 1884, p. 276.

Leboucq, H.—Un mot sur la technique des Coupes en séries. (A word on the technics of series sections.) 2 pp. Sep. repr. *Ann. Soc. Médec. Gand.*, 1884.

Linck, G.—Ein neues Reagens zur Unterscheidung von Calcit und Dolomit im Dünnschliff. (A new Reagent for Calcite and Dolomite in thin Sections.)
[*Post.*] *Ber. Oberrhein. Geolog. Vereins*, XVI. (1883).

Lissauer.—Ueber die Veränderungen der Clark'schen Säulen bei Tabes dorsalis; Zusatz zu dem Obigen von C. Weigert. [*Infra.*]
Fortschr. der Med., 1884, No. 4.

Ludwig, F.—Ueber die spectroskopische Untersuchung photogener Pilze. (On the spectroscopic investigation of phosphorescent Fungi.)
[See Vol. IV. (1884) p. 925 and *post.*]
Zeitschr. f. Wiss. Mikr., I. (1884) pp. 181–90.

M. D.—Microscopic Mounting.
[Reply to query for directions for mounting bone, cartilage, and muscle.]
Engl. Mech., XL. (1884) p. 289.

„ See Turntable.

Maggi, L.—Sull' essame Microscopico di alcune acque potabili della città di Padova. (On the microscopical testing of some Padua drinking water.)
106 pp., 8vo, Pavia, 1884.

Manton, W. P.—See Bibliography *a*.

Martinotti, G.—Sulle colorazione doppia coll' ematossilina e coll' eosina. (On double staining with hæmatoxylin and eosin.)
6 pp. Sep. repr. *Gazz. delle Cliniche* (*Torino*) 1883.

„ „ Sull' uso dell' allume di cromo nella tecnica microscopica.
[*Post.*] *Zeitschr. f. Wiss. Mikr.*, I. (1884) pp. 361–6.

Matthews, J.—See Davies, T.

Merian, A.—Beobachtungen am Tridymit. (Observations on Tridymite.)
[*Post.*] *Neues Jahrb. f. Mineral.*, I. (1884) pp. 193–5.

Owen, D.—On Mounting Sections stained with Picrocarmine.
["On removing the section from the staining solution, do not wash it, but absorb the superfluous picrocarmine with blotting-paper, and then mount in glycerin containing 1 per cent. of formic acid. It is not

necessary to remove all the picrocarmine from the section ; in fact it is advisable to leave a little adhering to the section, for, within a few days after mounting, the trace of dye left will be absorbed by the section."]

Sci.-Gossip, 1884, p. 275.

Pedley, P. R.—Stupefying active forms of aquatic life.

[Advocates the addition of 1–3 per cent. of ordinary soda-water or water charged with carbonic acid gas.]

Journ. and Proc. Roy. Soc. N. S. Wales, XVII. (for 1883) p. 261.

Plaut, H.—Färbungs-Methoden zum Nachweis der fäulniss-erregenden und pathogenen Mikro-organismen. (Staining methods for demonstrating the saprogenous and pathogenous Micro-organisms.)

[Gives in a tabular form a summary of all the more important investigation methods for Micro-organisms—*post.*]

2nd ed., 32 pp., 8vo, Leipzig, 1884.

Polycystina, cleaning and mounting. *The Microscope*, IV. (1884) pp. 280–2.

Pratt, W. F.—Staining Vegetable Tissues in Picrocarmine.

[Place the sections in alcohol for 1 hour. Immerse in staining solution ½–3 hours. Wash in alcohol. Immerse in an alcoholic solution of picrate of ammonia for 1 hour, and for a 2nd hour in a like solution. Place in alcohol and then in oil of cloves for a short time. From Cole's 'Methods of Microscopical Research,' 1884, Part XI.]

Sci.-Gossip, 1884, p. 276; 1885, p. 18.

Reynolds, R. N.—Notes on Microscopic Work. A Rat followed from the Corn-crib to the Microscopist's Cabinet. 16 pp., Detroit, 1884.

Richard, O. J.—Instructions pratiques pour la formation et la conservation d'une herbier de Lichens. (Practical instructions for the formation and preservation of an herbarium of Lichens.) 2nd ed., 44 pp., 8vo, Paris, 1884.

Royston-Pigott, G. W.—Note on the Structure of the Scales of Butterflies.

[Contains the following:—"Very much has been written whether the delicate membrane of these beautiful scales is complex—I mean double quadruple or single. The question seems settled by the following facts. The sap flows between the tubes; scales are apparently a kind of flattened hairs, most of which are more or less hollow and similarly endowed with molecules. Squeezed accidentally an oily sap escapes. But another fact of an optical nature is still more decisive. Under the very finest instruments extant the former hazy margin of the most delicate scales becomes brilliantly clear, sharp, and black—a thin black line about the hundred thousandth part of an inch thick. This sharp black line is as precious an indication of instrumental perfection as the black division is in Saturn's rings to the astronomer. This black line is thus caused. Light is stopped at the edge where the transparent membrane is folded back. As an illustration—if gold leaf, which is transparent and about 1/200,000 of an inch thick, be doubled back, at the line of doubling or folding a black line appears in the translucent blue of the leaf. I have seen the same thing on folding carefully a piece of goldbeater's skin. No light shows through at the line of folding. All transparent tubes visible in the best possible instruments show also too black for borders. In the same way each of the ribs of these scales when unclouded with beading or molecules exhibits these beautifully well-defined black lines. Any one who possesses an instrument which clearly and sharply displays these black margins in minute delicate scales may be congratulated on the superlative excellence of his instrument."]

Engl. Mech., XL. (1884) p. 215.

Säfftigen, A.

[Contains "Method of Preparation." Abstr. in 'Amer. Natural.,' XVIII. (1884) p. 1291. *Supra*, p. 147, and cf. also this Journal, IV. (1884) p. 897.]

Morphol. Jahrbuch, X. (1884) pp. 120–71 (4 pls.).

Saunders, W. D.—Microscopic Slide Centering.

[Turn one or more rings in ink with a fine steel pen on the back of the slide.]

Sci.-Gossip, 1884, p. 276.

Slack, H. J.—Pleasant Hours with the Microscope.
[Directions for making a "lead-tree" and "silver-tree."]
Knowledge, VI. (1884) pp. 518–9.
[Some hints on mounting objects.] *Ibid.*, VII. (1885) pp. 77–8 (1 fig.)

Stowell, C. H.—Dissecting Insects.
[The plan adopted by the author for holding the insects is as follows:—An empty blacking box is filled to a depth of about 1/8 in. with melted beeswax, and while this is still in a liquid condition, a grasshopper is placed in it in the desired condition, and the whole left to cool; when hard, water is poured in and the dissection begun. When one specimen is used up, the wax is again melted and another insect inserted.]
The Microscope, IV. (1884) p. 277.

Streng, A.—Ueber eine Methode zur Isolirung Mineralien eines Dünnschliffs behufs ihrer mikroskopische-chemischen Untersuchung. (On a method for isolating minerals in a thin section for the purpose of their microscopical and chemical investigation.) [*Post.*]
Ber. Oberhess. Gesellsch. f. Natur- u. Heilk., XXII. (1883) p. 260.

[Styrax for] Mounting the Diatomaceæ. *The Microscope*, IV. (1884) p. 280.

Technique, Hints on. *Ibid.*, pp. 243–6.

Thoulet, J.—Mesure par la réflexion totale des indices de refraction des mineraux Microscopiques. (Measurement of the indices of refraction of microscopic minerals by total reflection). [*Post.*]
Bull. Soc. Mineral. France, VI. (1883) p. 183.

Thurston, E.—Staining Bacteria for Micro-photographic purposes.
[Explains the process with vesuvine and Bismarck brown, both in the case of free bacteria and those occurring in the tissues. "The best form of balsam for mounting bacteria is that which is dissolved in xylol, which is very easy to work with and does not abstract the dye."]
Engl. Mech., XL. (1884) pp. 335–6, from 'Photographic News.'

Turntable, Microscopical.
[Replies to query as to ringing slides and "producing those fine lines of varnish which professionals put on their slides" by C. Arnold, B. Sc., and M.D.]
Engl. Mech., XL. (1885) p. 394.

Weigert, C.—Ueber eine neue Untersuchungs-Methode des Centralnervensystems. (On a new method for investigating the central nervous system.)
[*Supra*, p. 158.] *Centralbl. Med. Wiss.*, XX. (1882) pp. 753 and 772.
„ „ Ueber Schnellhärtung der Nervösen Centralorgane zum Zweck der Säurefuchsinfärbung. (On hardening rapidly the central nervous system for staining with acid fuchsin.) [*Supra*, p. 158.] *Ibid.*, p. 819.
„ „ Ausführliche Beschreibung der in Nr. 4 erwähnten neuen Färbungsmethode für das Centralnervensystem. (Description of the new staining method for the central nervous system.) [*Supra*, p. 158.]
Fortschr. d. Med., 1884, Nr. 6.
„ „ See Lissauer, *supra*.

West, T.—Hantsch's fluid.
[Alcohol 3 parts, water 2 parts, glycerin 1 part.]
Journ. of Microscopy, IV. (1885) pp. 41–2 and 30.

[Whitman, C. O.]—Modern Methods of Microscopical Research.
Amer. Natural., XIX. (1885) pp. 106–8.

Witlaczil.
[Contains remarks on the treatment of the Ova and Embryos of the Aphides. Abstr. in 'Amer. Natural.,' XVIII. (1884) p. 1290. *Supra*, p. 147.]
Zeitschr. f. Wiss. Zool., XL. (1884) pp. 559–696 (7 pls.).

V.—*The Lantern Microscope.* By Lewis Wright.

(*Read 12th November*, 1884.)

It is about three years since I was urged by several Fellows of this Society, and others, to turn my attention to the improvement of the oxyhydrogen Microscope, being assured that any instrument which would display objects *effectively* even on the scale of 600 or 700 diameters, would be an immense advance upon anything then obtainable. By one or the other of those interested, all the instruments of most repute were placed in my hands, and it appeared that there was indeed much to be desired; since not one of them, with the best lime-light possible, would exhibit the bulk of those slides which any demonstrator with a serious purpose in view would desire to place upon the screen.

My own efforts in this direction were to some extent hindered by my comparative ignorance of microscopy, as such. I do not even yet know, as stated further on, what my own instrument will perform in diatom work, and the problem was to me chiefly an interesting one in optical projection, whose difficulties constituted its main charm. An examination of the instruments lent me, however, presented the clearest internal evidence that previous failure to overcome those difficulties was due to either ignorance or neglect of the peculiar conditions of the oxyhydrogen lime-light.

The conditions alluded to are easily indicated. If a luminous point is placed at a conjugate focus of a lens, the diverging rays will unite in the other conjugate focus, or parallel rays will be brought to the principal focus. It is obvious, that under such conditions, by placing a small lens in various positions on one side or other of this focus, any possible kind of pencil may be obtained, or an illuminated surface of any desired size or minuteness. Accordingly, writers on the lantern Microscope and photo-micrography have described every possible use of a secondary condenser in this way; so that there is absolutely no room for any really novel (in theory) optical combination.

Now such a condition fairly represents the case with solar rays, which are sensibly parallel, though even the solar rays cannot be converged to a point. Hence the Duboscq Microscope, the best I have found, and which consists mainly of a small convex lens adjusted by rack and pinion anywhere near the focus of a large condensing lens, will produce good results with the heliostat. It will also produce fair results, though not so good, with the electric arc; because with this also the radiant point is tolerably small, while the light is ample to allow of waste. But the lime-light radiant is a luminous surface as large as the thumb-nail, and this quite upsets the whole matter; for the radiant having a very

material *size*, we have necessarily a very much larger image of the radiant instead of a point. The small movable lens will no longer collect more than a small part of the light; and taking the lime-light even at 500 standard candles, we have no light to spare. Hence the failure of all instruments modelled on the usual theoretical diagrams, or heliostat practice.

This is not quite all. It is plain that we must condense, as nearly as possible, all the light upon the object, however small its size. And it is further plain, that the smallness of this illuminated spot must be a function of the relative foci of the large lantern condenser, and the final secondary condenser. But if we use for the latter a large lens of very short focus, then we get such a high angle that most of the light crossing in and diverging from the object, never passes through the objective. If on the other hand we use a very small lens, most of the light never gets through this lens.

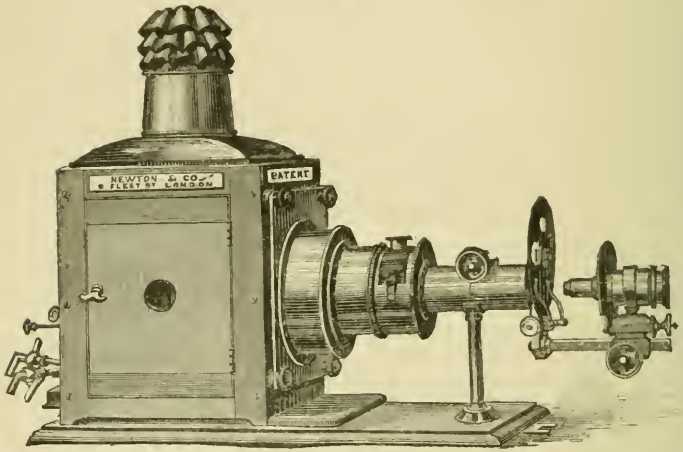
Hence the matter becomes one of practical adjustment, at every point; and each secondary, or as we may perhaps call it, substage condenser, must be specially constructed for powers of a certain range only, in focus *and angle*. Except for low powers, each substage condenser is almost necessarily composed of two lenses; one of fairly large size, to take up and condense or bring down all the cone of light; the other, to still further condense that light to the size of the object desired, without employing an angle too great for the objective. There was further to be studied perfect protection from the heat, which is very great; and absolute simplicity of parts and manipulation, without which work in the dark cannot be effectively performed. In regard to several of these objects, I felt it very desirable that such an instrument should be constructed by opticians specially familiar with lime-light projecting apparatus, and who would test every instrument actually upon the screen. For want of this latter precaution, one lantern Microscope lent me behaved far worse than another of the same make: copied unintelligently, and sent out without testing (for it never could have been tested), it was really unworkable, and no one had ever been able to do anything with it. It was also natural to expect that such opticians would more readily understand the reasons for some of my arrangement, and sympathize with my passion for *simplicity*, without contriving or urging upon me extra provisions of screws and other brasswork, so dear to the average instrument maker, and proper enough for many purposes, but which in the dark would be to a practical demonstrator a source of unmitigated distress.

All these expectations were realized, the instrument being completed by Messrs. Newton and Co., with both care and skill. It is shown in fig. 40. Some points in it they have, in the exercise of an equitable right I was bound to recognize, desired to protect

by patent; but these I need not particularize, and will only briefly describe the Microscope as constructed by them.

I had neither time nor inclination to study any false "originality," or which served no useful purpose. Finding therefore the general mechanical arrangement of the Duboscq Microscope, so far

Fig. 40.



as regards the rack-bar for the coarse adjustment, and the internal rack-and-pinion movement for focusing the substage condensers, well adapted to all my purposes, I adopted it. The action of the French focusing rack, so awkward to English hands, was however reversed to the usual direction by Messrs. Newton, and the useless so-called fine adjustment replaced by a steady screw movement on the plan now so usual in histological stands. Optically the arrangement is far different. In the Duboscq instrument one small lens permanently fixed in the rack-tube is intended to (and with the heliostat does) produce various kinds and angles of illuminating pencil; whereas in mine various removable condensers are employed, suitable for their purposes, and always *before* the lantern focus is reached, except in the special case of an achromatic condenser presently described.

I prefer to use a special triple lantern condenser of high angle (95° or 100°) 5 in. in diameter, which is calculated to utilize the whole of the rays. In the nozzle of an ordinary good lantern the illumination is somewhat less; but as at the higher angle there is more loss by reflection, and by the third lens, there is not *so much* less as might be expected—not more in my opinion than about 15 per cent. A special double condenser can be made nearly equal to the triple form.

In the convergent cone of rays from the lantern condenser, is placed a parallelizing plano-concave lens, giving an approximately parallel beam (i. e. as nearly parallel as admitted by the conditions stated above) of about $1\frac{3}{4}$ in. diameter. This lens is of highly dispersive glass, and therefore to a large extent corrects the chromatic effects of the lantern condenser.

In the same position, nearly, is placed the alum trough. In but one lantern Microscope which I have examined, is there anything like adequate protection from heat for balsam slides. I have found it advisable to employ a full inch of alum solution, and in addition, to form the second side of the cell of a *double* plate of glass, the two cemented together by Canada balsam. This layer of balsam absorbs any special balsam-heating rays which get through the alum. With these arrangements protection from heat is not comparative, but absolute and perfect. Less than this is not real protection; for the heat in the conjugate focus of a good lime-light is sufficient to ignite black paper. I may remark that I have seen a layer of balsam employed to protect balsam slides years ago, but am not now certain by whom.

For ordinary purposes, I cement the concave lens with balsam on the alum trough, thus making this lens the second of the two glass plates. By this expedient the loss of light by two reflections is avoided.

From the parallelizing concave lens to the stage is about 5 inches. Less than this would suffice for mere focusing purposes, with plain work only; but this distance is not enough to produce much of the waste by scattering above alluded to, while it allows of a really good-sized polarizing prism being introduced when necessary, such as will give a polarized slide-disk of 3/4 in. diameter—none too much for rock sections. Also it appeared to me, from such experiments as I could make, on the sole occasion I was able to borrow for a few hours an "achromatic condenser," that the latter gave more light and worked better when not placed in parallel light, but just after allowing the rays to *cross* from the lantern condenser, without parallelizing them at all. I therefore provided for this, which is easily accomplished by having a spare alum-cell with a plane second side, instead of the concave lens. I since find that the same conclusion as to using crossed rays has been reached by Dr. Hayes,* though for somewhat different reasons. At all events, it seemed desirable to provide the widest possible range in the optical manipulation of achromatic condensers.

The end of the condenser-focusing rack-tube, is a tube-fitting of the standard $1\frac{1}{2}$-in. substage gauge. I adopted this in order that any standard apparatus, such as a paraboloid, or achromatic condenser, may be used with facility. As the tube racks out

* See this Journal, iv. (1884) p. 805.

beyond the stage, any such can be inserted, or changed, in an instant. For ordinary use a simple series of condensers are provided, adapted to the different powers. Upon these condensers taking up the whole parallel beam, bringing it down to the required size, and so bringing it down at an angle approximately corresponding to that of the objective, or rather somewhat within it, depend both (1) the illumination and (2) the definition. A good objective will not give good definition with an unsuitable condenser, nor will its field be at all evenly illuminated.

The stage consists of a revolving diaphragm-plate; that is, of the very plate itself. A great point is, the most absolute simplicity; and nothing can be so simple as a perfectly free and open flat plate, with two ordinary stage springs to hold the slide. Any slide, or trough, or object, or apparatus can be adjusted on this without difficulty. Moreover, it is often desirable to have the apertures close to the slide; while the slide can always be elevated, if desired, by a packing of wood or card.

Of objectives not much need be said. For large whole insects, or other large objects (which can be shown brilliantly up to 1¼ in. diameter), I still find one of the old-fashioned double-plano un-achromatic form, a little over 2 in. focus, most useful. By careful adjustment of its stop in size and position, and adaptation of the condenser, such a lens will give much better results than might be supposed, and no achromatic form of the same focus will cover *nearly so large a field*. Such work is scarcely microscopy, but nevertheless such objects often have to be shown. With achromatic powers the great difficulty was to get lenses which would give a picture *flat* to the edges. It must be borne in mind that the screen shows an object three times the diameter of the image utilized from the same lens in the compound Microscope. A lens may be fairly flat to the edge of the compound field; but that will be the mere centre of the screen field. Very few lenses, out of many I tested, but broke down here. Absolutely the *only* half-inch powers that really gave a flat image, so far as my own trials went, were an old formula of the late Mr. A. Ross, lent me by Mr. Curties, and the 40° with correction collar of Messrs. Powell and Lealand, lent me by Mr. Crisp. An old Gundlach lens lent me by Mr. Teasdale, however, enabled me to get through Mr. Curties 6/10 and 4/10 lenses which performed well. The lower achromatic powers had to be specially worked out on the screen itself by Mr. Herbert Newton, the only good and flat lens I could find out of dozens, being an 8/10 made by Zentmayer. Though I think Mr. Newton's is still better, chiefly in *blackness* of image, this last is an extremely fine lantern lens. But there are doubtless many objectives I have not tried which will give good

results. I have not however, up to the date of this, yet found a 1/4 or 1/5 which gives a flat image, and shall feel exceedingly obliged for the loan, or trial under the owner's eye, or from any maker, of any promising objective. The most suitable angle is 90° to 100°.

The objectives screw into a short jacket or body, which has a sliding fitting into a socket. Thus by providing an extra jacket, powers can be rapidly changed.

A very important accessory to the objectives is a *concave amplifier*. Though it would be necessary to have one calculated for each objective to obtain perfect results with this, sufficiently good definition and flatness can be obtained with one only. In most cases a *slight* impairment of definition is observable when an amplifier is used, owing I believe as much to reflection from its surfaces as anything else. But it is not noticeable on many objects, and results are thus obtainable which are not so in any other way. Thus, if the concave doubles the amplification, a 1/2 in. so amplified is not the same thing as a 1/4 in., since (1) it covers *double the field;* (2) more light can be passed throught it; (3) there is far more working distance; and (4) there is far more penetration or depth of focus. Again, a very low-power concave may be so adjusted (see past papers of the late Dr. Woodward) as to preserve the ordinary working distance at the far longer screen distance, and so keep all the corrections of an immersion lens unaltered. And still again, an amplifier, or one or two amplifiers, give a great *range* of scale on the screen, at various distances. In brief, while as a rule the unamplified image is best wherever it will give exactly what is desired, results can be got with an amplifier, in many cases, which could not possibly be got without one, especially as regards the *size of object* shown under a given power, or the depth of focus required.

Pretty good results can be got with the more brilliant opaque objects under a Lieberkühn, and many objects show beautifully under black-ground illumination. The most precious portion of the parallel beam is of course stopped by the dark disk or spot. To avoid this, I have devised a concave glass *cone*, which splits the rays from the centre, and so uses approximately all of them, in spite of the spot or opaque disk.

Some may wish to have an idea of what can be shown on the screen with the oxyhydrogen light, and how far any special slides are necessary. Where transparency is combined with opaque detail, 1200 or 1500 diameters are easily obtained; and a flea can be shown about 14 feet long, as sharply and nearly as brilliantly as a painted magic-lantern slide. Where extreme transparency of ground is combined with great opacity of detail, as in a fly's

cornea, a 1/5 amplified, at 25 feet distance, passes enough light to exhibit it 2500 diameters. For this I prefer a Kellner eye-piece as condenser. What can be done with diatoms I do not know, having had no opportunity as yet of trying the completed instrument with those excellent condensers made for this express purpose; if any one interested is disposed to assist me in such trials, I shall feel exceedingly obliged, this class of work being rather out of my range, and depending so much upon experience, and technical knowledge, and apparatus, which I do not possess. So far as definition of the objectives goes, I have ascertained that a Zeiss homogeneous 1/8 will give every dot in an image of *N. lyra* 4 feet long; but my condensers for lower powers do not give sufficient illumination. The best I have myself done with high powers has been, with this same lens, to show the cyclosis in Vallisneria so that the motion of the chlorophyll granules could be clearly seen about 12 feet away from the screen; but I am satisfied that more than this is possible with proper arrangements, and probably one of Powell and Lealand's new formula immersion lenses would do better than the Zeiss, fine lens though the latter is: for work in the dark, water is certainly preferable to oil or chemical solutions. Now that my instrument is done with for "pattern" purposes, I hope to experiment further in this direction.

As to slides, the better the slide the more can be shown in it, of course; but no more is required in the vast majority than any microscopist would select for himself with a pocket lens as the "best" out of half-a-dozen. In special cases, whatever he wants to exhibit, he must of course see is really clear in the slide. The conjugate focus on the screen is so enormously long in proportion to the other, that where no amplifier is employed "depth of focus" is of course diminished. Hence biological or other sections should be chosen rather *thin*, that the image may be as nearly in one plane as possible. This is the chief point to keep in mind; but I have found no difficulty amongst any lot of sections, in selecting one which would answer all purposes.

Before concluding, I should wish to suggest two ways in which a good lantern Microscope may, I think, render service to general microscopic work, besides its more proper task of screen demonstration. Original research is of course out of the question, since its magnifying power must always be far beneath that of the compound instrument, simply because an illumination amply sufficient when gathered into the small area of the pupil of the eye, is so tremendously diluted when spread over a large screen. Moreover, quite coarse detail on a screen cannot be seen *at any distance*: an image of a diatom a foot in diameter is really very coarse, and quite brilliant; but it is surprising at how small a distance off the details cease to be distinguished by the unaided eye, while still

plainly visible through an opera-glass. This is indeed the real difficulty.

But, first, such an instrument much facilitates *photo-micrography*, beautiful images being obtainable with facility, and with no other apparatus. Whether or not diatoms may be sufficiently shown by the lime-light on the screen for an audience to see the details, lovely images are easily obtained, either direct or with black-ground illumination (up to 12 in. in the one case or 6 in. in the other), of such brilliancy that very short exposures amply suffice. As any condenser or lens found to do good work can be employed, with no preparation whatever beyond stopping stray light by black cloth, I hope there may be some field for usefulness in this direction.

The other direction is, the *improvement of lenses* as regards their aberrations from flatness of field. My experiments have shown how far most lenses are from perfection in this respect. Now a moment's reflection will suggest, that if a lens called "flat" over all the field of the compound Microscope, breaks down utterly in flatness over a field three times the diameter, it is not *really* flat at all. If we are to express the deviation from flatness by a trace drawn to ordinates in the familiar way, it is for instance

Fig. 41.

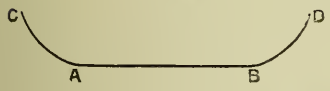
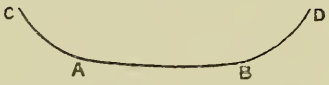


Fig. 42.



utterly impossible that the field can be really flat from A to B as in fig. 41, and the aberration commence and rapidly increase from A to C and B to D. The whole must be a curve resembling C A B D in fig. 42, A to B being only *approximately* flat but not really so. And this is the case; for it will be found that if such a lens is focused for the centre of the field, the microscopist, for his own comfort, brings the point under examination to the centre. This is particularly the case with half-inch powers. But with the one modern half-inch lens which, as already stated, I found to "hold out" to the edge of the screen field, it is not so; the eye rests with *equal comfort* on any part of the field of view in the compound. *The best lens on the screen is the best on the compound*, as regards this particular point. It is perfectly true, that if a lens be worked out solely for the screen, it may prove very second-class for compound work; for there are other important elements which this test does not touch. But if the lens is properly computed for these other elements of general work, and *its corrections for flatness are worked out on the screen*, then I have every reason to believe that a far better result will be obtained. I only know one optician, to whom

I recommended this plan, who as yet has adopted it; but he is so far satisfied with the results that he tells me he shall continue to do so. Hence I hope that an instrument which allows objectives to be thus tested easily, and with ample illumination, may produce some improvement in this respect. Micro-photographs of lines of print are excellent tests for this purpose.

Finally, I wish to thank those who have aided me in my experiments. To the Rev. P. R. Sleeman, Mr. Adolf Schulze, and several others who do not wish their names mentioned, I am indebted for trial of previous lantern Microscopes. Mr. T. Sebastian Bazley, Mr. T. Curties, Mr. Washington Teasdale, and Mr. Crisp, have kindly furnished me with objectives, the two former with large and valuable collections. To Dr. Carpenter I have been indebted for both objectives, for valuable advice as to an assortment of test-objects and what ought to be made visible in them, and for some of his own slides for my earliest experiments. But to no one are my obligations greater than to Mr. A. Topping, who has given much personal effort to supply such slides as were deemed desirable, and who in particular, when he knew that I had in vain endeavoured for months to procure the section of a fly's eye sufficiently minute in detail, made it his special study to prepare one for me in time for the meeting on November 12th. It is not that such slides as some he thus prepared are specially easy to show; in some respects the contrary is the case, and a coarser slide would be easier; but the labour in preserving the utmost detail has been considerable. I am glad to report that Mr. Topping found in such a task something of the same personal fascination I found in my own; since others may find similar advantage in procuring, not only from his hands, but doubtless from others also, similar high-class work for special purposes.* I must not forget to add that from Dr. Maddox and Mr. Crisp I also received timely bibliographical help regarding certain points—especially the concave amplifier (which is by the way a very ancient *lantern* expedient)—concerning which I particularly wished to know what had been done by others.

I hope ere long to have an opportunity of testing what this lantern Microscope will perform with the electric arc. The smallness of the radiant, as well as its greater brilliancy, will give this a great advantage with high powers; and if any of the lamps obtainable will keep steadily in focus, I have every reason to believe that almost anything can be shown up to 5000 diameters.

* A blow-fly's proboscis thus prepared for me, was pronounced by one of the most able photo-micrographers in England, to be much the best he had tried, out of dozens, for photographic purposes; and exquisite photographs were sent me of it upon a very large scale.

VI.—*On Some unusual Forms of Lactic Ferment—Bacterium lactis.* By R. L. Maddox, M.D., Hon. F.R.M.S.

(*Read 14th January*, 1885.)

The different appearances which some of the Schizomycetes assume under variable conditions, such as excess or deficiency of proper nutriment and air, or from improper food, temperature, and possibly unrecognized circumstances, are in themselves exceedingly interesting, especially so, as when fully known, they are likely to diminish the number of described species. It is therefore of some importance to note such varieties in form as happen to be found in the examination of normal cultures, for they may be significant of such changes in the life-history of the individuals as portend either an increased vegetative, generative, or degenerative act. This pleomorphism of some of the well-recognized forms has already led to a different classification, which I suppose we may simply term "the reduction of nature to the scale of our own intelligence," and which may not be "the expression of the Divine veracity in nature." Unfortunately it too often happens that the alteration of the form visible under the Microscope cannot be accompanied by any definite statement of the changed conditions which have led to the variation of form, for the normal and abnormal, as in the present case, are found together; hence I am inclined to regard the latter as tending rather to a higher than to a lower phase. There is great difficulty in deciding this question with our present knowledge. As I have not seen in any publication figures quite similar to those which accompany this short notice, I consider it may be useful to record them. The drawings are made from my original negative photomicrographs which are magnified 460 diameters, by aid of a low power and the camera lucida, reaching to 1020 diameters; hence they do not represent the ordinary dull grey appearance of the organism as seen under the Microscope.

The lactic ferment or *Bacterium lactis* may be described as an elongated sphere in its simple or coccoid form, which in growth soon becomes lengthened, then contracted in the middle much like the links in solid chain work. These divide and form filamentous chains of very variable lengths. The size of an individual article or joint is generally stated at $0 \cdot 5$ or $0 \cdot 6\ \mu$, the breadth being less. Most of the chains present nothing of moment; others show the different articles or joints increased much in size in different parts of the chain in an irregular manner, fig. 43 (1); whilst in others some of the articles have become more or less globular and very enlarged; this is particularly the case with two cells united by a very narrow bridge occurring in the middle of a short chain (2); in others the tendency to the round shape is

more continuous, less inflated, and one of the ends may be terminated by a somewhat flattened, double-goose-head expansion, containing well-marked granular matter, which stains very deeply, as in (3). Out of a large number of examinations I could not find in any of the specimens that these granules were ejected, though in some cases the terminal cells had been largely emptied of their granular contents.

Fig. 43.

The nearest approach to these figures I have seen are in the drawings of Sir Joseph Lister's paper on *Bacterium lactis*.* The simple filamentous form there figured I did not meet with. I had the pleasure of handing Dr. Roux, one of M. Pasteur's able assistants, a photo-negative of (2), as he had not seen a similar example; a little later he informed me that M. Pasteur had seen a like form. The lactic ferment was prepared by my friend Mr. W. S. Squire, as he wished photo-micrographs of the same with some other ferments, for lantern exhibition in connection with his scientific lecture "On the processes concerned in the conversion of starch into alcohol," read before the London Section of the Society of Chemical Industry, June 9th, 1884.† It was after leaving the sample of lactic ferment in an undisturbed state for nearly a month, in a test-tube closed with sterilized cotton, that I found these inflated chains near the surface of the fluid. One naturally asks, are we to consider the enlarged cells as the result of a generative effort by virtue of which the organism can be tided over such conditions as, if continued, would otherwise lead to its destruction, or are we to look upon them as a degenerative state, or a return to a primary phase in its life-history? My own opinion, as before stated, inclines to the former view, partly from the close resemblance to the generative forms in higher types, say for example *Œdogonium ciliatum* of the Confervaceæ. Whether the terminal enlarged inflated granular cells may be antheroidal cells, and the granules immature androspores which ultimately set free antherozoids, and the globular connected cells as in (2) sporange cells which when fertilized by the former furnish oospores or a sporangium, or resting spore, must in our present knowledge be taken as conjectural, and only to be decided by extended observations with the aid of the cultivating stage.

* Quart. Journ. Micr. Sci., N.S., xiii. (1873) pp. 380–408 (3 pls.).
† Journ. Soc. Chemical Industry, July 29, 1884.

MICROSCOPY.

a. Instruments, Accessories, &c.

Schieck's Bacteria Microscopes.*—F. W. Schieck supplies the instruments shown in figs. 45 and 46, ostensibly for the examination of Bacteria.

They are chiefly remarkable for the strange position of the rack

Fig. 45.

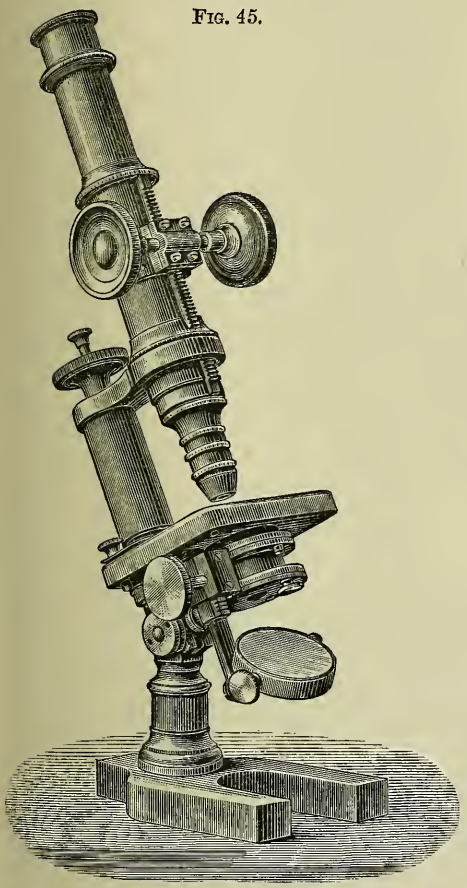
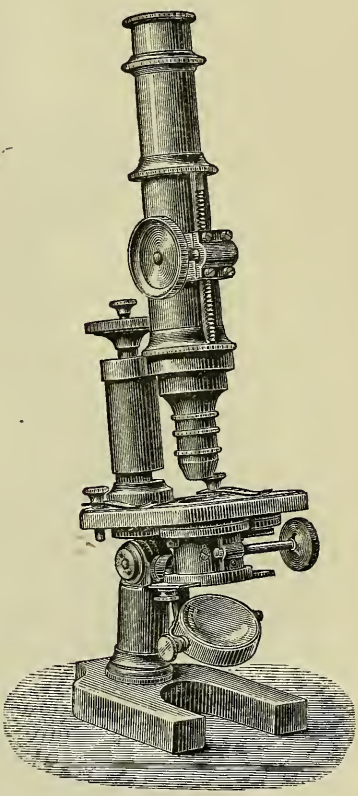


Fig. 46.



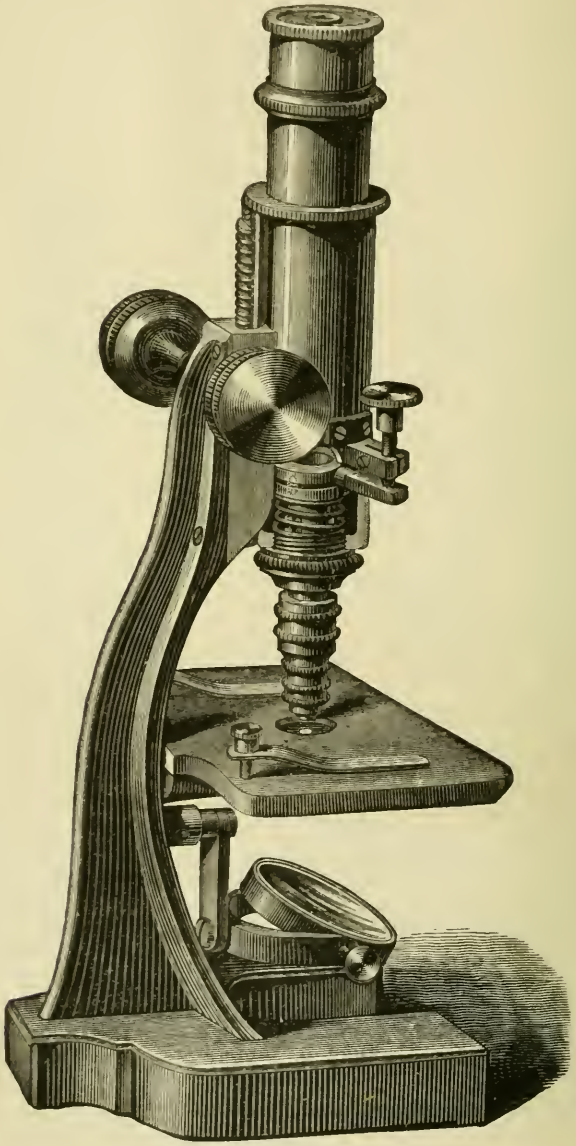
and pinion of the coarse adjustment, which is placed in the front of the body-tube instead of behind. It seems to us that this change has nothing to recommend it, and we are at a loss to understand why it has been adopted.

The illuminator is a modified Abbe condenser.

* See Dippel's 'Grundzüge der Allgemeinen Mikroskopie,' 1885, p. 233.

Reichert's No. VII. Microscope.—Herr C. Reichert, referring to fig. 147 of Vol. IV., sends us fig. 47, which represents a Microscope

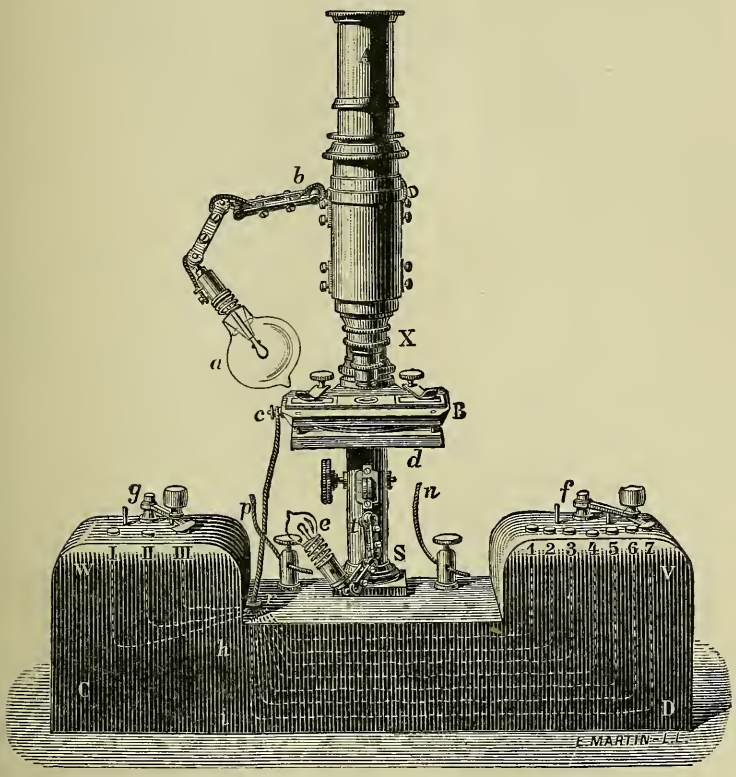
Fig. 47.



he is in the habit of making, in which the stand is constructed in the same way, the "Jackson" limb being continued to the base. It has, however, the addition of a fine adjustment.

Stein's Microscopes for use with the Electric Light.*—Dr. S. T. Stein has designed the arrangements for applying the incandescent electric light to the Microscope shown in figs. 48 and 49. The

Fig. 48.



ingenuity which he has displayed is unquestioned, but we cannot help feeling that after all it is in several respects undesirable that the electric apparatus should be permanently connected with the Microscope. It is, we think, preferable to use a lamp on a separate stand as suggested by Mr. Stearn in this Journal,† and by Dr. Stein

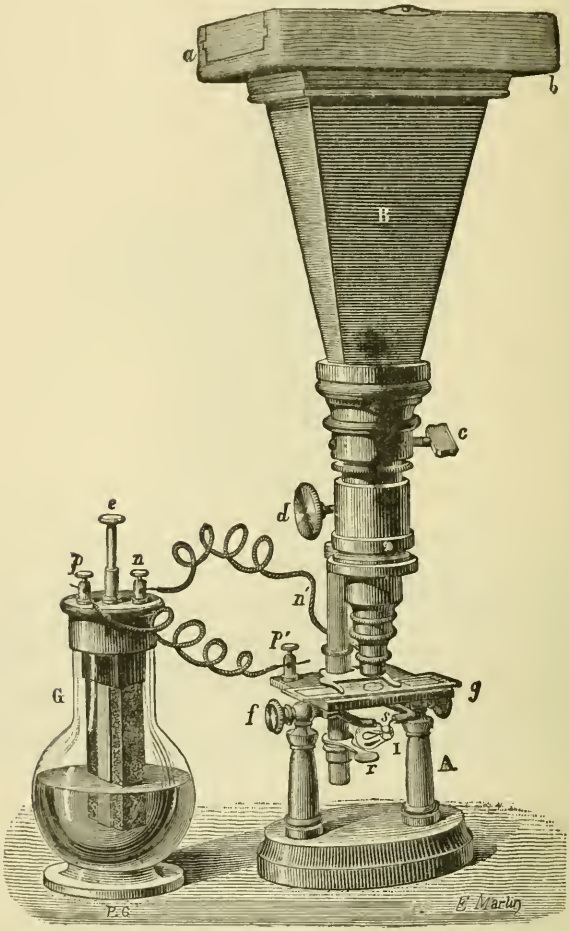
* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 161–74 (7 figs.). The clichés with which Dr. Stein has obligingly supplied us met with an accident, which has unfortunately delayed the appearance of this notice, prepared for an earlier issue of the Journal.

† See this Journal, iii. (1883) p. 32.

himself. The expense of a separate Microscope is thus saved as any stand can be used, and the light readily applied above or below the stage.

Dr. Stein's Microscope X (fig. 48) is screwed by its foot S to a wooden base C D, with two raised parts W V similar to the stand of a

Fig. 49.

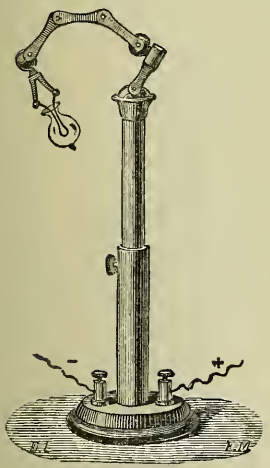


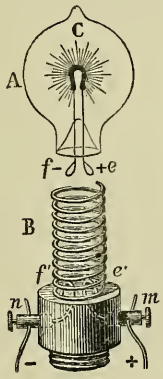
dissecting Microscope. This base contains the wires which convey the current. One lamp *a* is attached to the socket for the body-tube by the jointed arm *b* and serves for the illumination of opaque objects, while a second smaller one *e* is attached to the foot of the stand by a similar arm *t* and is intended for transparent objects. The wires to and

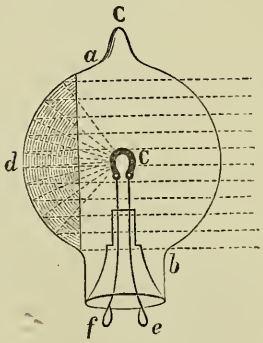
from the battery enter and leave at p n respectively. The former is connected, through the arm f, with 7 spiral German-silver wires h i of different thicknesses, contained in the wooden base, which act as a rheostat to increase or diminish the intensity of the current received by the lamps. By means of the arm f the current can be made to pass through any one (1–7) of the wires until the proper degree of illumination is obtained. At the other end the wires are, by the arm g, put in connection with any one of the three wires I, II, or III. These are connected with the end of the treble wire r c, and from the latter point are led separately either to the large or small lamp or to the stage B, where (at d) the current is made use of for heating purposes.* The wire from n is in communication with the foot of the Microscope, the latter thus serving as a conductor for the return current.

A simpler form of Microscope is shown in fig. 49 A (with photo-micrographic camera B attached). The lamp I is beneath the stage, replacing the mirror, and is put in communication with the battery

Fig. 50. Fig. 51. Fig. 52.







G by the wires p n, p' n' and s. The piece r is for raising or lowering the lamp without having to touch it when hot; (d is the milled head for the coarse adjustment, and f g the trunnions on which the body-tube and also the stage are inclined).

For a separate lamp Dr. Stein uses the stand fig. 50, which is practically identical with that of Mr. Stearn.†

The lamps used by Dr. Stein are shown in figs. 51 and 52 and are identical with the Swan lamps in use in this country. A is the small lamp with its spiral socket B, and C the larger lamp. (The connecting

* Dr. Stein's warm-stage arrangement will be described in a subsequent number of the Journal in connection with a summary of the various warm-stages which have been suggested.

† Loc. cit.

wires and hooks are *e f*, *e' f'*, and *m n*, and the incandescent carbon at C. For the smaller lamp two, and for the larger three Bunsen or Grove elements (20 cm.) are sufficient. If it is desired to throw a strong light on the object, part of the lamp may be silvered, as at *a b d*, or opal glass may be used if less illumination is required. The great steadiness of the lamps renders them specially serviceable for use with the Vertical Illuminator, and they can obviously be very conveniently applied at the side of the Microscope. If a very intense beam of parallel rays is required to be thrown on the object, an Abbe or other condenser should be used and the lamp placed exactly in the focus.

For photo-micrographic purposes a camera similar to that of B,

Fig. 53.

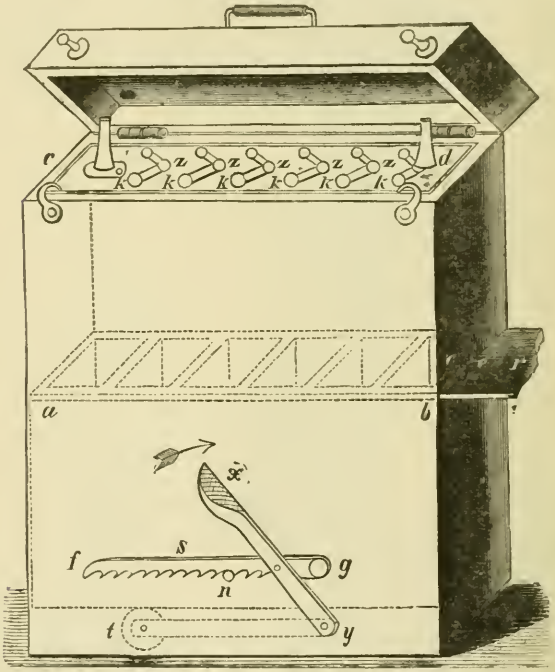
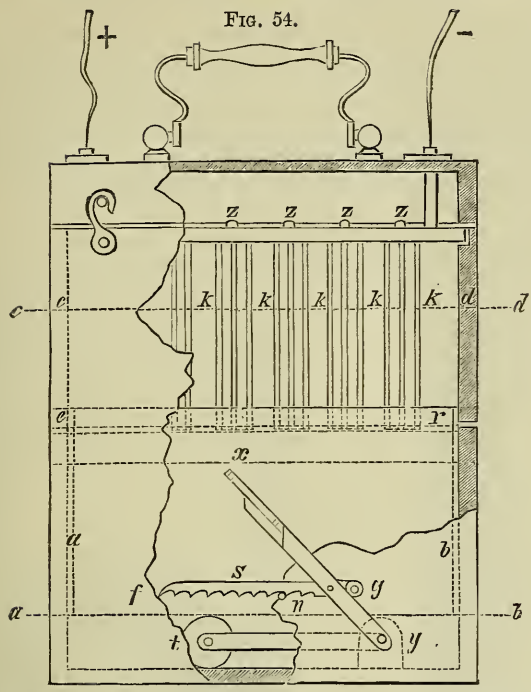


fig. 49, can be used, *a b* being the box for the plate, and the whole being attached to the body-tube by the screw *c*. Dr. Stein is somewhat enthusiastic on the use of the electric light for photo-micrography and urges that all microscopists should employ it. He has photographed *Pleurosigma angulatum* × 500 with an exposure of only 70 seconds, and an incandescence lamp of five volts.

Dr. Stein has recently designed the battery figs. 53 and 54 specially for use with the Microscope. Holding 300 gr. of bichromate solution it will actuate for two hours lamps of 2–8 volts and 1–6 candles. The speciality of the battery is the contrivance, *f x s n g y t*, for lifting the cells *a b* up and down to increase or

Fig. 54.



decrease the light. The higher the cells, and the deeper therefore the immersion of the elements (carbon and zinc *k z*), the greater the illumination. The wires pass out through *c d*. At *e r* a cover can be introduced to prevent the fluid spilling when carried. The whole measures 8 in. × 9 in. × 3 in.

Fig. 55.

As we have recently * dealt somewhat fully with the advantages of electrical illumination for microscopical work, it is unnecessary to recapitulate them here, but we may mention that Dr. M. Flesch records † some further experiments both with arc and incandescence lamps, and commends the steadiness of the light and the very perfect manner in which colours are shown, differences of tint hardly appreciable by daylight being readily discriminated with the electric light.

Swifts' Sheep-Scab Microscope.—This (fig. 55) was constructed by Messrs. Swift for a microscopist who desired to examine the scab in sheep without having to approximate his face too closely to the diseased portion of the animal. It would of course be found equally useful in the case of examinations of other contagious or disagreeable diseases.

* See this Journal, iv. (1884) p. 966. Cf. also ii. (1882) p. 419.
† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 561–3.

The Microscope consists of two tubes only, the objective being screwed to the outer one and the eye-piece sliding in the inner. A pin on the inner tube works in a slot in the outer, serving as a guide when the former is drawn out. With the eye-piece tube closed, the instrument is $4\frac{1}{8}$ in. long and extended $6\frac{3}{8}$ in. The power varies from 3 (closed) to 12 (extended), with a working distance of from $6\frac{1}{2}$ in. to 3 in. The adjustment for focus is of course made by moving the whole Microscope to and from the object.

Winkel's Demonstration Microscope.—The speciality of this instrument (fig. 56) consists in the arrangement for moving the object. This is effected as represented in fig. 57, which shows the lower part of the Microscope when the upper portion is disconnected. The slide is attached by spring clips to the movable plate, shown in the fig., which has a long slot working on a pin, so that the plate can be moved laterally for rather more than 1/2 in. At the same time a motion in arc for about the same distance can be obtained by pivoting the plate on the pin. The combination of these two motions brings all parts of the object into view. Since fig. 56 was drawn, three feet have been added, forming a tripod support for the instrument when standing on the table. The fine adjustment screw has also been removed from its position at the top of the base and placed below. Its action is to raise or lower the slide-plate at one end slightly. There is a spring clip on the top of the base to receive a card with the name of the object.

Fig. 56.

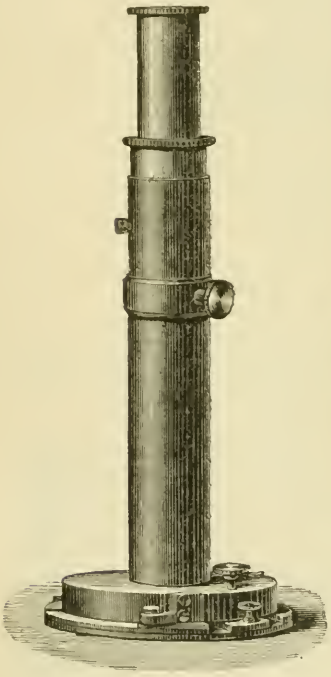
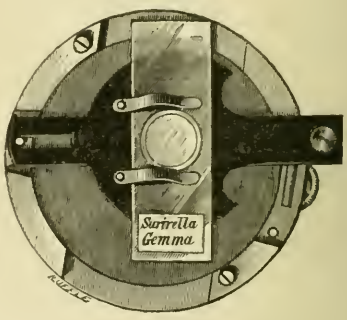


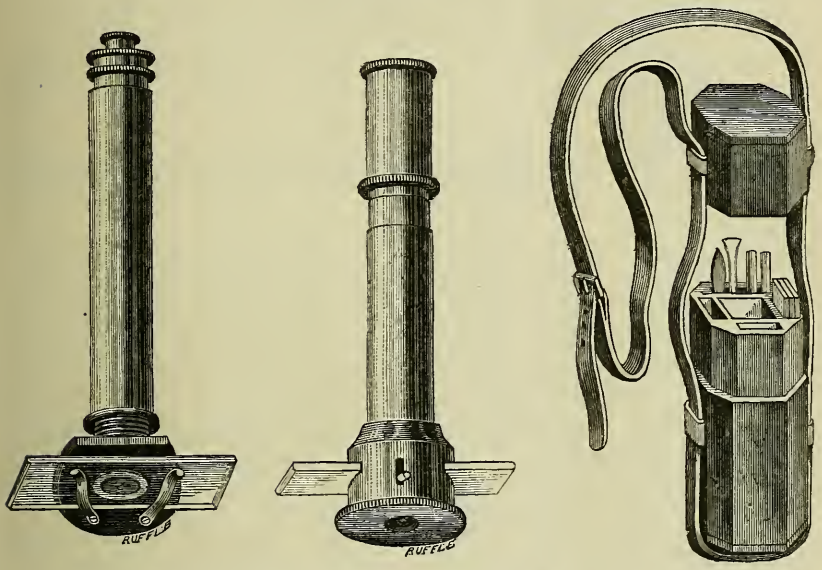
Fig. 57.



Tolles' Clinical Microscope.—This (fig. 58) consists of a principal tube or sheath, into the upper end of which slides the body-tube, with eye-piece and objective, while in the lower end works a third

short tube, with outside screw. In this tube slides the socket to which the stage is attached, and by the action of the screw (on the principal tube being revolved) a fine adjustment is obtained. The screw, though coarse, is of large diameter ($1\frac{1}{8}$ in.), so that the motion is sufficiently slow. A coarse adjustment is made by sliding the body-tube. On removing the stage the end of the Microscope can be closed by a cap, for more conveniently carrying it in the pocket. The total length is $7\frac{3}{4}$ in.

Fig. 58. Fig. 59. Fig. 60.



Klönne and Müller's Pocket Microscope.—This (fig. 59) is similar in general design to the preceding, but is without any arrangement for fine adjustment. The slide is passed through a transverse opening in the drum which forms the end of the principal tube or sheath, and is kept in position by the action of a spring, the two ends of which move in slits as shown in the fig. There is an aperture in the drum to admit light to the object.

For use in the field the Microscope is carried in the case shown in fig. 60, which contains knives, needles, glass tubes, and slides.

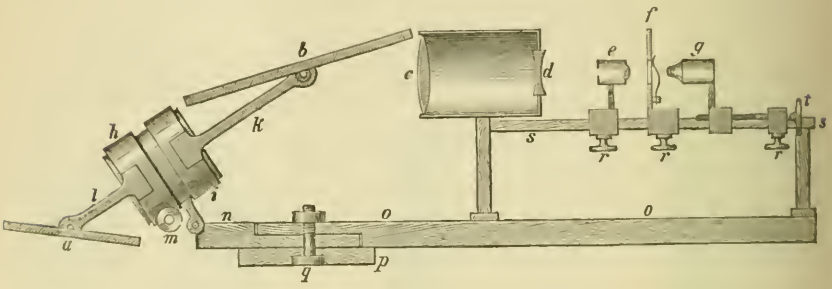
Janney's Simple Solar (or Projection) Microscope.*—This (fig. 61) is a somewhat primitive form of solar Microscope devised by R. Janney, which however, on account of its cheapness and the absence of a heliostat, may be found useful for school demonstrations in countries where there is a fair amount of sunshine. It is claimed

* Scientific American, l. (1884) p. 276 (2 figs.). The fig. is from Zeitschr. f. Instrumentenk., iv. (1884) p. 319, and slightly differs from the original.

that an object (piece of a fly's eye) less than 1/16 in. in diameter can be exhibited clearly and with good definition enlarged to 10 feet, and a bee's sting to 20 feet.

Two mirrors, *a* and *b*, are supported by the arms *l* and *k*, on which they swing. The arm *l* is attached to the ring *h*, which rotates on the

Fig. 61.



inner cylinder by the milled head *m*. The cylinder being directed to the pole the mirror *a* by the rotation of the ring *h* will be made to follow the sun. The arm *k* is similarly attached to the ring *i*, which rotates by hand, and by which the mirror *b* can be set so that the sunlight is thrown through the condenser. The inner cylinder which is directed to the pole is connected by a hinge joint *n* to the base plate *o o*. The optical part consists of the convex and concave lenses *c d*, small condenser *e*, and the objective *g*. The condenser and objective with the stage *f* slide along two rods *s s*, and are clamped by the screws *r r r*. The fine adjustment is at *t*. The lens *e* can be adjusted vertically or laterally by screws not shown in the fig.

The parts *n o o* are of wood 4 in. by 3/4 in. and 22 in. long. They can be turned about *q*, which is immediately under the centre of the mirror *b*. The piece *p* extends 2 in. beyond either side of *n o*, and is screwed to the window-sill. The three pieces *p n o* all turn independently, and in use *o o* is turned to point to the place where the image is to be shown.

The apparatus can be used with the electric or lime light. Clockwork could be applied to it.

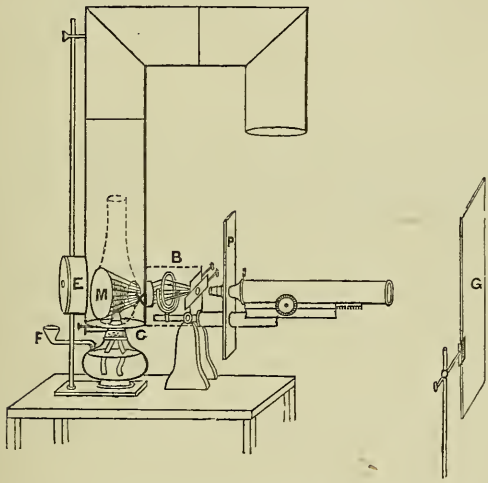
Thompson's Projection Microscope.*—W. G. Thompson describes the following adaptation of a Microscope (designed by himself and Dr. J. W. Roosevelt) "as a sort of magic lantern" for class-room demonstration, which he has found extremely useful, cheap, and practical.

A large common kerosene "duplex" lamp (fig. 62, facsimile of original) is the illuminator. Superfluous light is cut off by a piece of 6-in. stove-pipe, which fits over the lamp-chimney, and rests upon a horizontal collar C, of stove-pipe metal. The collar prevents the pipe from coming down too far upon the lamp, which would cause the

* Science, iv. (1884) pp. 540–1 (1 fig.).

kerosene to become dangerously hot. The lamp is filled at F with a curved glass funnel; and the two flat wicks, $1\frac{1}{2}$ in. broad, are turned by their separate keys outside the pipe. The pipe has two elbows, which conduct heat and smoke away, and completely cut off the light from the top of the flame. These elbows may be rotated into any convenient position. Opposite the lamp-chimney a third short elbow E is inserted, closed by a movable cap. Through this elbow the chimney can be removed, the wicks trimmed, and a concave glass or tin reflector M, $4\frac{1}{2}$ in. in diameter, may be placed behind the flame. The flat of the wicks should be parallel to this mirror. Opposite the mirror, and directly in front of the flame, a plano-convex lens X, 2 in. in diameter, is inserted in a hole in the pipe. The

Fig. 62.



light reflected from the mirror M passes through this lens, and falls upon the mirror of the Microscope, whence it illuminates the object upon the slide in the ordinary way. The object is magnified by a 1/5 or 1/2 in. objective; the eye-piece is removed; and the image is projected upon a ground-glass screen G, $1\frac{1}{2}$ ft. square, which is placed from one to four feet in front of the Microscope. The screen is supported by a perpendicular iron rod and cork-lined clamp, such as is in use in every chemical laboratory, to hold glass retorts, tubes, &c. The iron rod rests upon the floor, occupies very little space, and can be moved to any convenient focusing distance. A similar stand supports the horizontal elbow of the stove-pipe. The body-tube should be blackened inside as in photo-micrography.

The great difficulty with the apparatus consists in trying to prevent the reflection of superfluous light. To obviate this, a pasteboard box B, 6 × 6 × 8 in., is readily cut to fit closely over the plano-

convex lens and the back of the stage, thus inclosing the mirror and allowing it room to be focused properly when the lid of the box is removed. It is also advisable to fit a sheet of pasteboard P tightly over the body-tube at right angles to it, in order to cut off the rays which escape around the object illuminated, pass along the axis of vision outside of the tube, and tend to blur the image on the screen.

"Physiological, histological, pathological, and botanical specimens may be clearly shown. A number of students can look on at once. The slides are rapidly changed, and student and instructor may always be sure that they are discussing the same particular cell; which, unfortunately, is not the case when a beginner in the use of the Microscope looks through the instrument alone. The apparatus may readily be constructed by any one for about five dollars; it is easily portable, and always ready for use in any darkened room. . . With some lenses, the use of the eye-piece adds distinctness, but in most cases it cuts out too much light. An Abbe illuminator may be inserted. The image on the screen G is seen most distinctly upon the farther side; and some objects become clearer if the screen be moistened with water, or covered with a thin coat of transparent varnish laid over the ground surface. The image may also be received upon white glazed paper, but this is less clear.

For demonstration on a larger scale, an oxyhydrogen light can of course be used, or some form of electric light. The arc light is not sufficiently steady, and the incandescent light requires a great deal of storage-room for batteries. The light above described shines with thirty-six candle power, is clear and steady, and serves every ordinary purpose: the circulation in the frog's foot, varieties of epithelium, injected lung tissue, tubercle, plant-cells, &c., may all be clearly shown. The colours of stained or injected specimens come out distinctly.

The principle of this apparatus is by no means new; but its application is made so easily within the reach of any one who owns a Microscope, that it is especially recommended to instructors in schools and colleges."

Apparatus for Botanical Lectures.*—Dr. E. Hallier describes the apparatus which he has found useful in his botanical lectures.

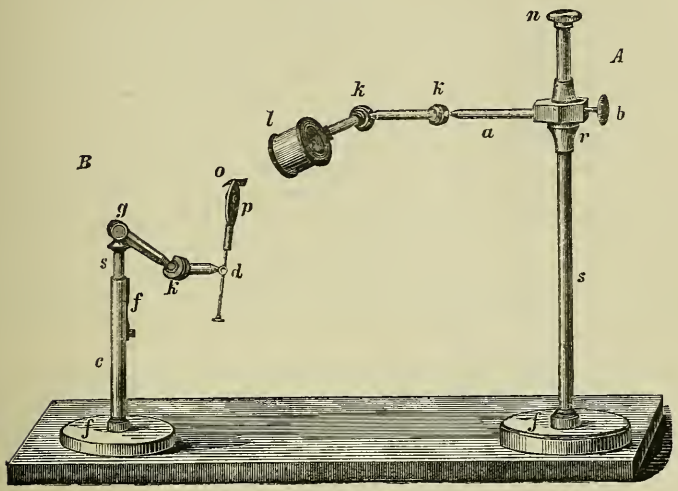
1. *Stand for the Magnifiers and Objects.*—Whilst it is, of course, always required that each student should have in his hand a perfect example of the plant to be described, and that he should dissect it with the knife during the lecture, and then examine each part separately with the magnifier, yet this is not satisfactory with a large number of students, because the teacher cannot superintend the manipulation of each one separately, and cannot be certain that the specimen is dissected and examined as it should be in order to show its essential parts.

Accordingly, Dr. Hallier uses the apparatus shown in fig. 63. A is the stand for the magnifier. To the heavy brass foot *f* the column *s* is screwed, with an arm *a* clamped by the screw *b*, and

* Zeitschr. f. Instrumentenkunde, i. (1881) pp. 393-7 (1 fig.).

movable through *r* to any height. By unscrewing *n* the arm can be removed altogether. The magnifier *l* (a Brücke lens) is connected with *a* by two shorter arms with ball-and-socket joints, *k k*.

Fig. 63.



B is the stand for the object. A hollow tube *c*, screwed into *f*, holds a steel rod *s*, which can be removed up or down by the spring *f*; a double arm hinged at *g*, and having a ball-and-socket joint *k*, carries the forceps *p* for holding the object *o*. They can be moved up or down in *d*. The apparatus has the great advantage of being movable in any direction.

In use, the apparatus is placed by the south window of the lecture room, and, to obviate any unsteadiness, it stands upon a piece of felt about an inch in thickness. A large sheet of white cardboard, for which black can be substituted if necessary, is placed on the table as a background for the object. To prevent too strong a light, there are two frames—one having white calico, and the other black cardboard—which fit exactly into the lower part of the window. If the light is required to fall on the object from above, then the black one is used, but the white one if the light is to be dispersed. The specimen being arranged in a good light beforehand, one student after another should examine it; and the Professor has found that, after a short description of the object, the student can dissect the specimen more correctly, and can make a more accurate observation of its parts at his desk than he would otherwise do.

2. *Use of the Sciopticon for Botanical Lectures.*—Every teacher will agree, Professor Hallier says, that there can hardly be too many expedients for demonstrating objects in botanical lectures, the only difficulty seems to lie in the choice of means. To illustrate the teaching of natural science, the preference is always given to the

object itself rather than to a representation of it. A boy who has seen an elephant or a monkey in the Zoological Gardens has a great advantage over his companion who has only seen pictures of these animals. In the same way the anatomical dissection of the human body itself must be thoroughly understood by the medical student, and cannot be replaced by the observation of any artificial model, however skilfully constructed. The same principle applies to botany. Pictorial representations of plants and their parts can in no way replace the necessity for a personal examination by means of the Microscope and the dissecting knife.

One of two methods are usually employed in using the Microscopes, i. e. they are either passed from hand to hand, or are fixed in the lecture room. The first method has the advantage that the explanation is immediately connected with the observation of the object, but it is likewise attended with the great disadvantage, that the larger the audience, the more likely is the position of the instrument to be disturbed, and the object displaced. Besides, while the student is looking at the Microscope, the lecturer has, perhaps, proceeded to another object.

The second method is intended to remove the inconvenience of the former. Several Microscopes are set up, and certain hours fixed for demonstration, and thus the disturbance of the object is avoided. A more serious inconvenience arises however from the fact that it is impossible for the teacher to give an oral explanation, because each student has a different object before him.

Whilst the actual microscopic image is indispensable, it is nevertheless not sufficient by itself, and recourse must often be had during the lecture to diagrams; for this purpose the Sciopticon has been found exceedingly useful. Its advantage lies in its cheapness, and in the very strong light thrown upon the object, consequent upon the arrangement of the lamp and the ventilation. Three kinds of objects can be used with it. First, for a small audience, the microscopical preparation itself; secondly, photographs from the preparations; and, thirdly, photographs from diagrams. Great care in making the photographs of specimens is necessary. For example, sections of wood or bark must be perfectly thin and even, that the photograph may be clear and not perplexing to the beginner by too great a number of unessential parts. Photographs from diagrams have the great advantage of giving the whole development of an organism or an organ in the same diagram, and differently magnified, according to the requirements of each object.

Every object is not, however, suitable for this kind of demonstration; for example, the photograph of a diatom is to be preferred to one made from a drawing of it.

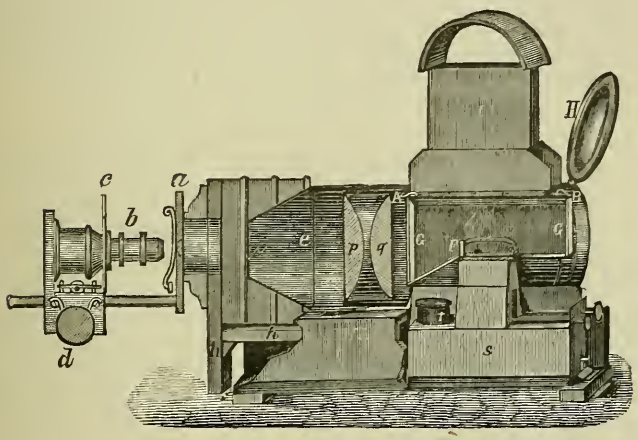
"All objections which teachers formerly made to the Sciopticon have disappeared, after the experience of many years. My audience comprises 60 students, and those at the end of the room can see the images almost as clearly as those in front. Some teachers have expressed the fear that young students would take advantage of the darkness to play mischievous tricks, but it will be found, on the

contrary, that they usually follow this kind of demonstration with the greatest interest. The room, also, need not be entirely dark; gas may be burnt perfectly well at one end, so that the master may control the behaviour of his pupils."

We are inclined to think that the value of the Sciopticon is over-rated by Dr. Hallier, at least for natural objects. We recently obtained one from Germany, but were warned by the maker that whilst excellent for showing photographs, it was limited in its operation for ordinary preparations. The image cannot be made more than a half metre in diameter in the latter case, as against 8–9 feet in the former, as there is too little light.* The lime light would of course allow of a larger image and higher objectives, but one of the advantages of the apparatus is then lost.

The instrument in its ordinary form is sufficiently familiar. With

Fig. 64.



the arrangement for microscopic slides it is shown in fig. 64, in which *a*, *b*, *c*, *d* is the special addition (in place of the usual lenses) necessary for projecting the image on a screen, *a* being the stage, *b* the objective (25–30 mm. focal length), *c* a diaphragm, and *d* the focusing arrangement; *p q* are the condensing lenses, having a blackened cone *e* in front of them. The part *h h* is movable for adjusting the illumination. *s t* F is the lamp, A B the case for it, closed by glass at G G, C the "chimney," and H a silvered reflector.

For the lamp is used petroleum in which camphor is dissolved to saturation. A painted white wall is the most suitable for receiving the image. If a transparent image is desired, very white tracing linen is best, instead of wetted linen which is decidedly to be avoided.

* M. Fritz, in 'Das Scioptikon vervollkommneter Projectionsapparat für den Unterricht,' 6th ed., 1881, vi. and 83 pp. (4 figs.), says "The images are quite sharp and bright enough, if not exceeding 50 cm. in diameter, to be seen with all details by eight to ten persons simultaneously."

An improved Sciopticon is announced * by O. Wigand, the principal features of which (for microscopical purposes) are (1) that there is a more perfect combustion of the gases of the petroleum lamp, and therefore a more intense white light, and (2) that none of the reflector is covered up by the frame of the lantern.

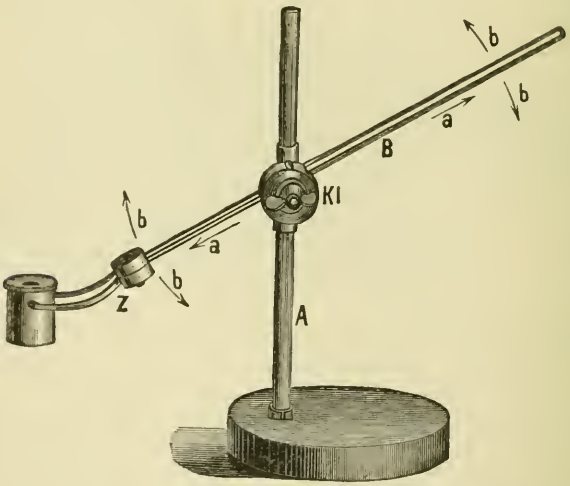
L. Edinger,† as noted *ante*, p. 147, uses the sciopticon for readily making drawings of large sections under low powers. The rays are received by a mirror inclined at an angle of 45°, and the image thrown direct on the drawing-paper.

C. J. Taylor ‡ finds a valuable screen is made of a sheet of French tracing-paper, of a kind which possesses a remarkably dull, non-reflecting surface. With this screen and only an oil-lamp lantern, it is quite easy to show pictures well to a couple of hundred people in a room fairly well lighted—sufficiently lighted indeed to enable note-taking or reference to books to be accomplished with perfect ease—provided that extraneous lights are not placed behind the screen.

Westien's Universal Lens-holder.§—A. v. Brunn describes H. Westien's lens-holder (fig. 65).

To the standard A is attached the arm B by the "patent junction

Fig. 65.



clamp Kl." The arm can be moved (1) up and down the standard, (2) round it, (3) backwards and forwards through the clamp in the direction of the arrows *a a*, or (4) round the axis of the clamp, as also shown by the arrows *b b*. These various movements are all controlled

* Central-Ztg. f Optik u. Mech., iv. (1883) (1 fig.).
† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 250–1.
‡ Nature, xxxi. (1885) pp. 388–9.
§ Arch. f. Mikr. Anat., xxiv. (1884) pp. 470–1 (1 fig.).

by the clamp, so that a turn of the one screw fixes the arm securely in any given position. This is the principal speciality claimed for the instrument. The lens is held by a kind of spring forceps Z, having at the ends of the arms points turned inwards, which pass into shallow holes in the sides of the lens. "A very striking advantage is that any Microscope-objective of low power can be used as the lens, since the necessary holes can be bored in it without damage."

The construction of the clamp is shown * in fig. 66 (viewed from above). It consists of a pin C, two disks E and D, and a thumb-screw

Fig. 66.

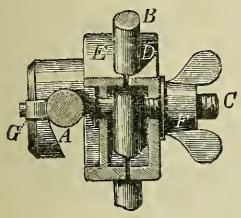
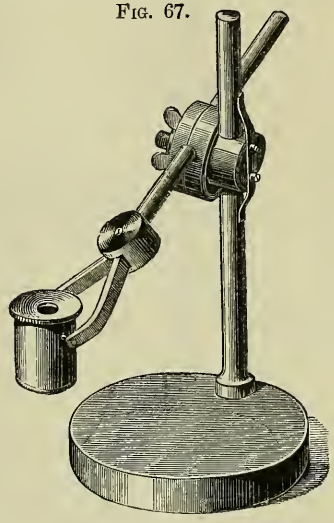


Fig. 67.



F, the standard being at A and the arm at B. When F is screwed home the two disks close together over the arm B. The disk E is at the same time forced against the standard. To prevent the clamp falling when the screw is loosened to release the arm, two springs are added as shown at G and in fig. 67, which press against the standard.

It is claimed that the clamp has all the advantages of a ball-and-socket joint and none of its disadvantages.

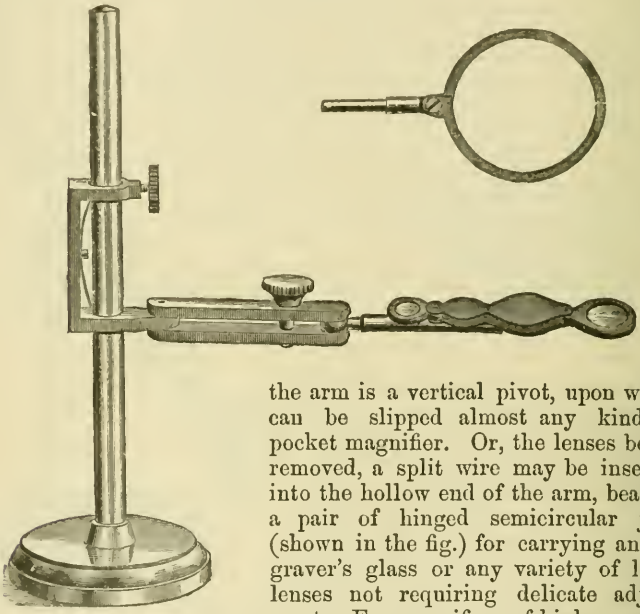
Ward's and Queen's Lens-holders.—R. H. Ward † finds the lens-holders in use are too light to carry large lenses and too short armed for the convenient study of handwriting upon large sheets of paper or mounted herbarium specimens, or else too unstable for use with higher powers, and he has therefore devised the form shown in fig. 68. It consists of a rectangular frame which slips over the pillar of a bull's-eye stand, both it and the bull's-eye being best mounted upon the same stand for the sake of simplifying the apparatus, and because they are often advantageously used in combination. The frame slides smoothly up and down the pillar, being held in any position by an included spring. To an extension of the bottom of the frame is attached a horizontal arm, having first a horizontal pivot joint, and, secondly, a ball-and-socket joint, the tension of these being readily

* Zeitschr. f. Instrumentenk., v. (1885) p. 18.

† Proc. Amer. Soc. Micr. 7th Ann. Meeting, 1884, pp. 162–4 (1 fig.).

adjustable by means of a screw with a large milled head. By bending the joints, the lens may be brought near the pillar for use in connection with the bull's-eye; or by attaching the jaws or ring to a longer wire, the total arm-length may be increased at will. At the end of

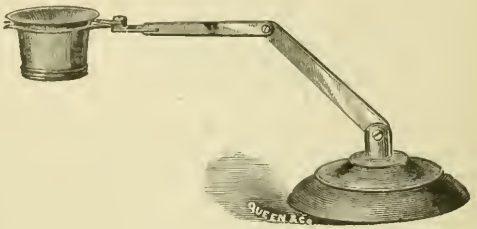
Fig. 68.



the arm is a vertical pivot, upon which can be slipped almost any kind of pocket magnifier. Or, the lenses being removed, a split wire may be inserted into the hollow end of the arm, bearing a pair of hinged semicircular jaws (shown in the fig.) for carrying an engraver's glass or any variety of large lenses not requiring delicate adjustment. For magnifiers of higher power, requiring more precise adjustment, a ring is substituted for the jaws.

There is a fine adjustment at the top of the rectangular frame, where a screw with milled head, pressing the pillar against the

Fig. 69.



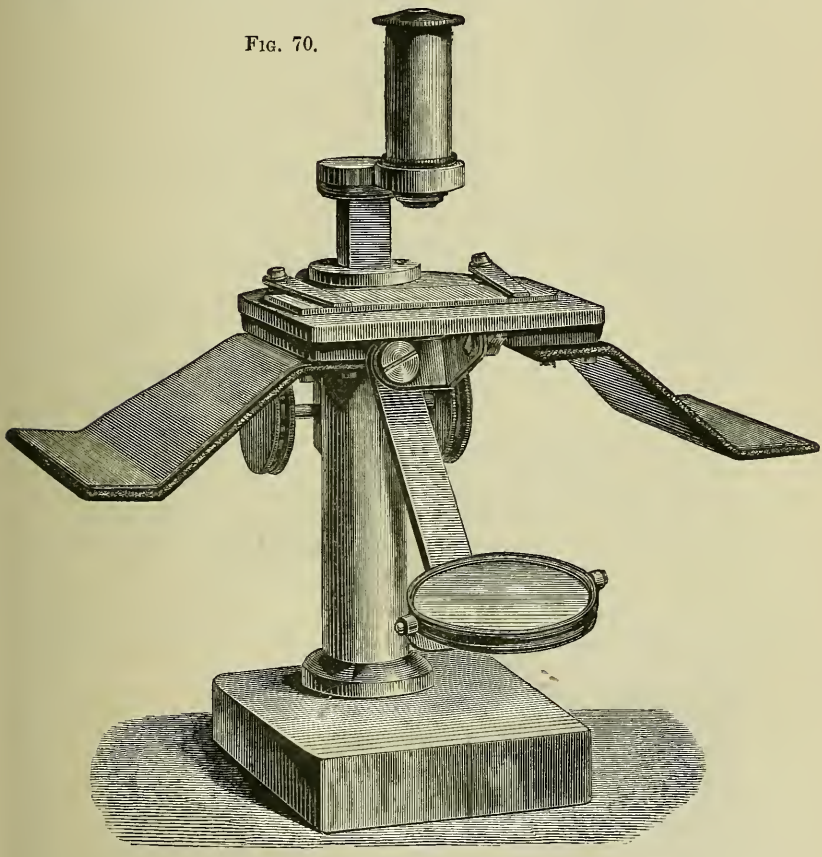
spring, promptly but steadily depresses the lenses to the extent of about four times its own motion.

Simplicity can hardly go further than in J. W. Queen & Co.'s

dissecting stand † (fig. 69). It will take lenses of various sizes and powers. Its stability must be doubtful, especially at the joints of the arms.

Dissecting Microscopes with Brücke Lens.—Dissecting Microscopes are now much in vogue on the Continent in which in place of a

Fig. 70.

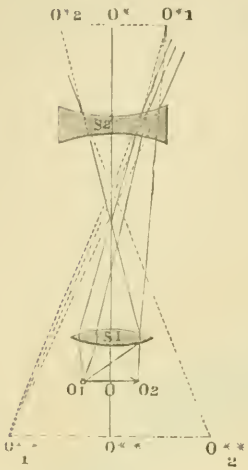


single lens, doublets in the Brücke form are employed. Fig. 70 shows the large dissecting Microscope of Dr. Zeiss, the general form of which requires no explanatory description. The optical action is shown in fig. 71, where S_1 is the objective and S_2 the concave ocular. The pencils from the object O_1 O O_2 which after their passage through the objective converge towards O_2* O* O_1* are intercepted by the ocular and converted into diverging pencils which (prolonged) converge at the distance of distinct vision and there form an erect enlarged image of the object, O_1** O** O_2**. The objective is in

† Micr. Bulletin, i. (1884) p. 38 (1 fig.).

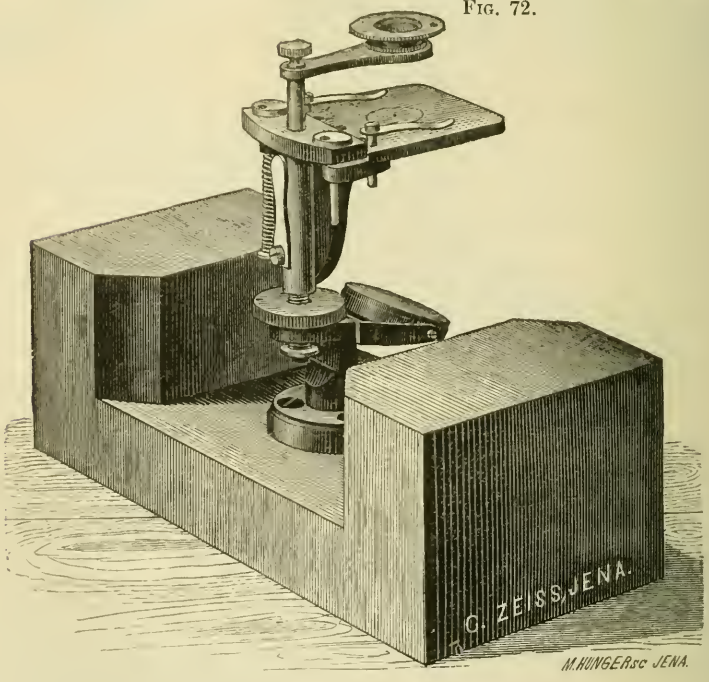
fact a triple achromatic combination (a triplet and two doublets) and when used without the ocular (also achromatic) the different combinations will give amplifications of 15, 20, or 30 times. When used with the ocular, amplifications of 40, 60, and 100 can be obtained with a working distance of 27, 16, and 9 mm. Mr. E. M. Nelson informs us he has found the power of 100 useful in finding particular specimens on slides, and for the examination of slides such as Cole's series. The field of view visible at one time is small, but by moving the eye over the eyepiece a considerable area can be looked over.

Fig. 71.



In this form there is no provision for increasing or diminishing the power of the combination as was effected in the original Brücke lens,* by varying the distance of the ocular from the objective, a device anticipated by the "objectif variable" of C. Chevalier,† in which the lenses

Fig. 72.

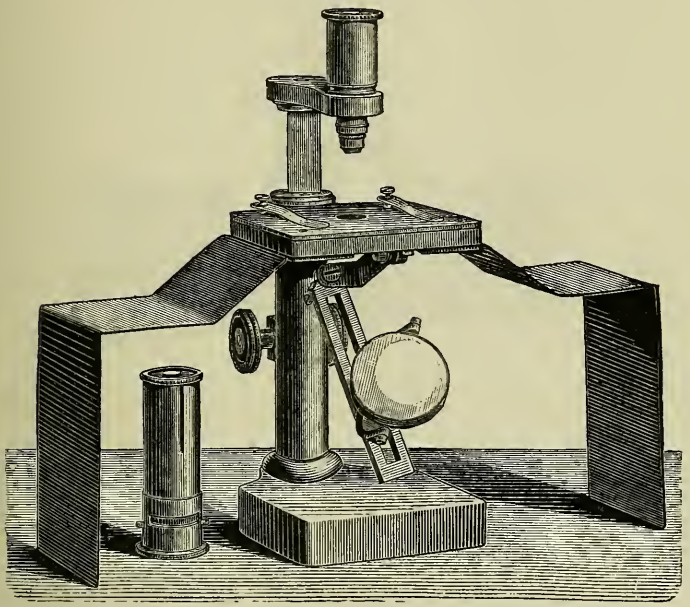


* See this Journal, ii. (1882) p. 101.

† Chevalier, C., 'Des Microscopes et de leur usage,' 1839, p. 156 (2 figs.).

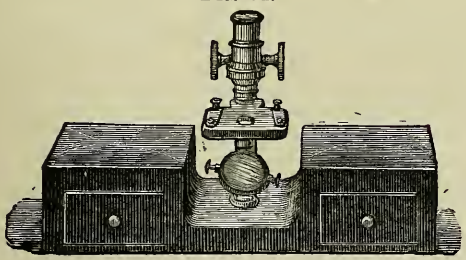
of which the objective is composed are placed in two tubes so that they can be more or less separated, either by sliding or by rack and pinion. This plan was more recently adopted by Dr. Zeiss in the "adjustable objectives," described Vol. III. (1880) p. 524. The fixed

Fig. 73.



mount enables Dr. Zeiss to use a small diaphragm within the tube which protects the eye from the glare seen with the ordinary Brücke lens.

Fig. 74.



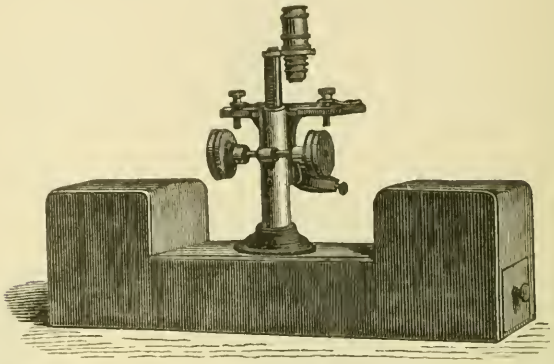
The smaller dissecting Microscope of Dr. Zeiss, with which, by means of an adapter, a Brücke lens can also be used (though not so conveniently as with the former stand, on account of the long working distance of the lens), is shown in fig. 72.

In Klönne and Müller's large dissecting Microscope (fig. 73), with which is also used a Brücke lens, the supports for the hands are

made of two pieces of thin sheet brass bent in the manner shown in the woodcut.

Two other dissecting Microscopes are shown * in fig. 74 (Schieck's) and fig. 75 (Böcker's), in which a Brücke lens in a slightly varied

Fig. 75.



form is employed. None of the English dissecting Microscopes are, so far as we know, provided with other than single lenses or the older form of doublet.

Standard Eye-pieces. — The Committee appointed by the American Society of Microscopists † to report on the nomenclature and sizes of oculars, brought up a further report at the last (Rochester) meeting.‡

The Society adopted the original recommendation of the Committee for 1·25 in. as the standard size of tube (with a preference of 1·00 or 1·35 in. where other sizes are required), and 0·75 in. for cap-tubes (for interchange of camera lucidas, &c.), and 1·50 in. for substage tubes, all outside measure. They also adopted the following resolution on nomenclature, somewhat varied from the Committee's suggestion in their first report.

"Resolved that this Society recommends that oculars be named by the equivalent focal lengths in English inches, representing their actual power in use in the compound Microscope with objectives of not more than 1/4 in. equivalent focus, and with a working tube-length of 10 in. including the mounting of the objective, on the basis of 1-in. focus corresponding to 10 diameters of amplification."

The Report of the Committee on which the resolution was founded was as follows:—

"*The naming of oculars, like objectives, by their equivalent focal lengths in inches, but estimated in a conventional manner at a somewhat arbitrarily chosen distance.* This is an attempt to secure in the case of oculars an approximate and serviceable nomenclature having some-

* Löwenherz's Bericht u. d. Wiss. Instr. a. d. Berliner Gewerbeausstellung, 1880, p. 295 (1 fig.). Dippel's 'Das Mikroskop,' 2nd ed., 1882, p. 186 (1 fig.).

† See this Journal, iii. (1883) p. 711.

‡ Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 228–33 (1 fig.).

what of the practical convenience of that in use for objectives, which shall imply a reasonable suggestion not claiming to be a precise statement of the power employed. Though not free from criticism, our nomenclature of objectives has been used, and continues to be used, with some satisfaction, and it is conceded to be the best plan yet brought into actual service. It has been already applied to oculars by several makers and by many users, and it is simple and so in accord with present usage and habits as to seem scarcely an innovation, and to be capable of adoption without conscious effort or sacrifice. The only other plan seriously proposed, naming by numbers representing the actual magnifying powers, has long ago been tried and abandoned by most competent authorities. It involves such extreme changes of idcas and habits in thinking and speaking of oculars and objectives, that there is great doubt as to the practicability of securing its early adoption. Nor is it certain to be advantageous if adopted. It lacks the simplicity which in the other case classes the powers in a limited number of familiar groups, and introduces an indefinite number of names marked by larger figures, clumsy to use and difficult to remember, and not so easily suggestive of their practical significance. It also involves the claim for a precision which it does not possess, since the complications of collar adjustment and tube-length, which only somewhat impair the value of the approximate method, seem as yet wholly incompatible with a more precise system. Furthermore, the nomenclature by inches would be so easy a movement in the direction of sensible method, that it might prove to be a step toward, rather than from, any further improvement that might prove desirable.

It is not claimed, and has never been supposed, that the proposed method of measurement would give results exactly corresponding with the optical values of the oculars, as computed by the Cross formula or any other. Nor does it seem certain that persons not opticians can locate the focal planes of their objectives and oculars, with such ease and precision as to secure in each case a tube-length, that would work the various systems exactly at their theoretical power, or that such varying tube-lengths if secured would be within the limits of a convenient working length.

For these reasons it was suggested to establish a conventional nomenclature, representing as nearly as possible the working value in the Microscope as actually employed, without regard to their value under other circumstances. By this plan a 1/2 in. system would be one which, as used in the Microscope, would double the power when substituted for a 1 in., and a 2 in. would be one which would give one-half the power of a 1 in. This is deemed to be an experiment, for the purpose of obtaining at least temporarily approximate results that would be an improvement on the present practice, in the course of which it is assumed that difficulties will be encountered and intelligent work become necessary, especially in applying it to oculars of exceptional construction. The estimate of powers on the ten diameters' rule would evidently cease to be fairly approximate in relation to objectives of very low power, unless a similar nomenclature should be applied to the objectives also. If the proposed method of

measuring the powers of oculars prove impracticable or undesirable, the effort may at least lead to the discussion and adoption in some form of the nomenclature by inches, which is the essential portion of the proposition. It remains for the Society to say whether it is prepared to take the responsibility of trying the experiment or not."

Testing the different Sectors of Objectives.*—Mr. E. M. Nelson finds that all the sectors of an object-glass are not equally good in defining objects. In fig. 76, sectors 1 and 2 may not be as good as 3 and 4. If, however, to test this we rotate the object, the test is not a satisfactory one, as the illuminating conditions are altered, so that when, for instance, a *Podura* scale is being rotated, something must be allowed for the alteration of the illuminating conditions with regard to the position of the exclamation marks, as well as something for the difference in the quality of the sectors.

Fig. 76.

"The importance of separating these variables will be obvious to every one. For this purpose I have designed a revolving nose-piece, which will enable the object-glass to be turned round, and so bring its various sectors into play. By this means it can be easily demonstrated how much of the difference in the pictures is due to the objective, and how much to the illumination. When I practically tried this nose-piece, I was very much astonished at the enormous difference I found in the defining powers of the alternate sectors of an object-glass. To illustrate the difference in the chromatic aberration, let me mention only an example. A very fair water-immersion 1/8, 1·17 N.A., showed the exclamation marks red in one position, but turned them green when the object-glass was rotated through an angle of about 90°.

"The practical outcome of all this is important. (1) An object-glass which performs well enough when exhibited on the optician's Microscope, may tell a very different tale when tried on the purchaser's instrument, because the objective may not screw up to the same point. (2) It may account for the difference of opinion held by experts as to the quality of any particular objective, for they might have been testing different sectors.

"It would be worth while, in the case of expensive object-glasses, to have the Society's screw portion of them capable of rotation, and provided with jam screws, so that the purchaser might place the better pair of sectors in a line across his own Microscope, then fix it with the jam screws. He would only have to remember to place any exceptionally difficult object in a line with the front and back of his stand."

Mr. Nelson was no doubt not aware when he wrote the foregoing, that the testing of objectives in the way suggested has been practised for many years. All the objectives of Zeiss are thus tested. The matter is referred to by Dr. Dippel, from the suggestions of Prof. Abbe, as follows:†—

To ascertain the faults which arise from defective centering, or which act in a similar way, and may be called want of symmetry in the

* Engl. Mech., xli. (1885) p. 34 (1 fig.).

† See Dippel's 'Das Mikroskop,' 1882, pp. 347–8.

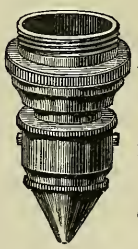
optical action of an objective, it is necessary to be able to rotate the latter on its axis without using the screw. This is accomplished by an adapter, the upper part of which screws into the end of the body-tube, while the lower receives the objective and rotates easily and concentrically on the upper. An object such as the silvered test-plate * is placed on the stage and illuminated by oblique light. The objective is then rotated on its own axis from 1/4 to 1/4 or 1/8 to 1/8, and to be approved the sharpness of the image and the character of the spherical and chromatic aberrations must be identical in all positions. If this is not so, there are either defects in the centering or local faults in the lenses or in the cement. This test when used on an appropriate object is a very sensitive and valuable one, and is indeed the only one which furnishes a *real* test of the centering of the lenses. The other methods which have been recommended for that object test only the centering of the screws, which in regard to the optical action is quite an unimportant matter.

Cost of Objectives of Large Aperture.—The great increase in the labour necessary to produce an objective of large aperture is but little appreciated by microscopists. Some estimate may, however, be formed from the fact that so low a power as a 1/6 in. of 1·50 N.A. costs 35*l*. Even at this price there are no signs of any tendency to underselling or competition among opticians. So far as we have been able to form an opinion, the price in question, large as it is, does not represent more than a very moderate return for the skill which the construction of such an objective requires.

Finder.†—P. Francotte describes a finder the designer of which is unknown.

The adapter A (fig. 77), with Society screw, carries a tube B which is kept extended by a spring, but can be pushed back again with very slight pressure. Two screws prevent the tube rotating. To the end of this tube is screwed the conical piece C, the point of which is cut out like a ring punch, so that when smeared with bitumen or ink it will impress a small circle on the slide about 1/50 in. in diameter.

Fig. 77.

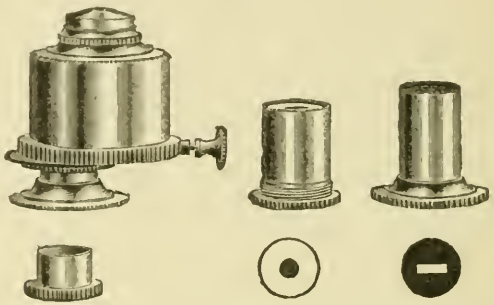


When the object is in the centre of the field the objective is removed and replaced by the finder, and a circle is impressed on the cover-glass. The spring prevents any damage to the object. With low powers the circle is readily found again. With high powers the procedure is given as follows, though we should have supposed that even with the highest powers it would not be necessary to have recourse to the finder again: — The finder is replaced on the body-tube without any eye-piece. The piece C is removed and the slide placed so that the circle is in the centre of the opening. A small diaphragm will facilitate this operation. The finder is then removed and the objective screwed on.

* See this Journal, iii. (1883) p. 125.
† Bull. Soc. Belg. Micr., xi. (1884) pp. 48–50

Ward's Iris Illuminator.*—R. H. Ward, in order to obtain, with oblique illumination, the advantages obtained with the iris diaphragm with axial illumination, has devised the arrangement shown in fig. 78. It consists of any desired lens-system, either dry or

Fig. 78.



immersion, under and close to which is mounted an iris diaphragm with a decentering adjustment; the diaphragm being set in a sliding plate pushed by a screw or lever, so that it can be moved into any position from the centre to the periphery of the system without altering the position of the latter. Thus not only the obliquity of the light, but the exact amount desired or found advantageous at any chosen obliquity, can be regulated with perfect precision by a touch of the hand to the screw and to the adjusting collar of the diaphragm.

A blue glass disk is fitted to the bottom of the dark well of the diaphragm. A special adapter is also provided for the use, in place of the iris, of central stops for securing dark-field illumination; or of a horizontal slit or pair of horizontally arranged apertures, for the better illuminating of binocular Microscopes, as proposed by the writer in the 'American Naturalist' for December 1870; or of any special stops desired by the user; or of a polarizing prism and selenite plate. The whole apparatus rotates about its own optical axis, which remains coincident with that of the Microscope itself.

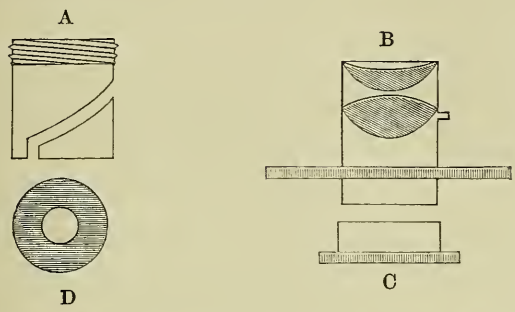
It is used to the best advantage with a 4/10 achromatic condenser, or with the thick non-achromatic immersion lenses of the Abbe condenser. It cannot, without outgrowing the limits of the standard $1\frac{1}{2}$ in. substage ring, be applied to the largest lenses now used as condensers, and for this reason, if for no other, it might be unavailable for extreme resolution with objectives of excessive aperture.

By removing the lens from the top of the apparatus, the iris diaphragm, with or without its blue glass disk or the polarizing prism, will be found in position for use by itself.

* Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 160–1 (1 fig.).

Nelson's Simple Condenser.*—E. M. Nelson's object in suggesting this condenser was to provide a very inexpensive, but at the same time efficacious means of illumination for the micro-organisms which are now the subject of so much investigation, and for which purpose it is desirable that the necessary apparatus should involve as little outlay as possible. As exhibited it was attached to a Leitz 3*l.* 12*s.* instrument.

Fig. 79.



It consists of a socket A, having a spiral slot. This socket screws into the stage, and in it slides a second tube B which has a $1\frac{1}{4}$ in. milled flange for focusing by rotation, and a pin which works up and down in the slot. This tube carries the lenses, which are a meniscus and biconvex. A cap C with large aperture in the centre fits at the end of the tube to hold diaphragms, like that shown at D. The small vertical piece of the slot prevents the condenser being accidentally twisted out. The aperture is 0·5 N.A.

Madan's Method of isolating Blue Rays for Optical Work.—Mr. H. G. Madan finds a combination of ordinary blue glass with a peculiar bluish-green glass, known as "signal-green" glass, much more convenient than the usual glass cell filled with solution of cuprammonium sulphate. Glass coloured with cobalt absorbs most of the rays of medium refrangibility, but transmits besides blue rays a portion of the red rays in the neighbourhood of Fraunhöfer's line A.

The "signal-green" glass (so called from its being used for railway signal lamps) is remarkably opaque to red and yellow rays, and hence if a piece of it is superposed on cobalt-blue glass, the only light transmitted by both is that which lies between Fraunhöfer's lines F and G, constituting a beam at any rate not less homogeneous than that transmitted by cuprammonium sulphate.

In cases where the double thickness of glass may be an inconvenience, as in disks for stage diaphragms, a plate of "flashed" blue glass may be cemented, flashed side downwards, upon the signal-green glass, and then the whole of the colourless part of the blue glass can be ground away, leaving only the coloured film upon the signal green, and thus forming a plate hardly thicker than the latter alone.

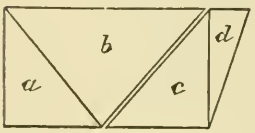
* Engl. Mech., xli. (1885) p. 34 (1 fig.).

Signal-green glass is, so far as the author knows, only made as "pot-metal" and never flashed. The colouring matter is believed to be (di-valent) copper.

Madan's Modification of Foucault's and Ahrens's Polarizing Prisms.*—H. G. Madan suggests that if a film of air (as in Foucault's prism), instead of a film of Canada balsam (as in Ahrens's prism), is placed between the middle spar-prism and the next, the ordinary ray will be totally reflected, while the extraordinary will still emerge and be available as a plane-polarized ray for experiments, as in Foucault's prism.

This extraordinary ray, however, is not only deviated on emergence, but also over-corrected for colour; but both the deviation and the dispersion can be almost entirely corrected by passing the ray through a prism of crown glass combined with a prism of very dense flint glass, as shown in fig. 80 (*a* and *b* calc spar, *c* crown glass, *d* dense flint glass). The combination forms a polarizing prism with an angular field of 28°, about equal to that of an ordinary Nicol's prism, and far greater than that of a Foucault's prism (which is only 8°).

FIG. 80.



The following points, among others, appear noteworthy in the above prism:—

(1) Its length is scarcely more than twice its breadth, the proportion between the two dimensions being rather greater than in Foucault's prism, about the same as in Ahrens's prism, and much less than in Nicol's prism. (2) Only half the prism is made of Iceland spar, a material which is becoming deplorably scarce and expensive. (3) The combination is not quite free from distortion and chromatic aberration, but this is not serious enough to interfere with its use for many optical purposes, especially as a polarizer. (4) In using it, a diaphragm should be placed in such a position as to limit the entering cone of rays to 28°, since at a greater angle the ordinary rays are not separated by total reflection.

"Ahrens's polarizing prism is certainly," Mr. Madan adds, "a remarkable one. I do not think that a double-image prism has ever been previously constructed in which the extraordinary ray emerges without deviation, while the other ray is deviated to the extent of very nearly 60°."

Illumination of Microscopes and Balances.†—In measurements and weighings where high scientific accuracy is needed it is sometimes necessary to use artificial means of illumination, and it is found that when reflected light cannot be conveniently introduced, the heat from ordinary lamps causes variations of the temperature of the room, &c., which slightly affect the accuracy of the results to be obtained. By using, however, an incandescent electric lamp fitted inside a glass vessel of water, the light may be even brought near to the Microscope

* Nature, xxxi. (1885) pp. 371–2.
† Ibid., p. 440.

or balance without any appreciable interference with temperature. The glass vessel is provided with a pierced cover or shade, and a little stream of water of a uniform temperature may be kept flowing through the vessel.

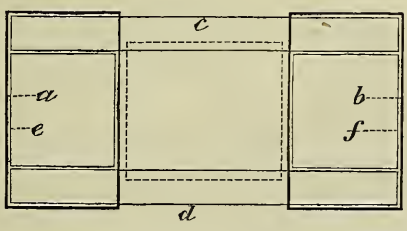
By means of a "chromozone" battery, supplied by Mr. O. March, it has been found, at the Standards Office, that a light may be maintained at an insignificant cost for fifty hours without, of course, any attention. During a recent comparison made by Mr. Chaney of two standard kilogram weights it became necessary to use the lamp, but the action of the balance was not interfered with by the proximity of the lamp, the probable error of the result being only ± 0·005 mgr.

Standard Thickness of Glass Slips.*—E. M. Nelson suggests that it would obviate much inconvenience where immersion condensers are used, if a standard thickness was adopted for glass slips. At present there are so many thicknesses in use that it is sometimes very troublesome to adjust the focus properly with high powers, as if too thin the drop will not adhere, and if too thick it gets squeezed out. He proposes that a thickness of 1/20 in. should be adopted as the best standard, and "if every person would buy slides of that gauge only, the thing might easily be done."

Mr. A. D. Michael said, at the meeting at which this suggestion was made, that he thought he should find a standard gauge for glass slips a great nuisance, especially for such objects as required the use of high powers; while Dr. Carpenter thought it might be well to try to get some uniform slip for use with oil-immersion objectives.

Rabl's Slide for Viewing Objects on both Sides.†—C. Rabl describes a slide (fig. 81) which he found useful in his researches on cell-division. It consists of two pieces of glass *a b* (thick lines),

Fig. 81.



with two strips *c d*, and two square pieces *e f*, cemented on so as to form a frame of glass surrounding a central space. A piece of thin glass (shown by dotted lines) is cemented beneath, on which the object is placed, and when a similar piece is placed over the object it can be examined on either side with the highest powers.

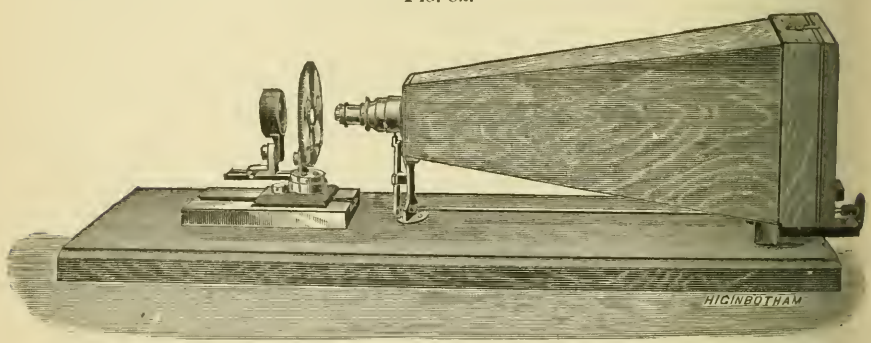
* Journ. Quek. Micr. Club, ii. (1885) pp. 120–1.
† Morphol. Jahrbuch, x. (1884) pp. 218–9 (1 fig.).

Whitney's Life-Box.*—J. E. Whitney reduces the cost of a life-box to a minimum by getting a full set of brass ferules, consisting of about a dozen of graduated sizes, fitting one inside the other. Take any two which fit well together and cement the smaller one, large end down, to the centre of an ordinary glass slide. Cement to the top of the ferule one of the thickest cover-glasses that fits it. Take another thick cover-glass which fits *inside* the large ferule, and cement it to the inside at the top. The box is now complete, and all that remains to be done is to slip the large ferule over the other. Mica can be used instead of the cover-glasses if desired. The set will make an assortment of various sized boxes.

Micrometers mounted in Media of High Refractive Index.—It was suggested some years ago † that a Nobert test-plate should be mounted in a saturated solution of phosphorus in bisulphide of carbon, with the view of increasing the visibility of the lines. Prof. W. A. Rogers has applied the same method to a stage-micrometer made for the National Museum at Washington. Whils not better in ruling than others from the same source, it is reported to be of peculiar excellence, owing to the fact that it is mounted in Prof. Hamilton Smith's medium. The fine lines are thereby made far more visible and sharp than on ordinary micrometers, and, as anticipated in the case of Nobert's plate, "very fine lines, which are scarcely visible otherwise, are readily seen when mounted in the new medium."

Atwood's Apparatus for Photo-micrography.§—H. F. Atwood describes an "apparatus capable of doing any work in photo-micrography perfectly, and that can be put in the hands of the microscopist

Fig. 82.



at an expense less than that of ordinary camera attachment for his Microscope." It is shown in fig. 82.

The coarse adjustment is made by sliding the stage and fittings

* Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, p. 215.
† In a paper by Mr. J. W. Stephenson. See this Journal, ii. (1882) p. 164.
‡ Amer. Mon. Micr. Journ., v. (1885) p. 38.
§ Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 176-7 (1 fig.).

by hand on the slide on which it rests. On reaching an approximate focus, the stage is secured by a friction-screw. The fine adjustment is controlled by a milled head placed directly under the ground glass focusing-plate, and acts by lever on the nose-piece carrying the objective, and thus tight cords ruining the fine adjustment fixtures are dispensed with. The substage has a fitting to receive any ordinary illuminating apparatus, and by a simple device a condenser can be accurately centered.

Actinic and Visual Foci.—Statements have recently been made that with modern under-corrected microscopic objectives there is no difference between these foci, and that no allowance need therefore be made in focusing. Dr. J. D. Cox, while finding this correct for the generality of objects, remarks that it does not apply when large amplifications are in question. When powers of 1500 and 1600 are used for photo-micrography there is a distinct difference between the two foci, and it is therefore still necessary to give particular attention to the focusing in order to obtain sharp photographs.

Compound Negatives.* — In photo-micrography it frequently occurs that the operator, instead of devoting a negative to each of two or more similar objects for comparison, printing both upon the same print, prefers to have the whole series upon one negative, taking from this a single print. There is often room for two or more images upon the same plate. If the centre of the plate is devoted to one, obviously no more can be accommodated on it, but by placing one at each end, or one on each corner of the plate, both economy of plates and convenience of printing are secured. C. M. Vorce points out that this end may be readily accomplished by "matting" the plate as a negative is matted in printing.

Suppose it be desired to photograph four different species of *Acari* on one plate, the image of each when magnified to the desired extent only covering about one-fourth the exposed area of the plate. First, a mat is prepared of cardboard or thick non-actinic paper, which is adjusted to exactly fill the opening of the plate-holder, lying in front of and close against the plate when exposed, and having one quarter very exactly cut out. A convenient way to fit this mat is to leave projecting lugs on each side at exactly the same distance from the ends, and cut notches in the plate-holder into which the lugs may closely fit. If this work is carefully done, the mat may be reversed both sidewise and endwise, and the lugs will fit the notches; if so, it is ready for use. The object being focused, the camera is raised one-half the vertical dimension of the plate, and displaced to one side half the horizontal dimension, when the image will be found to occupy one quarter of the plate. The mat being placed in the plate-holder, a focusing-glass is inserted in the position the plate will occupy, and final adjustment and focusing made. The plate is then marked on one corner on the film side with a lead pencil, placed in the holder without disturbing the mat, and the exposure made. When the plate is replaced for a second exposure, either the mat is reversed or the

* Amer. Mon. Micr. Journ., vi. (1885) pp. 13–4.

plate turned end for end; but it is best to always place the plate in the holder in the same position, and change the mat to expose successive quarters, but this requires the camera to be moved for each exposure.

Monocular Stereoscopic Vision.*—Prof. Fritsch describes an optical phenomenon observed during the microscopical examination of certain objects, and which he considers is due to monocular stereoscopic vision. Certain images, in particular those of the transverse section of the principal nerves of the electric organ, give the idea of a funnel-shaped depression, such as is otherwise obtained only in binocular stereoscopic vision. He found it especially easy to receive this impression by moving the eye from side to side.

Journal of the New York Microscopical Society.—We are glad to welcome this new microscopical journal. While every addition to the number of new journals adds to the strain which is put upon both space and time so far as we are concerned, it is, we think, clearly to the advantage of the cause of microscopy that there should be a fair number of microscopical journals. Nearly all those published hitherto have at one time or another been the means of adding to our knowledge to no inconsiderable extent.

Strasburger's Practical Botany.†—E. Strasburger supplies an extremely useful handbook for practical botanical students. The smaller work is intended for beginners only. The larger one is printed in two different types. The paragraphs in larger type are adapted for beginners, and those in smaller type for more advanced students, the whole being arranged in thirty-four "lessons" for a six-months' course. The introduction to the larger work deals with Microscopes and all other apparatus, reagents, &c., necessary for workers in the botanical laboratory. In the lessons themselves, plants are in general chosen which are readily accessible; and the mode of treatment is described best calculated to bring out the various important points in their structure. The whole is illustrated by admirable woodcuts.

Microscopical Societies.‡—R. Hitchcock discusses the fact that microscopical societies are "vigorous for a time, then they gradually languish, and sometimes disband. There is scarcely an exception to this rule." He considers the remedy to be to make the meetings of value and interest to the members.

"If the meetings are to be interesting and instructive, somebody must work to make them so. It involves no little labour on the part of the few who undertake to conduct a successful society. Still the time thus spent is not without profit both to the individual and to the members. One need not be thoroughly informed upon microscopical subjects to be an efficient leader. It requires energy, interest, and a willingness to work, more than anything else. Let those who are willing to give their time and work for the benefit of others who do

* Nature, xxxi. (1885) p. 212.

† Strasburger, E., 'Das Botanische Practicum,' xxxvi. and 664 pp. (182 figs.). 'Das Kleine Botanische Practicum für Anfänger,' viii. and 285 pp. (114 figs.). 8vo, Jena, 1884.

‡ Amer. Mon. Micr. Journ., v. (1884) pp. 215–7, 237–8.

little else than attend the meetings to learn what they can, study up and present different subjects of interest in papers, or more informally, and continue in this way. After a while they will find others coming forward, and the society will grow. If the meetings can be made instructive, members will be sure to attend. If they are dull, and if nothing is done to make the time pass profitably as well as pleasantly, so that members will feel that it is worth while to attend, the society might as well disband."

"**What is a Microscopist?**" *—Some "microscopist" has (we hope unwittingly) given mortal offence to a writer in 'Science,' as it is evident that the following could only have been penned under the severest provocation.

"What is a microscopist? First and last, an amateur who rejoices in the beautiful variety of microscopical specimens; one who treasures slides in the exact centre of which is a ring of cement neatly put on, and holding a cover-glass under which lies some fine test-object,—a delicate diatom, a Podura scale, a bit of tissue the vessels of which are injected with gorgeous red, a polarizing crystal: in short, almost any tiny scrap of the universe, if so it be pretty in the pattern of its shape and colour. These same treasured slides must have neatly bordered labels, and be catalogued and stored by a special system. The microscopist is one who has a formidable and extensive deal of brass stand, which can hold together a cabinet of appliances; and he will display the most admirable patience in getting them in position, until at last he sees the specimen, and is ready to clean and pack away his apparatus. His series of objectives is his glory; and he possesses a fifteenth of Smith and Brown, which will resolve a band of Nobert's not to be resolved by the objectives of any of his friends. His instrument is his pet: about it his interest centres, while the direction of his studies is determined, not by any natural bond between the objects, but by the common quality of minuteness. Is it not curious? Imagine any one deliberately setting out to study whatever he could cut with a knife. We should pity the man who chopped up the sciences according to the instrument he used. We cannot be brought to regard anatomy as a department of cutlery, nor can we seriously admit histology as a department of microscopy.

Scientific men have been very lenient towards the microscopists; and yet the latter, who have long been allowed to march as hangers-on to the regular scientific army, have gradually lagged behind. The army has grown, and divided into many separate corps, traversing the country of the unknown in all directions, and the microscopist knows not whither to follow. If he turns in any direction, he must join with the special work there, and can glean only in one field: he is no longer the universal gatherer. One must be of the army to be with it, and the forces are too scattered for any hanger-on to flit from one division to another. The would-be microscopist has no place among scientific investigators. He must enlist in one company and there remain, or else be content to rank as an amateur, and not as a scientific man."

* Science, v. (1885) p. 164.

It is of course very easy to prove anything if only we are allowed to start with a premiss or definition of our own choosing. If, for instance, a zoologist is held to be a man whose whole delight is to arrange quadrupeds and birds on pieces of nicely polished wood, with every hair of their bodies and every feather in their tails exactly in place, how surely it follows that zoologists ought not to be allowed to "hang-on" to the scientific army. If botanists are people whose only object is to spread plants out flat on pieces of paper of elegant design and with regard only to the prettiness of the arrangement, botanists clearly ought to be shunned by all right-thinking persons. The writer has apparently never heard of a class of men, of whom Dr. Carpenter may be taken as a type, who are truly "microscopists," and yet are not addicted to the vices of the imaginary beings who figure in the above article. Nor does he seem to have ever heard of another class, of whom Prof. Abbe may be taken as an illustration, who are even still more typically "microscopists."

But even if the writer were correct in his definition of a microscopist, he is wholly wrong in the moral he attempts to draw from it.

Why should a person be derided who purchases a Microscope with the intention of using it for the same end as his neighbour uses a stereoscope, viz. as a means of amusement or, as the French say, as a "distraction"? Every one would of course desire that all possessors of a Microscope would devote themselves to working out one or more of the innumerable problems that still remain to be solved, but that furnishes no valid reason for insisting that no one shall use a Microscope who is not pledged to a course of scientific investigation on pain of being denounced as unfit for the society of decent people. It would be just as logical to insist that no one should grow flowers who did not examine them botanically, or that no one should buy or look at pictures who has not mastered the principles of art. Our artists are much too wise in their generation to denounce such persons or to proclaim them "hangers-on," or to suggest that they have had enough of them, that they are nearly at the limit of their patience, or any such absurdities. Scientific societies largely profit by the subscriptions and other support of the so-called "hangers-on," and it is doing no good to science to attempt to shut them out from participating in its pleasures by derision and insult, or by trying to make the possessor of a Microscope feel that he is in the same category as the keeper of an illicit still. *Cæteris paribus*, the man who takes an interest in what the Microscope reveals is likely to be a better man than one who does not, and the greater number of such persons there are the more the ranks of actual workers will be recruited. Moreover, it is in the case of the Microscope *par excellence* that "hangers-on" have secured so great an advantage in the instrument for the benefit not of themselves only, but the world in general. A notable instance of this—the case of objectives—is curiously enough made the subject of (deserved) national glorification in another part of the same paper. The increasing army of observers of micro-organisms are already beginning thoroughly to appreciate how much

they owe to the "amateurs," who alone have been the means of bringing the Microscope objective to its present pitch of perfection.

There is plenty of scope for useful and proper exhortation to microscopists without descending to the caricatures of the writer in question.

American Society of Microscopists, Constitution and Bye-laws of, and List of Members and Officers.

Proc. Amer. Soc. Micr., 7th Ann. Meeting, pp. 283–93 and ii.

Anthony, W. A.—See Micrometer.

Atwood, H. F.—A new Apparatus for Photo-micrography. [*Supra*, p. 330.]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 176–7 (1 fig.).

B.Sc.—Microscope.

[Recommendation to stick to monocular. "The great majority of men who use the Microscope as a tool and not as a plaything look upon the English craze for binoculars and complicated stages and accessories as sheer waste of time."]

Engl. Mech., XL. (1885) p. 457.

„ See Short *v.* Long Body-tubes.

Bausch, E.—The Universal Screw for Microscope-objectives.

[Complaint of discrepancies in the standard gauges sent out by the Society, and suggestion for "decisive action on the question of a new Universal Screw. . . . We need a screw which is larger than 0·8 in., but still of such a size that it can be universally applied to instruments as now made."]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 153–9.

See also *Science*, V. (1885) p. 179.

„ „ Considerations in testing Objectives.

[General remarks, dealing principally with adjustment of mirror, thickness of cover-glass, and variations in length of tube.]

The Microscope, V. (1885) pp. 1–5.

Behrens, W.—Winkel's Mikrometer-ocular mit vertical beweglichen Mikrometer. (Winkel's Micrometer eye-piece, with Micrometer moving vertically.) [*Post.*]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 41–3 (2 figs.).

Botterill, C.—The Theory and Practice of Microscopical Illumination.

[Abstract of Presidential Address to the Liverpool Microscopical Society.]

Sci.-Gossip, 1885, pp. 64–5.

Bradbury, W.—The Achromatic Object-glass, XLIV.

Engl. Mech., XL. (1885) pp. 489–90 (5 figs.).

Bulloch, W. H.—The magnifying power of Microscope-objectives and Lenses.

[1. Magnifying power of objectives measured from the posterior focus for parallel rays. (Results of a series of measurements to fix the position of the posterior focus of different objectives and the magnifying powers at 10 in., 12½ in., and 15 in. from the ascertained focus, with table.)

2. The magnifying power of double convex lenses, *post.*

3. The position of the Wollaston camera in measuring objects. "As there is some disagreement among microscopists as to whether it makes any difference in the measurement of objects by means of the Wollaston camera lucida if the distance is the same between the table and the camera and the camera and the object on the stage, he made some measurements (results given in a table) to test the matter, and cannot see that it makes any difference whether the distance between table and camera is changed or with the draw-tube the distance between camera and object."]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 183–5, and table.

Carpenter, W. B.—See Nelson, E. M.

Cheeseman, E. L.—A Growing Slide.

[Ordinary slide with cover confined by a light rubber band and immersed in a dish of water.]

Amer. Mon. Micr. Journ., vi. (1885) p. 53.

Cox, J. D.—Photography with High Powers by Lamplight: illustrating structure of diatoms.
[Nearly the same as Vol. IV. (1884) pp. 853-8.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 99-104 (2 pls. of photo-micrographs).

D. E. T.—Graphic Microscopy. (See in future under Microscopy β.)

Dippel, L.—Einige neue Mikroskop-formen. (Some new forms of Microscopes.) (Describes stands by Zeiss, Leitz, Seibert, Hartnack, Schieck, Reichert, Wächter, Winkel, and Geneva Co.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 37-40 (1 fig.).

Ermengem, E. van.—See Heurck, H. van.

Fell, G. E.—See Micrometer.

Francotte, P.—Description d'instruments construits par M. Reichert de Vienne. (Description of instruments constructed by Herr Reichert of Vienna.)
[Stands, cf. Vol. IV. (1884) p. 438, and *supra*, p.302. Microtomes, see *infra*, Microscopy β.]
Bull. Soc. Belg. Micr., XI. (1885) pp. 102-7 (4 pls.).
„ „ Exposé succinct de la Théorie de la formation des images microscopiques, d'après Abbe. (Succinct account of the Abbe theory of the formation of microscopic images.)
Bull. Soc. Belg. Micr., XI. (1885) pp. 108-27 (1 pl.).

Frey, Dr. J., death of. *The Microscope*, V. (1885) p. 24.

Friedrich, K.—Instrument zum Messen und Theilen von Linien. (Instrument for measuring and dividing lines.)
Title only of German Patent, 1885, Kl. 42, No. 2056.

"Gamma Sigma."—Conical Illumination for Opaque Objects.
[Pointing out the absurdity of "Prismatique's" suggested illuminator, *infra*.]
Engl. Mech., XL. (1885) p. 560.

Griffith, E. H.—The Griffith Nose-piece.
[Cf. Vol. IV. (1884) p. 801.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, p. 170 (1 fig.).
„ „ The Griffith Eye-piece.
[Cf. Vol. IV. (1884) p. 443.]
Ibid., p. 170 (1 fig.).

Gundlach, E.—An improvement in Objectives. [*Post.*] *Ibid.*, pp. 148-52.

Hardy, J. D.—Lantern Illustrations.
[Reply to query, and referring to his direct vision camera enlarged so as to show images fairly well up to 2 ft. (The camera is an oblong box, 20 in. × 10 in., with a hole at one end to admit the tube of the Microscope shortened to 2 in. At the other end is a sheet of plate glass, with tissue or oiled paper to receive the image.)]
Sci.-Gossip, 1885, p. 43.

Heurck, H. van.—Note sur la photographie des perles de l'*Amphipleura pellucida*. (Note on a photograph of the "beads" of *A. pellucida*.)
[In part similar to his note *ante*, p. 173, with reply to E. van Ermengem *ante*, p. 140. Also rejoinder by E. van Ermengem.]
Bull. Soc. Belg. Micr., XI. (1885) pp. 86-92.
„ „ Le Microscope depuis 1878. (The Microscope since 1878.) I. Montures. Objectifs.
Moniteur du Praticien, I. (1885) *Bull. de la Microgr.*, pp. 14-6.

[Hitchcock, R.]—The New York Microscopical Society.
[Comments on their proposed publication of a monthly journal.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 17-8.
„ „ Science True and False.
[Complaint that microscopical literature in America has of late abounded in insulting personalities; and quotation of remarks by Prof. E. L. Youmans on the spirit of pure science.]
Ibid., pp. 18-9.

[Hitchcock, R.]—Black-ground Illumination and Polarized Light.
[Objecting to T. West's condemnation of them, cf. vol. iv. (1884) p. 976. "One might as well say, as Mr. E. M. Nelson does, that the use of oblique light in microscopy is not desirable."]
Ibid., p. 20.
" " Beading of *Amphipleura*. [*Infra*, p. 380.] *Ibid.*, p. 32.
" " Postal Club Boxes.
[List of preparations with remarks.] *Ibid.*, pp. 32–4.
" " Among the Dealers.
[Account of a visit to opticians in Philadelphia and New York, and their products.]
Ibid., pp. 35–6.
" " 1 in. American Objective of very wide angle unfavourably compared in Paris with a 25 fr. French. Also a 1/10 in. American (hom. imm.) favourably compared with a 1/12 in. English. *Ibid.*, pp. 38–9.
" " Beading of *Amphipleura* and photo-micrography. [*Post.*]
Ibid., pp. 42–5.

"Homologous Sections, Electric Light, and Molecules.—Mr. Edison has just "completed and transmitted to Prof. F. G. Fairfield, of the New York College "of Veterinary Surgeons, an electric lamp which has the novelty of being "probably the most minute ever constructed. . . . The instrument was made "to illuminate a microscopic objective constructed upon the new discovered "law of homologous sections. This lens renders it possible to obtain a power "of sixty thousand diameters. At such a power only a section of a coloured "corpuscle of human blood can be viewed at a time. Computing the molecule "of living matter to be about a twenty-millionth of an inch in diameter, Prof. "Fairfield believes it possible to project the image of it upon a screen with "the help of the lamp, and to take photographs showing the molecular con- "stitution of such complex bodies as albumen."
Micr. Bulletin, I. (1884) p. 14. From "a daily paper."

Hunt, G.—The *Triceratium favus*—to Mr. Nelson.
[Inquiry as to what he ought to see with a 2/3 in. and dark-ground illumination by the achromatic condenser. "Surely not the minute puncta in the hexagons arranged in rows converging towards the centre of the triangular figure of the diatom."]
Engl. Mech., XL. (1885) p. 539.

Illumination of Microscopes and Balances. [*Supra*, p. 328.]
Nature, XXXI. (1885) p. 440.

"Invicta."—See Short *v.* Long Body-tubes.

Journal of the Royal Microscopical Society (1884).
[Review.] *Journ. of Science*, VII. (1885) pp. 95–6.
" " " " [Note on.]
Knowledge, VII. (1885) p. 177.

James, F. L.—The Deposition of Silver on Glass and other non-metallic surfaces.
[Describes principally the process of Liebig, Draper, Petitjean, and the author.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 71–80.

Künckel d'Herculais, J.—Nouveau valet compresseur pouvant s'adapter au Microscope et permettant l'examen de substances molles et opaques. (New Compressor adapted to the Microscope and allowing the examination of soft and opaque substances.)
[Exhibition only.] *Bull. Soc. Zool. France*, IX. (1885), *Proc. Verb.*, xxiii.

Lens, glory of [like that of a man is work].
Journ. New York Micr. Soc., I. (1885) p. 29.

Löwit, M.—Ein heizbarer Objecttisch für starke Vergrösserungen. (A hot stage for high powers.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 43–6 (1 fig.).

M. Q. M. C.—See Short *v.* Long Body-tubes.

Madan, H. G.—On a Modification of Foucault's and Ahrens's Polarizing Prisms. [*Supra*, p. 328.]
Nature, XXXI. (1885) pp. 371–2 (1 fig.).

Malley, A. C.—Photo-micrography, including a description of the Wet Collodion and gelatino-bromide processes, with the best methods of mounting and preparing microscopic objects for photo-micrography.
2nd ed., vi. and 166 pp. (3 pls. and 28 figs.), 8vo, London, 1885.

Mayall, J., Jun.—Nobert's Ruling Machine. [*Infra*, p. 378.]
Times, *6th and 28th March*, 1885.
Engl. Mech., XLI. (1885) p. 30.

Michael, A. D.—See Nelson, E. M.

Micrometer, Standard, report of Committee on,—with reports of G. E. Fell, W. A. Rogers, and W. A. Anthony.
[Reports "the result of the effort to obtain copies of the Standard."]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 220–7.

Microscopist, What is a? [*Supra*, p. 333.] *Science*, V. (1885) p. 164.

Nelson, E. M.—Microscopic Illumination.
["Right-angled prisms are used in telescopes for the purpose of economizing every particle of light. In the Microscope, however, even with a 1/2 in. wick there is more light than one knows what to do with."]
Engl. Mech., XL. (1885) p. 482.

„ „ *Triceratium.*
[Reply to query by G. Hunt, *supra*, and further denunciation of the "oblique light and striæ business."]
Ibid., p. 560.

„ „ Brass and Glass.
[(1) Testing the different sectors of Objectives, *supra*, p. 324. (2) Simple condenser, *supra*, p. 327.]
Ibid., XLI. (1885) p. 34 (2 figs.).

„ „ Standard thickness of glass slips, and remarks by A. D. Michael and W. B. Carpenter. [*Supra*, p. 329.]
Journ. Quek. Micr. Club, II. (1885) pp. 120–1.

Oculars, report of the Committee on, with appendix of extracts from paper by F. Crisp on "Optical tube-length," Vol. III. (1883) p. 816.
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 228–33 (1 fig.) and 277.

Phillips, P. A.— *Amphipleura pellucida*—to Dr. Royston-Pigott.
[Inquiry as to how far his experimental proofs (*infra*) go against the Abbe diffraction theory.]
Engl. Mech., XL. (1885) p. 560.

Photo-micrography at the Health Exhibition.
[A description of the aëroscopes, culture-cells, sterilizing and other apparatus, Microscopes, photo-micrographs and apparatus. *Post.*]
Amer. Mon. Micr. Journ., VI. (1885) pp. 28–32,
from *Brit. Journ. of Photography.*

"Prismatique."—Conical Illumination for opaque objects.
[Consists of a glass paraboloid in immersion contact with the upper surface of the slide having a cylindrical hole in the centre for the objective to pass through and focus on the object. "Gamma Sigma" points out that none of the rays reflected from the back surface could possibly reach the object unless the cylindrical opening is filled with oil, and not many even then!]
Engl. Mech., XL. (1885) p. 520 (1 fig.).

Queen, J. W.—Note on Centering the Illuminating Beam. [*Post.*]
Micr. Bulletin, II. (1885) p. 1 (4 figs.).

Rogers' (W. A.) Stage-micrometer. [*Supra*, p. 330.]
Amer. Mon. Micr. Journ., VI. (1885) p. 38.

„ „ See also Micrometer.

Royal Microscopical Society, visit of deputation from, to the American Society of Microscopists. *Proc. Amer. Soc. Micr.*, 7th Ann. Meeting, 1884, pp. 262, 269, 271.

Royston-Pigott, G. W.—*Amphipleura pellucida.*
[Result of examination with the Diatomescope.]
Engl. Mech., XL. (1885) p. 520.

ROYSTON-PIGOTT, G. W.—*Amphipleura pellucida* and diffraction. I.
[Reply to P. A. Phillips, *supra*. Also the following, "With proper precautions the limit of angular vision or linear diameter in my experience lies beyond the 1/1,000,000 in. with the best glasses and finest manipulation."]
Ibid., XLI. (1885) pp. 35–6.

Sachs' (J.) Heating apparatus. [*Post.*]
Micr. Bulletin, II. (1885) p. 6, from 'Sachs' Text-book of Botany,' p. 658.

SCHULTZE, E. A.—Electrical Illumination in Microscopy: Experiments and Views of Dr. H. van Heurck and T. Stein.
[Principally an abstract of Dr. Stein's paper, *supra*, p. 303.]
Journ. New York Micr. Soc., I. (1885) pp. 1–6 (4 figs.), and cf. also pp. 19–20, 22–4.

Sexton, L. R., Obituary of.
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 251–3.

Short *v.* Long Body-tubes.
[Further discussion by B.Sc. (better results with a 7 in. or 8 in. than 10 in.), M.Q.M.C. (refers to paper on "Optical tube-length," Vol. III. (1883) p. 816), and Invicta.]
Engl. Mech., XL. (1885) p. 457.

SOUTHALL, G.—Photo-micrography.
[As to the wide differences between the natural and artificial representations of the same object.]
Knowledge, VII. (1885) p. 181.

ST. CLAIR, R. W.—A new Electric Lamp.
[Incandescence lamp; battery with 6 cells and holding 5 oz. of fluid. It has been in use for more than a year. The President referred to it as "the best for brilliancy yet brought before the Society."]
Journ. New York Micr. Soc., I. (1885) p. 42.

Stearn's (C. H.) Electric Lights for the Microscope.
[Brief description, with illustrations, of apparatus described Vol. III. (1883) p. 29. Also reference to Stein's, *supra*, p. 303.]
Science, V. (1885) p. 142 (3 figs.), from 'Science et Nature.'

STEINHEIL, A.—Zur Orientirung über Objektive aus zwei Linsen und ihre Fehler. (On the orientation of Objectives of two lenses and their aberrations).
[Telescope Objectives.] *Centr.-Ztg. f. Optik u. Mech.*, VI. (1885) pp. 37–40.

Tolles, R. B., Portrait of.
Proc. Amer. Soc. Micr., 7th Annual Meeting, 1884, Frontispiece.

VORCE, C. M.—Photographic Methods.
[I. Formulas for printing solutions (Blue prints. Black prints. Cheap proof solution). II. Compound negatives, *supra*, p. 331.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 13–4.

WARD, R. H.—The Iris Illuminator. [*Supra*, p. 326.]
Proc. Amer. Soc. Micr., 7th Annual Meeting, 1884. pp. 160–1 (1 fig.).
Amer. Mon. Micr. Journ., VI. (1885) pp. 14–5 (1 fig.).
„ „ New Lens-holder. [*Supra*, p. 317.]
Proc. Amer. Soc. Micr., 7th Annual Meeting, 1884, pp. 162–4 (1 fig.).
The Microscope, V. (1885) pp. 32–4 (1 fig.).

Weisiger, W. R., Obituary of.
Proc. Amer. Soc. Micr., 7th Annual Meeting, 1884, pp. 250–1.

WESTIEN, H.—Mittheilungen aus dem physiologischen Institute der Universität Rostock i. M. 7. Die Patent-Anschlussklemme und ihre Anwendung. (The Patent Junction Clamp and its use.) [*Supra*, p. 316.]
Zeitschr. f. Instrumentenk., V. (1885) pp. 18–9 (3 figs.).

WHITNEY, J. E.—A cheap and efficient Life-box. [*Supra*, p. 330.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, p. 215.

Woodward, J. J., Obituary of.
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 253–7.

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

Modified Hardening Process for the Central Nervous System.*—It is difficult to obtain the human brain in a fresh condition, 36–48 hours generally elapsing after death before it is available for examination. Giacomini proposes the following process to give the preparation greater firmness and elasticity.

After the preparation has been hardened in Müller's fluid, instead of putting it in alcohol it is placed for some days in a 5 per cent. sublimate solution, which is renewed every day until it is no longer coloured. If left in the fluid too long, the preparation becomes black, or if not long enough, small black points will appear. It is very elastic and firm, and very thin sections can be cut, and it stains well with ammonia-carmine.

Preparing Meroblastic Ova.†

The following are C. Kupffer's methods:—

Reptilian Ova.—The ova taken from the oviduct are opened in a dilute solution of 0·1 per cent. osmic acid and the albumen removed as far as possible. The osmic acid is then turned off and a weak 1/3 per cent. solution of chromic acid added for 24 hours. With a fine pair of scissors the germinal area is cut round just outside its margin, and after it has been completely encircled with the incision, floated carefully off from the body of the yolk. The yolk and acid are next removed, and a copious supply of clean water added, which must be several times renewed. It is then put for 3 hours in Calberla's fluid (ā ā glycerin, water, and absolute alcohol in equal parts), hardened in 90 per cent. alcohol, and stained in Böhm's carmine acetate for 24 hours.

Teleostean Ova (*T. fario*).—Chromic acid (1/3 per cent.), 24 hours. Distilled water for 2 hours. The egg-membrane expands, and may now be easily removed. Wash in distilled water 12 hours. Absolute alcohol, glycerin, and aq. dist. in equal parts for 4 hours. Absolute alcohol. Böhm's carmine acetate (1 to 2 days). Mixture of water and glycerin (equal parts), and 1/2 per cent. hydrochloric acid, for a few minutes. Wash in water (4 to 5 hours). Absolute alcohol (12 hours) preparatory to imbedding in paraffin.

Karyokinetic figures are brought out with great distinctness.

Hydrogen Peroxide as a Bleaching Agent.‡—J. D. Hyatt finds this to be very successful for insects. A flea, for instance, thus bleached shows the heart and all the other internal organs clearly and perfectly and in their proper place. The respiratory system is particularly fine. In the process of decoloration by liquor potassæ, these delicate structures are either partly or quite destroyed.

* 'Fascia dentata del grande ippocampo nel cervello umano.' Torino, 1883, pp. 66–7. Zeitschr. f. Wiss. Mikr., i. (1884) pp. 449–51.

† Arch. f. Anat. u. Physiol. (Anat. Abtheil.) 1882, p. 4. Cf. Amer. Natural., xix. (1885) p. 332, and Lee's Microtomists' Vade Mecum, 1885, p. 316.

‡ Journ. New York Micr. Soc., i. (1885) p. 22.

Biniodide of Mercury and Potassium as a Swelling Agent.*—L. Dippel finds that a solution of iodide of mercury in iodide of potassium possesses the property of causing the innermost layer of the cell-wall to swell while the other layers remain unchanged. The preparations after carefully washing can be preserved in glycerin or calcium chloride. The degree of concentration of the solution requires to be tested for each object.

The inner layer can be stained without the others. The sections should be placed for some hours in an aqueous solution of fuchsin, and after washing the inner layer will be found at the thinnest points to be stained a pale red. A dilute solution of hæmatoxylin gives a pale violet stain.

Erlicki's Hardening Solution.†—This is a variation of Müller's solution. The latter is composed of bichromate of potash, 2–2½ parts; sulphate of soda, 1 part; and water, 100 parts; the duration of the reaction being about the same as with the simple solutions of chromic salts.

In Erlicki's solution the sulphate of soda is replaced by 1/2 p. c. sulphate of copper. The hardening properties are superior to those of Müller's solution. It is now very generally employed in Germany.

Böhm's Carmine Acetate.‡—Böhm proposes the following formula:—

Three to four grms. carmine are pulverized in 200 grms. water, and ammonia is added by drops until the solution becomes cherry-red (the carmine should now be fully dissolved). Acetic acid is then slowly added until the colour becomes brick- (or sealing-wax-) red. The addition of acetic acid should be accompanied with stirring, and should cease the moment the change in colour is effected. Then filter until no trace of a precipitate remains.

If the colour is not sufficiently deep, a few drops of ammonia should be added before filtering, and the solution left in an open vessel until the smell of ammonia is not perceptible.

Objects may be left for 24 hours or more in the fluid (or longer if they are more than 1 mm. in thickness). The deep stain should be partially removed by immersion in a mixture of water and glycerin (equal parts), with 1/2 per cent. hydrochloric acid, for a few minutes.

Staining Method for Karyokinetic Figures.§—P. Baumgarten finds the following an excellent method. Place the sections for 24 hours in a dilute alcoholic solution of fuchsin (8–10 drops of concentrated solution in a watch-glass of water), then rinse in absolute alcohol, then for 4–5 minutes in a concentrated aqueous solution of methyl-blue, dehydrate for 5–10 minutes in absolute alcohol, and lastly place in oil of cloves. The effect of the methyl-blue is to remove the red stain almost entirely from all parts except the nuclei.

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 251–3.

† Lee's Microtomists' Vade Mecum, 1885, pp. 159 and 403.

‡ Arch. f. Anat. u. Physiol. (Anat. Abtheil.) 1882, p. 4. Amer. Natural., xix. (1885) pp. 332–3. Lee's Microtomists' Vade Mecum, p. 54.

§ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 415–7.

The author's main object was the examination of the cells of tubercle for which the chromic acid process was found unsuitable. If it is desired to examine the bacilli at the same time, the sections should first be placed for 24 hours in a dilute alcoholic solution of methyl-violet and then treated with the fuchsin and methyl-blue. The bacilli are stained blue, and the karyokinetic figures an intense red. It is advisable to leave the sections only 5–10 minutes in the fuchsin and 5–40 seconds in the methyl-blue; if left longer in the fuchsin the bacilli lose their stain.

Ribesin and Eosin.*—Prof. H. Fol, after expressing and throwing away the juice of black currants (*Ribes nigrum*), boils the skins for some hours in 10 per cent. alum solution. The resulting deep violet solution may conveniently be diluted with water, and after the lapse of a day should be filtered, and may then be used for staining.

The stain resembles in its effect that of Boehmer's hæmatoxylin, but is a still more precise nuclear stain. It is a bright, somewhat greenish blue, agreeable, distinct, and permanent. Alcohol objects stain quicker than chromic acid ones, but the most suitable of all are bichromate objects.

A ribesin stain may be followed by eosin-staining, or a double stain may be at once obtained by adding a little eosin to the above ribesin solution and filtering (the filtrate should be cherry red). Wash out with alcohol charged with a little eosin, and clear with clove oil also charged with eosin. The blue of the ribesin remains fixed in the nuclei. In many respects this is a better double stain than Renaut's hæmatoxylic eosin.

Plaut's Staining Process for the Demonstration of Saprogenous and Pathogenous Micro-organisms.†—H. Plaut tabulates the methods of investigation for the various micro-organisms; instructions for the examination, choice, and treatment of the material, the production and treatment of the preparations, the best staining reagents and their action, methods of preservation, &c. In the case of the pathogenous Schizomycetes, the different methods are described, for each species, of the various investigators, Koch, Friedländer, Weigert, &c. The sections are as follows:—A. Saprogenous Schizomycetes: in fluids; in and upon solid substances. B. Pathogenous Schizomycetes: in the blood; in organs; micrococci in Area Celsi; *Leptothrix buccalis;* Lepra; bacillus of cattle-disease; pneumonia-cocci; recurrent spirochæte; bacillus of glanders; tubercular bacilli; typhus bacilli. C. *Gregarina* — moulds, &c.: gregarina; favus and *Oidium lactis; Actinomyces.*

Staining the Spores of Bacillus tuberculosis.‡—A. F. Negri describes a method he has found successful for staining either the spores of *Bacillus tuberculosis* or the organism itself:—

1. Powdered carmine, gr. 0·5; strong ammonia, cc. 1; distilled

* Fol, H., 'Lehrbuch d. vergl. Mikr. Anatomie,' 1884, pp. 183 and 196. See Lee's Microtomists' Vade Mecum, 1885, p. 402.

† Plaut, H., 'Färbung's-Methoden zum Nachweis der fäulniss-erregenden u. pathogenen Mikro-organismen.' 2nd ed., 32 pp. 8vo, Leipzig, 1884.

‡ Journ. de Microgr., viii. (1884) pp. 349–51. From 'Lo Sperimentale.'

water, cc. 30. This, protected from dust, is exposed to the air till every trace of ammonia has disappeared, when the clear fluid is poured off and the sediment thrown away.

2. Commercial alcohol, cc. 100 ; pure hydrochloric acid, drops 20.

3. Concentrated solution of picric acid in distilled water.

4. No. 2, cc. 15 ; No. 3, cc. 15.

5. No. 4, with the addition drop by drop of No. 1. Into this a small crystal of thymol is dropped to prevent the growth of mycelium, and the preparation is kept in a stoppered bottle.

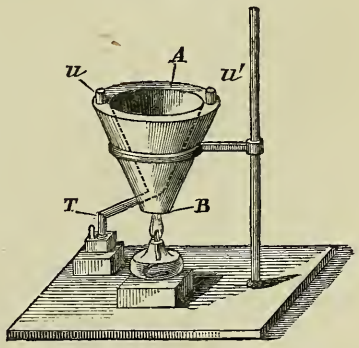
6. Methyl violet, gr. 0·7; absolute alcohol, cc. 10; anilin oil, cc. 4. To this when the colouring matter is completely dissolved is added distilled water, cc. 15.

The sputum is spread in a uniform but not too thin layer on a cover-glass, and then dried in the air and slightly warmed. It is next placed in a watch-glass with the preparation upwards; some of No. 6 poured on it with an ordinary indiarubber drop-measure, is covered over and left from half an hour to an hour in a temperature of 15° C. It is then washed in water till the excess of colour is dissipated entirely, when it is put into No. 2 until the preparation is cleared, when it is washed in a fresh quantity of the liquid, and whilst still moist some drops of No. 5 are poured on, and it is left to stand for five minutes. The excess of carmine is removed by draining: it is then washed anew in No. 2, and plunged into distilled water, twice renewed, for eight to ten minutes. The preparation is then dried and mounted in pure balsam.

When examined under the Microscope the spores appear of an azure-blue inclosed in the transparent envelope of the bacillus, on a rose-coloured ground.

When it is desired to colour the whole bacillus instead of the spores alone, the preparation is washed, after being subjected to the action of the carmine, in distilled water without being placed in No. 2.

Fig. 83.



Francotte's Paraffin Filter.* —P. Francotte suggests the apparatus, fig. 83, for readily freeing paraffin that has been used, from the dirt, fragments of sections, &c., which after a time contaminate it. A B is a double funnel with water between the two casings, the inner one terminating in a bent tube T. Blotting-paper is placed inside the funnel and a spirit-lamp applied at the bottom. An aperture at *u* is for a thermometer and one at *u'* for supplying water.

The apparatus will also enable paraffin to be obtained at any

* Bull. Soc. Belg. Micr., xi. (1885) pp. 79–82 (1 pl.).

given point of fusion. Pieces of paraffin are placed in the funnel and heated to the point desired. The liquid which runs out of the funnel is collected, and will be found to melt at the temperature indicated at the moment of filtering.

Dr. Francotte also suggests that the funnel A B may replace the vessel R in his vacuum apparatus, *ante* p. 149, one of the apertures being used for the barometer tube and the other communicating with the vessel with the paraffin. The funnel is cooled by passing water through it.

Parabolic Mirror for Correction of too hard or too soft Paraffin.* —Prof. H. Fol suggests that if, after the cutting has begun, the paraffin is found to be too hard, it may be softened by the following simple and ingenious expedient:—

A lamp provided with a parabolic reflector is set up near the microtome in such a position that the heat-rays of the flame are thrown by the reflector on to the imbedded object. The right temperature is obtained by adjusting the distance of the lamp. If, on the contrary, the paraffin be found too soft, it may be hardened by exposing it to the cooling influence of a lump of ice placed in the focus of a similar reflector.

Beck's Universal Microtome. — In this microtome (fig. 84) Messrs. Beck have very ingeniously combined in one instrument the means for cutting sections of soft tissues under all the varied conditions required in this class of work:—1stly, for cutting consecutive sections, which are carried off the knife by a continuous ribbon. 2ndly, for cutting sections when frozen by ether. 3rdly, for cutting unimbedded sections. 4thly, for cutting sections with a long diagonal knife. Special arrangements are made for freezing by ice, or for cutting substances under spirits if desired. The Schanze form has been adopted as the basis of the instrument, the main frame consisting of a solid iron base and an upright. The latter carries on one side a carefully planed out V-shaped groove A, on which a heavy brass block B, to which the knife is attached, slides with great accuracy and ease. To this block and behind the knife the apparatus carrying the revolving ribbon C is clamped. This is readily removed when desired.

On the other side of the upright is a vertical slide working in a dovetail, and carrying the mechanism to which the object-holder is attached. The various modes of holding the object are shown at—D when the object is imbedded in paraffin for ribbon cutting; E when the object is frozen by ether; and F when it is clamped in the holder. The socket into which the object-holder fits has rectangular movements controlled by the two thumb-screws, so that the object-holder can be placed in any position. The whole is moved up and down by the lever seen in front of the upright, which brings it in contact with the top of a highly polished steel screw of very delicate construction, upon which it rests. To this screw is attached a large ratchet

* Fol, H., 'Lehrbuch d. vergl. Mikr. Anatomie,' 1884, p. 123. Cf. Lee's Microtomists' Vade Mecum, 1885. p. 401.

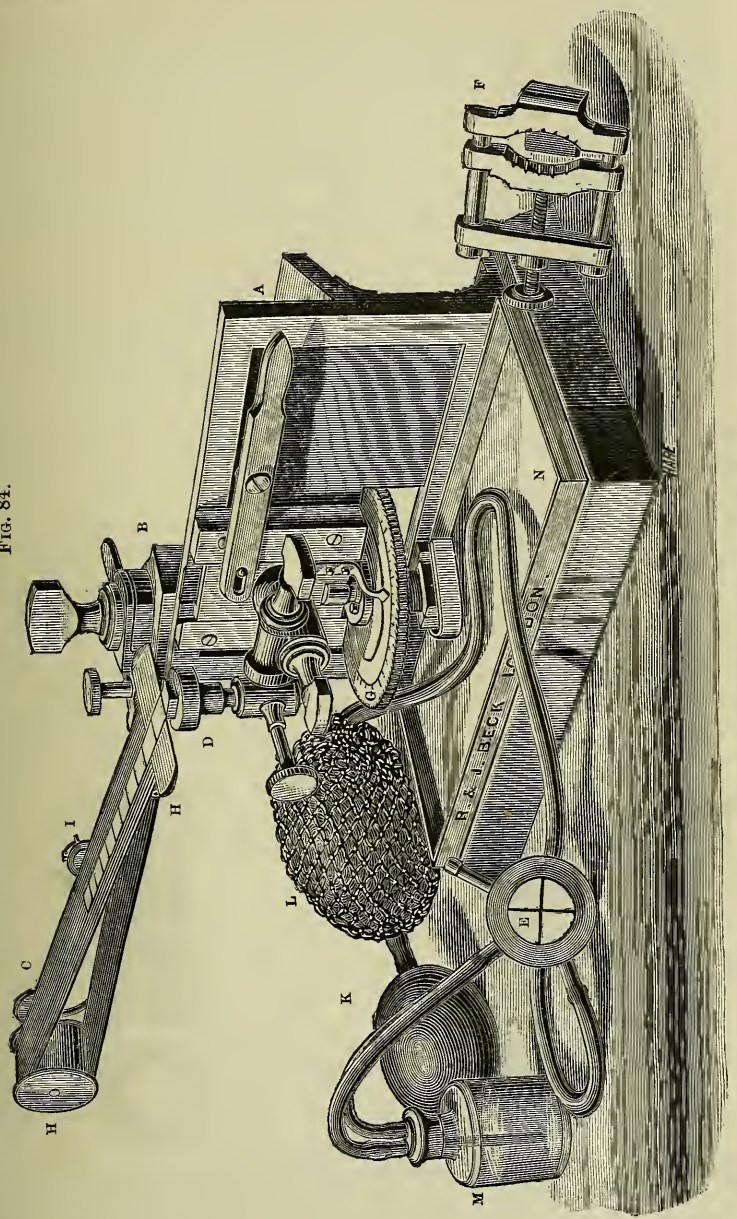


Fig. 84.

Beck's Universal Microtome.

wheel G, which is automatic in its action, being moved forward any distance required at each stroke of the knife. This movement is adjusted by a screw at the side, by which the number of teeth moved forward at each stroke is determined. If the instrument is so adjusted that the wheel moves one tooth at each stroke the thickness of the section will be 1/3600 in., or 7μ, and so on up to 10 teeth or 1/360 in. (70 μ).

The arrangement for ribbon cutting consists of two drums H H carrying the ribbon C. The distance the ribbon moves is regulated by a small ratchet wheel I, capable of minute adjustment and varying according to the breadth of the section cut.

The other freezer consists of an indiarubber tube communicating with a chamber E upon the outside of which the object to be frozen is placed; a hand-bellows K, an intermediate regulating bladder L, and a bottle M in which the ether is placed, and into which the two tubes for the ether and drainage are fitted.

The zinc tray N holds any droppings.

If desired a crank movement can also be applied, whereby a continuous motion is given to the knife carrier and to the ribbon apparatus.

The advantage is obvious of having a simple microtome to which a simple ribbon apparatus can be attached when it is desired to cut series of sections, and which does not interfere with the ordinary use of the instrument.

Reichert's Simple Hand-Microtome.—Figs. 85 and 86 show the simple hand-microtome of C. Reichert for objects of 15–25 mm. in diameter.

A metal cylinder has at the lower end a disk *a* with an excentric aperture. One end of a lever *b* within the cylinder passes through

Fig. 85.

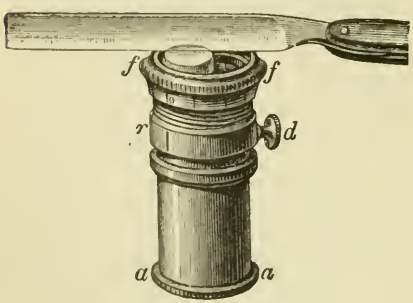
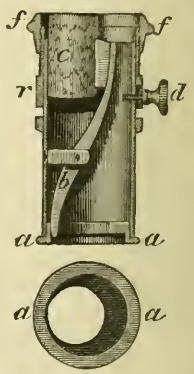


Fig. 86.



the aperture, while the other presses against the piece of pith *c* used for imbedding, and the pressure can be increased or diminished according as *a* is rotated. Over the upper end of the cylinder is fitted a

shorter one, having a fine screw-thread terminating in *r*. The clamp-screw *d* fixes it. A ring *f* with a screw-thread works in that on the short cylinder, its upper edge serving as a guide for the knife. By rotating the ring it is lowered and more of the object to be cut exposed to the knife. The divisions on the ring mark 1/10 mm. in the thickness of the sections.

Reichert's Microtome Object-clamp.—C. Reichert now supplies for use with his microtomes the clamp shown in figs. 87 and 88. The object is fixed between two plates, one of which is movable and is

Fig. 87.

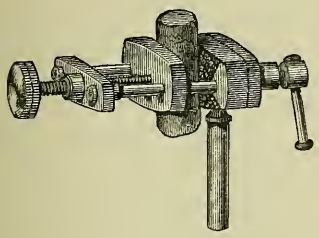
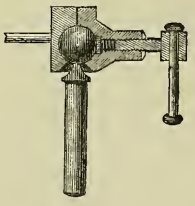


Fig. 88.



controlled by the screw on the left. A universal motion is given to the clamp by a ball-and-socket arrangement shown in section in fig. 88, so that it can be set at all inclinations.

Improvements in Microtomes and Knives.*—P. Francotte suggests attaching to the plate of the Ranvier microtome, on each side of the opening, two pieces of glass, 0·5 cm. broad, and of exactly equal thickness. These will serve as slides for the razor, which, owing to the reduction of friction, will move more regularly, and thus perfectly parallel sections will be obtained which it is otherwise difficult to do.

Another suggestion is to attach two pieces of glass, 1 mm. thick, to the plane face of the razor, a little less in length than the breadth of the blade, so as to leave the edge free. The glass would be better replaced by metal, but that would require a specially constructed knife which it is the object of his suggestions to avoid.

Rogers' Section-Cutter.† —W. A. Rogers describes a form of section-cutter suggested by part of the mechanism employed in the comparator of Princeton College. New tree-ways upon which the Microscope-plate moves are the cores of very long magnets, and it was found that the pulling force required to move the plate under the action of a current developed by four bichromate cells was about 135 lbs.

The apparatus now proposed obviates the uncertainty as to the mechanical indication of the thickness of the sections as well as the uncertainty with reference to its rigidity and the number of parts by

* Bull. Soc. Belg. Micr., xi. (1885) pp. 84–5.

† Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 191–3.

which the increment of motion is given. It consists of (*a*) A bed-plate of iron about 15 in. long by 6 in. in breadth, having elevated walls on each side and running the entire length. The cores of two or more magnets project through this bed-plate, being fastened beneath. (*b*) A rectangular plate moving freely between the walls of the bed-plate, and resting directly upon the cores of the magnets. (*c*) A Microscope-arm attached to the bed-plate in such a way that a ruled metal plate attached to the moving plate can be brought under the objective. (*d*) A simple means, either by a lever or a screw, of running the rectangular plate over any distance indicated by the scale. (*e*) The mechanism for holding the object upon the rectangular plate and for moving the knife.

The object being mounted for cutting, each increment of motion is obtained by moving the rectangular plate over a given distance under the Microscope. There can be no mistake about the magnitude of this motion, because it can be at any time verified by reading the scale. In order to fasten the plate, preparatory to making the section, we have only to turn a switch and complete the circuit. By the principle employed there can be no disturbance during this operation, and this fact can be verified by again reading the scale.

Preparing Thin Sections of Shells and Teeth.*—E. Ehrenbaum recommends that before grinding thin sections of teeth, shells of molluscs, foraminifera, &c. (especially small objects), they should be placed in a very fluid and not too warm mixture of 10 parts colophonium (rosin) and 1 part ordinary wax, the latter serving to reduce the brittleness of the former. It is quite transparent, and the object can be oriented in any desired position in the grinding. The objects should be placed in the mixture and after a short time lifted out with the forceps with as much as possible of the mixture hanging to them, and allowed to cool. Or the mixture with the object may be poured in a very small paper box.

The grinding is done on a glass plate with emery powder of various degrees of fineness. When one side is smooth, the section is attached to the slide, and the other side similarly ground down and polished. It is then washed with oil of turpentine and (moistened with the oil) left under a bell glass to clear and render it transparent. The remainder of the imbedding material is best removed with chloroform.

If the section is damaged and likely not to hold together, it can be mounted without dissolving the colophonium, which when pure is little inferior to Canada balsam. In this case the slide should be warmed very gently or some drops of chloroform run over it before the cover-glass is put on.

Rapid Method for Making Bone and Teeth Sections.†—Under this heading E. T. Nealey describes a process which consists of using only perfectly fresh tissue and grinding down first one side and then the other of the tooth or sawn section of bone on a dentist's lathe

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 414–5.

† Amer. Mon. Micr. Journ., v. (1884) pp. 142–4.

with a set of emery wheels. He uses the palmar surface of the index finger to press the section against the stone. "If a part of the ball of the finger happens to come in contact with a finely polished and well-moistened stone it will have but little if any effect upon the epidermis."

A tooth can thus be made ready to mount in thirty minutes after its removal from the jaw, and the following advantages are claimed for the method over the older ones, viz., "rapidity of preparation, and thereby the specimen retains all of its original tenacity. It does not curl up or become brittle, and thus one is enabled to get a larger and more perfect specimen . . . . Perfect longitudinal sections of teeth have been made in this way which were so thin that they would bend under their own weight. This would be simply impossible in a tooth that had become dry during the old process, as they become too brittle to allow of such extreme reduction. The rapidity of reduction and preparation readily admits of staining the protoplasm of bone sections before retrogression sets in, and thereby their value is greatly enhanced."

Staining and Mounting Pollens and Smuts.* — Rev. J. T. Brownell gives the following as an original method:—

"Place a blank slide on the turntable; apply a small drop of the staining fluid to the centre of the slide and place in it the requisite amount of pollen and spread it evenly on the glass by placing the sharp point of a teaser in the centre of the mass, and drawing it gently to one side while the slide is rapidly revolving, washing away the superfluous stain by dropping clean alcohol on the mass of pollen, using for this purpose a sharp-pointed teaser; wipe away the outflowing fluid by the use of a small piece of clean cloth rolled up neatly and applied to the outer edge of the waste fluid, gradually moving it inward as the slide revolves, until only a small circle is left covered with pollen. Allow a few moments for the alcohol to thoroughly evaporate from this; then apply a minute drop of spirits of turpentine, so that the balsam may permeate the mass without inclosing air-bubbles. Next apply the balsam, *dropping it in a ring around the pollen*, and moving it up to the centre by placing the edge of a small chisel held upright to the surface of the slide, and at an angle such as to gather it (the balsam) together as the slide revolves. Now lay on the cover-glass and settle it well into place, applying pressure (with a tremulous motion of the hand) sufficient to bring all the pollen-grains to a common plane, but yet so as to avoid crushing them. Remove the superfluous balsam, using the small chisel as before, only setting it so as to throw the balsam away from the cover into an outer ring, which operation serves also to accurately centre the cover-glass; and lastly, using a wider chisel, take up this ring of balsam, and the slide, furnished with a temporary label, is laid away to cure."

Practical suggestions are given as to collecting clean pollen, preserving it for future use, avoiding mixing, teasers, chisels, &c.

* Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 212–3.

It is added that "all that has been said applies equally to the mounting of smuts, save that these being dark in colour do not need to be stained, which is also true of many pollens."

Brownell Turntable.*—Rev. J. T. Brownell has constructed a turntable (fig. 89) upon the general plan of that devised some years ago by C. M. Kinne, but with several important improvements.

Fig. 89.

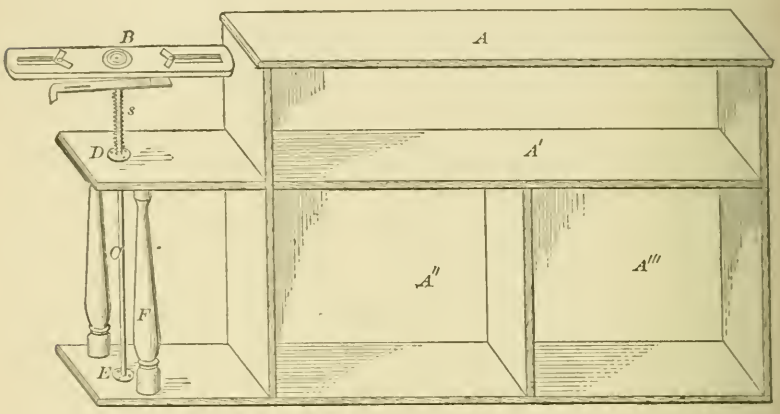


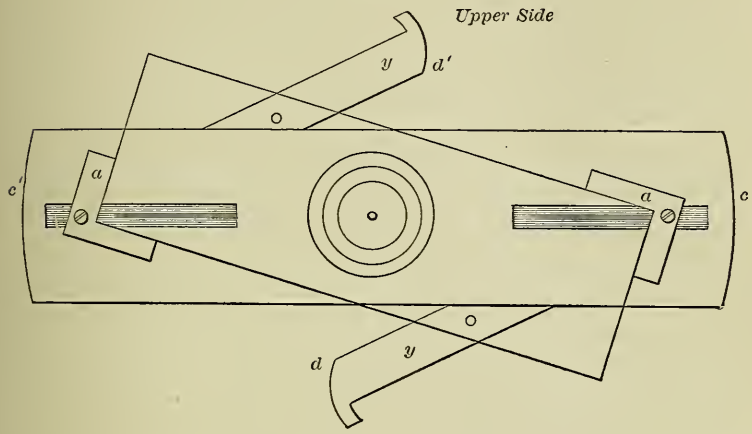
Fig. 89, which is reduced to one-third of full size, represents the table, front view. The stand A is made of wood, with the open chambers A' A'' A''', affording a convenient place for laying the various utensils in use, and also for packing them together with materials, &c., for transportation. The head-block B is of solid brass $4\frac{1}{8} \times 1$ in., and 1/4 in. thick. It stands on a spindle C 5 in. long, which is supported by the metallic collars D and E. The lower end of the spindle is dressed to a sharp point, and rests on a plate of polished agate underneath the collar E. A couple of inches of the central portion of the spindle are milled, and the instrument is run by the tips of the fingers of the left hand placed against this milled portion, while the hand is steadied by resting the thumb against the pillar F. The revolution of the slide is thus under the complete control of the operator, who can readily keep it in uniform motion, quick or slow, for any desired length of time. Fig. 90 shows the upper side of the head-block, with a glass slip held in place.

The clutches *a* (fig. 90) are set so as to grasp the slip diagonally, bringing it to a true centre, and at the same time leaving one of its corners projecting 3/8 in. on either side for convenient handling. The clutches are secured in position, being screwed fast to the brass blocks *x* (fig. 91), which move firmly but freely through the grooves cut for them. The lever-bars *y* are attached to these blocks by the

* Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 173-5 (3 figs.).

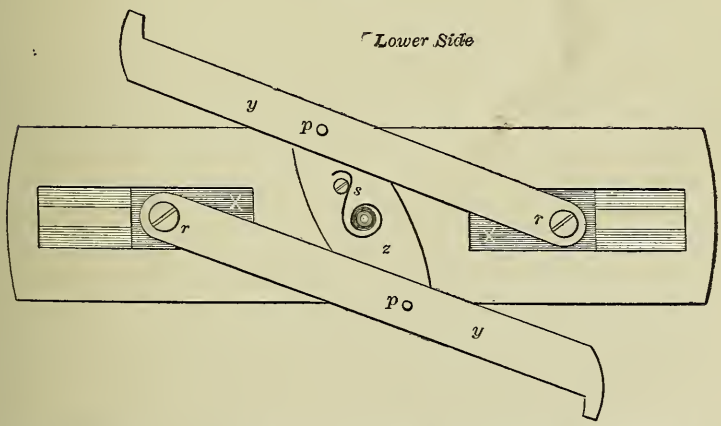
strong screws r, and are connected by the centre bar z, which is let into them by a mortice and held by the pins p. The clutches are opened for the reception of the glass slip by placing a finger of the

Fig. 90.



right hand against the milled end of the head-block at c (or c'), and pressing the end of the lever-bar with the thumb at d (or d'). The grasping force of the clutches is secured through a spiral spring s

Fig. 91.



(figs. 89 and 91), coiled around the head of the spindle, as shown in the figures.

The whole rests on disks of rubber, so that it will neither slide about nor mar any surface on which it may be used.

Smith's Mounting Media.*—H. L. Smith describes his colourless medium (1·8 to 2·0 refractive index). It consists of arsenite of antimony (a white powder) dissolved in liquid chloride of arsenic until a somewhat dark-coloured honey-like viscid fluid is obtained, which is used precisely like balsam. Caution is required in the manufacture, which should be done in small quantities and in a homœopathic vial. This should be about one-third filled with the chloride and some of the arsenite, say one-third the bulk of the liquid, added, and the mixture warmed over a spirit-lamp until all is dissolved; then successive portions of the arsenite are added and dissolved until the viscid fluid is obtained. If the ingredients are clean, no filtering will be required. In mounting, the boiling should be prolonged until the large easily-formed bubbles of the excess of chloride disappear; the portion outside will be hard, and require a sharp edge to remove it, care being taken not to disturb the cover. After this the cover and adjacent parts can be washed over with tissue paper moistened with hydrochloric acid; not water or alcohol, as they decompose the medium, causing it to become an opaque white. A wax ring is the best protection for the mount. The medium improves with age, and with further experiments can, it is hoped, be made to give permanent mounts by obviating the tendency to deposit crystals.

The deep-yellow medium (2·4 refractive index) Prof. Smith pronounces to be entirely permanent. Its composition he keeps a secret. It is to be regretted that he should have decided to inaugurate such a departure from the ordinary and very salutary scientific usage in such matters. In the case of dealers this can hardly be legitimately objected to, but we hope that scientific workers in general will not be misled by Prof. Smith's example, to make a mystery of methods and processes which they have hitherto been so ready to make known for the benefit of their fellow-workers.

Balsam of Tolu as a Medium for Mounting.—Mr. F. Kitton writes: "It is stated in the February number of the Journal that this medium is objectionable for mounting purposes, as crystals are apt to form in it sooner or later. I tried it shortly after reading Dr. Kain's recommendation (early in September last), and have now over a hundred preparations in the medium. In February I went through them with some trepidation, but was gratified to find that no symptom of crystallization had appeared. This I should have attributed to the short time that had elapsed since the preparations had been made, had it not been stated that recent preparations (made about the same time as mine) were already full of crystals. I can only account for this by supposing that either tolu is variable in its composition, or that my method of preparing and using it prevents crystallization. Dr. Kain recommends alcohol or chloroform as a solvent; I employ benzole. I remember some years ago inquiries were made as to the cause of crystals sometimes occurring in preparations made with balsam or dammar dissolved in chloroform. As I never found them in my

* Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 186-90.

own preparations made with pure balsam, I attributed them to the chloroform.

Shortly after I began using tolu a correspondent informed me that some of his slides were spoilt by a kind of crystallization, which he described as being like a delicate cobweb. I have noticed a similar appearance in balsamed slides that had been overheated, and in consequence the balsam had become brittle. I have sometimes seen the formation of it when cleaning off the superfluous balsam; a sudden change of temperature, such as the heat of the hand, will produce it. The appearance is caused by innumerable fissures permeating the film of balsam. Tolu if hardened too much will no doubt act in the same manner. Being of slightly higher refractive index than styrax, it is useful for many forms, and I hope that this defect may be remedied either by the use of benzole or by making the tolu less hard."

M. J. Amann also,* as the result of nearly three years' experience, considers tolu superior to Canada balsam and equivalent to styrax. The only drawback is that it has a little more colour than the latter, though, like styrax, it becomes colourless with age and when exposed to the light. On the other hand, it is much simpler to prepare. It is only necessary to dissolve 1 part of the balsam in 2 or 3 parts of chloroform, then filter, and it is ready for use.

Mr. C. Van Brunt, however,† confirming a statement of Mr. E. G. Day, speaks to the crystallization of balsam of tolu, even in slides prepared by an experienced hand.

Glycerin and Balsam Mounts.‡—J. S. Kingsley, referring to the praise recently given to glycerin as a mounting medium, considers that for every-day work it cannot compare with balsam, and that the difficulties connected with the use of balsam have been over-stated. He gives the following comparative statements, the first being the steps required with balsam, and the second with glycerin.

a. Harden with chromic acid. *b.* Dehydrate with alcohol of different grades. *c.* Transfer to chloroform. *d.* Transfer to paraffin. *e.* Cut sections. *f.* Dissolve paraffin with turpentine. *g.* Place on slide in balsam and apply cover.

With glycerin we follow the same steps to *f*, and then we have to add the following:—

g. Get rid of turpentine by alcohol. *h.* Place on slide with glycerin, and apply cover. *i.* Fasten cover.

It seems to him "that some people needlessly take many steps in doing microscopic work which are absolutely needless. For instance, in the time one occupies in finishing a balsam slide he could mount another, and in the experience of the writer all use of cements for fastening the cover in the case of balsam mounts is unnecessary."

Mounting in Phosphorus.§—R. Hitchcock referring to the recommendation to use Walton's glucine or Ray's coaguline as cements,

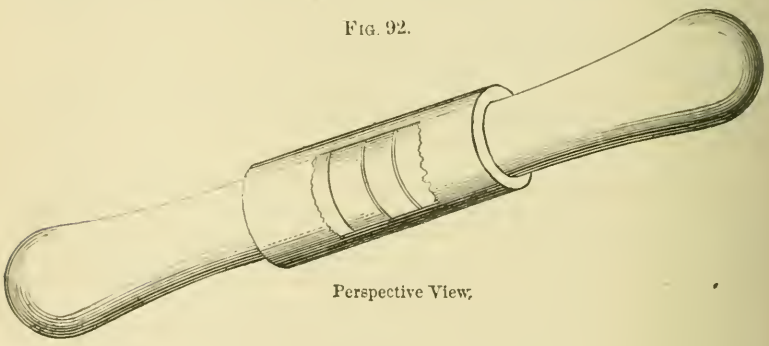
* Bull. Soc. Belg. Micr., xi. (1885) p. 127.
† Journ. New York Micr. Soc., i. (1885) pp. 41-2.
‡ Science Record, ii. (1884) pp. 269-70.
§ Amer. Mon. Micr. Journ., vi. (1885) p. 7.

suggests a cement which in his opinion will unquestionably serve perfectly well. It is solution of ordinary gelatin in water, coloured slightly with potassic dichromate. A rather thick solution can be used to make a cell, if used warm on a warm slide. When the mount is finished exposure to light for a short time after the gelatin is dry renders it quite insoluble.

Diatoms in Phosphorus.*—L. Dippel finds that all those diatoms which, when mounted dry, show the markings clearly and sharply, act in the same way in the phosphorus solution, while those (especially *Grammatophora*) for which dry mounting is not suitable, are also badly shown in phosphorus. *Amphipleura pellucida*, *Surirella gemma*, species of *Nitzschia* and *Pleurosigma*, *Navicula rhomboides* and *Frustulia saxonica* are best shown in phosphorus; *Grammatophora* in monobromide of naphthaline or biniodide of potassium and mercury.

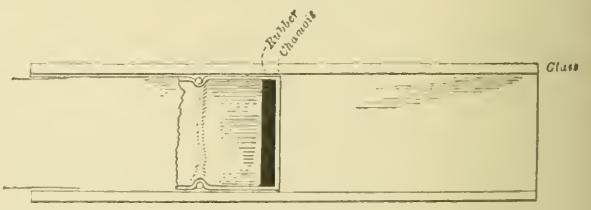
James' Cover-glass Cleaner.†—F. L. James's device (figs. 92 and 93) is especially convenient for cleaning and polishing extremely thin covers.

Fig. 92.



Perspective View.

Fig. 93.



Section.

It consists of three parts: a piece of stout glass tubing, 3 in. to 5 in. long and of sufficient internal diameter (7/8 in.) to receive the glass to be cleaned, and two plungers of hard wood long enough to penetrate the tube half-way and leave a good hold for the hands. They

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 413–4.

† Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 181–2 (2 figs.).

should be a little smaller than the diameter of the tubing. One end of each must be cut very smoothly and exactly at right angles with the axis. From a sheet of indiarubber, which should be at least 1/10 in. in thickness, two disks should be cut of the same size as the end of the plunger, and one attached to the smooth end of each plunger. A piece of chamois large enough to go over the rubber and be fastened to the plunger completes the apparatus. A shoulder should be cut on the end of the plunger to receive the thread or wire used to bind the chamois to its place.

The cover to be cleaned is laid on the end of one of the plungers and inserted into one end of the tube. The other plunger is inserted from the other end of the tube, and friction is made by rotating the plungers. If properly made, the full strength may be exerted on the thinnest cover-glass without breaking it.

Cole's 'Studies in Microscopical Science.'—Mr. Cole's 'Studies' are now resumed. They are divided into four sections: Botanical Histology, Animal Histology, Pathological Histology, and Popular Microscopical Studies. The contents of the first parts of each section are noted *infra*, p. 364. We need only refer to what we have already said as to the great want which these studies are so well calculated to meet, and urge microscopists to support an enterprise which, under the most favourable circumstances, must still leave the editor and publishers with little for their reward beyond the consciousness of having performed a most valuable service to biological students and workers.

Lee's Microtomists' Vade Mecum.*—No literature is more inconveniently scattered than that which deals with histological methods, and Mr. A. B. Lee is deserving of all praise for having accomplished the laborious task of collecting into a handy form for reference all the methods in actual use at the present day, or which have been recommended within recent years.

The book is divided into two parts. The first contains a collection of formulæ under the heads of fixing, staining, hardening, imbedding, cleaning agents, cements, injection-masses, &c. The second part deals with special cases, and is divided into cytological methods, embryological methods, the integument, tactile organs, retina, myelon, tissues, blood, &c., of Vertebrata, with separate chapters for the different divisions of the Invertebrata.

Nearly 700 different methods are described with great conciseness but at the same time completeness; and to make the book useful to beginners as well as advanced anatomists, a general introduction is given, with a series of introductory paragraphs to some of the chapters.

The book will be invaluable to a large class of workers as a ready means of reference, either on matters of detail or otherwise, for which there is a great want. We had to spend some time recently in the endeavour to discover what Erlicki's fluid was, a point which Mr. Lee's book would have cleared up at once.

* Lee, A. B., 'The Microtomists' Vade Mecum: A Handbook of the Methods of Microscopic Anatomy,' xvi. and 424 pp. 8vo, London, 1885.

"Working Session" of American Society of Microscopists.—A leading feature of the last (Annual) meeting of this Society was the "Working Session," an afternoon of the week of meeting being devoted (under the direction of Mr. E. H. Griffith) to the practical exhibition and explanation of methods of manipulation and investigation, with the view to improvement in technique. Three hours were occupied, the first devoted to preparatory work, the second to finishing work, and the third to questions and discussions. Four pages of the 'Proceedings' contain twenty practical questions which were asked, with answers and suggestions.*

Compound Eyes and Multiple Images.†—J. D. Hyatt finds that to show multiple images in compound eyes it is best to cut out with a small punch a circular disk not larger than can be pressed flat without disturbing the facets. The most perfect eye for giving images is that of the cockroach. It is very brittle, and so only a small part of the cornea can be pressed flat in one piece. A piece large enough to fill the field of a 1/2 in. objective and B eye-piece can, however, be cut out, and the many advantages which it possesses more than counterbalance its want of superficial extent. They can be mounted in glycerin, and thus kept quite transparent without losing their properties as lenses.

The eye of a mosquito can be made to show 200 and more pictures of a person in silhouette with great distinctness. The eye of *Limulus* will also give multiple images, a small disk cut from the central part being used. Also the minute globules of water produced by breathing on a slide, and even the transparent parts of any structure which are lenticular or globular.

The fact of the image being erect or inverted may, it is suggested, be of "service in determining the character of minute bodies or structures, such as human blood-corpuscles, all of which show erect images; a proof that they are nucleated or at least lenticular at the centre. The head of the pin-shaped sponge-spicule and the nuclei in certain diatoms produce inverted images."

Examination of Butter and Fats.‡—T. Taylor (U. S. Department of Agriculture) describes his observations on "artificial butter." Formerly oleomargarine was easily detected, but latterly the manufacture has been so much improved as to make the task much more difficult.

In the early stages of investigation by the Microscope, it was considered that butter might be distinguished from oleomargarine by a comparison of the oil-globules of each; but it was found that this was an unreliable method. Aware of the fact that all artificial butter was made directly from crystallized fats, he then devised a method by which it could be distinguished by using Nicol prisms. Butter being destitute of free fats, the colours of polarized light would not appear.

* See Proc. Amer. Soc. Micr. 7th Ann. Meeting, 1884, pp. 199–219.

† Journ. New York Micr. Soc., i. (1885) pp. 33–7.

‡ Taylor, T., 'Microscopic Observations. Internal Parasites in domestic Fowls and Butter and Fats.' 8vo, Washington, 1884, 7 pp. and 1 pl.

The manufacturers of oleomargarine, however, made further improvements, and it was so free from crystals of fat that the Nicols failed to distinguish them from butter. He therefore introduced a selenite plate, the object of which was to detect fatty bodies in a homogeneous state. Although not so much as a single crystalline form may be present, all the prismatic colours are shown throughout the homogeneous mass, while pure butter exhibits under the same conditions only plain red or green. A non-microscopic test is also given by the author. A coloured plate illustrates the paper.

Polarized Light in Vegetable Histology.*—L. Dippel directs attention to a method of observation by polarized light which has afforded him much assistance in researches into the minute structure of the cell-wall.

Examined with ordinary light, a very thin transverse section of a tissue with thickened cell-walls, cut perpendicularly to its long axis, exhibits the so-called "middle-layer" of Hofmeister, Sachs, and others, in which, beyond the well-known gusset in the angles, no further differentiation is perceptible (fig. 94). Under polarized light, however, and with crossed Nicols, there is a substantial alteration in its appearance (fig. 95). The apparently homogeneous structure is traversed by a fine black line, and is thus divided into three parts.

Fig. 94.

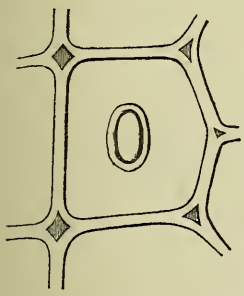
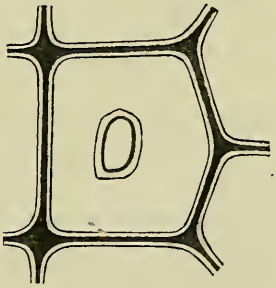


Fig. 95.



Observation with polarized light thus tells us very decisively that the "middle-layer" is not simple, but consists of three laminæ, of which the central one is singly refracting, and the two lateral ones doubly refracting. The former is therefore of a different molecular structure, and even chemical constitution, from the other two. Polarized light may also be appealed to to support the results obtained by maceration and reagents, which have been questioned.

On the question of the nature of the first solid secretion-product of the living cell-body, i. e. the first wall-formation to which the "middle-layer" owes its origin, observation with polarized light also affords an explanation if applied to the cell-wall during its

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 210–7 (5 figs.). Transl. in Micr. News, iv. (1884) pp. 291–7 (5 figs.).

development. A transverse section through the cambium-region of a conifer when observed in the darkened field proves that before the primary wall (at once manifesting itself by double-refraction) is formed out of cell-substance, an envelope singly refracting, and consequently not consisting of cell-substance, is secreted out of the protoplasm, which envelope remains during the conversion into wood or bast of the cambium-daughter-cells, and thus becomes the central plate of the "middle-layer."

As to the share to be assigned to the wall-layers in the formation of the pore-canals and the closure of the pores, Dr. Dippel confirms Hartig's view that it is the innermost layer of the cell-wall which is transformed into pore-canals, and that the closure is formed by two adjoining cells here brought together (fig. 96). The fact, as

Fig. 96.

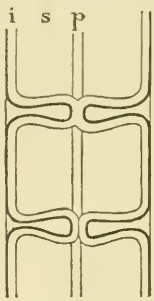


Fig. 97.

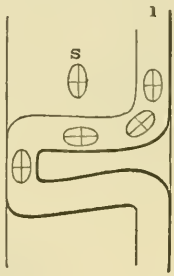
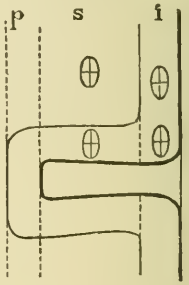


Fig. 98.



represented in the fig., is admitted by Strasburger, but another interpretation is given to it. According to him the inner layer represents a later differentiation, which arises in consequence of contact with the cell-contents; and the more strongly refracting layer, which only apparently extends from the inner plane uninterruptedly into the pore-canal, represents just such a differentiation of the secondary thickening in the parts adjoining the pore-canal, whilst the closed end of the pore is formed out of the primary walls.

Since the collective layers of the cell-wall possess the form of an ellipsoid of elasticity, which, in the transverse and longitudinal sections appears as a section of an ellipse, in which the smallest axis lies radially or perpendicularly to the stratification, and the greater axis parallel to the stratification (the transverse section yielding the least, and the longitudinal section the greatest axis), observation with polarized light must afford the most trustworthy elucidation of the course of the stratification. If the course of the inner layer is as Hartig maintains, then the sections of the ellipsoids must change in the direction as represented in fig. 97. If, on the contrary, the real structure is in accordance with the view of Strasburger, then such a change cannot take place, and the sections of the ellipsoids will be represented in fig. 98.

In proof that the former view is correct, the author adduces the

phenomena observable when a very thin section of the seed-albumen of *Phytelephas macrocarpa* is viewed by polarized light with a red selenite plate.

Extremely striking results are also given by spectrally-analysed polarized light. With a transverse section of *Pinus sylvestris*, the singly refracted cambium-wall in the parts of the section lying above the dark Müller's band appears most distinctly as a dark streak between the primary walls, which are of a brilliant green, whilst the other parts show the cambium-wall as a coloured streak between the strongly darkened, almost black, primary walls. A longitudinal section through the seed-albumen, examined in a like manner, gives similar striking results, which the author describes and which he considers to prove his theory yet more conclusively.

Direct Observation of the Movement of Water in Plants.*— G. Capus has used the following contrivance for this purpose in the case of plants with hollow stems, or filled only with a very delicate pith, such as the dahlia, artichoke, and a species of *Begonia*. A tangential cut is made on one side of the stem, reaching to the cambium; at a spot exactly opposite a small piece of the woody cylinder is cut out, and the pith carefully removed up to the spiral vessels. In this way, through a Microscope placed horizontally, a sufficiently clear view can be obtained of the vessels and of the air-bubbles contained in them. It may thus be seen that in cloudy weather, or whenever the sun is not shining directly on the plant, the vessels are injected with water; while in direct sunshine numerous air-bubbles make their appearance which gradually become larger.

Microchemical Detection of Nitrates and Nitrites in Plants.† This is possible by the reagent suggested by Wagner, viz. diphenylamin. Molisch uses a one pro mille solution in pure sulphuric acid, applying this to dry sections. If either of the salts above named is present, a deep blue coloration appears, which soon changes to brownish yellow. Brucin in about the same strength is nearly as sensitive a test, producing a transient red or reddish-yellow colour. Molisch employs this method also for approximate determination of the amounts of the salts present, and finds that the percentage decreases from below upward in the plant.

New Method for the Transfer of Sterilized Broths, and the Determination of the number of Living Germs in Water.‡ — A new method has been proposed by Dr. H. Fol for preparing, sterilizing, and using nutritive fluids for the cultivation of bacteria, in water and air analyses. The following is a brief abstract of the method adopted. The original is accompanied by figures of the apparatus, and others have been supplied in a private note.

Originally engaged with Professor Dunant in the examination of the potable waters supplied, or that might be supplied to Geneva, Dr. Fol was led to adopt a plan which he considered preferable to

* Comptes Rendus, xcviii. (1884) p. 1087.
† Ber. Deutsch. Bot. Gesell., i. (1883) pp. 150-5.
‡ Arch. Sci. Phys. et Nat., xi. (1884) pp. 557-74 (1 pl.).

those in use by others. The principal novelty is the method of transfer. The change that occurs in some nutritive fluids when heated to 110° C. for several hours led to the adoption of repeated heatings for shorter periods, the cold sterilization and filtration, the gelatin plan of Koch, and cultivations on solids, as boiled potatoes, &c. Dr. Fol gives the preference to sterilized beef-broth as used by Dr. Miquel, but instead of sterilizing the flasks and their contents in boiling salt-water bath or concentrated solution of chloride of sodium, or in a Papin's digester charged with water, which he considers has some advantages, he endeavours to get rid of the risks incurred in the superheating and charging of the empty superheated flasks or tubes, and to obtain a less percentage by loss.

Dr. Fol never passes the liquid into a fresh receiving vessel except by a sterilized tube made to perforate the plug closing its mouth. Carded, fine, flexible, silky asbestos is preferred for the plug, as being more easily sterilized and perforated than cotton. The decoction of beef is prepared after Dr. Miquel's formula: 1 kilogramme of lean beef to 4 litres of water, boiled five hours and skimmed from the first boiling, then cooled, the fat removed on the morrow, and the acidity neutralized by caustic soda. Dr. Fol now filters this through a paper filter into a Papin's digester, kept for one hour at 110° C., then cooled and re-filtered to remove the flaky precipitate. It now remains perfectly clear, is returned to the Papin's digester with its special arrangements, and kept at 110° C. from four to six hours, by which time a notable quantity of peptones are formed in the broth. The longer the boiling, the deeper the tint. The cover of the digester is pierced with three openings; one retains a copper tube closed beneath for holding the thermometer, a little oil being placed in the tube; the second corresponds to the valve which is loaded for a temperature between 110° and 112° C.; the third is closed by a pierced cork and screw-nut. Through the cork is pushed a tight-fitting metal tube, twice bent at right angles to form a siphon, the long leg being inside the digester. This tube is flamed before being put in position; the short outside leg is terminated by a thick, short caoutchouc tube, into the open end of which a metallic canula is fitted; this is a trochar tube, into which the steel point of the trochar cut off has been soldered, and just above it an oval aperture is made in the tube. This tube is used to pierce the asbestos plugs and to transfer the broth. The ordinary culture flasks have the neck narrowed at one part to keep the plug in position, and with it are sterilized at 200° C.

The transfer of broth is made by drawing up the long leg of the siphon above described into the vapour space in the digester; a pinch-cock that closed the caoutchouc junction is opened, and the vapour allowed to escape through the canula for ten minutes. The outer surface and point of the canula are now flamed by a Bunsen burner; then the point is placed in sterilized cotton, the pinch-cock closed, and the tube pushed down nearly close to the bottom of the digester. A little broth is now allowed to escape by the canula, and this is then plunged, the pinch-cock being shut, through the plug of

asbestos into a sterilized flask, the pinch-cock opened, and the broth allowed to enter the flask, the canula withdrawn, and other flasks filled. A sterilized cotton plug is placed above the asbestos one in the flasks, and they are set in the stove at 35° C. for proving. No failures are recorded with this plan. These standard flasks hold about 1/4 litre, and are useful for estimating the number of germs in water by the plan that will be presently described; otherwise small experimental flasks of 10 cc. are filled directly from the digester. The necks of these small flasks are long and narrow, and for necessary precaution the top of the tube-neck is covered with sterilized asbestos, and over it is placed a tube-cap with a plug of cotton in it, the lower edge being rounded off by the flame; this is fitted over the little flask-neck, the space between the neck and cap being closed by the overlying asbestos, some being carried down the sides when the cap is fitted on. Through this top layer of asbestos, after the removal of the cap, the pointed canula can be easily passed without displacing the layer over the top of the neck-tube. When charged they are placed in the stove at 160° C., not more, for some time. This plan has answered well, but control experiments are always made at the same time.

To collect the water for analysis and to estimate the number of germs in a given volume, Dr. Fol takes a tube and places two plugs of asbestos at one end, a little distance apart; the other end is then drawn out, sealed, heated, and the tube bent twice at a right angle, bayonet fashion, the bends being some little distance from each other, like the metal part of a carpenter's drill-stock. To collect the water the plugged end is attached to a caoutchouc tube for aspiration, and the point after due flaming is broken off by sterilized pliers, either before entering or whilst beneath the water, so as not to vitiate the result by the use of another vessel. For taking deep water from the lake, the tubes are sealed at both ends, then heated, and fixed to a metal stem or support also flamed, having a movable branch or arm that can be actuated at some distance by a connected pull-wire, so as to cause rupture of the point, by which the water enters so as to partially fill the tube, then by turning the point upwards a bubble of the sterilized air inside is made to occupy the point, and this is at once sealed. This bayonet curved tube admits of manipulation without wetting the asbestos plugs, which *must be* avoided. For analysis the water is agitated in the tube, the point cut off, a few drops allowed to escape, and the estimation made of the number of germs after the method in use by Dr. Miquel, i. e. by dilution with sterilized water, to be afterwards distributed in prepared culture flasks, but instead of water it is mixed directly with the sterilized broth, and this is distributed into sterilized empty flasks.

For this a burette narrowed at each end is used of 100 cc., divided into tenths of a centimetre, and numbered so that 100 cc. corresponds exactly with the inferior orifice and 0 is at a little distance from the upper end. The burettes are sterilized in a special stove, the orifices closed by asbestos and attached caoutchouc tubes, which are previously washed with oxygenated water. For use, the

burette is fitted to an orifice in the digester and placed in a special wool-lined cradle, so that the lower end may be strongly inclined downwards; the heated vapour is allowed to traverse it for half an hour, a pinch-cock is then applied to the lower caoutchouc tube, and its open orifice closed by a short glass rod, and the upper end similarly closed by a tube plugged with asbestos and having a pinch-cock. It is then fixed to a vertical support, the glass rod at the lower end is replaced by a sterilized canula, and the upper end after removal of the glass tube is closed by sterilized asbestos; the trochar canula is then passed through the asbestos plug after removal of the top cotton plug into one of the proved standard flasks containing the broth. The lower pinch-cock is opened and the fluid runs into the burette and readily fills it; the pinch-cocks are then opened and the fluid allowed to descend to about two-tenths below zero. To charge the burette with the water, the large open end of the collecting bayonet-tube has a small caoutchouc ball fixed to it, whilst the drawn-out narrow end, after due precautions, is passed through the asbestos plug (taking care not to wet the plug), and some of the water allowed to flow out, the pinch-cocks again closed and the fluids mixed, then transferred into the small capped flasks which are then placed in the culture stove for a month. The canula in use must *always* be placed in a sterilized space or covering and *not* be heated during the transfers.

Since the above was published, Dr. Fol has made sundry alterations, such as stoppering the necks of the tubes by pushing the asbestos plug in by a short straight funnel tube, like a very short test-tube with a small hole in the bottom, this little hollow stopper being itself plugged with sterilized cotton, so that the charging by the narrow trochar canula can be more easily accomplished, and the plug remain equally effectual. Reliable results can only be obtained by employing the greatest care in the details.

Discrimination of Bacillus lepræ and B. tuberculosis.*—P. Baumgarten describes four methods of fuchsin staining by which these *Bacilli*, though nearly identical in form, may be readily distinguished. By all the processes the *B. lepræ* are stained red, while the *B. tuberculosis* are unstained.

Examining Bacteria.†—E. Thurston strongly advocates the examination of bacteria, whenever it is possible, in their natural state, so that their appearances and characteristics may be observed when they have not been subjected to the action of heat or chemical reagents. In many instances species which are undistinguishable from one another microscopically can be easily recognized by their appearance (colour, consistence, &c.) and mode of growth in cultivating media; and for this reason microscopical examination should always be combined with artificial cultivation.

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 367–71.
† Journ. Quek. Micr. Club, ii. (1885) pp. 121–4.

Ady, J. E.—The Microscopic Study of Rocks.
[Three figs., only, relating to previous article, *ante*, p. 161.]
Sci. Monthly, III. (1885) p. 44 (3 figs.).
" " The Microscopic Study of Rocks. II.
[Crushing rocks for their examination under the Microscope. General remarks.]
Ibid., pp. 67–70 (1 fig.).

Amann, J.—Sur l'emploi du Baume de Tolu pour les preparations de Diatomées. (On the employment of balsam of Tolu for preparations of diatoms.)
[*Supra*, p. 353.] *Bull. Soc. Belg. Micr.*, XI. (1885) p. 127.

American Society of Microscopists, the "Working Session" at Rochester meeting of. (Programme.) [*Supra*, p. 356.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 199–202.
" " " Practical questions, answers, and suggestions at "Working Session" of Rochester Meeting of. *Ibid.*, pp. 216–9.

B.Sc.—A Freezing Microtome.
[Describes the Williams. Cf. Vol. I. (1881) p. 697.]
Sci.-Gossip, 1885, pp. 37–8 (2 figs.).

Bacteria, Culture Media for. *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 55–7, from *Journ. Amer. Med. Assoc.*

Behrens, W.—Bernsteinlack zum Verschliessen mikroskopischer Präparate. (Amber varnish for sealing microscopical preparations.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 54–7.

Bienstock, —.
[Double staining of *Bacillus subtilis*, &c., at period of sporulation—Ehrlich's method for *B. tuberculosis* stains the spores red and the rest of the organism blue.]
Bull. Soc. Belg. Micr., XI. (1885) pp. 92–3.

Böhm's Carmine Acetate. [*Supra*, p. 341.] *Amer. Natural.*, XIX. (1885) pp. 332–3, from *Arch. f. Anat. u. Physiol.* (*Anat. Abtheil.*) 1882, p. 4.

Booth, M. A.—White Zinc Cement.
[Sending slides, for which the cement was used, in proof of his commendation of it. Mr. R. Hitchcock in a note says that every slide arrived smashed to pieces, and he reiterates his objection that it is unreliable. A cement that hardens slowly will not do for many workers. Shellac enables quick and sure work to be done.]
Amer. Mon. Micr. Journ., VI. (1885) p. 39.

Brayley, E. B. L.—Mounting Insects.
[Reference to Wilks' cell, Vol. IV. (1884) p. 477. Similar note by W. S.]
Sci.-Gossip, 1885, p. 65.

Brearley, W. H.—See M'Calla, A.

Brownell, J. T.—The Brownell Turn-table. [*Supra*, p. 350.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 173–5 (3 figs.).
" " Original method of staining and mounting Pollens.
[*Supra*, p. 349.] *Ibid.*, pp. 212–3.
" " How to make wax cells neat, permanent, and free from "sweating."
[Sheet wax marked off into 5/8 in. squares. Press a square of white wax on the slide without crushing. Add other coloured squares to the desired height. Turn out the centre with a chisel and turn-table (but leaving the bottom white layer). Turn off the outside. Cover the whole (and fasten on the cover-glass) with a thin coating of shellac varnish, leaving uncovered enough of the bottom to hold the object.]
Ibid., p. 214.

Brunt, C. van, and E. G. Day.—Remarks on the tendency of Balsam of Tolu to crystallize. [*Supra*, p. 353.] *Journ. New York Micr. Soc.*, I. (1885) pp. 41–2.

Bulloch's (W. H.) Combination Microtome. [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) p. 45 (1 fig.).

Carter's (J. & Co.) Boxes of curious seeds for the Microscope.
[12, 25, 50, and 100 varieties.]
Midl. Natural., VIII. (1885) p. 56.

Cole, A. C.—Studies in Microscopical Science.

Sec. I. Botanical Histology. Parts 1 and 2, pp. 1–8. The Comparative Morphology of Typical Reproductive Organs in the Vegetable Kingdom. (1) Conjugation. Plate I. *Mesocarpus* in Conjugation × 200. (2) Formation of Oospores in *Vaucheria*. Plate II. *V. racemosa* × 300.

Sec. II. Animal Histology. Parts 1–2, pp. 1–8. The Primitive Cell and its Progeny. Plate I. Cornea of Cat. Gold stained. Hor. Sec. × 250. Plate II. Ovary of Kitten. Tr. section, stained carmine × 75.

Sec. III. Pathological Histology. Parts 1–2, pp. 1–8. Alveolar Pneumonia. Plate I. 1st stage × 170. Plate II. 2nd stage × 170.

Sec. IV. Popular Microscopical Studies. Parts 1–2, pp. 1–8. Plate I. Spinneret of Spider (*Epeira diadema*) × 70. Plate II. Foot of Garden Spider (*Epeira diadema*) × 75.

D., E. T.—Graphic Microscopy.

XIV. Toe of Mouse, injected.

[Contains an addendum to No. 13 as to a medium for preserving *Hydrachnæ* without sacrifice of their shapeliness. Distilled water (with a trace of carbolic acid), 8 parts; pure glycerine, 1 part. The characteristic plumpness remains intact, and the ocelli, palpi, &c., are so well preserved and displayed as to bear scrutiny under the highest powers.]

XV. *Polysiphonia elongata.*

[Contains the following:—"A very simple and useful addition to the 'material' of a microscopist are pieces of ordinary glass (not too thick), 3¼ in. square; between such plates, specimens capable of being dried and flattened without injury, as portions of fronds of ferns, zoophytes, wings and parts of insects, seaweeds, and many various objects, may be temporarily stored, and thus protected from dust or fracture. The glasses are held together by strips of gummed paper bordering the edges; the advantage being they can be examined on the stage of the Microscope when it is desired to select any part for a permanent mount."]

Sci.-Gossip, 1885, pp. 25 (1 pl.), 49–50 (1 pl.).

Day, E. G.—See C. van Brunt.

Dienelt, F.—[Advocates an American clothes-pin instead of a bullet for pressing cover down.] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 59–60.

Duffield, G.—A few hints on hardening, imbedding, cutting, staining, and mounting specimens.

[Hardening by alcohol—Imbedding with celloidin—Cutting with the Schanze Microtome—Staining with picro-carmine or alum-carmine and hæmatoxylin—Mounting in Canada balsam thinned with chloroform.]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 209–11.

Field, A. G.—Mounting Urinary Deposits.

[Glycerin and distilled water each 4 fluid drachms, chloral hydrate 5 grains, creosote 5 drops, gum camphor 2 grains. Mix, shake thoroughly, and filter. Directions for preparing the casts follow.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 39–40.

Flemming, W.—Berichtigung. (Correction.)

[Note that the hæmatoxylin solution for nuclei, described in his "Zellsubstanz, &c." as Grenacher's, is probably Prudden's.]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 57–8.

Francotte, P.—Inclusion dans la paraffine. (Imbedding in paraffin.)

[A. Apparatus for filtering paraffin, &c., *supra*, p. 343. B. Imbedding boxes (with permanent bottoms). C. Microtome, *supra*, 347.]

Bull. Soc. Belg. Micr., XI. (1885) pp. 79–86 (1 pl.).

„ „ Description d'instruments construits par M. Reichert de Vienne. (Description of instruments constructed by Herr Reichert of Vienna.)

[Stands, see Microscopy *a*. Microtomes, Vol. IV. (1884) pp. 823–4, and *supra*, p. 346. New object-clamp, *supra*, p. 347.]

Ibid., pp. 102–7 (4 pls.).

GAGE, S. H.—Serial Sections.
[Directions for making sections, preparing the slides, staining, mounting, and labelling. *Post.*]
Proc. Amer Soc. Micr., 7th Ann. Meeting, 1884, pp. 202–8 (3 figs.).

GIERKE, H.—Färberei zu mikroskopischen Zwecken (Staining for Microscopic purposes), (continued). [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 13–36.

GRIFFITH, E. H.—Descriptions of the Griffith Turn-tables. [*Post.*]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 165–7 (6 figs.).

" " The Griffith Microscopist's Working Cabinet.
[Description of a cabinet resembling "a medium-sized bookcase and intended to be so finished that it may be placed in any room in the house as an ornamental piece of furniture as well as a thing for use." It contains the Microscope, objectives, accessories, and all mounting materials.]
Ibid., pp. 168–70.

HAILES, H. F.—Gum Styrax as a Mounting Medium.
Journ. Quek. Micr. Club, II. (1885) p. 116.

HAMLIN, F. M.—The Ideal Slide. [*Post.*]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 179–80 (2 figs.).

HARDY, J. D.—Hardy's Flat Bottle.
[Correction of report of January Meeting of Royal Microscopical Society, and description of the bottle. Cf. Vol. IV. (1884) p. 977, and *ante*, p. 176.]
Engl. Mech., XL. (1885) p. 496 (1 fig.).

HATFIELD, J. J. B.—Description of Rotary Section Cutter. [*Post.*]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 171–2 (2 figs.).

HAUSHOFER, K.—Mikroskopische Reactionen. (Microscopical reactions.)
SB. K. Bayer. Akad. Wiss., 1884, pp. 590–604 (3 figs.).

HELLER.—Zur Mikroskopischen Technik. (On Microscopical technics.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 47–8.

Henshalls' (W.) "Fabric" Slides.
["Calculated to render assistance in determining by means of the Microscope, the nature and quality of textile fabrics."]
Sci.-Gossip, 1885, p. 64.

[HITCHCOCK, R.]—Preparing Phosphorus Solution and Mounting in it.
[Remarks on A. W. Griffin's paper, Vol. IV. (1884) p. 993, and cf. *supra*, p. 353.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 6–8.

" " The Study of Vegetable Fibres.
[Gives the method as carried out in the National Museum, for the examination of fibres and for mounting specimens for microscopical study or for reference and comparison.]
Ibid., pp. 22–5.

" " See also Booth, M. A.

HÜPPE, F.—Die Methoden der Bakterien-Forschung. (The methods of investigating Bacteria.) viii. and 174 pp., 2 pls. 8vo, Wiesbaden, 1885.

HUSSAK, E.—Anleitung zum bestimmen der gesteinbildenden mineralien. (Guide to the determination of the rock-forming minerals.)
iv. and 196 pp. and 103 figs. 8vo, Leipzig, 1885.

HYATT, J. D.—Hydrogen peroxide as a bleaching agent. [*Supra*, p. 340.]
Journ. New York Micr. Soc., I. (1885) p. 22.

" " Compound Eyes and Multiple Images. [*Supra*, p. 356.]
Ibid., pp. 33–7 (1 fig.). Cf. also p. 52 as to Leeuwenhoek being the earliest observer of the multiple images.

JAMES, F. L.—Cover-glass Cleaner. [*Supra*, p. 354.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 181–2 (2 figs.).

" " Zinc Cement again.
["In every instance where zinc cement disappoints its user, it is because the article is improperly made or improperly used, or both."]
The Microscope, V. (1885) pp. 65–6, from 'National Druggist.'

King's (J. D.) Microscopic Sections of the 60 species of Abietineæ of the United States.

["So prepared by bleaching and double-staining as to show the cross-section and the whole structure of the leaf very perfectly," ·01 to ·0012 in. in thickness.]

Science, V. (1885) p. 81.

Kupffer, C.—The Preparation of Meroblastic Ova. [*Supra*, p. 340.]

Amer. Natural., XIX. (1885) p. 332,

from *Arch. f. Anat. u. Physiol.* (*Anat. Abtheil.*), 1882, p. 4.

Kny's (L.) Method of Studying Algæ.

[Suspend a glass slip in a cylinder of water and allow it to remain until covered with the growths. Cf. also *ante*, p. 146.]

Amer. Mon. Micr. Journ., VI. (1885) p. 38.

Lee, A. B.—The Microtomists' Vade Mecum. A Handbook of the Methods of Microscopic Anatomy. [*Supra*, p. 355.]

["I desire here to make special acknowledgment of the great assistance rendered me by the Journal of the Royal Microscopical Society—in many respects the best edited periodical known to me."]

xvi. and 424 pp. 8vo, London, 1885.

Lett, H. W.—Cloudy Mounts.

[Cloudiness arises from moisture in the tissue dispersing through the balsam in bubbles. The remedy is dehydrating in alcohol and oil of cloves. Superfluous oil of cloves is best got rid of by placing the object on note paper (not blotting paper).]

Sci.-Gossip, 1885, p. 43.

Lewis, W. J.—Hair: Microscopically examined and medico-legally considered. [*Post.*]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 59–70 (2 pls.).

Maxson, E. R.—The Microscopy of Life and Death.

[Paper read before the Syracuse (U.S.A.) Microscopical Society.]

Syracuse Sunday Herald, February 1st, 1885, p. 2.

M'Calla, A.—The Working Session.

[Claims to be the originator of this feature of the meetings of the American Society of Microscopists; and answers by J. O. Stillson, F. W. Taylor, W. H. Brearley, and C. M. Vorce, maintaining Mr. E. H. Griffith's claim to be the originator.]

The Microscope, V. (1885) pp. 5–7, 42–6.

Mercer, A. C.—The Syracuse Solid Watch-glass.

[Cf. Vol. IV. (1884) p. 983.]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, p. 178 (1 fig.).

Osborn, H. F.—Preparing Brains of Urodela. [*Post.*]

Amer. Natural., XIX. (1885) pp. 328–30 (1 fig.),

from *Proc. Nat. Sci. Philad.* 1883, p. 178, and 1884, p. 262, and a letter.

Owen, D.—Clearing Fluid for Vegetable Tissues.

[When freshly cut put the tissues in alcohol for a few minutes. Then transfer them for 10 minutes to a clearing fluid of absolute alcohol and eucalyptus oil in equal parts. Then in pure eucalyptus oil to remove the alcohol. Mount in glycerin jelly.]

Sci.-Gossip, 1885, p. 43.

Piersol, G. A.—Staining Tissues for Photography. [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) pp. 41–2.

Rabl's (C.) Methods of studying Karyokinetic Figures. [*Supra*, p. 217.]

Amer. Natural., XIX. (1885) pp. 330–2 (1 fig.).

from *Morph. Jahrbuch*, X. (1884) pp. 214–330.

Rogers, W. A.—On a new form of Section-cutter. [*Supra*, p. 347.]

Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 191–3.

S., W.—See Brayley, E. B. L.

Sahli, H.—Ueber eine neue Doppelfärbung des centralen Nervensystems. (On a new double stain for the central nervous system.) [*Post.*]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 1–7 (1 pl.).

Sahli, H.—Ueber die Anwendung von Boraxmethyleneblau für die Untersuchung der centralen Nervensystems und für den Nachweis von Mikroorganismen, speciell zur bacteriologischen Untersuchung der nervösen Centralorgane. (On the use of Borax-methyl-blue for the central nervous system and for the detection of micro-organisms, especially for the bacteriological investigation of the central nervous organs.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 49–51.

Salmon's Culture-tubes.—See Sternberg's.

Schiefferdecker, P.—Mittheilung, betreffend das von mir verwandte Anilingrün. (Note on the anilin green used by me.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 51–3.

Slack, H. J.—Pleasant Hours with the Microscope.
["Brief account of the progress lately made in the discovery of disease-germs and in their modification so as to render them promoters of safety instead of agents of destruction."]
Knowledge, VII. (1885) pp. 143–4 (9 figs.).
" " " " [Stomata.]
Ibid., pp. 190–1 (1 fig.).
" " " " [Seeds.]
Ibid., pp. 232–3 (2 figs.).

Smith, H. L.—A new Mounting Medium. [*Supra*, p. 352.]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 186–90.
Cf. also *Amer. Mon. Micr. Journ.*, VI. (1885) p. 38.

Spee, F.—Leichtes Verfahren zur Erhaltung linear geordneter, lückenloser Schnittserien mit Hülf von Schnittbändern. (Simple process for obtaining linear, successive series-sections by section-ribbons.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 7–12.

[Sternberg's & Salmon's] Culture-tubes for Micro-organisms.
[Gives drawings of both, and statement by Dr. Salmon of the advantages of his tube.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 1–2 (2 figs.).

Stieda, L.—Ueber die Verwendung des Glycerins zur Anfertigung von anatomischen Dauerpräparaten. (On the use of glycerin for anatomical permanent preparations.)
[Described in its application to macroscopic preparations.]
Arch. f. Anat. u. Physiol. (*His and Braune*) 1885, pp. 112–9.

Stillson, J. O.—See M'Calla, A.

Stowell, C. H.—A Microscopic Geissler Tube with Fluorescent Solution.
[By Dr. A. Y. Moore—1/50 in. in diameter by 1/2 in. in length. Platinum wires are soldered into the ends, and the tube contains rarefied air. Around the tube is a fluorescent solution. Mounted in a wooden slide 3 × 1 × 3/8 in. "It is the very latest and handsomest production brought before the Microscope world."]
The Microscope, V. (1885) p. 41.
See also *Journ. New York Micr. Soc.*, I. (1885) p. 26.

Taylor, F. W.—See M'Calla, A.

Thurston, E.—On Bacteria and the methods of staining them.
[First demonstration of the 3rd series. Cf. *supra*, p. 362.]
Journ. Quek. Micr. Club, II. (1885) pp. 121–4.

Vorce, C. M.—See M'Calla, A.

Waller, T. H.—Presidential Address delivered March 4th, 1884.
["A sketch of some of the subjects relating to geology which have given an interest to the past year . . . confined to points which have a bearing on the chemical and microscopic side of the science."]
Rep. and Trans. Birm. Nat. Hist. and Micr. Soc. for 1883, pp. i.–xviii.

Whitney, J. E.—Cheap Punches for Sheet Wax.
["Get a set of brass ferules, and with a round file bevel the large end to a cutting edge, which is easily done, and you will then have a set of punches adapted to making wax rings of sizes corresponding to all the ordinary sizes of cover-glass."]
Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, p. 215.

at 2900 metres on the Aletsch glacier, a bacillus and micrococcus, a mildew spore and torula were found; omitting these last as not being microbes properly so called, there was an average of 1 per cubic metre. Out of 3000 litres taken at 3340 metres on the Col du Théodule a *Bacterium termo* and a mildew spore were found, or one microbe per 3 cubic metres. On the Niesen out of 600 litres of air taken during rain, snow, and intense fog a minimum of four microbes (without counting mildew spores) was found. In a second trial out of 1725 litres four bacteria were found. The abundance of microbes here is explained by the fact that the observations were taken during hay-making and by the presence of bacteria in the soil.

Experiments made at lower levels were as follows:—Near the Eggischhorn Hotel at 2193 metres above the sea, out of 110 litres a *Penicillium* and three species of *Bacillus* were found, or at least 30 germs per c. m. At Zermatt (1620 metres) 100 litres gave a *Bacillus subtilis* and a mildew spore. A room in the hotel near the summit of the Niesen gave an average of one bacillus to 7 litres of air. At Gurten, near Bern, at an elevation of 323 metres above that town, no germs were obtained: whilst at Bern itself 444 and 250 microbes per cubic metre were taken.

The conclusion drawn from the experiments is that the purity of the air of mountains is much greater than has been supposed, and is only surpassed by sea air. This purity is owing (1) to the progressive disappearance of bacteria-producing centres; at the zone of eternal snow the absence of these centres is complete. 2. To the diminished density of the atmosphere, which becomes less and less capable of sustaining long in suspension the microbes it contains; at the same time the foreign particles are more diluted by the very fact of this decreased density, the space occupied by a given volume of air from the plains augmenting with the altitude.

MICROSCOPY.

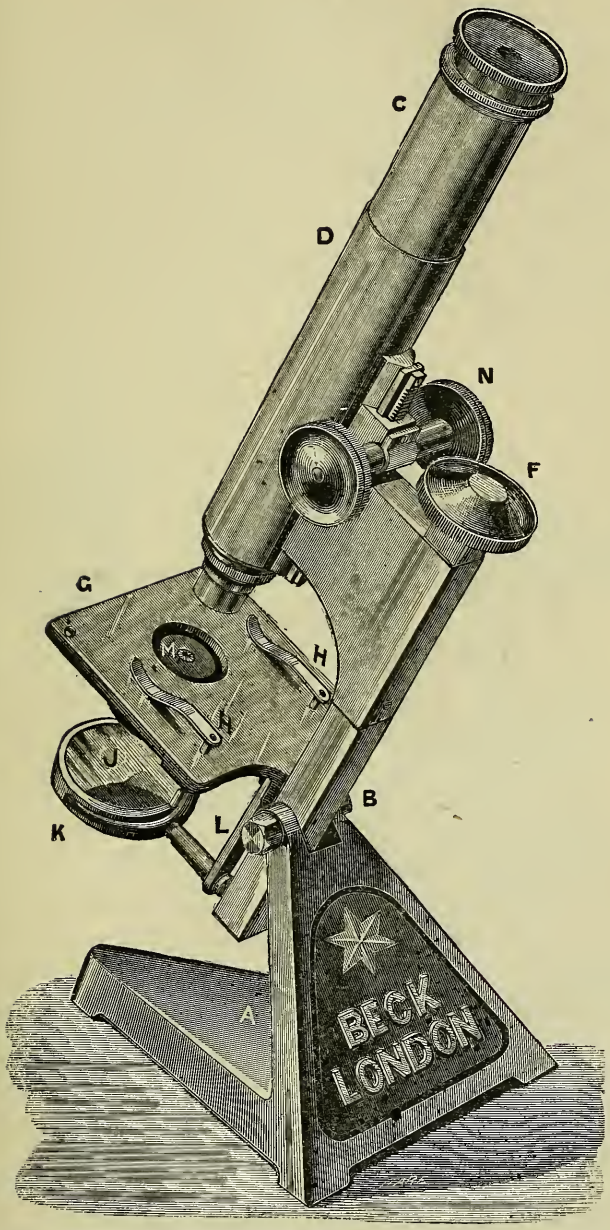
a. Instruments, Accessories, &c.*

Beck's "Star" Microscope.—In the construction of this Microscope (fig. 99) Messrs. Beck appear to have reduced the cost of an efficient instrument to its very lowest limits, 3*l.* 3*s.* only being charged for it, including a 1 in. and 1/4 in. objective, which, it is claimed, "are accurately worked, purely achromatic, and thoroughly suited for scientific research."

The Microscope is nickel-plated throughout, with the exception of the base, which is solid in design, and contrived so that the instrument is steady in every position. It is made in two forms, with a sliding or a rack-and-pinion coarse adjustment.

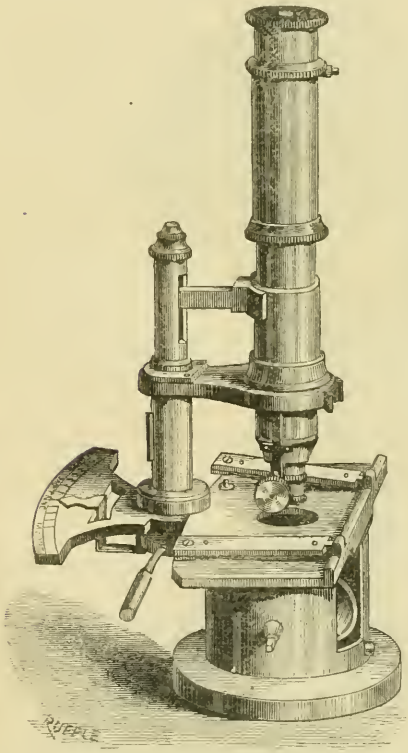
* This subdivision is arranged in the following order:—(1) Stands; (2) Eyepiece and Objective; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

Fig. 99.



The foundation of the stand is a solid cast-iron base A, having at its top a hinge-joint B, which allows the instrument to be inclined at any angle, and is sufficiently firm to permit of its being placed horizontal for use with Wollaston's camera lucida. The body D has a draw-tube C, with coarse and fine adjustments at N and F. The stage G has two springs H H, the pins attached to which may be inserted in any of the four holes on the stage, and by their pressure (which can be varied by pushing them more or less down) will hold the object under them or allow it to be moved about with the greatest accuracy. The mirror J, besides swinging in the rotating semicircle K, is attached to a bar L, with a joint at each end allowing a lateral movement, so as to throw oblique light on the object. An iris diaphragm M, in which the size of the aperture is varied by revolving it in its fitting, screws into the under surface of the stage, and can be removed when other substage apparatus is required.

Fig. 100.



Class Microscopes.—M. Nachet's instrument (fig. 100) is an attempt to cope with the mischievousness of youth, whose eccentricities are liable to invade even the domains of Microscopy.

All the adjustable parts are locked by a removable "key," the large milled head of which is shown near the objective. Thus the eye-piece is fixed so that it cannot be moved; the body-tube can only be raised or lowered by the application of the key to a pin at the top of the pillar (concealed by the ornamental cap, which is unscrewed); the objective is rendered immovable by the same means, the key acting on a screw which passes through the projecting piece, whilst the mirror has no milled heads to the axis, and can only be turned by the key. The slide is fastened down by two bars, one of which is shown slightly raised in the figure.

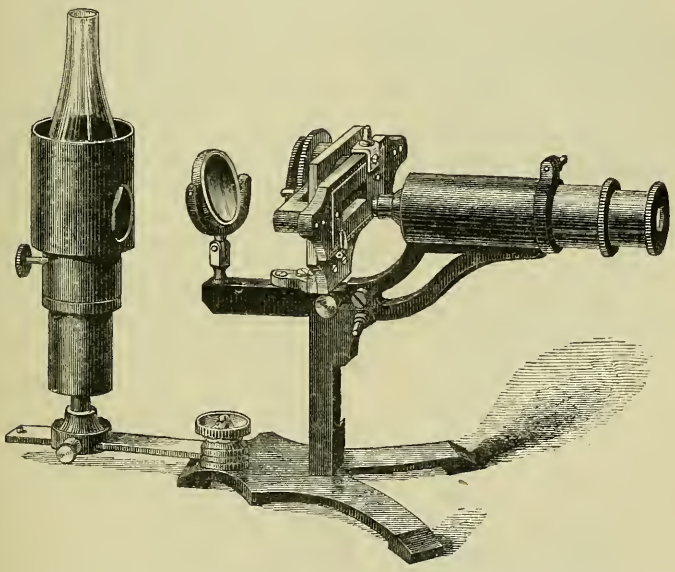
The only part left free is the fine adjustment, which is effected by turning the handle seen at the base of the pillar, which slightly raises or lowers the body-tube. An index shows the extent of move-

ment on a graduated arc with ten divisions, which is marked "Vue presbyte," "Vue moyenne," and "Vue myope."

We believe that the Microscope, though perfect as regards the manner in which it carried out the mechanical part of the problem, was not found in the result to accomplish all that was desired. The very fact of such an attempt being made to restrain the practical jokes of the students ("les barbares d'élèves") only served to quicken their determination not to be thus baffled, and improvised "keys" soon left matters in a worse condition than if no such means had been adopted in the first instance.

Messrs. Murray and Heath's Class Microscope (fig. 101) has similar arrangements for locking the parts liable to be disturbed.

Fig. 101.



The body-tube is locked by a pin near the top of the socket in which it slides, the fine adjustment being effected by the eye-piece. The slide is placed in a shallow box, which can be locked in the same way. The box, which is movable on the stage, can be fixed when desired by two screws beneath the stage also set fast by the key. A fourth locking arrangement in the limb fixes the Microscope in a horizontal position.

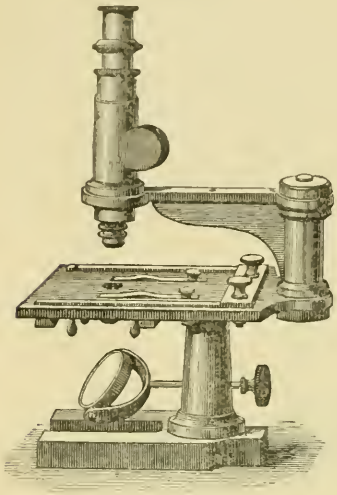
Giacomini's Microscope with large Stage.*—Herr Schieck has already devised a Microscope † with a large stage to meet the wants of observers who have to deal with large sections. The stage is

* Sep. Repr. Giorn. R. Accad. Med. Torino, 1883, fasc. 6, 8 pp. and 2 figs.

† See this Journal, ii. (1882) p. 673.

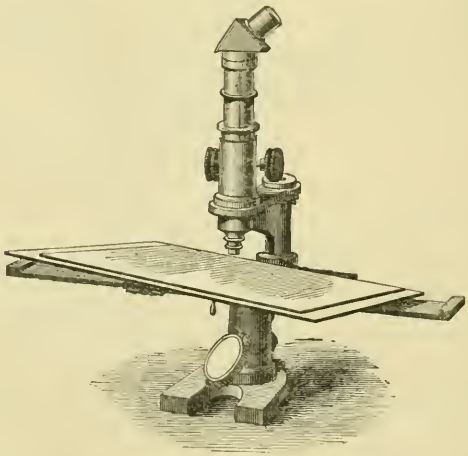
enlarged to 11 cm. in width, and in addition four arms 4 cm. long can be extended when desired from the sides of the stage.

Fig. 102.



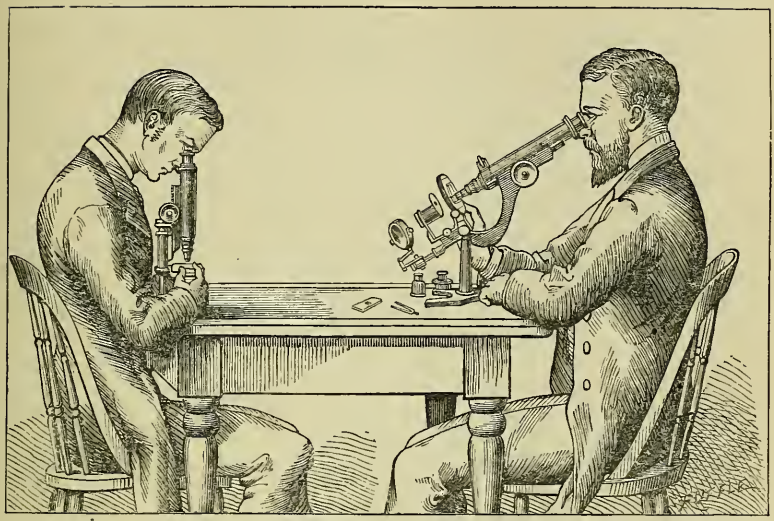
For the purpose of examining sections of the entire human brain Prof. C. Giacomini has constructed the Microscope shown in figs. 102 and 103, which appears to be practically identical with Schieck's. The pillar supporting the stage is in its normal position, and the aperture in the stage is retained at a short distance (4·5 cm.) from the front edge of the stage, so that there is no such obstruction of light as would take place if the aperture (and with it the mirror) were placed further back at the centre of the enlarged stage. The pillar, however, which carries the arm for the body-tube is moved much further backwards, so as to leave a distance of 15·5 cm. between it and the stage aperture. The stage is therefore 20 cm. from back to front, and its width can be increased so as to take slides up to 34 cm. by attaching to it the two supports shown in fig. 103, on which the ends of the slide rest.

Fig. 103.



As there is some inconvenience in leaning over the instrument to reach the eye-piece, an Amici prism is used to divert the rays at an angle of 30°.

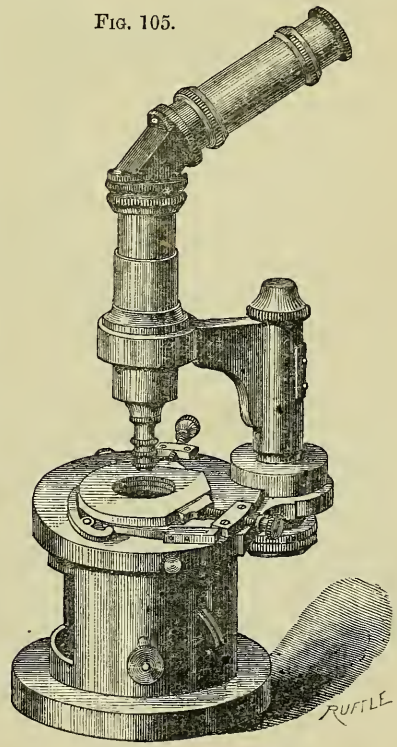
Fig. 104.



Microscopes with Bent Body-tube.— It is generally admitted that a vertical position of the Microscope is a very inconvenient one for the observer, and that an inclined position is in every way preferable. The late Mr. C. Stodder illustrated this by the drawing reproduced in fig. 104.

On the other hand, there is no doubt that in a large proportion of laboratory researches the conditions of observation with objects in fluid necessitate the stage being maintained in a horizontal position. The two conditions, however, of an oblique body-tube with a horizontal stage can well be reconciled by the plan originally suggested by M. Nachet, of inserting a truncated equilateral prism in the body-tube, as shown in fig. 105. The upper part of the tube above the prism being inclined, the observer is relieved from the discomfort which long obser-

Fig. 105.



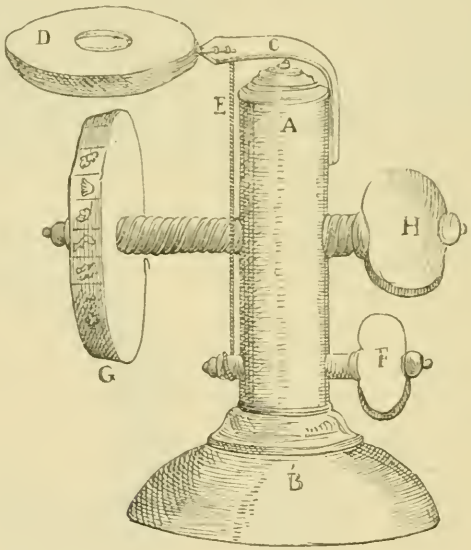
vation with the vertical tube entails upon the muscles of the neck.

The prism, unless badly made, does not interfere with the definition of the objective, even when used upon *Amphipleura pellucida*.

The same prisms were adopted by M. Nachet in his double-bodied Microscope for two observers.

Old Italian Microscope.—In a pamphlet in Italian entitled 'Nvove inventioni di tubi ottici dimostrate nell' Accademia Fisico-matematica Romana l'anno 1686' (19 pp. and 3 pls.), which concludes with the signature of "Carlo di Napoli Dottor nell' vna, e l'altra Legge Prosecretario," several quaint forms of Microscopes and telescopes are described. One of the most curious of the Microscopes is that shown in fig. 106 (reduced from the original fig. to about 2/3 size.)

Fig. 106.



The speciality of the instrument consists in two points. (1) The objects are placed round the circumference of a wheel which has two motions; one on its axis for bringing the different objects under the lens, and a second motion of the whole wheel laterally by rotation of its screwed axis, by which means all parts of the objects can be observed by the lens. (2) The adjustment for focus is effected by the very primitive device of fixing the lens at the end of a spring, to which a cord is also attached. On winding up the cord on a screw peg, the spring is bent and the lens brought closer to the object. On reversing the motion the spring is relaxed again and the lens withdrawn.

The following is a translation of the description as given in the original text:—

"More ingenious still was the next invention shown in figure 5 [fig. 106] in which A B is a stand of wood: C is a bent iron spring, carrying the ring D in which is inserted the lens: E is a thin string, which causes the spring C to move upwards or downwards by means of a small peg F on which it is wound. The objects are placed around the circumference of a disk G which is attached to a screw-peg H, by which the object is adjusted perpendicularly under the lens D."

The writer of the pamphlet does not give the name of the inventor of the Microscope, but he refers to this and other models in terms which suggest that he had had some experience with them. It is of interest as being the earliest example of a drum-carrier for a number of objects, and therefore in this respect displaces Winter's "Revolver" Microscope described in Vol. IV. (1884) pp. 114–5. In view of the extreme improbability of ever meeting with one of these instruments we have had one constructed closely to the original. If it survives to a later age this notice may serve to prevent its being accepted by posterity as a genuine model, a mistake which the imitative skill of the workman has rendered possible even at this period.

Müller's Insect-catcher with Lens—Insect-cages.—Herr P. Müller has designed * the instrument figs. 107 and 108 to serve the double purpose of catching and observing insects.

It consists essentially of a glass tube having at one end a lens, and inside, close to the focal point, an adjustable mica-plate. A plug is passed up the tube, on which the insect is brought to the focus of the lens. A conical catcher at the opposite end of the tube serves for catching the insect, and can be used as a stand during observation with the lens.

The lens *b* is attached to the glass tube *a*, the inner surface of which is ground as far as *a*—*β*. At *d* is the mica-plate, between the spring rings *c c*, and at *e f* is the catcher.

The following is translated verbatim from the inventor's specification:—

"In use the instrument is taken with two fingers by the ring *f*, and quick as lightning placed over the insect to be caught, whether it is on level ground, on a hedge, or on the side or top of a wall. With skill and the necessary caution the capture is generally successfully effected. It is still more certain if the insect happens to be on an accessible leaf, blade of grass, twig, or flower. In such a case the insect-catcher is held in the way described, and cautiously brought near to the insect. At the same time the open left hand is brought near the insect from the opposite side, and as soon as the capture seems certain the funnel and the hand are brought together over the insect. All the different kinds of flies, gnats, moths, and such others as seek the light will quickly be seen in the illuminated glass tube, from the top of which they will seek to escape. The plug *h* is now

* Specification of German Patent, 6th June, 1883, No. 25,806.

quickly pushed up the tube, as shown at fig. 108, the end of the tube being closed meantime with the thumb. The captured insect by this means can be confined to the field of view, and all its movements can be conveniently observed in all weathers. The size of the insect

Fig. 107.

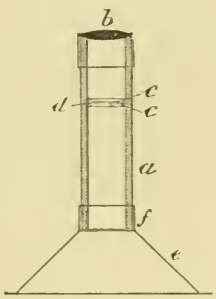
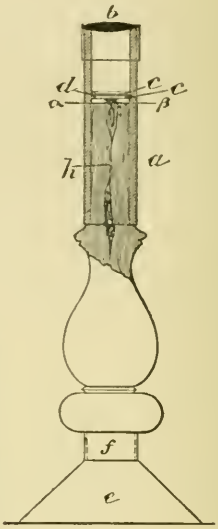


Fig. 108.



can also be determined by a divided scale on the top of *h*. By this process of capture the delicate wings and antennæ, and the fine dust and hairs are not injured, as the captive insect is neither held in the fingers, nor killed, nor pierced through. Shy insects, and those that do not readily escape, as beetles and caterpillars, as well also as spiders, can be knocked from the plant into the funnel by the plug.

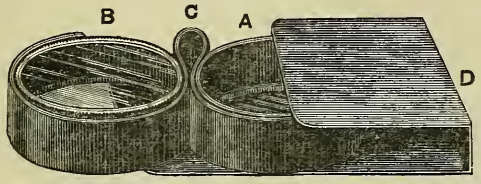
It may be here remarked that the roughening of the inside of the tube *a* is intended for those insects which have no hooks on their feet, to crawl up more easily. Should it happen that, in spite of this, these animals will not move up the tube, it must be held with the eye-piece down and the insect shaken into the tube. After the insertion of the plug the funnel is put on the lower end to serve as a foot to the instrument."

The patentee further says that what distinguishes his apparatus from all others is the following contrivance:—"After observing the captive insect in all its parts from above, it can be observed from the under side, by simply turning the apparatus upside down, so that the insect lies on its back on the mica-plate. If the space is increased by withdrawing the plug slightly, and so giving the insect more room for moving, it immediately turns itself over and stands upon its feet. If the plug is again pushed in as far as *α*—*β*, and the apparatus turned with the eye-piece upwards, in a few moments the observer is in a position to examine the insects on the under side. This alternate observation can be repeated at will. If the insect is restless, the mica-plate need only be pressed a little closer, in order to hold it very gently. The space above the plug is adjusted to the size of the insect by moving the ring *c c* up or down. In order to avoid having

to repeat the adjustment of the mica-plate it is advisable to catch a number of large or a number of small insects at a time, which is not difficult to arrange, considering their immense numbers and variety."

An insect-cage supplied to us by Messrs. Beck is shown in fig. 109. It consists of four parts. A is a ring, open at the bottom but closed

Fig. 109.



at the top by a glass plate, and having an aperture on one side. B consists of two rings similar to A, one sliding within the other and forming a box. Small insects can pass into the box through apertures in each of the rings, but this can be closed at pleasure by revolving one of the rings on the other. C is a frame into which A and B are placed, and having also a hole through the centre divisions.

A and B being in position in the frame C, and the apertures arranged so that there is a passage from the one box to the other, A is placed over an insect which it is desired to secure for observation. The bent brass plate D is then slipped under it so that A is in darkness and B in the light. The insect will then pass from A to B which can be removed for examination, the aperture being closed by rotating the rings.

If the box B were arranged, as could easily be done, so that the space between the top and bottom could be reduced to suit the size of different insects, we think the apparatus would be decidedly superior to that of P. Müller as it could then be placed on the stage of a compound Microscope and any mode of illumination could be used, transparent as well as opaque.

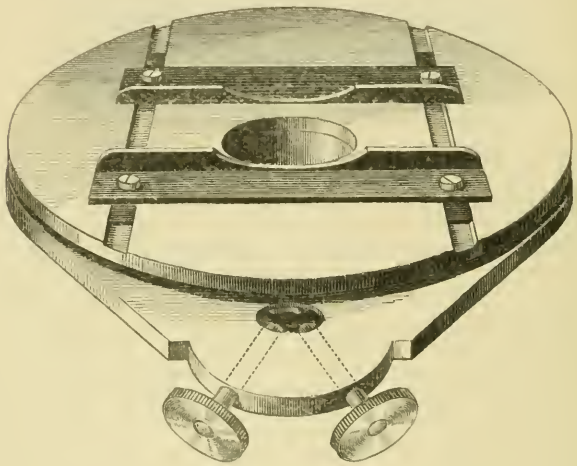
A somewhat similar contrivance was suggested by Mr. F. N. Tillinghast * to obviate the difficulty of introducing a third or even a second insect into a box without letting one of those already caught escape. It consists of a box divided into two compartments of unequal size by a sliding division, the end of the larger compartment being of glass. The new capture is placed in the smaller compartment and the lid of the box being closed the slide is withdrawn and the insect, observing the light through the glass of the larger compartment, passes into it. On again closing the slide the box is ready to receive further supplies.

Tolles's Centering Stage.—The stage shown in fig. 110 was found among the effects of the late Mr. R. B. Tolles after his death, and is an example of one of the many efforts made by him to improve the mechanism of the Microscope. It was apparently devised to meet

* Amer. Journ. Micr., vi. (1881) pp. 133–4 (2 figs.)

the demand for an inexpensive form of rotating stage with means for centering the motion exactly in the optic axis. The upper plate is fitted to rotate on the lower one, and the latter is attached to the standard or limb by the excentric opening shown. The screws enable it to be adjusted so that the rotation of the upper plate will be concentric with the optic axis.

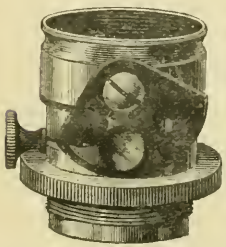
Fig. 110.



Such a system of centering must, we think, render the attachment of the stage too unstable, which probably accounts for the fact of Mr. Tolles not having further perfected it.

Diaphragms for Beck's Vertical Illuminator.—The diaphragms suggested by Mr. Tighlmann* for the vertical illuminator were found inconvenient in use as the force required to revolve the ring which carried them rendered the apparatus liable to displacement.

Fig. 111.



Messrs. Beck now supply the illuminator with the diaphragm shown in fig. 111. There are two apertures, the smaller one being circular and the larger one the shape of a broad crescent. The latter gives many varieties of form when moved laterally in front of the fixed circular opening in the cylinder.

In using the vertical illuminator with such objects as *A. pellucida*, we have obtained the best results by applying a narrow slot diaphragm to one of the small

* See this Journal, i. (1881) p. 941.

openings in the circular disk of apertures supplied by Powell and Lealand with their illuminator.

Stephenson's Immersion Illuminator.—Fig. 112 shows the general appearance of this illuminator, of which a diagram only was given *ante*, p. 208. There are two sets of diaphragms, one on a vertical revolving disk, and the other on a horizontal sliding plate, intended for the higher and lower apertures respectively.

Fig. 112.

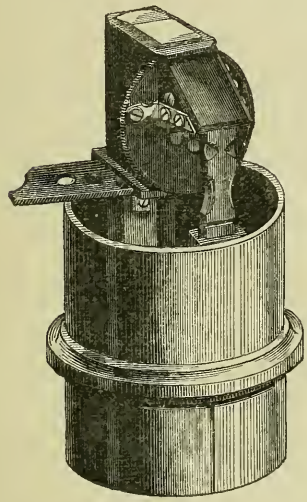


Fig. 113.

West's Adjustable Dark-ground Illuminator. — In the cabinet of the late Mr. F. L. West, optician, of Cockspur-street, W., we found the dark-ground illuminating device shown in fig 113.

It consists of a plano-convex lens through the axis of which a hole is drilled to receive a socket with an internal screw. In the socket is a steel rod carrying a disk of thin metal, which lies over the plane surface of the lens. According to the distance of the disk from the lens more or less of the central rays are shut off. The rod is supported on a pivoted arm similar to that ordinarily used for Darker's wells.

Mirror Diaphragms.—In Dr. J. E. Smith's 'How to see with the Microscope' (p. 53), a reference is made to "slot diaphragms of different widths, covering the whole surface of the mirror, and only allowing light to pass through the slot in such a direction that very sharp shadows by oblique light will be produced." A mirror diaphragm of this kind has been sent us by the Bausch and Lomb Optical Co., and is shown in fig. 114. It is made of ebonite and fits as a cap over the concave mirror, the ebonite being moulded concave

so as to come nearly in contact with the glass surface. It would, we think, be preferable that the ebonite diaphragms should be flat so as to be applied to either side of the mirror.

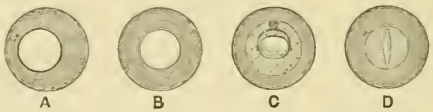
The suggestion of applying diaphragms to the mirror is a revival of a plan adopted towards the end of the last century by Dellebarre. He made disks of thin metal with circular apertures of different sizes to be applied as caps over the plane or concave surface of the mirror, being held in position by three angle-pins projecting from the periphery.

Fig. 114.

Centering the Illuminating Beam.*—Mr. J. W. Queen points out that it is a practical point of much importance in the use of the Microscope to have strictly central light. To secure this he is accustomed to pursue the following plan :—

Having the object in place and lighted from the mirror, the objective screwed on, and the eye-piece in the tube, first focus. Then remove the eye-piece, and applying the eye centrally to end of the body-tube, notice the spot of light at the back of the objective. It may appear as in A, in which case move the mirror or diaphragm, or both, until the illuminating beam appears central, as in B. If now the lens is a good one, properly adjusted, and the inner circle of B presents an evenly illuminated disk, a good, sharply defined image should be obtained. But there may not be light enough, or there may be too much, in which case a diaphragm of different size should be used, or its distance from the object varied, thus varying the angular size of the illuminating pencil. If the diaphragm be too large or placed too near the object, it ceases to affect the angular size of the illuminating

Fig. 115.



beam (although it may act in another way), and in this case the image of the mirror is seen within the circle of the diaphragm, as at C, if the objective is of sufficient aperture.

If lamplight be used, the image of the flame may be seen within the disk of mirror and diaphragm, as at D. This shows that the beam is not focused upon the object. This may be remedied by the use of a condenser placed near the source of light, making parallel the rays falling on the mirror, or simply by altering the distance of the mirror

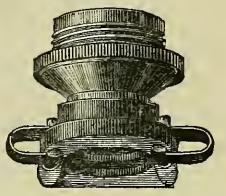
* Micr. Bulletin, ii. (1885) p. 1 (4 figs.).

from the stage. In some cases, however, the mirror is not of the right focus and the latter course cannot be adopted. The appearance should be like B as nearly as possible.

Many objectives have front lenses much larger than is necessary. This is a real detriment, for light is admitted by the outer zone, which has nothing to do with forming the image; and although it does not reach the eye directly, yet it is reflected again and again from the various lens-surfaces of the objective, forming a haze. Gundlach, in some of his recent objectives, evidently recognizing this fact, turns down the lens-front to the mere size actually used. Where the working distance is sufficient, a diaphragm cap would effect the same purpose. Upon this principle also is the action of a substage diaphragm of suitable size (about the size of the field). Especially is it frequently the case with lenses of large aperture and short working distance that only a small proportion of the front surface is used.

Bertrand's Adapter Nose-piece.—This adapter was devised by M. E. Bertrand, now Secretary of the Académie des Sciences, Paris, to facilitate the rapid change of objectives. It consists of a short tube having an internal thread to screw on the ordinary French nose-piece; the tube extends below in a broad thick flange, on either side of which is a U-shaped spring. The under surface of the flange is cut out slightly in front to permit the entry of a shallow flange-ring, with which each objective is furnished in place of the usual screw. The flange-ring on the objective slides between the adapter and the springs, and to insure correct centering, a short collar on the upper face of the flange is pressed by the springs into a corresponding cylindrical hollow in the adapter.

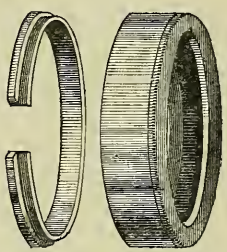
Fig. 116.



This system of adapter does not appear to have been devised for general use, but only for the series of objectives used with M. Bertrand's Petrological Microscope.*

Rings for throwing the Coarse Adjustment out of gear.—Messrs. Beck now supply the rings shown in fig. 117 for preventing the inadvertent use of the coarse adjustment at soirées, &c., when an object is being shown with a high power. It consists of a cut ring with a screw-thread which is passed over the axis of the milled heads of the coarse adjustment, and a second deeper ring, also with a screw thread, which fits over the milled heads, and to which the cut ring can be screwed. The deep ring has on its outer side a flange which forms with the inner circumference of the cut ring a deep groove rather wider than the milled head. This prevents the ring from being moved laterally, whilst at the same time it fits loosely

Fig. 117.



* See this Journal, iii. (1883) p. 413.

over the milled heads, and if the hand is inadvertently applied to it, it revolves freely without acting on the milled head, and the object is thus saved from destruction.

Messrs. Powell and Lealand are the designers of two earlier forms which have been in use some years (figs. 118 and 119). The former is identical in principle with that just described, the only difference being that the cut ring is broad and substantial, which obviates the liability to "spring," unavoidable in the case of a thin ring.

Fig. 118.

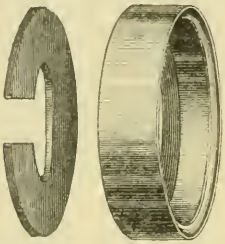
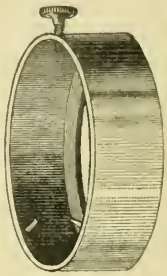


Fig. 119.



Their still older form (fig. 119) has the deep ring only, which has two pins and a screw projecting inwards. When the latter is withdrawn the ring can be slipped over the milled heads, and when screwed home the ring is prevented from slipping off, but revolves freely, as in the other forms.

Fabre-Domergue's Current Apparatus.*—M. P. Fabre-Domergue suggests the following apparatus, as not possessing the inconvenience of monopolizing the Microscope and rendering "all other observation impossible if only one instrument is at our disposition."

A metal plate 4 cm. by 15 cm., with a central aperture, is placed on the stage. One end projects 4 cm. beyond the stage, and supports a small cup of water at the level of the stage. The other end is bent twice at a right angle, and the horizontal portion supports a second cup, about 1 cm. below the stage. Two threads keep up the communication between the cup and the object in the centre. When not under observation the plate can be removed from the stage, and replaced without disturbing the preparation or interrupting the current of water.

Moist Chamber.—A simple moist chamber can be made by cutting a piece of thick rough cardboard to the size of the slide, and punching out a circular hole in the centre of such a size as to be covered by a cover-glass. The piece of cardboard is then soaked in water (or boiled in water when pure cultures of fungi are to be made) so as to saturate it, and placed on the slide. The object is immersed in a drop on a cover-glass, and the latter inverted over the hole in the

* Bull. Soc. d'Hist. Nat. Toulouse, xviii. (1884) pp. 162–3.

cardboard in the usual way. Any loss from the chamber by evaporation is prevented by occasionally wetting the cardboard on the slide.*

Arrangement of the Micro-spectroscope.†—Dr. C. A. MacMunn uses for the researches recorded *supra* p. 429 a binocular Microscope provided with a substage achromatic condenser, to which are fitted two diaphragms. The objectives are so adapted as to enable both fields to be fully illuminated when any power up to 1/8 in. is used. The left-hand tube is used as a "finder," and as a means of getting any required portion of the object into the centre of the field so that its spectrum may be obtained in the spectrum eye-piece of the right-hand tube. In this way the various portions of a very small piece of tissue or organ may be readily differentiated from each other, and their spectra observed. By the use of the iris diaphragm, which is placed below the substage condenser, the marginal part of the field can be readily cut off. A compressorium is indispensable to squeeze out the sections thin enough to allow the spectrum to be observed.

Examining the Spectrum of Chlorophyll.‡—Mr. F. O. Bower and Dr. S. H. Vines recommend the following as a convenient method of examining a solution of chlorophyll spectroscopically.

The tube of the Microscope is withdrawn and replaced by a glass tube, the bottom of which covers the opening of the stage; the sides of the tube being rendered opaque by wrapping round them a sheet of black paper. The solution is then poured into the tube and into the opening of the latter a microspectroscope is introduced. Light is then reflected on to the bottom of the tube by the mirror. The advantage of this method is, it is said, that it enables the observer to vary the thickness of the layer of the solution to be examined.

Multiplying Drawings.§—Mr. C. M. Vorce calls attention to the ferro-prussiate process for this purpose. Let the camera-lucida drawing be made with good black ink directly upon tracing-paper placed over white paper, or it may be drawn on white paper and carefully traced on tracing paper. In either case, when dry, gum the tracing paper on a sheet of clear glass, with the drawing next the glass; it may then be printed from as an ordinary negative, and any lettering will be produced in its proper position. With suitably prepared ferro-prussiate paper in clear sunlight it prints quicker than an ordinary gelatine negative; from 10 to 15 seconds will suffice for well-made drawings on clear paper. The copies are thus made very quickly in any number, and are rinsed in water, and dried much more quickly than an equal number of silver prints could be toned and fixed. Fine details are well reproduced.

As the plan proposed by Mr. Vorce does not dispense with the necessity of camera-lucida drawings, which seems to be a desideratum,

* Bower and Vines's 'Course of Practical Instruction in Botany,' 1885, p. 16.

† Proc. Physiol. Soc., 1884, No. 4. See Nature, xxxi. (1885) pp. 326–7 (1 fig.).

‡ Bower and Vines's 'Course of Practical Instruction in Botany,' 1885, p. 42.

§ Amer. Mon. Micr. Journ., v. (1884) pp. 207–8.

Mr. R. Hitchcock suggests that instead of making a camera-lucida drawing, a negative should be taken from the object, and a blue print made on the ferro-prussiate paper. The drawing may then be traced from that on the tracing-paper, which would doubtless be a better plan for those who cannot use the camera well; but the following plan is even better. Coat very thin and transparent paper with the ferro-prussiate solution, and print from the negative upon that. Then draw the outlines and necessary details on the print with indian ink. Having done this, bleach out the blue picture with very dilute ammonia, which will leave the paper white, with the black ink lines intact. Should there be a yellowish colour left on the paper, a little weak acid will remove it. After the paper is washed and dried, it may be spread on a flat, heated plate—a flat-iron, for example—and paraffin rubbed over it. This will make the paper transparent (like "wax-paper") and it can then be attached to a glass plate, as suggested by Mr. Vorce.

Value of Photo-micrographs.* — Mr. T. Charters White calls attention to some photographs of young tench in their eggs, as showing that the sensitive film (or "retina of science") possesses a power of discriminating greater than that possessed by the human retina, a structure quite invisible under the Microscope may become distinctly visible in the photograph. When seen under the Microscope the jelly-like envelopes were of a clear and structureless character. What, however, was clear and gelatinized under the Microscope, was in the photograph shown to be pierced by innumerable tubes which passed through the egg-cases in parallel lines.

Parallel Rays in Photo-micrography.†—Mr. W. Pumphrey calls attention to the great advantage obtained by the use of parallel rays, obtained by causing the light to traverse two apertures, placed 1½ in. from each other, interposed between the lamp and the object. By this means the intervention of a condensing lens is dispensed with, and a much finer definition obtained.

Small Negatives—Robinson's Miniature Microscopic Camera.—Dr. Roux makes negatives about the size of a sixpence, which bear enlarging to the ordinary lantern size of transparencies. These negatives go far to support what is not generally allowed—that better negatives of bacteria and very minute objects can be produced without the eye-piece, by obtaining more perfect small negatives, than by original large direct negatives. There is, of course, the additional trouble of copying and enlarging; but this must not be a hindrance when seeking for the best work.

The plan adopted by Dr. Roux, intended to meet rapid laboratory work, is to fix a small camera or cell to the eye-piece end of the Microscope, containing a little gelatino-bromide plate, the position of the focus and the image having been previously determined by placing a piece of plain glass in the slide, and on its upper surface a

* Photogr. News, xxix. (1885) pp. 179–80 (2 figs.).
† Midl. Natural., viii. (1885) p. 113.

few insect scales. These are brought into focus by a low-power objective used as a focusing-glass, and the image of the object on the stage of the Microscope and the image of the scales are made to coincide. Hence, by withdrawing the little camera and inserting the focusing objective, the focus of any object on the stage can be made to occupy the exact position of the scales on the transparent glass. In other words, the focus of these and the new image are coincident, and, the surface of the plate falling exactly in the same plane, there can be no error through the different thickness of the glass-plate.

The miniature camera of Messrs. Robinson is well suited for taking such negatives as those recommended by Dr. Roux. It is only 3 in. by $2\frac{1}{2}$ in.

Dr. H. Van Heurck * also describes a very small mahogany camera, extremely light, receiving at its posterior part a gelatino-bromide plate of $4\frac{1}{2}$ cm. by $5\frac{1}{2}$ cm. Anteriorly the camera carries a copper tube $5\frac{1}{2}$ cm. in length, terminated by a Zeiss amplifier. The copper tube enters the tube of the Microscope a short distance.

Amphipleura pellucida and the Diffraction Theory. — The photographs of this diatom recently made by Dr. Van Heurck have given rise to some discussion, and some of those who do not admit the reality of the beaded appearance shown by the photographs, claim to rest their view on the Abbe diffraction theory.

This shows that some misconception exists as to the application of the theory, which does not establish, as supposed, that all appearances of minute structure with high powers are wholly illusory and do not correspond to any physical structure. On the contrary, the images shown by the Microscope are all, in fact, caused by real structural peculiarities of the object observed. Thus in the case of the "beads" of *A. pellucida*, the existence of such an image proves that the diatom has not merely a periodic differentiation of structure in one direction, but that such differentiation exists in two directions which cross at right angles.

What the diffraction theory shows is that the *real* form and structure of the beads cannot be determined by the mere inspection through the Microscope of their images. The Microscope leaves wholly undecided the question whether they are elevations, or depressions, or simple centres of thickening in the substance of the valve, resulting, it may be, from the intersection of two siliceous layers, the densities of which vary periodically.

* Amer. Mon. Micr. Journ., vi. (1885) pp. 42–5.

"A Binocular M.D."—See Monocular v. Binocular.

Abbe Condenser.

[Zentmayer's simplified mounting. *Post.*]

Amer. Mon. Micr. Journ., VI. (1885) p. 84 (1 fig.).

Abbe, E.—See Heurck, H. van.

B.Sc.—See Monocular v. Binocular.

Banks, C. W.—**Slides of arranged and isolated Diatoms.**

["By J. C. Rinnbock of Vienna, who probably has no living equal in the production of these marvels of exquisite taste and manipulative skill. With marvellous patience, hundreds of diatoms are arranged on a glass slide in patterns of wonderful beauty. In the slides exhibited Mr. Rinnbock has introduced a novel feature by combining in the same pattern with the diatoms butterfly scales of various hues, and also the plates of *Holothuridæ*. By a happy combination of these varied forms and by taking advantage of the brilliant chromatic effects produced by many diatoms when viewed with low powers, Mr. Rinnbock has produced slides which, under the Microscope, blaze like a kaleidoscopic arrangement of resplendent gems."]

Proc. San Francisco Micr. Soc., Feb. 25th, 1885.

Bates, C. P.—**Warm Stage.** [*Post.*]

Proc. San Francisco Micr. Soc., March 25th, 1885.

Breckenfeld, A. H.—**Graduated Glass Modifier.**

[Consists of a disk revolving upon an adapter under the stage. It is "flashed" from clear glass to dark blue, and one-half of its surface being lightly ground, any desired tint of field may be obtained, from white to deep blue, either transparent or translucent, by merely revolving the disk.] *Proc. San Francisco Micr. Soc.*, March 11th, 1885.

See *Engl. Mech.*, XLI. (1885) p. 187.

Cox, C. F.—**"What is a Microscopist?"**

[Detailed protest against the remarks under this title, *ante* p. 333, "on the ground that instead of keeping to a true estimate of the scientific spirit, they set up narrow and exclusive standards, and are essentially and offensively personal," and editorial rejoinder.]

Science, V. (1885) pp. 205–6, 209–10.

D'Agen, F.—See Monocular v. Binocular.

Enal.—See Monocular v. Binocular.

Exner, S.—**Ein Mikro-Refractometer.** (A Micro-refractometer.) [*Post.*]

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

Fabre-Domergue, P.—**Note sur une nouvelle platine mobile et sur l'emploi de "finders" comparables pour faciliter les relations des micrographes entre eux.** (Note on a new movable stage and on the employment of finders to facilitate the intercommunication of microscopists.)

[Describes the Maltwood finder, also suggests the following as a very simple and inexpensive movable stage which is mostly wanting in French Microscopes, and without which the Maltwood finder cannot be used:—Two glass plates 130 mm. by 35 mm. have a central aperture 25 mm. in diameter. Their two ends are cemented to two strips of glass 35 mm. by 5 mm., leaving between them a space equal to the thickness of the strips, about 2 mm. On the left of the top plate is cemented an elbow piece for the slide to butt against. The space between the two plates serves for the springs which by a simple pressure immobilize the apparatus.]

Bull. Soc. D'Hist. Nat. Toulouse, XVIII. (1884) pp. 148–51 (1 fig.).

Foulis.

["Demonstration of the circulation in the web of a frog's foot and of some botanical test objects by means of the oxyhydrogen light. The light, transmitted through a powerful condenser, passed through an ordinary Microscope lens, and was thrown upon a large plate of ground glass at a distance of about 25 feet. The image of the object demonstrated could be focused on this plate with great exactitude, the definition even with high powers being excellent, and the general effect strikingly satisfactory."]

Engl. Mech., XLI. (1885) p. 255.

GUNDLACH, E.—**The Examination of Objectives.** (*In part.*)
Micr. Bulletin (*Queen's*), II. (1885) pp. 14–5, from *Amer. Journ. of Micr. for* 1877.

HEURCK, H. VAN.—**Les Perles de l'*Amphipleura pellucida*.** (The Beads of *A. pellucida*.)
[Note read at Meeting of 11th March, *ante*, p. 380. With opinion of Prof. Abbe.]
Journ. de Microgr., IX. (1885) pp. 129–31.

„ „ **La 'Rêtine de la Science.'** (The Retina of Science.)
[Reply to criticisms of M. Van Ermengem on photographs of *Amphipleura*—also quotations from S. T. Stein and T. C. White, *supra*, p. 528.]
Journ. de Microgr., IX. (1885) pp. 132–4.

[HITCHCOCK, R.]—**Microscopical Societies.**
[Notice of intention to publish a list of U. S. A. Societies.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 76 and 95.

„ „ **Microscopical Exhibitions.**
[Suggestions for improvement by showing, not a promiscuous collection, but a series of objects in their proper order to illustrate certain subjects.]
Ibid., pp. 77–8.

„ „ **Postal Club Boxes.**
[List of preparations, with remarks.] *Ibid.*, p. 78.

„ „ **Objectives for special use.** [*Post.*] *Ibid.*, pp. 95–6.

„ „ **Electric Illumination.**
[General remarks on lamps and batteries.] *Ibid.*, pp. 96–7.

HOLMES, O. W.—**Biography of R. W. Emerson.**
["In the recently-published biography of Ralph Waldo Emerson, by Dr. Oliver Wendell Holmes, reference is made to the diary he kept of his first visit to Europe, in 1833. The biographer states (p. 63) that Emerson 'visited Prof. Amici, who showed him his Microscopes magnifying (it was said) two thousand diameters. Emerson hardly knew his privilege; he may have been the first American to look through an immersion lens with the famous Modena philosopher.'"]
Engl. Mech., XL. (1885) p. 493.

KINNE, C. M.—**Presidential Address to the San Francisco Microscopical Society.**
Proc. San Francisco Micr. Soc., Feb. 11th, 1885.

KORISTKA, T.—**Norme pratiche per l' uso del Microscopio.** (Practical rules for the use of the Microscope.) 8vo, Milano, 1883, 14 pp.

LANCASTER, W. J.—**Microscopic.**
["By all means have a lengthening tube or a series of lengthening tubes, if you want to get out of a lens all that it is possible to get. I have used a two-foot tube and have obtained charming definition with some objectives, while others break down long before the two foot is reached. You must take care that the whole of the tubes are quite perpendicular to the stage, and that you have diaphragms about every 9 in. of tube, otherwise you will get internal reflection spoiling definition. If you place your Microscope in a horizontal direction, and have two supports to carry the tube, one, say, 10 in. from stage, and another 8 in. further on, then have a 3/4 in. paraffin wick-lamp as source of illumination, using thin edge of flame to stage, and dispensing with mirrors, you will have many a feast out of the lengthened body."]
Engl. Mech., XL. (1885) p. 437.

LANKESTER, E.—**Half Hours with the Microscope.**
16th ed., 142 pp. and pls., 12mo, London, 1885.

LAURENT, L.—**Sur un Appareil destiné à contrôler la courbure des surfaces et la réfraction des lentilles.** (On an apparatus for checking the curvature of surfaces and the refraction of lenses.) [*Post.*]
Comptes Rendus, C. (1885) pp. 903–5 (4 figs.).

Lommel, E.—**Ueber einige optische Methoden und Instrumente.** (On some optical methods and instruments.)

[Contains methods for determining (1) the focal length of a lens, and (2) refractive indices. Also spectroscope with internal slit.

Zeitschr. f. Instrumentenk., V. (1885) pp. 124–6 (3 figs.).

Loudon, J.—**Geometrical methods chiefly in the theory of thick Lenses.**

Proc. Canadian Institute, III. (1885) pp. 7–17 (1 pl.).

MacMunn, C. A.—[Arrangement of the Microspectroscope.]

[*Supra*, pp. 429 and 527.] *Proc. Physiol. Soc.*, 1884, No. 4.

See *Nature*, XXXI. (1885) pp. 326–7 (1 fig.).

Mayall, J., Jun.—**Nobert's Ruling Machine.**

Journ. Soc. Arts, XXXIII. (1885) pp. 707–15.

See also *Engl. Mech.*, XLI. (1885) pp. 101 and 109.

Journ. of Sci., VII. (1885) pp. 243–4.

Knowledge, VII. (1885) p. 433.

Journ. de Microgr., IX. (1885) pp. 176–8.

Monocular v. Binocular.

[Replies in favour of the former by B.Sc., Enal, and E. A. Tindall. Also remarks by R. D. R.]

Engl. Mech., XLI. (1885) pp. 88–9 and 110.

" "

[Comments on B.Sc.'s letter, *ante*, p. 335, by W. P. Oldham (pointing out the unsoundness of B.Sc.'s advice, insisting that "the binocular is a comfort, a pleasure, and a help," and protesting against the "undesirable practice of sneering at one class of observers because they do not happen to follow the particular line most favoured by another class"), by "A Binocular M.D." (supporting the binocular and the use of the Microscope "as a means to an end, and that end is the pleasure derived from the acquisition of knowledge"), and E. M. Nelson (each is best in its own department. The loss of definition with the binocular is quite inappreciable with the class of objects suitable for it), and F. D'Agen.]

Ibid., p. 132.

" "

[Remarks by F. D'Agen on R. D. R.'s letter, *supra*. "Many professional readers would be delighted to hear of a cheap Stephenson's erecting binocular with very short tubes (not having too great a slant), and fitted with two powers, one like Zeiss's variable low objective, and the other, say, about 2/3 in. . . . If this ideal Microscope could further have wood supports applied to stage (for hand rests), and be supplied at 5*l.* to 6*l.*, I may safely predict it would have an enormous sale, and would do all that any binocular can for natural history, dissection, &c. With such an instrument, and one other for high powers, the scientific worker would be completely armed. With regard to the high-power instrument, a very short monocular one is best. . . . (The binocular is not of the slightest advantage for high powers. The rest it affords the eye can as suitably be obtained by other plans without its expense and cumbrousness.) For goniometric, polarization, and spectroscopic observations a totally distinct instrument, or rather set of instruments, should be used. . . . If makers would give more of their attention to perfecting a set of instruments to suit the varying requirements of different workers at as low prices as possible, I think a decided improvement would set in. . . . I do not mean to contend that all attempts at combination are impossible, but only that such combination in the main limit, and do not extend, the advantages of the instruments so combined."]

Ibid., p. 151.

Moore, A. Y.—**Homogeneous Immersion Objectives.**

[Remarks in favour of correction collars, and as to the necessity for two fluids (for central and oblique light). Also as to a new Spencer 1/8 in which it is claimed that "the difference in both chromatic and spherical aberrations for the central and peripheral zones of the lenses has been reduced to such a small residuum that there is practically no difference."

The single fluid used with it is one devised by Prof. H. L. Smith, having an index as nearly coincident with that of the front lens as anything yet devised. Thus it will readily be seen that by doing away with one of the fluids and yet not impairing the performance of the objective, its value is greatly increased as a convenient working lens."]

The Microscope, V. (1885) pp. 73–5.

NELSON, E. M.—**Short v. Long Tubes.**

[One of the objections to a short tube is that deeper eye-pieces are required to maintain the same magnification, and there is no doubt about the disadvantage of deep eye-pieces.]

Engl. Mech., XLI. (1885) p. 132.

„ „ See Monocular v. Binocular.

"NEMO."—**Amateur Microscope Construction.**

[A serviceable plain instrument is, he considers, within the power of one who is fairly skilful at lathe and metal work, and he suggests the publication series of articles on the 'Construction of the Microscope.']

Engl. Mech., XLI. (1885) p. 127.

OLDHAM, W. P.—See Monocular v. Binocular.

"OS."—**Microscope Construction.**

[Reply to query as to making a Microscope. "The glass-work must be purchased, but a really intelligent man who can use his lathe ought to be able to make for 20*s.* that for which he would pay an optician 10*l.*"]

["Any decent amateur can construct such an instrument as a Microscope without a special series of papers other than what have appeared in the E. M."]

Engl. Mech., XLI. (1885) pp. 151 and 193.

PELLETAN, J.—**Microscope Mineralogique de M. E. Bertrand.** (Mineralogical Microscope of M. E. Bertrand.)

[Same as that described Vol. III. (1883) p. 413.]

Journ. de Microgr., IX. (1885) pp. 163–6 (1 fig.).

PUMPHREY, W.—[Apparatus for photo-micrographs and method of producing them.]

Midl. Natural., VIII. (1885) p. 113.

R., R. D.—See Monocular v. Binocular.

"ROB. CRUS."—**The Micro-objective. I., II.**

[Description of a "plan by which the amateur optician may produce a fair combination." Two plano-convex lenses with foci 2 : 1 placed with planes to object and at a distance apart equal to half the sum of their focal lengths —the shorter focus lens being a thick one. With perfectly central light the definition of thin objects is very little troubled with colour and not at all distorted.]

Engl. Mech., XLI. (1885) pp. 214 (1 fig.), 258 (1 fig.).

SEAMAN, W. H.—**Microscopical Societies and Microscopy.**

[Abstract of address at the first Annual Soirée of the Washington Microscopical Society.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 87–9, and 98.

Smith, C. Vance, death of.

["The deceased was noted for his skill in preparing vegetable tissues for the Microscope."]

Journ. of Sci., VII. (1885) p. 244.

STEINHEIL, A.—**Ueber die Bedingungen und Fehler von Objectiven aus zwei Linsen.** (On the conditions and aberrations of Objectives of two lenses.)

Zeitschr. f. Instrumentenk., V. (1885) pp. 132–6 (1 fig.) from *Astron. Nachr.*, No. 2606.

[STOWELL, C. H. and L. R.]—[Beads of *Amphipleura pellucida*.]

[Americans should bear in mind that the slide from which Dr. van Heurck's photograph was made was prepared by Dr. A. Y. Moore. "We have seen one of these photographs, and the appearance of the *beads* is unmistakable."]

The Microscope, V. (1885) p. 91.

TINDALL, E. A.—See Monocular v. Binocular.

Tyrrell, P.—**Concerning Angles.**

[Statement of his experience as to the superiority, "for histological work or anything else," of wide-angled homogeneous-immersion objectives over water-immersion.]

Amer. Mon. Micr. Journ., VI. (1885) p. 80.

Van Brunt, C.—**Presidential Address.**

[Improvements made in the Microscope—Protoplasm, Schizomycetes, &c.].

Journ. New York Micr. Soc., I. (1885) pp. 53–9.

Vorce, C. M.—**Lantern transparencies.** [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) pp. 84–5.

Wales.—**Observations on resolution of** *Amphipleura pellucida.* [*Post.*]

Journ. New York Micr. Soc., I. (1885) p. 103.

White, T. C.—**The Retina of Science.**

Photogr. News, XXIX. (1885) pp. 179–80 (2 figs.).

Winter, W.—**Ueber die Darstellung Naturwissenschaftlicher Objekte.** (On representing Natural History objects.) [*Post.*]

Ber. Senckenberg. Naturf. Gesell., 1884, pp. 75–7.

Zimmermann, O. E. R.—**Atlas der Pflanzen-Krankheiten welche durch Pilze hervorgerufen werden. Mikrophotographische Lichtdruckabbildungen der phytopathogenen Pilze nebst erläuterndem Texte.** (Atlas of plant-diseases produced by fungi. Photo-micrographic illustrations of the phytopathogenic fungi, with explanatory text.) Part I.

16 pp. and 2 pls. of 15 figs. each. Text 8vo, Atlas fol., Halle a. S., 1885.

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

Collecting Rhizopods.*—Prof. H. Blanc describes a method of obtaining material from the deep water of the Lake of Geneva by lowering to the bottom a large St. Andrew's cross, to the four extremities of which are attached pieces of very thick glass. After three or four weeks this is raised to the surface again and the fine mud that has collected on the pieces of glass removed with a brush.

Cultivation of Actinomyces.†—Dr. O. Israel found great difficulty in cultivating Actinomyces from the slow growth of the fungus, as it was crowded out by the growth of other organisms. No result followed attempts at cultivation on fluid nutrient media—beef-bouillon, meat-extract, peptone-solutions, fluid bullock's blood-serum at the temperature of the room and body, or peptone-salt-gelatine-meat solution at 20° C. Only Koch's coagulated bullock's blood-serum proved a suitable nutrient soil, in which it grew very slowly.

The growth appeared as a very thin, velvety, dry looking clump on the bright surface of the coagulum, in which (not for 14 days) small nodules appeared. Cultivation of eight weeks' growth hardly extended more than 1/2 cm. on either side of the point of inoculation. Microscopically the vegetations in the culture corresponded with those which exist in the animal body. With low powers the margin showed a serpiginous border.

Cultivation Methods for the Investigation of Fungi.‡—Dr. O. Brefeld observes that a substratum on which the fungus exists in

* Bull. Soc. Vaudoise Sci. Nat., xx. (1885) pp. 287-8.

† Virchow's Arch. f. Pathol. Anat. u. Physiol., xcv. (1884) p. 140.

‡ Brefeld, O., 'Botanische Untersuchungen über Schimmelpilze,' part iv. pp. 1-35. 4to, Leipzig, 1883.

nature, is in all probability also an appropriate one for the cultivation of the fungus, and one can in many cases make a nutrient solution by cooking the substratum. For example, the dung of herbivora is a very fertile nutrient soil for a variety of fungi, and a decoction of it made clear and freed from fungi by sterilization, is a very good nutrient medium. Nutrient solutions can also be made from sweet fruits, e. g. plums, raisins, &c., of which a watery extract is made, and sterilized by heat. The free acids of the fruit check the development of many fungi. Beer-wort is also a convenient culture-fluid, but is difficult to clarify, and when cooked forms a precipitate. Again, a decoction of yeast, with more or less sugar, or a weak solution of meat-extract, with or without sugar, may be used: or bread, which is not acid, and which has been placed in an air-bath at 150° C. for 24 hours. Lastly, one can use a variety of organic and inorganic compounds. Many fungi flourish in acid solutions, while even a trace of acid prevents the germination of the spores of others.

Brefeld purifies the vessels, &c., used in cultivation experiments, by boiling water, heating, or placing them for some time in 10 per cent. hydrochloric acid, and afterwards scalding them in distilled water. The methods of cultivation and study of spore-formation are entered into, and the means by which impurities from access of air, &c., can be prevented are minutely described.

Net for Microscopists.*—Mr. H. A. Walters first tried a deep conical net, stretched upon a framework of cane, bent (after boiling) somewhat to the shape of an iron hook ⌒. Across the open portion, a copper wire, not less than six inches in length, was stretched, which served as a finer cutwater than the cane, and made a strong and effectual "scraper" for such stems as those of the water lily. He found, however, considerable difficulty in turning a net of this shape inside out, and, to overcome this, contrived the following one.

The framework is the same as the first. The muslin bag is so arranged that the point of the cone comes exactly opposite to the centre of its mouth when stretched out behind it, and within this point is inserted a 1/2 in. test-tube having the bottom ground off. The ends of the muslin for 1/2 in. are bound tightly round the head of the tube; the projecting rim of the glass preventing it from being pulled out. Round the whipping is placed a broad band of cork, a wine cork, with the centre burnt out, and the edges bevelled forward to prevent undue resistance to the water, which keeps the tube always behind the muslin, and ready to receive the contents of the net; otherwise, when the net is moving very slowly in the water, the tendency of the tube is to sink below the mouth, thereby causing all animal life to be merely washed in and out again. The tube is closed by placing a square of muslin over the open end, and securing it with a very small band of indiarubber. Duplicates of both muslin square and elastic band are indispensable, these being the two most important parts of all. Care should be taken when cutting the muslin that the piece coming from the wire is quite flat and remains so after being

* Sci.-Gossip, 1885, pp. 78-9.

fixed in its place, for if there is any looseness in the wire, thereby forming a small hollow below the level of the tube head, solid matter, instead of flowing at once into the tube, will "hang" in this hollow.

In constructing the net it is advisable so to arrange the muslin that when travelling in the water the wire may precede the cane; for when skimming, if the shadow of the framework is allowed to pass over the life collected on the surface before the wire with the net attached, is able to follow it up, it is more than likely that many specimens will make good their escape.

When it is required to remove the contents of the net to the collecting bottle, proceed thus:—The net should be raised from the water as rapidly as possible, and the thumb of the right hand pressed tightly against the bottom of the tube so that it may be kept full of water, and it can then be examined. The small diameter of the tube does not prevent the use of a pocket-lens, which is practically useless when the objects are procured in the dipping bottle. If the tube is found to contain anything of value the left thumb is placed on the head of the glass, the latter turned upside down, the square and band removed, and the water gently poured into a bottle.

After using this net for a few minutes the author "has always found more in the glass tube than others have been able to collect in as many hours, while using the favourite bottle and stick; and it is worth remembering that each plunge of the dipping bowl adds seldom less than half-a-pint of water to the total amount that must be carried, perhaps for miles, while the net and tube increases the amount by never more than one tablespoonful."

Preparing Brain of Urodela.*—Prof. H. F. Osborn describes his method of preparation as follows:—Before hardening, the brains were distended with Müller's fluid, so as to preserve the natural proportion of the cavities. After treatment with alcohol, they were placed for a week in dilute carmine. Calberla's egg-mass was employed, the ventricles being injected with the mass before hardening. The delicate parts of the brain-roof were thus retained. It appears now that celloidin may be used for this purpose to equal, if not to greater advantage in results, and with considerable economy of time. The sections were cut in absolute alcohol, were then floated upon a slide in consecutive order, from twenty to fifty at a time, and were covered with a delicate slip of blotting paper during treatment with oil of cloves.

For imbedding, the egg-mass was prepared by shaking the white and yolk of egg together, with three drops of glycerin to each egg, and then filtered through coarse cloth. The bath is then prepared as follows:—There is a large water-pan for boiling with the Bunsen burner, &c. Inside this, supported on rests to prevent jarring, is a covered glass dish, filled to about 1 in. in depth with 85 per cent. alcohol. Within the glass dish is placed a piece of coarse wire netting, which supports the imbedding box, raising it above the alcohol.

* Amer. Natural., xix. (1885) pp. 328-30 (1 fig.), from Proc. Acad. Nat. Sci Philad., xvii. (1883) p. 178, and xviii. (1884) p. 262, and from a letter.

The box, made of paper in the usual way and one-fourth filled with the imbedding mass, is kept in the bath until the mass is hardened enough to support the brain. The brain is next placed on the hardened stratum and covered with the fresh mass. The second stratum is hardened just enough to hold the brain in place, and then a third is added, filling the box.

The whole mass must now be allowed to harden through and through, requiring about fifteen minutes. The hardening is completed by passing the box through three grades of alcohol—80, 90, and 100 per cent., allowing it to remain twenty-four hours in each. When the mass becomes nearly white and ceases to discolour the alcohol it is ready for cutting.

Method of preparing permanent specimens of Stained Human Blood.—Dr. V. D. Harris writes us as follows :—

Although at first sight a very simple matter, it is found in practice to be anything but easy to prepare specimens of human blood, so that the corpuscles may retain their shape and may be at the same time well stained. After the trial of a large number of different methods I recommend the following as giving the most satisfactory results. The finger is pricked and a large drop of blood is allowed to exude; a perfectly clean cover-glass is lightly drawn upon the top of the drop so that a very thin layer of blood adheres, so thin as hardly to be evident until it is dry. It is then dried in the air or put at once without drying into one of the following solutions, viz. chromic acid 1/12 per cent.; bichromate of potassium 1/2 per cent.; methylated spirit or absolute alcohol for five or ten minutes, washed in water and again dried. The specimen is now ready for staining. The best dye for this purpose will be found a *recently prepared* 1 per cent. solution of Spiller's purple in water to which a few drops of alcohol have been added, or a weak spirit solution of rosein. A few drops of one or other dye having been filtered into a watch-glass, the cover-glass is placed upon the surface of the solution blood downwards, and allowed to remain so for from five to ten minutes. It is then removed, washed for some time in a gentle stream of distilled water, dried thoroughly, and mounted in Canada balsam with or without previous treatment in clove oil for a minute or two. On examination of the specimen the coloured corpuscles should be found of normal shape and coloured purple or red, according to the dye used, and the colourless corpuscles similarly stained. The method with Spiller's purple will be found especially useful when blood is examined in disease conditions in which the existence of micro-organisms is suspected, and is superior to any other of the many anilin dyes (such as methyl-violet) which I have tried.

Demonstrating the Origin of Red Blood-corpuscles in Cartilage at the Margin of Ossification.*—Dr. B. Bayerl, after decalcifying and hardening the specimen in alcohol, imbedding it in paraffin, and cutting, treats the sections with turpentine, soaks in absolute

* Arch. f. Mikr. Anat., xxiii. (1884) pp. 30–45.

alcohol, and places them for fifteen to twenty minutes in a mixture of equal parts of the following solutions:—(*a*) Carmine, 2; borax, 8; water, 130. (*b*) Indigo-carmine, 8; borax, 8; water, 130. They are then treated with a saturated solution of oxalic acid, washed, and mounted in balsam.

The ground-substance of the unchanged cartilage is not stained, while at the margin of ossification it is pale red; the cartilage cells are reddish, with dark nuclei; bone and osteoclasts, red; blood-corpuscles, green. The latter stain is a specific property of hæmoglobin, and, of other tissues, only the inner root-sheath of hairs takes on a greenish hue.

Preparing the Sympathetic Nervous System of Periplaneta orientalis.*—Dr. M. Koestler recommends the following process:—

The fresh parts of the animal to be examined are held over osmic acid for two to three minutes, washed, and transferred to weak alcohol. They are then stained with picro-carmine for twenty-four hours beneath the bell-jar of an air-pump, and are found to be perfectly hardened. When all traces of alcohol have been removed by washing they are placed in white of egg, freed by filtration from all fibres, &c.

At the end of about two hours the albumen is coagulated, first by weak and then by absolute alcohol, warmed to 40° C., so as to bring about as even a coagulation as possible. The object can then be treated in the usual way with oil of cloves, imbedded in paraffin, and cut with a microtome.

Fixing, Staining, and Preserving Infusoria.†—For fixing Infusoria, Dr. L. Cattaneo employs a watery solution of chloride of palladium, which hardens the organism in a few minutes without modifying its form or blackening it, and allows the granules and cell-nuclei to stand out prominently. Similar effects are produced by double chloride of gold and cadmium, which brings out the cell-nuclei much better than the former. For the study of protoplasmic networks iodide of mercury and potash (1–2 per cent.) is of use, as it stains the granules of the protoplasm black, and brings out clearly the granules of the cell-nuclei. Beautiful preparations can be made with corrosive sublimate, in 5 per cent. solution, which kills the infusorian instantly, and rapidly fixes all the anatomical elements. Further, it gives such consistence to the protoplasm that the most complex staining processes can be carried out.

Specimens treated with osmic acid are dark, and lose their transparency.

Cattaneo places in the second rank as fixing media chromic, picric, and picro-sulphuric acids, and bichromate of potash.

Preparations can be with advantage treated with nitrate of silver (1/2–1 per cent. solution), and afterwards washed with a solution of acid sulphate of soda. As staining reagents, magenta-red and fuchsin give good, and nigrosin and logwood still better results. Both

* Zeitschr. f. Wiss. Zool., xxxix. (1883) pp. 572-95.

† Bollettino Scientifico, 1883, Nos. 3 and 4.

nigrosin and logwood (Kleinenberg's) should be used in weak solutions, and allowed to operate for a long time.

The most preferable staining reagents are considered to be carmine and picro-carmine, which may be used singly or together. As mounting media, Cattaneo recommends glycerin and oil of cloves.

Preparing Euglena.*—Cooked turf, steeped in nutrient salt-solution, is advocated by Dr. G. Klebs as a good substratum for the cultivation of *Euglena* and Algæ. Carminic acid is employed for killing the cilia.

The membrane of *Euglena viridis* is almost entirely consumed by pepsin in twenty-four hours; that of *Phacus* is apparently unchanged after days. One ingredient is removed from the membrane of *Euglena* by the pepsin, while another remains behind in the original structure. The first belongs to the group of albuminoids, and the other must be considered as a cellular membrane substance.

Euglena can be kept for many weeks in nigrosin and indigo-carmine without taking up the colouring matter. Living specimens of *E. spirogyra* have been successfully stained with logwood. The whole membrane became dark blue, after first treating it with 0·5 per cent. solution of sodium chloride, to which 1 per cent. chromic acid was afterwards added. After several seconds the *Euglena* was washed and placed in a watery solution of logwood. The membrane can also be stained with carmine, eosin, and anilin-blue. With sulphuric acid it becomes yellow or brown. The whole membrane becomes yellow or nearly black when impregnated with hydrated oxide of iron.

It has not been found possible to separate the cytoplasm from the membrane even when a saturated solution of sodium or calcium chloride is applied. The separation is most easily effected by mechanical pressure, or by alcohol, best when the *Euglena* has been previously killed.

By the application of 10 per cent. sodium chloride the principal vacuole breaks up, and its water is absorbed. Alkaloids produce an enormous dilatation. With sulphate of quinine, only in *Phacus pleuronectes* and *P. pyrum* is a slight increase of the principal vacuole observed; but this is not the rule.

Preparing the Bacillus of Syphilis.†—In sixteen cases of syphilis Dr. S. Lustgarten has found characteristic bacilli in the initial lesion, lymphatic gland, papules, and products of the tertiary stage.

Sections hardened in alcohol are stained in Ehrlich-Weigert's gentian-violet from 12–24 hours at the ordinary temperature, and then for two hours at 104° F. They are then washed in absolute alcohol for several minutes, and transferred on a glass or platinum needle to a watch-glass containing about 3 c.cm. of a 1½ per cent. aqueous solution of permanganate of potash, in which they remain about ten seconds. A brown precipitate forms in the fluid and on the

* Untersuch. aus d. Botan. Institt. zu Tübingen, i. (1883) pp. 233–62.

† Wiener Med. Jahrb., 1885.

surface of the sections. They are then placed in an aqueous solution of chemically pure sulphurous acid, in which they lose the colouring matter in parts. They are next washed in distilled water, and again placed in the permanganate solution for 3–4 seconds, and afterwards in the sulphurous acid. The process is repeated until the sections are colourless, and they are then dehydrated, and mounted in the usual way.

The bacilli of syphilis, leprosy, and tuberculosis are not decolorized by this method; all other bacteria are. The bacilli of syphilis are decolorized by nitric acid. They appear as straight, curved, or irregularly bent rods, $3\frac{1}{2}$–$4\frac{1}{2}$ μ in length, and under high powers their surface appears undulatory and slightly notched. Each bacillus contains 2–4 oval spores. The bacilli were always inclosed in cells varying from a trifle larger than, to double the size of a white blood-corpuscle, in the midst of the infiltration. The bacilli are found in them singly, in groups of two to nine or more, or in irregular confusion.

Methods for observing Protoplasmic Continuity.*—Mr. T. Hick, in an article on protoplasmic continuity in the Fucaceæ, says that he found the following methods, as a rule, furnished such favourable results, that, for the guidance of those who may wish to verify his statements, he gives them in full.

To obtain a general view of the structure of the thallus of the plant under investigation, thin sections were placed in fresh water for a few minutes and then stained with methyl-green acidulated with acetic acid. After well washing with water or acetic acid, the sections were put for a short time—varying in different cases—into alum-carmine. They were again well washed with water, swollen with strong ammonia, and mounted in glycerin. Sections prepared in this way turn out in a very pretty condition, the protoplasmic structures being coloured green and the framework a pale pink or violet. Before swelling with ammonia the sections must be thoroughly washed, to remove all traces of alum, as otherwise the ammonia will cause a precipitate of aluminic hydrate to be thrown down.

For the determination of more refined details the sections were treated as follows:—Having been washed with fresh water, they were stained with an aqueous solution of saffranin; again washed with water and swollen with strong ammonia; and finally mounted in glycerin. Thus prepared, the sections showed the protoplasts of a pink colour and their envelopes yellow, deepening here and there to brown.

Still more satisfactory results were, however, obtained thus:—Sections were soaked for from 3 to 12 or 20 hours in a mixture of strong sulphuric acid 1 part, and water 3 parts. They were then washed, stained with saffranin as in the preceding process, and mounted in a mixture of glycerin and ammonia. If the ammonia is employed to swell the sections before mounting, they become so much disintegrated that it is then impossible to transfer them to a slide.

* Journ. of Bot., xxiii. (1885) pp. 97–102.

In good sections prepared by either of the first two methods a suspicion of the existence of continuity will be created by the appearance of the cell-contents. A mere suspicion, however, is not sufficient, and to be convinced that it actually exists the ends of the cells must be more closely investigated. For this purpose sections prepared by the third method must be made use of, and even these must be supplemented by others of a still more demonstrative character. The latter may be obtained by slightly modifying the modes of treatment as follows:—

1st. Sections that are to be treated by the second method should be previously placed for a few moments in a weak solution of ordinary bleaching powder.

2nd. Sections that have been treated by the third method should be warmed gently in a mixture of equal parts of glycerin and potash solution, before being mounted in glycerin and ammonia.

Tolu instead of Chloroform for Imbedding in Paraffin.*—Dr. M. Holl finds that objects imbedded in paraffin can be better and more easily cut when they have been previously treated with tolu instead of chloroform. After the object has been hardened in alcohol it is placed directly into the tolu for twenty-four hours (or less for small objects), and transferred from it to the paraffin bath, in which it is also kept for twenty-four hours.

Imbedding Small Objects.†—For imbedding small objects, e. g. embryos or parts of them, Dr. L. Gerlach gives the following receipt:—40 grm. gelatin are added to 200 c.cm. of a saturated solution of arsenious acid, with 120 cc. of glycerin. This fluid is clarified with white of egg, and remains perfectly clear for years in a well-stoppered bottle. Objects hardened in alcohol are most suited for imbedding in this mass. They are, prior to imbedding, placed in weak glycerin (glycerin 1 part, water 2 parts), to which some thymol has been added, for two hours or more, according to their size. So as to remove all traces of alcohol, the fluid is changed from hour to hour.

Advantages and Disadvantages of Different Forms of Microtome.‡—Dr. M. Gottschau has a useful summary of the advantages and disadvantages of different microtomes.

Microtomes are referable to two types. In one (e. g. Oschatz's) the object is raised by a micrometer screw, in the other (e. g. Rivet's) by altering its position on a plane which gradually rises towards the horizontal cutting edge of the knife. In the former a free application of the knife in any direction is feasible; but where the object is slid on a rising rail, the knife must be fastened and guided on a horizontal slide. In the former, again, the preparation must be so firmly clamped or imbedded that it rises without lateral displacement. It is raised by the screw to the fraction of a mm. above the upper opening of the

* Zool. Anzeig., viii. (1885) pp. 223–4.

† Gerlach, L., Beiträge z. Morphol u. Morphogenie. Unters a. d. Anat. Inst. Erlangen, i., Stuttgart, 1884.

‡ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 327–48.

cylinder, and this projecting part is cut off by the knife. The upper edge of the cylinder is fixed into a metal plate, usually covered with glass, on which the knife is guided by the hand, and a quiet and steady movement of the same obtained.

The possibility of making fine sections does not depend solely on the small and uniform raising of the preparation, but especially on the fixing of the preparation, and the impossibility of lateral displacement from the horizontal. The slightest imperceptible change of direction of the object must produce unevenness of the section.

In cylinder microtomes of older construction the preparation is clamped or imbedded in a glass tube; in others (Ranvier, Gudden, Oschatz) the cylinder is closed below by a plate which is moved by a screw. The hollow cylinder is filled with paraffin, spermaceti, &c., and the preparation imbedded in the mass, so that fine rings of the imbedding mass are removed with the sections. Unless the imbedding mass is quite close to the wall of the cylinder it is not firmly fixed, and even sections cannot possibly be made. But this is impossible if the imbedding mass is to be raised in the cylinder, and, further, all imbedding masses contract on cooling. It is a very difficult matter to make micrometer-screws faultless, i. e. with absolutely regular distances of the threads. Even if it were possible to make a faultless male and female screw, it would entail more trouble and cost than a rail on which a slide is uniformly raised.

Whilst, in preparations raised perpendicularly by a screw precision can hardly be obtained for 1/200 mm., slide microtomes are now made which raise the object 1/1000 mm. A further objection to the screw micrometer is the wearing of the screw, whereas a slide microtome, when properly used (i. e. when one does not always use the slide only at one place, but allows it to traverse, when possible, the whole rail), is always better for use, as the slide is always carried symmetrically over the rail.

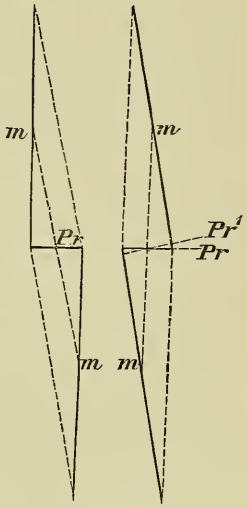
Attempts have been made to remedy the defects of screw microtomes of older (cylinder) construction. The movability of the object in the cylinder and the difficulty of fixing it satisfactorily have been abolished by a slide, which carries the preparation in place of the cylinder. The preparation is tightly fastened to it by a clamp. This method of fastening and raising offers more advantages than the earlier ones, but one must not overlook the fact that the grooves and edges of the slide must be made to fit as accurately as possible, and that even slight wearing produces a loosening of the slide and an appreciable, if slight, movableness of the object.

In the improved screw microtomes, as also in those which carry the preparation on a slide which is moved in a vertical direction, the screw should, after use, be turned to the end. By use a wearing of the screw as well as of the slide-guide is inevitable, with consequent loosening and inaccuracy of raising.

In all microtomes which are used for fine work the knife is no longer guided by the unaided hand, but by a slide which runs in a horizontal plane, and to which the knife is screwed. The position of the edge is of great importance in the preparation of fine sections.

The knife should pass through the object to be cut in as nearly as possible its whole length. If we make a drawing so as to appreciate the course of the knife better, we obtain (fig. 120) an ideal knife-guidance by hand. In this case the knife *m* runs in a sagittal direction obliquely through the preparation *Pr*, and thus passes through it in its entire length. (The dotted lines show the course of the individual sections of the knife.) If we alter this drawing only by bringing the knife into the position shown in fig. 121, and cut in the inverse direction from left to right, in which we draw the knife in a "sagittal" direction towards us, we have the course of the knife on the microtome, and the same figure as before, only that, in the latter case, the knife must be a trifle longer, and the position of the preparation to it is more oblique. If we lay, in a special case, particular value on the direction in which the knife glides through the object, we can easily alter the position of the object in such a way that the individual segments of the edge pass through the preparation in precisely the same way as in fig. 120. The dotted line *Pr'* marks the position thus altered.

Fig. 120. Fig. 121.



The longer the knife is in proportion to the preparation to be cut, the less must be the pressure applied in cutting; the shorter the distance over which the knife is used, the greater must be the pressure which is applied with similar size of the object, and the more will the edge crush and chisel. A surface which has been cut through is more smooth and uniform than one which has been pressed on, and the greatest possible use of the edge of the knife offers the best guarantee for perfect sections.

The position of the surface of the knife to the cut surface must also be taken into account. A knife must be applied the more flat the finer the piece to be cut; if the knife is placed in a steep direction, the edge scrapes. The finest and most perfect sections are obtained with a knife when it is in such a position that the side of the knife which is turned towards the cut surface only touches the object at the extreme margin of the edge.

Above all it is necessary to test the edge of the knife, and the shape of the cross-section of the knife. All our ordinary table, bread, or meat knives in their cross-section have the form of a wedge with straight sides, i. e. of an isosceles triangle (fig. 122 *a*). If it is blunt it should have a steel passed over it, applying it not perfectly flat, but at the sharpest possible angle to it; the result of this being that the whole surface is not ground, but only its extreme edge, so that the wedge assumes a pentagonal instead of a triangular form, as is shown on an enlarged scale in fig. 122 *b*. The newly made surfaces do not converge

at such a sharp angle as they did originally, and the edge is, in consequence, not so sharp. The harder the object which is to be cut through, the thicker the iron, and the blunter the angle of the edge, the more frequently must the cutting surface be sharpened and ground. In fine knives the transformation of the triangular into a pentagonal wedge must have a very prejudicial influence on the capacity of the edge, but careful grinding of the whole surface takes up much time, so this means has been devised of grinding the knife hollow, as it must always be kept hair-sharp. We distinguish between whole and half-hollow ground knives. It is a great error to lay the hollow ground knife obliquely, and not perfectly flat on the sharpening surface. Half-hollow ground knives should be laid on the strop as shown in fig. 123 in cross-section. In whole-hollow ground razors the

Fig. 122.

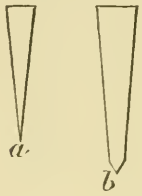


Fig. 123.

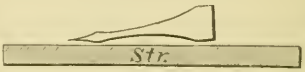
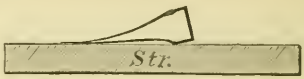


Fig. 124.



anterior margin of the edge lies flat on the surface of the stone or strop, and the ground surfaces consequently converge at a very acute angle (fig. 124). But this advantage is combined with a serious disadvantage for our purpose, that the edge, which is almost as thin as paper, is very unresisting, and easily bends and gives way before the object to be cut. After all, one should not select such a knife as the latter for a microtome, and it is only useful for quite soft and unresisting preparations. Two forms of knife have proved themselves to be sufficient in practice. The one is only slightly hollow ground, and is used for hard objects; the other, which is the most useful, has the side which is directed upwards whole-hollow ground, and the lower side either quite plane or only slightly hollow. If it is plane a thin wire is placed at the back during sharpening, so that only that part which is next to the edge, and not the whole surface, is sharpened (fig. 125).

Fig. 125.

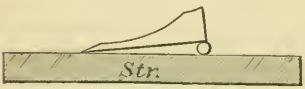
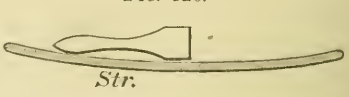


Fig. 126.



Of all razor strops for knives, those are to be rejected in which two leather straps, which can be stretched tight at pleasure, furnish the rubbing surface. An inflexible knife must, if a fine edge is to be obtained, be moved backwards on a perfectly plane and hard surface. This assertion is best established by reference to fig. 123

in which the shape of the knife is of the well-known form, whereas on a curved leather strop (fig. 126) the surfaces which form the edge are not plane, but convex, and meet in two arcs.

The two figures differ especially in the angle at which the surfaces of the edge meet, and this angle is more blunt with soft strops. It is hardly necessary to mention that the flat-lying knife should not be pressed firmly during sharpening, as by pressure the leather is pressed down and a convexity produced on the edge.

As regards the direction of the under surface of the knife to the cut surface, the knife-slide of several microtomes is provided with an arrangement by which the inclination can be increased or diminished at pleasure. If one is cutting a hard object, e. g. ebony or bone, the knife must be set more steeply than for soft wood. But such an arrangement seems superfluous, as one can by manipulation so adjust the knife for hard substances that when screwed into the slide it has a more slanting direction. A slight difference in the inclination of the knife, as a rule, has little or no effect on the making of fine sections. A sharp-angled knife always does its duty, while a blunt one must be set more steeply, but scrapes rather than cuts.

Uniform hardening and imbedding of the preparation is of primary importance. Every paraffin imbedding-mass is only able to be cut within certain definite limits of temperature, and the recent modifications, which consist of admixture with tallow, spermaceti, oil, and other fats, do not solve the secret of an equally suitable mixture for all temperatures. Experience tells us that a mixture with a low melting point is cut at a temperature of 17° C. rather than at 25° C., and that one generally gives up making sections in series at a temperature of 30° C. and upwards, as the cooling in the water or spirit takes place too quickly.

In recent times too little attention has been paid to the fixing of the knife. In the microtome of Fritsch the author first learned a method by which the free end of the knife can be fixed. A spring screwed into the knife-slide exercises, by means of a screw at its free end, a slight pressure on the end of the knife, and keeps it perfectly firm.

When the earlier slide microtomes (e. g. Long's) are much used their precision fails, and uniformly thin sections cannot be made. Further, in cutting, the knife-slide runs stiffly, so that it has to be constantly taken out and oiled. Thoma constructed a rail in which the slide runs on 5 narrow (2–3 mm.) points, which give great steadiness and easy motion to the slide when this is accurately fitted. In Jung's microtome the knife-slide runs on five, the object-slide on six points. Here too the whole rail should, when possible, be traversed by the slide, as, by unequal usage of the long rail, the knife glides inaccurately.

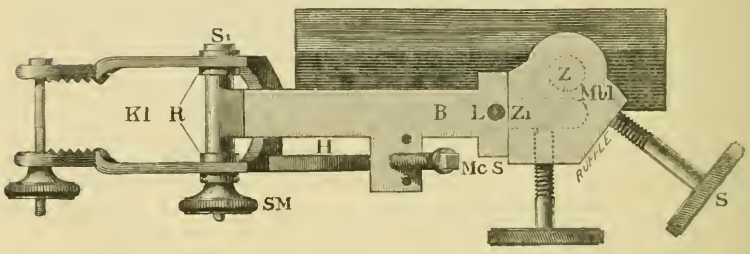
A preparation slider, which moves the preparation forwards by a screw instead of the hand, is found in Spengel and Jung's microtomes. In the former the screw is of the same length as the instrument, and is attached to the side of the instrument. In the latter the screw is shorter, and possesses a pawl, by which the desired revolution of the

screw is made appreciable to the ear, an advantage which one appreciates when cutting sections in series.

The most certain and suitable method of fastening the preparation is between plates, which can be screwed together or apart at pleasure, so as to obviate loosening by temperature, &c.

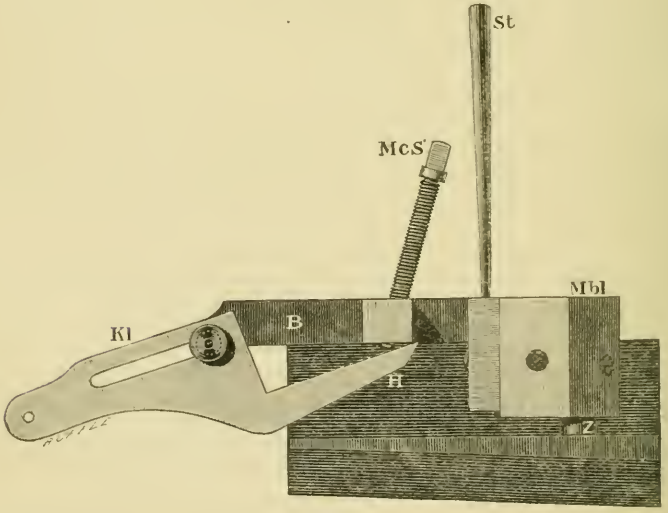
The simplest form of such apparatus is the pincer, which is added to most slide and screw microtomes. The author has had constructed

Fig. 127.



a "clamp for wedge and plane parallel sections," in which the position of the preparation can be changed in three dimensions in a moment, and with which one can make wedge or plane parallel sec-

Fig. 128.

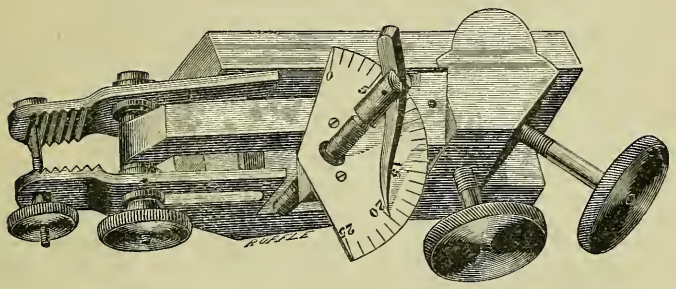


tions of definite thickness. This apparatus as at present made (figs. 127–129) presents the following features:—

The pin Z which carries the whole apparatus, is placed further

back than in Long's microtome. On the pin is a brass block Mbl, which is movable in a horizontal plane and can be fixed by a screw S. In the brass block is a solid beam B, ending in a round pin Z_1. This beam is penetrated at its free end by a steel screw S_1, on which is set a clamp Kl, movable in a backward and forward direction in a slit. This is intended to hold the preparation, and can be pushed 2 cm. forwards or backwards, and is movable on the axis S_1. The clamp is fastened, when it has been brought to the most suitable position, by a female screw SM, which acts on the axes of its two branches and

Fig. 129.



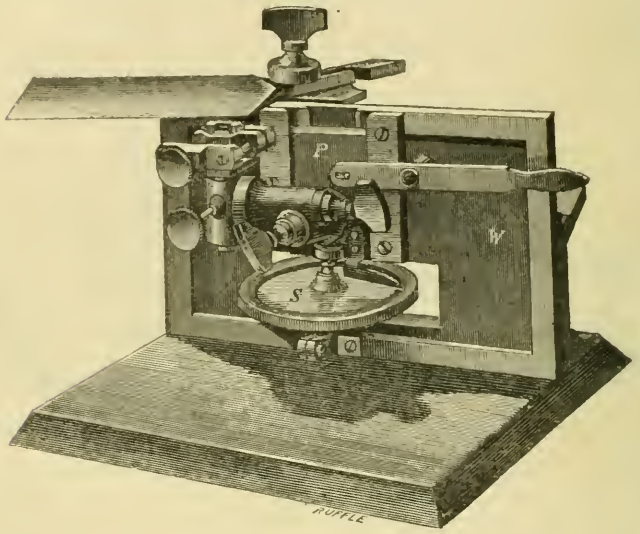
presses them against a metal tube R, so that after fastening displacement is impossible. Below, the clamp communicates with a lever H, which is of the same length as the clamp. A micrometer screw MeS presses on the lever and runs in a side-piece of the beam B. By greater or less turning of this screw one can at pleasure make sections of any degree of thickness. In order to be able to move the screw with accuracy, a quadrant divided into 25 parts is placed on the cross-beam, and a small key on the screw carries the pointer. At the end of the beam is a hole, in which a long steel pin St is fixed, with which the movement around the "sagittal" axis is effected.

Schanze's Microtome.—We append fig. 130, showing Herr M. Schanze's microtome,* which is deserving of record as being the original form on which was founded Mr. Bulloch's instrument, as well as that described *ante*, p. 344. Like that of Körting,† it is a combination of the screw and the slide arrangement, the knife being attached to a slide, while the object is raised by a vertical screw S, which is graduated, each division corresponding to a rise of 1/100 mm. This screw works against a plate P, which slides in a dovetail in the vertical plate W and carries the clamp. Two axes at right angles, controlled by thumb-screws, allow of the object-clamp being inclined in any direction. There is a freezing attachment, in addition to a holder for clamping hard specimens and another for objects which have been hardened with any of the usual reagents.

* Cf. Fol's Lehrbuch d. Vergl. Mikr. Anatomie, 1884, pp. 128–9 (1 fig.).
† See this Journal, i. (1881) p. 690.

A special advantage of this arrangement is that the screw is at the side of the object and not directly under it, so that it is not injured by fluid dropping from the object.

Fig. 130.



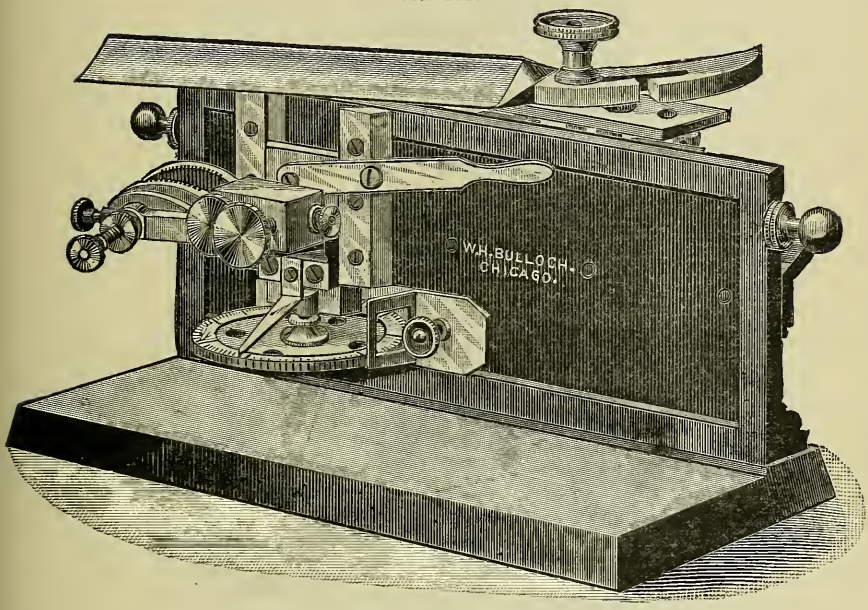
Bulloch's Combination Microtome.*—This microtome which has lately been constructed by Mr. W. H. Bulloch, is claimed to be a combination of the best points of the German and French instruments with some of his own improvements. A general idea of the construction is shown in fig. 131. The main slide for the knife-carrier is 10½ in. long; the height to the cutting edge of the knife 5½ in.; the knife-carrier is made with eight ivory bearings—four on each side—which provide a smooth and easy running surface, which does not require to be lubricated, At each end of the main slide there is a stop with rubber cushions, to prevent the carrier passing over the end. The upper surface of the knife-carrier is made adjustable, so that the knife can be made to cut at whatever inclination is found best. The knife can also be placed at an angle for cutting, or adjusted to cut at right angles for cutting sections into ribbons. The screw for elevating the slide and holder is graduated to 1/200 mm., and has a spring-click for registering. The spring-click can be turned aside when not required.

The holder for the material to be cut has universal motion, so that the specimen can be adjusted to be cut at any plane. Each movement is independent of the others, and all are so combined that

* Amer. Mon. Micr. Journ., vi. (1885) pp. 45–6 (1 fig.).

the specimen is not raised or lowered in adjusting. For the convenience of using the knife square, or at a right angle to the direction of motion of the knife-carrier, and also for cutting sections in ribbons,

Fig. 131.



the holder is reversible, in which position the specimen is in about the centre of the slide. There is also the German freezing attachment, with atomizer.

The base and upright are of japanned iron, the other parts of brass, nickel plated. The case is so made that it is not necessary to remove the instrument when operating, as it unfolds, and will lie flat on the table.

Cambridge Rocking Microtome. — The Cambridge Scientific Instrument Company have just introduced an improved and greatly simplified microtome for producing ribbons of sections imbedded in paraffin (fig. 132).

The principle of the simplification is in the employment of a rotary instead of a sliding movement of the parts. The continuous moving silk band which is used in all previous forms is entirely done away with, and the ribbon of sections falls by its own weight direct from the razor on to a sheet of paper or on to the glass slide on which the sections are to be finally mounted.

The construction of the instrument is as follows :—Two uprights are cast on the base-plate, and are provided with slots at the top into which the razor is placed and clamped by two screws with milled

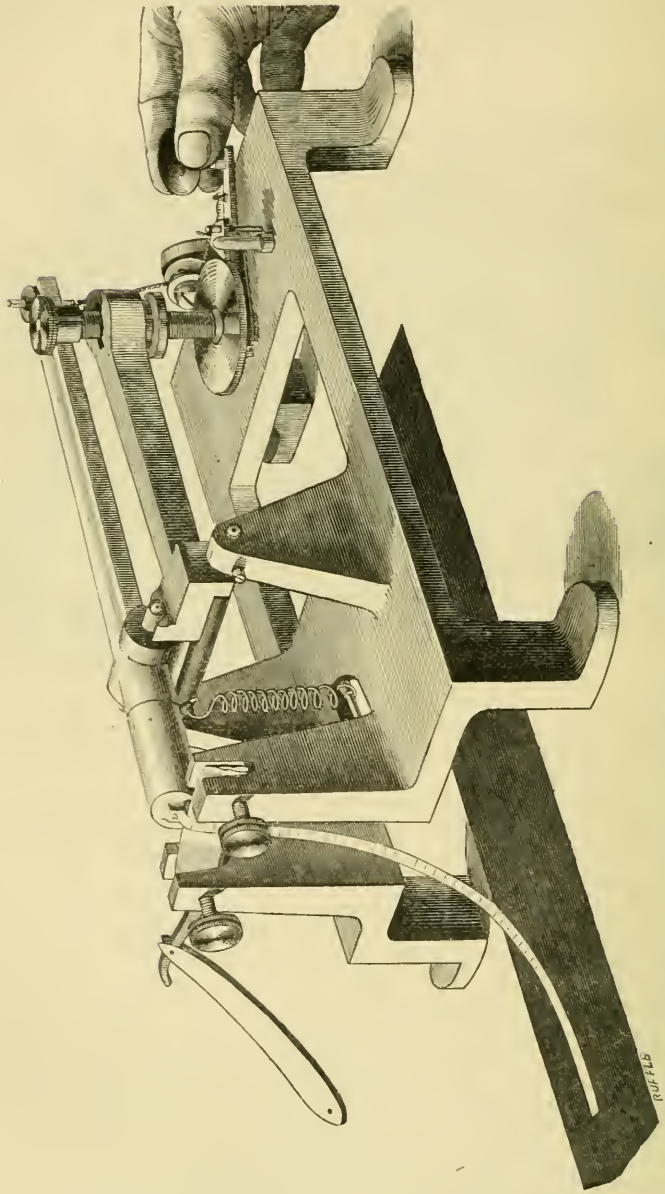


Fig. 132.

Cambridge Rocking Microtome.

heads. The inner face of the slot is so made as to give the razor that inclination which has in practice been found most advantageous. The razor is thus clamped between a flat surface and a screw acting in the middle of the blade, and the edge of the razor is consequently in no way injured.

The imbedded object is cemented with paraffin into a brass tube which fits tightly on to the end of a cast-iron lever. This tube can be made to slide backwards or forwards, so as to bring the imbedded object near to the razor ready for adjusting. The cast-iron lever is pivoted at about 3 in. from the end of the tube. To the other end of this lever is attached a cord by which the motion is given, and the object to be cut brought across the edge of the razor. The bearings of the pivot are V-shaped grooves, which themselves form part of another pivoted system.

Immediately under the first pair of V's is another pair of inverted V's, which rest on a rod fixed to two uprights cast on the base-plate. A horizontal arm projects at right angles to the plane of the two sets of V's; the whole being parts of the same casting. On the end of the horizontal arm is a boss with a hole in it, through which a screw passes freely. The bottom of the boss is turned out spherically, and into it fits a spherical nut working on the screw. The nut is prevented from turning by a pin passing loosely through a slot in the boss. The bottom of the screw rests on a pin fixed in the base-plate.

It will be seen that the effect of turning the screw is to raise or lower the end of the horizontal arm, and therefore to move backwards or forwards the upper pair of V's, and with them the lever and object to be cut. The top of the screw is provided with a milled head, which may be used to adjust the object to the cutting distance.

The distance between the centres of the two pivoted systems is 1 in. and the distance of the screw from the fixed rod is $6\frac{1}{4}$ in. The thread of the screw is 25 to the inch; thus, if the screw is turned once round the object to be cut will be moved forward 1/25 of $1/6\frac{1}{4}$ or 1/156 in.

The turning of the screw is effected automatically as follows:— A wheel with a milling on the edge is fixed to the bottom of the screw. An arm to which a pawl is attached rotates about the pin which supports the screw. This arm is moved backwards and forwards by hand or by a cord attached to any convenient motor. When the arm is moved forward the pawl engages in the milling and turns the wheel; when the arm is moved back the pawl slips over the milling without turning the wheel. A stop acting against the pawl itself prevents any possibility of the wheel turning, by its own momentum, more than the required amount. The arm is always moved backwards and forwards, between two stops, a definite amount, but the amount the wheel is turned is varied by an adjustable sector, which engages a pin fixed to the pawl and prevents the pawl from engaging the milling on the wheel. By adjusting the position of this sector the feed can be varied from nothing to about 5/32 of a turn, and hence, since the screw has 25 threads to the inch, the thickness of the sections cut can be varied from a minimum, depend-

ing on the perfection with which the razor is sharpened, to a maximum of 5/32 of 1/25 of 1/6¼ or 1/1000 of a turn. The practical minimum thickness obtainable with a good razor is approximately 1/40,000 in. The value of the teeth on the milled wheel are as follows:—

1 tooth	of the milled wheel	= 1/40,000 in.	= ·000625 mm.
2 teeth	„	„	= 1/20,000 „	= ·001250 „
4 „	„	„	= 1/10.000 „	= ·0025 „
16 „	„	„	= 1/2500 „	= ·01 „

The movement of the lever which carries the imbedded object is effected by a string attached to one end of the lever. This string passes under a pulley and is fastened to the arm carrying the pawl. Attached to the other end of the lever is a spring pulling downwards.

When the arm is moved forward the feed takes place, the string is pulled, the imbedded object is raised past the razor, and the spring is stretched. When the arm is allowed to move back the spring draws the imbedded object across the edge of the razor, and the section is cut. The string is attached to the lever by a screw which allows the position of the imbedded object to be adjusted so that, at the end of the forward stroke, it is only just past the edge of the razor. This is an important adjustment, as it causes the razor to commence the cut when the object is travelling slowly and produces the most favourable conditions for the sections to adhere to each other.

The following are perhaps the most prominent advantages of this instrument. (1) The price is one-sixth that of the original form. (2) Less skill is required from the operator, for the endless silk band is superseded, and the troublesome and difficult operation of lifting the first sections from the razor on to the silk band is entirely avoided; the ribbon of sections now falls of its own weight direct from the razor on to a piece of paper or glass slide placed to receive them, and by occasionally moving the paper forward any length of ribbon can be obtained. (3) The razor is fixed at what has in practice been found the most advantageous inclination and angle for cutting, and thus an unnecessary adjustment and waste of time is avoided. (4) The imbedded object is with great ease and quickness brought up to or away from the edge of the razor; first for large amounts by sliding backwards or forwards the brass tube on the cast-iron lever, then for smaller amounts by turning round the screw, when the pawl is out of gear, by means of a small milled head placed on the top for this purpose. (5) There are no delicate working parts which can get out of order, and the whole instrument is easily taken apart for packing and is very portable.

"Ribbon" Section Cutting.*—Mr. A. B. Lee gives the following as the factors necessary for the production of a chain of sections:—

First, the paraffin must be at a melting-point having a certain relation to the temperature of the laboratory. Insufficient experiments have yet been made to settle the melting-point of the paraffins that should be used at the different temperatures at which sections

* 'The Microtomist's Vade Mecum,' 1885, pp. 400-1.

are usually cut; but at least one point can be indicated with considerable accuracy. *Small* sections can always be made to chain when cut from a good paraffin of 45° C. melting-point in a room in which the thermometer stands at 16° to 17° C. (The temperatures quoted apply to the case of rooms heated by an open fire, and probably would not apply to the case of rooms heated by closed stoves, such as are usual in Germany.) At 15° C. the paraffin will be found a trifle hard. At 22° C., the proper melting-point of the paraffin will probably be found at about 48° C. Second, the knife should be set square. Third, the block of paraffin should be pared down very close to the object, and should be cut so as to present a straight edge parallel to the knife-edge; and the opposite edge should also be parallel to this. The block should in no case be cut so as to present a pointed side, as recommended at the Naples Zoological Station.* Fourth, the sections ought to be cut rapidly, with the swiftest strokes that can be produced. It is evident that this condition can only be conveniently realized by means of a sliding microtome; but it is by no means necessary to have recourse to special mechanical contrivances, as in Caldwell's automatic microtome. The Thoma microtome, well flooded with oil, is sufficient.

Rapid Method of making Sections of hard Organized Substances.†—Dr. F. v. Höhnel first files the object (e. g. a piece of hard wood) level with an ordinary file, and makes the surface quite even with finer files. A piece (1/2–1 mm. thick) is then split off with a scalpel or cut with a saw from that portion which has been filed smooth. A drop of Canada balsam is then placed on a slide, and on it the piece of wood, with the filed surface below, and the slide warmed till the balsam is melted. The wood is then pressed down firmly with the finger, and the slide set on a cold metal plate till the balsam is cold, a small piece of blotting-paper being laid on the object, which is pressed firmly on the slide with a soft cork. The blotting-paper and superfluous balsam are then removed. The section is next filed, till it is so thin as to be transparent, with a coarse file, and with finer files until it is quite smooth and shining. If the section is to be quite faultless it is rubbed for a short time on a dry Mississippi or Arkansas stone, which should be freed from adherent particles of resin with a cloth damped with alcohol. After the final filing and polishing the slide and edge of the object are cleaned with a towel wetted with alcohol. The object is then mounted in Canada balsam or glycerin. In this way ten to twelve sections can be prepared in a day.

Contribution to the History of Staining.‡—Prof. G. Holzner writes to claim that G. C. Reichel, of Leipzig, was the originator of the process of staining for histological purposes. In his 'De vasis plantarum spiralibus,' 1758, he not only pointed out the different behaviour of the tissues and their elements with a decoction of logwood, but used the reagent for the discovery of the vessels.

* See this Journal, iii. (1883) p. 917.
† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 234–5.
‡ Ibid., pp. 254–6.

Staining for Microscopical Purposes.*—In continuance of his former articles, Dr. H. Gierke gives a tabular account of (1) the use of anilin dyes for ordinary and bacteriological investigations; (2) the differentiation of tissue-elements by the reduction of silver salts, especially nitrate of silver; (3) impregnation of tissues with chloride of gold, and chloride of gold and potassium; (4) treatment with osmic acid.

Staining Technique.†—For studying cell-division and bringing out nucleoli, Dr. W. Flemming hardens the fresh tissues in the following mixture:—Chromic acid (1 per cent.) 15 parts; osmic acid (2 per cent.) 4 parts; glacial acetic acid 1 part, or less. The pieces remain therein two to three days for complete hardening. They are then washed in water, and, for cutting, further hardened in alcohol, or cut under alcohol, and washed in water. They are then stained in strong saffranin solution and washed in absolute alcohol (with 0·5 per cent. hydrochloric acid).

For staining the inner root-sheath of hairs, the sections are placed for several hours to one day in picrocarmine of medium strength, and then for several hours in Grenacher's logwood,‡ washed in water, and mounted in glycerin or cloves. The fibrillæ of the connective tissue are rose or red; muscles, yellowish red; all cell-bodies, similar; cell-nuclei, dark purple-violet; horny substance of the hair, picric yellow (pale greenish in old chromic preparations); the inner root-sheath, so far as it is horny, of a brilliant light-blue colour.

As a simple method of staining cell-substance and other parts yellow, treatment with an alcoholic solution of picric acid is recommended, after staining with logwood, alum-carmine, or other nuclear stains. This can be applied to specimens hardened in alcohol, bichromate of potash, chromic, picric, or osmic acids.

Susceptibility of the Different Tissues to Colouring Matters.§—Prof. Ehrlich has obtained some physiologically important results from investigations into the susceptibility of the different tissues to colouring matters.

When colouring solutions—in particular methyl-blue—were injected into living animals, and then, with the utmost expedition, particular tissues were examined, interesting reactions of the living tissue under the colouring materials would be perceived, which, in spite of their rapid evanescence, revealed important facts which by other methods were in part wholly unascertainable, in part to be ascertained only with difficulty.

After the injection of methyl-blue, Prof. Ehrlich found in the submucous tissue of the tongue very numerous fibres and fibrous reticula coloured intensely blue, which sent processes to the epithelial formations, and it was easy to determine that these fibres were the

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 372–408.

† Ibid., pp. 349–61.

‡ Flemming, W., 'Zellsubstanz, Kern- und Zelltheilung,' 1882, p. 383.

§ Nature, xxxi. (1885) pp. 547–8. Report of Proceedings of Berlin Physiological Society, 27th Feb., 1885.

axis cylinders of the sensory nerves. These blue-tinged axis cylinders were found very numerously in the gustatory cuplets, at the bases of which they formed a quite narrow reticular network, whence, single fibres ending in knots proceeded anteriorly to the ciliated cells. Networks of blue fibres were found very copiously and closely in the cornea. The iris likewise showed blue plexuses, particularly on the anterior side ; on the posterior side only long cancellated reticula were observed. In the muscles, on the other hand, were found only detached blue fibres, the ending of which in the muscle-fibre could not be established. The axis cylinders of the motor nerves were, according to this experiment, not coloured by methyl-blue during life ; it was only the sensory nerves which reacted to the colouring matter. The vessels, arteries, capillaries, and veins were surrounded by blue plexuses. It could not, however, be decided whether the blue fibres proceeded to the smooth muscle-cells. In the retina the nervous layer showed no blue colouring. In the ganglion layer, on the other hand, cells richly charged with blue, and having numerous branching processes, were found, which, too, were in communication with the processes of neighbouring cells. In the mixed nerve-stems and in the roots of the nerves no blue fibres were found. The central ends, on the other hand, showed a decided methyl-blue reaction, as did also the peripheral ends of the sensory nerves. In the brain, blue fibres were found only rarely, but were very abundant in the medulla oblongata, while they were wanting, again, in the spinal marrow, and from these results it appears that the colouring of living organs with methyl-blue is a very important means of observing the endings of sensory nerves in them.

It must, however, be borne in mind, that the examinations had to be prosecuted very rapidly after the colouring process, because, in living tissue, the colouring material was lost by diffusion very quickly —in the course of a few minutes—and the colouring of the axis cylinders disappeared.

Staining the Nervous System of the Muzzle and Upper Lip of the Ox.*—Dr. J. Cybulsky recommends the following method :—

Fresh pieces of the epidermis with a thin layer of the corium are imbedded in elder-pith, and cut with a knife wetted with alcohol and water. The sections are placed for a quarter to three-quarters of an hour in a weak solution of chloride of gold, washed with distilled water and placed in a hermetically sealed vessel in a solution of tartaric acid (saturated or diluted to 1/2). This is placed in water warmed to 50°–60°. Already, in a quarter of an hour, a bright red or bluish striation appears in the sections in consequence of the reduction. The proper degree of staining can only be learnt by experience. If the reduction is continued for a long time the acid must be renewed.

Employment of Colouring Matters in the Study of Living Infusoria.†—M. A. Certes finds that dahlia, chrysoidin, nigrosin, methyl-blue and iodine-green have the property in different degrees of colour-

* Zeitschr. f. Wiss. Zool., xxxix. (1883) pp. 653–82.
† CR. Soc. de Biologie, April 5th, 1885.

ing the nucleus, which, in living infusoria, is not coloured by quinoleïn-blue or Bismarck-brown.

Very weak aqueous solutions of dahlia, acid-green, and malachite-green colour the nucleus of a large number of ciliate and flagellate Infusoria. Diphenylamine-blue, on the contrary, even in solution of a deep hue, has no toxic action on Infusoria, which live and develope in it without any coloration being produced, except in the stomachal vacuoles from the ingestion of coloured food.

The solutions of dahlia, acid-green, and malachite-green should be made with the water in which the organisms to be studied are living. The resistance to the toxic action of the staining reagents is not the same in every species. M. Certes has succeeded with solutions of 1/10,000 as a maximum, and 1/100,000 as a minimum.

With dahlia and malachite-green the nucleus behaves differently in species which are closely connected, and in the same species the division of the chromatic material, or the affinity of the nucleus for colouring matters vary according as the infusoria are more or less distant from a period of reproduction by conjugation, e. g. malachite green colours intensely the double nuclei of *Stylonychia mytilus*, various Oxytriches, &c., while the simple nucleus of *Paramœcium aurelia* is more faintly stained.

With dahlia, the coloration, more intense in the nucleus, extends, but more faintly, to the rest of the parenchyma. There is often a more coloured zone at the anterior part of the animal, and the sarcode expansions, formed of glycogen, take a feeble tint, which does not seem to occur in Infusoria treated by other colouring materials.

The stomachal vacuoles are always strongly coloured whatever the reagent employed, owing to the vegetable matter or dead animals which are ingested. If a living infusorian is swallowed by a carnivorous infusorian, it only becomes intensely coloured when it has been killed by the action of the gastric juices.

Even deeply coloured solutions of diphenylamine-blue and the blues of Poirrier (B B S E and C 3 B) have no toxic action on Infusoria, while they colour and rapidly kill a number of bacteria.

The contractile vacuole is never coloured, except perhaps by dahlia, which faintly stains the sarcode expansions.

Dahlia, acid-green, and malachite-green, &c., bring about in most species slowing of their movements from a kind of paralysis. The contractions of the contractile vacuole first become less frequent, and this morbid phenomenon seems to explain the dropsy which ensues before death.

M. Certes noticed some peculiar phenomena in some Stentors which had been living for several days in a solution of Poirrier blue. The accumulation of the liquid had transformed the individuals into a large soapy bulla, the wall of which contained the nuclei and buccal ciliary apparatus. At a given moment, one of the individuals began to open, and rejected the enormous vacuole inclosed in a special wall and almost as large as itself. It then closed up and swam about apparently unhurt, while the vacuole remained inert at the spot where it was rejected, and became coloured blue.

After the action of malachite-green many organisms die in a state of extension; in Vorticellas the contractile peduncle becomes inert, and its central part coloured, before the vibratile cilia lose their movements and the peristoma ceases to contract.

By the simultaneous employment of dahlia and malachite-green the nucleus can be stained green and the protoplasm violet.

Diphenylamine-blue, which colours deeply vegetable débris, dead organisms, and some living microbes, colours neither parenchyma, nucleus, nor contractile vacuole of Infusoria, except the central part of the contractile peduncle of Vorticellas.

M. Certes has tried the cultivation of micro-organisms on plates of jelly coloured by diphenylamine-blue. The development of the colonies goes on in the usual way. Some remain uncoloured; others, apparently identical, are coloured. The jelly becomes decolorized whenever it is liquefied by the organisms.

Staining Vaucheria and Chara.*—Dr. J. Schaarschmidt finds that the granules of *Vaucheria* (*V. sessilis*, and *V. geminata*) which have been treated with osmic acid, glycerin, and alcohol, show different reactions with stains and reagents to those of *Saprolegnia*. The internal spongy part of the younger granules takes up the staining material with avidity, whereas the peripheral part remains colourless or only faintly stained.

They are most strongly stained by nigrosin, rosanilin, eosin, and saffranin; methyl-violet and gentian-violet stain especially the inner part of the granules. They are very resistant to strong chemicals, and in dilute or fairly concentrated sulphuric acid they are hardly altered even after several days. They are only dissolved by quite concentrated sulphuric acid.

Staining of Koch's Bacillus.†—Dr. B. Frankel proposes the following formula and methods:—

3 c.cm. anilin oil are dissolved in 7 c.cm. alcohol (or 1·5 c.cm. toluidin in 8·5 c.cm.) and added to 90 c.cm. of distilled water. To 100 parts of this 11 parts of a saturated watery solution of methyl-violet or fuchsin (Weigert). To prepare a solution fresh for use Frankel heats about 5 c.cm. of anilin or toluidin to boiling in a test-tube, and pours it into a watch-glass. To this hot solution the alcoholic solution of the dye is added drop by drop until a deep opalescent colour but no precipitate is obtained. Cover-glass specimens of bacteria floated on this hot solution are stained in two minutes.

The following solutions are used for contrast staining.

1. *Blue.* Alcohol 50, water 30, nitric acid 20; as much methyl-blue as is dissolved by shaking.

2. *Brown.* Alcohol 70, nitric acid 30; as much vesuvin-brown as will dissolve.

3. *Green.* Alcohol 50, water 20, acetic acid 30; as much malachite or methyl-green as will dissolve.

The cover-glasses are stained in these solutions for 1–2 minutes,

* Magyar Növénytani, viii. (1884) pp. 1–13.

† Berl. Klin. Wochenschr., 1884, No. 13.

washed in water or 1 per cent. acetic acid, and then in 50 per cent. alcohol, and dried (firstly between folds of blotting-paper, and then by passing them several times through a flame). In this way one can obtain a perfectly satisfactory double-stained specimen in four minutes.

Staining Bacteria with Dahlia.* — Dr. Ribbert employs for staining the micrococci of pneumonia in sputum a solution of dahlia, which stains the cocci deep blue and the capsules of a lighter hue. Typhoid bacilli in lymphatic glands were better stained by a solution of dahlia in anilin water, according to Gram's method, than by any other process.

Pergens's Picrocarmine.†—This is prepared as follows:—Boil for two hours and a half 500 grms. pulverized cochineal in 30 litres of water. Add 50 grms. potassic nitrate, and, after a moment of boiling, 60 grms. oxalate of potash; boil 15 minutes. On cooling, the carmine precipitates; it is washed several times with distilled water in the course of three or four weeks. Pour a mixture of one volume of ammonia with four volumes of water upon the carmine, taking care that the carmine remains in excess. After two days filter, and leave the filtered solution exposed to the air until a precipitate forms. Filter again, and add a saturated aqueous solution of picric acid; agitate, and then allow it to stand for twenty-four hours. Filter, and add 1 grm. chloral for each litre of the solution. At the end of eight days separate the liquid from the slight precipitate which is formed, and it is ready for use.

This liquid keeps unchanged for at least two years, and is recommended by Carnoy in preference to other picrocarmine solutions.

Application of the Colouring Matter of Red Cabbage in Histology.‡—Dr. M. Flesch concentrates the watery extract of red cabbage by evaporation, mixes with a solution of acetate of lead, and precipitates the latter as insoluble carbonate of lead by carbonic acid, whereby the greater part of the colouring matter is thrown down with the lead precipitate. After washing on a filter, the precipitate is dissolved by acid, the solution carefully neutralized, and treated with sulphuretted hydrogen. The filtrate contains a clear solution of the colouring matter, which is dried and dissolved, one part in water and another part in alcohol. In fresh preparations nuclei are stained green and protoplasm red. Both solutions proved to be good nuclear stains, even in preparations (brain hardened in chromic acid) in which carmine failed.

Double Staining.§—The following solutions are recommended by Dr. J. Brun for animal histology.

a. Blue. Soluble prussian blue 1 grm., oxalic acid 0·25 cgrm.

* SB. d. Niederrhein. Gesell. in Bonn, 1884, pp. 244–5.

† Amer. Natural, xix. (1885) p. 428, from Carnoy's 'Biologie Cellulaire,' 1884, p. 92. See also Lee's 'Microtomist's Vade Mecum,' 1885, p. 60–1.

‡ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 253–4.

§ Arch. Sci. Phys. et Nat., xiii. (1885) pp. 257–60.

These are allowed to act for some hours with a small quantity of water, and 100 grms. of pure water are then added. Filter.

b. Red. Dissolve 0·50 cgrm. of alum in 10 grms. of water, and add 0·50 cgrm. of saffranin dissolved in 10 grms. of pure alcohol. Filter.

The objects or sections are washed in distilled water and placed in the blue solution for 5–10 minutes. They are then washed in a large quantity of pure water and placed in the red solution for 5–10 minutes.

Before staining intestinal worms they are rendered transparent by a mixture of acetic acid and glycerin.

Staining Tissues for Photo-micrography.*—Hæmatoxylin stainings in very thin sections, while all that can be desired under the Microscope, are usually very disappointing when photographed; the delicate layer of tissue offers almost no actinic contrast when monochromatic sunlight is obtained by the ammonio-sulphate of copper cell. Since hæmatoxylin is so extensively employed, a ready modification to meet the needs of photography is of advantage, and the following is suggested by Dr. G. A. Piersol. While especially intended for nervous tissues it produces specimens of all organs admirably adapted for photography. No especial formula for hematoxylin is needed, using one which is capable of staining deeply and giving standard results. In the usual course of work the sections are stained; a very few thin ones, however, are allowed to remain in the solution, after those for ordinary preparation, until they are of an intense dark purple, when they are transferred, one by one, to a capsule containing a solution of borax 1·0; potassium ferricyanide 2·5; water 100·0. In this they are kept moving until the intense colour is gradually discharged, and the purple tint is replaced by a bronze-yellow, shading to saffron. Before the sections reach the latter colour they should be washed in water; the further usual steps in mounting are then completed.

Sections so stained, and mounted in balsam, will be found to possess all the differentiation given by hæmatoxylin, with a change from the purplish blue colour to the subdued tones of brown—a substitution often most pleasing and grateful to the eye.

Collodion and Phenol in Microscopical Technique.†—Dr. Bergonzini transfers sections which have been made from preparations hardened in alcohol or other reagent, and stained or not, from water into phenol (in which they become transparent) and mounts in a suitable medium. The specimen has not to be dehydrated as in other methods. The action of the phenol can be hastened by gently warming it. Pure phenol is used, to which only as much water is added as will dissolve it. Some recommend the employment of phenol and alcohol in equal parts.

Small animals, e. g. Insecta, can be placed alive in the phenol, which kills and renders them transparent.

* Amer. Mon. Micr. Journ., vi. (1885) p. 41–2.

† Lo Spallanzani, 1883, p. 196.

Dry Mounting of Opaque Objects.*—In the case of opaque objects it frequently happens that the cover-glass becomes covered with a film of oily or watery particles which condense upon its under surface. Prof. W. A. Rogers, whose rulings, as formerly prepared, were frequently injured in appearance by this condensation, has at last, so he believes, entirely obviated this annoyance. He now uses a brass ring for a cell to hold the ruled cover-glasses, but free communication between the air within and without the cell is established through a minute perforation in the side of the cell. Some preparers have been in the habit of maintaining this free communication by leaving a bristle or a thread passing through the wall of the cell until the mount is finished, after which it is withdrawn, thus making a minute perforation.

Examination of Water for the Development of Micro-organisms.†—The following methods are recommended by Dr. Tiemann.

200 cc. of water are placed in vessels carefully purified, disinfected by hot air, and plugged with disinfected cotton wool. The water is drawn up by a pipette, which has been well washed with distilled water. A drop of the water, which has been well shaken, is placed on a cover-glass, which is set with the drop downwards on a glass slide hollowed out in the centre, and magnified 100–500 times. Several such preparations are allowed to dry on the cover-glass, and then stained with methyl-blue, dried, and mounted in Canada balsam. The bacteria are thus stained blue.

To estimate the numbers of the organisms in the water, a certain quantity (1/1000–10 drops) is mixed with nutrient jelly. The quantity is measured in a graduated pipette, which has been previously heated, and washed with distilled water as well as several times with the water under examination. Each sample is added to 10 cc. of liquefied jelly, which is spread on a glass plate previously sterilized by heat. The colonies develop in the jelly, beneath a bell-jar, the air in which is kept damp, at various parts of the plate, and the number per square cm. is counted under a magnification of 30 diameters. The mean of the values thus obtained × the area of the jelly gives the number of organisms in the sample, and the number of the same per cc. of water can be calculated. For counting, one uses a plate divided into square centimetres, which is placed beneath the test-plate. The estimated is always less than the real number, as some colonies cover each other, and all the micro-organisms do not develope.

Examination of Water for Organisms.‡—If a sample of water contains but few organisms, these may easily escape observation under the Microscope. Mr. H. S. Carpenter and Mr. W. O. Nicholson have, therefore, devised a method by which these organisms may be cultivated, and consequently become so numerous as to be readily recognizable.

* Amer. Mon. Micr. Journ., v. (1884) pp. 210–11.

† Verh. Deutsch. Gesell. f. öffentl. Gesundheitspflege zu Berlin, 1883.

‡ Analyst, ix. (1885) pp. 94–6. See Journ. Chem. Soc.—Abstr., xlviii. (1885) pp. 442–3.

The necessary apparatus consists of:—(1) A short-necked four-ounce flask, fitted with a caoutchouc stopper through which two tubes pass; they are bent at right angles, and have their external ends drawn out; (2) a tube with a bulb (about 25 ccm. capacity) blown on the side, and the ends tapering to fine points; (3) a long combustion-tube 18 in. long, loosely packed for 10 in. with asbestos, which can be connected with a refrigerator. About 50 ccm. of Pasteur's solution are boiled in the flask, the combustion-tube is heated to, and kept at, a red heat, a slow current of air is passed through, the flask is attached, and the tubes are sealed up while the sterilized air is passing and the solution is boiling. A bulb-tube is sealed up at one end, distilled water is introduced and boiled off, and the other end is sealed up while the tube is full of aqueous vapour; one end is now broken off under the surface of the water to be examined, and when the bulb is full the end is immediately sealed up again. The heated combustion-tube is now connected with the refrigerator, and a rapid current of air passed to clear the apparatus; one end of the bulb-tube is connected by means of indiarubber tubing with the refrigerator, which is now cooled; the other by a similar connection with one of the flask-tubes; all the ends are broken by pressing the indiarubber connections, and the water from the bulb-tube rushes into the partially vacuous flask, followed by the cooled sterilized air; the flask-tube is then sealed up and placed in a convenient place for the development of the organisms, and the apparatus disconnected. All requisite precautions are taken to avoid the admission of extraneous organisms.

Removal of Microbes by Filtering.*—M. C. Chamberland finds that a filter composed of porous unglazed porcelain will entirely free any fluid from the microbes which it may contain. It is cleaned with the greatest ease by heating.

Effect of Prolonged Repose and Filtration through Porcelain on the Purity of Water.†—Prof. H. Fol and M. P. L. Dunant describe experiments on this subject. Struck by the small number of germs in the water of the Lake of Geneva compared with that of other drinking waters, and attributing it to the repose of the water, the authors resolved to test this theory. Impure water, estimated to contain not less than 150,000 germs per c.cm., was allowed to stand, and after eight days it was found that it had lost 94 per cent. of the germs, only one in seventeen remaining in suspension. At the end of fifteen days 23 per cent. more had sunk to the bottom, making 95·3 per cent. for the three weeks.

Water that had been passed through Chamberland's unglazed porcelain filters was found to be quite sterile, and the authors consider that not only water, but any liquid sufficiently fluid to pass through the porcelain under a pressure of from two to three atmospheres can thus be sterilized cold.

Determination of the Number of Germs in Air.—Prof. H. Fol writes that he now constantly employs curved tubes closed at one end

* Comptes Rendus, xcix. (1884) pp. 247–8.

† Arch. Sci. Phys. et Nat., xiii. (1885) pp. 110–8.

by the small funnel stopper mentioned *ante*, p. 362. The lower end of the tube, bent somewhat in the shape of a letter S lying down—ᔕ, is attached to the flexible tube of the aspirator, the upper end being closed by the funnel stopper. This is plugged at its lower end by sterilized glass wool, which is covered by a layer of sterilized salt. After the air has been drawn by the aspirator through this double plug, the salt, with the retained germs, is added to the bouillon used for the culture operations.

Examining Vegetable Powders.*—In the microscopical investigation of a vegetable powder as to its purity and its freedom from adulteration, Dr. A. Meyer recommends that it should be examined in water under a power of 50 diameters, and if a foreign element is detected this is magnified 180 diameters, and drawn with a camera lucida. The drawing is then compared with drawings which have been made under a similar magnification of the elements of the suspected adulterating material. Lastly, one compares, under a very high power, the suspected elements with as freshly-prepared specimens as possible of the adulterating material.

An account of the anatomical appearances and structure of the fruits of the buckwheat and maize follows, with a description of the action upon them of reagents: e. g. potash, Schultze's fluid, &c.

Sterilization of Fermentable Liquids in the Cold.†—M. A. Gautier describes a process for sterilization in the cold by means of a filter made of biscuit porcelain or faience rendered vacuous. The filter is placed in the particular liquid and the receiver connected with it. The liquid passes through the porous walls of the filter and thence into the receiver, and in this way solutions of albumen, serum, grape-juice, peptones, milk, &c., can be sterilized without the application of heat.

Ady, J. E.—**The Microscopic Study of Rocks. III., IV.**
[Methods of procuring suitable specimens of rocks and preparing sections from them for microscopical examination, with a description of hammer, and slitting and grinding machine.]
[Petrographist's grinding bench—Mounting rock sections for microscopical examination.]
Ill. Sci. Monthly, III. (1885) pp. 99–103 (4 figs.), 131–3 (2 figs.).

Anderson, J., Jun.—**Crystals for the Polariscope.**
[Complaint that such slides are not permanent. Nearly all his slides "show signs of deterioration, and in some the crystals have vanished altogether."]
Sci.-Gossip, 1885, p. 90.

Assmann, R.—**Mikroskopische Beobachtung der Wolken-Elemente.** (Microscopical Observation of Cloud-Elements.) [*Post.*]
Naturforscher, XVIII. (1885) pp. 120–30, from *Meteorolog. Zeitschr.*, II. (1885) p. 41.

Aubert, A. B.—**The Gum of Liquidambar styraciflua or American Storax as a Mounting Medium.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) pp. 86–7.

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* Zeitschr. f. Wiss. Mikr., i. (1884) p. 309.

† Bull. Soc. Chim., xlii. pp. 146–50. See Journ. Chem. Soc.—Abstr., xlviii. (1885) pp. 287–8.

BAYERL, B.—**Die Entstehung rother Blutkörperchen im Knospel aus Ossificationsrande.** (The origin of red blood-corpuscles in cartilage at the margin of ossification.) [*Supra*, p. 537.]

Arch. f. Mikr. Anat., XXIII. (1884) pp. 30–45.

BERTHOLD, V.—**Ueber die Mikroskopischen Merkmale der wichtigsten Pflanzenfasern.** (On the microscopic characteristics of the most important vegetable fibres.)

[Cf. Vol. IV. (1884) p. 829.]

Beil. d. Zeitschr. f. Landwirthsch. Gewerbe, 1883, Nos. 3–4.
Zeitschr. f. Warenkunde, 1883, pp. 14–5, 17–8 (16 figs.).

„ „ **Ueber den Mikroskopischen Nachweis des Weizenmehls im Roggenmehl.** (On the microscopical determination of wheat-meal in rye-meal.)

[Cf. Vol. III. (1883) p. 604.]

Beil. z. Zeitschr. f. Landwirthsch. Gewerbe, 1883, pp. 1–3 (8 figs.).

BLOCHMANN.—See Kirchner.

BONNET, R.—**Kurzgefasste Anleitung zur Mikroskopischen Untersuchung thierischer Gewebe.** (Brief introduction to the microscopical investigation of animal tissues.) 8vo, München, 1884.

BOWER, F. O., VINES, S. H., and DYER, W. T. T.—**A Course of Practical Instruction in Botany.** Part I. Phauerogamæ—Pteridophyta.

[Contains:—Introductory Chapters. I. Methods and Reagents: A. Making Preparations; B. Micro-chemical Reagents. II. Structure and Properties of the Cell: A. General Structure; B. Micro-chemistry of the Cell; C. Micro-physics of the Cell, pp. 1-43. Practical Directions for the Study of Types, pp. 44–226; and see *supra*, p. 484.]

xi. and 226 pp., 8vo, London, 1885.

BRUN, J.—**Procédé de double coloration applicable aux études microscopiques.** (Method of double staining for microscopic purposes.) [*Supra*, p. 558.]

Arch. Sci. Phys. et Nat., XIII. (1885) pp. 257–60.

BÜTSCHLI, O.—See Kirchner.

CARPENTER, H. S., and W. O. NICHOLSON.—**Examination of Water for Organisms.** [*Supra*, p. 560.] *Analyst*, IX. (1885) pp. 94–6.

CERTES, A.—**De l'emploi des matières colorantes dans l'étude physiologique et histologique des Infusoires vivants.** (On the employment of colouring matters in the physiological and histological study of living Infusoria.) [*Supra*, p. 555.]

Sep. repr. *CR. and Mém. Soc. Biol.*, 1884, 7 pp.

COLE, A. C.—**Studies in Microscopical Science.**

Vol. III. Sec. I. Part 3, pp. 9–12. Formation of Cystocarps in *Batrachospermum*. Plate III. *Batrachospermum* showing Cystocarps. Part 4, pp. 13–16. Structure of the Apothecium in *Solorina*. Plate IV. *Solorina crocea*. V. S. of Thallus and Apothecium.

Sec. II. Part 3, pp. 9–12. The Primitive Cell and its Progeny (*concluded*). Glands (in part). Plate III. *Anodon*. T. S. of Organ of Bojanus × 250. Part 4, pp. 13–16. Glands (*concluded*). Plate IV. Liver of Lobster (*Homarus vulgaris*). Tr. Sec. × 150.

Sec. III. Part 3, pp. 9–12. Alveolar Pneumonia (*concluded*). Plate III. 3rd stage × 170. Part 4, pp. 13–5. Broncho-pneumonia. Plate IV. × 100.

Sec. IV. Part 3, pp. 9–12. Spiders (*concluded*). Plate III. Jaws of Spider *Epeira diadema*, female, × 75. (Includes Methods of preparation: (1) Cambridge's process for preserving spiders entire; (2) Method of preparing and mounting dissections.

["The spinneret, leg, and falces having been respectively removed from the spider are placed separately in liq. pot. for 24–36 hours; then soaked in water to remove the potass: then placed in acetic acid (in which such parts of insects, &c., may always be preserved until required for mounting); then again soaked in water; then placed in methylated spirit for a short time; then cleared by means of oil of cloves, and lastly transferred to turpentine, and mounted 'without pressure' in cells. The

tongue of the spider carefully dissected out, forms an interesting preparation. The various parts of the mouth may also be dissected and separately mounted, the skin may be stained with carmine or logwood, and mounted in Canada balsam, whilst the eyes of many spiders, other than the well-known brilliant eyes of the jumping spiders, may be mounted in balsam, in cells as opaque preparations, with the best results."]

Part 4, pp. 13-6. Leeches (in part). Plate IV. Trans. Sec. Medicinal Leech × 50.

Culture Media for Bacteria.

[Directions for preparing flesh-peptone-gelatin, and directions for using the gelatin in plate-cultures and test-tube cultures.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 55–7, from *Journ. Amer. Med. Assoc.*

CYBULSKY, J. B.—**Das Nervensystems der Schnauze und Oberlippe von Ochsen.** (The nervous system of the muzzle and upper lip of oxen.)

[Contains methods, *supra*, p. 555.]

Zeitschr. f. Wiss. Zool., XXXIX. (1883) pp. 653–82.

D., E. T.—**Graphic Microscopy.**

XVI. Eggs of Vapourer Moth.

XVII. Transverse Section of Spine of *Echinus*.

Sci.-Gossip, 1885, pp. 73–4 (1 pl.) pp. 97–8 (1 pl.).

DAVIS, J. J.—**A simple Cover Compressor.**

["Divide a small cork transversely and cut a notch in one end of one of the pieces. Pass an ordinary stationer's rubber elastic ring over the end of the slide; put the piece of cork under it, the ring resting in the notch; then draw it along until the under side of the ring will rest under the point to which the pressure is to be applied, then lower the cork on the cover. If more pressure is desired a second ring may be placed over the first. Pieces of cork of different lengths give more or less pressure, and those of different diameters apply it over more or less space. The slides can be laid away side by side."]

The Microscope, V. (1885) p. 36.

DEBES, E.—**Das Reinigen und Präpariren von Diatomaceen-Material.** (Cleaning and preparing diatom material.) [*Post.*]

Hedwigia, XXIV. (1885) pp. 49–66.

DOLLEY, C. S.—**Preservation of Jelly-fishes at the Naples Zoological Stations.**

[Statement of the results obtained by Signor Lo Bianco, but no description of the method.]

Science, V. (1885) p. 272.

DYER, W. T. T.—See Bower, F. O.

EHRLICH.—[Susceptibility of the different tissues to colouring matters.]

[*Supra*, p. 554.]

Nature, XXXI. (1885) pp. 547–8 (Report of Proceedings of Berlin Physiological Society, 27th February, 1885.)

ETTI.—**Verhalten von Tannin und Eichenrindegerbsäure gegen verschiedene Reagentien.** (Behaviour of tannin and quercitannic acid with different reagents. *Ber. Deutsch. Chem. Gesell.*, 1884, No. 13.

EWART, J. C., and J. D. MATTHEWS.—**Directions for the examination of *Amœba*, *Paramœcium*, *Vorticella*, *Hydra*, *Lumbricus*, *Hirudo*, *Asterias*, and *Echinus*.**

4to, Edinburgh, 1885, 32 pp.

EYFERTH, B.—**Die einfachsten Lebensformen des Thier- u. Pflanzenreiches. Naturgeschichte der Mikroskopischen Süsswasserbewohner.** (The simplest forms of life in the animal and vegetable kingdoms. Natural history of the microscopical inhabitants of fresh water.)

2nd ed., 130 pp. and 7 pls., 4to, Braunschweig, 1885.

FABRE-DOMERGUE, P.—**Note sur les Rhizopodes et les Infusoires des eaux de Toulouse, leur récolte et leur préparation.** (Note on the Rhizopods and Infusoria of Toulouse, their collection and preparation.)

[Describes principally M. Certes' methods. Also a current apparatus, *supra*, p. 526.]

Bull. Soc. D'Hist. Nat. Toulouse, XVIII. (1885) pp. 152–88.

FRANCOTTE, P.—**Tableaux synoptiques représentant les principales manipulations dans les laboratoires d'histologie et d'anatomie comparée.** (Synoptical tables of the principal processes in histological and comparative anatomy laboratories.)

Bull. Soc. Belg. Micr., XI. (1885) pp. 134–42. Extracted from the author's 'Manuel de Technique Microscopique,' in the press.

Gierke, H.—**Staining Tissues in Microscopy. I, II.**

[Transl. by Prof. W. H. Seaman from 'Zeitschr. f. Wiss. Mikr.']

Amer. Mon. Micr. Journ., VI. (1885) pp. 65–8 and 76, 89–94.

GRANT, F.—**Microscopical Staining—Mounting Bacteria.**

[Description of "methods with reference to sputum in particular, but also with reference to bacteria or Schizomycetes generally."]

Engl. Mech., XLI. (1885) pp. 212–4.

HARRISON, W. J.—**Simple Methods of making Lantern-slides.**

[Includes "pictures of what one has actually seen . . . through . . . the Microscope."]

Knowledge, VII. (1885) pp. 284–5, 326.

HAY, O. P.—**Some Anatomical and Histological Methods.**

[1. Modification of Semper's method of making dry preparations. 2. A method of making double injections for dissecting purposes. 3. A method of producing double injections for histological purposes. *Post.*]

Amer. Natural., XIX. (1885) pp. 526–9 (1 fig.).

HOLL, M.—**Tolu statt Chloroform bei Paraffineinbettung.** (Tolu instead of chloroform in paraffin imbedding.) [*Supra*, p. 541.]

Zool. Anzeig., VIII. (1885) pp. 223–4.

IBIZA, L. é.—[Gelatine-glycerine as a substitute for Canada balsam.]

[*Post.*] *An. Soc. Españ. Hist. Nat.*, XIV. (1885) Actas, pp. 12–15.

JENKINS, A. E.—**New methods of Work.** (*In part.*)

[Lavdowsky's 'Myrtillus,' vol. iv. p. 652, and Heidenhain's Hæmatoxylin, *ante*, p. 158.]

The Microscope, V. (1885) pp. 85–7.

KAATZER, P.—**Die Technik der Sputum-Untersuchung auf Tuberkel-Bacillen.** (The technics of the investigation of sputum for tubercle-bacilli.)

2nd ed., 15 pp., 8vo, Wiesbaden, 1884.

KIRCHNER, BLOCHMANN, and BÜTSCHLI.—**Die Mikroskopische Pflanzen- und Thierwelt des Süsswassers. Theil I. Die Mikroskopische Pflanzenwelt des Süsswassers.** (The microscopical vegetable and animal world of fresh-water. I. The microscopical vegetable world of fresh-water).

56 pp. (4 pls.), 4to, Braunschweig, 1885.

KLEIN, E.—**Micro-organisms and Disease. An introduction to the study of specific micro-organisms.**

[Contains chapters on "Microscopic examination," "Preparation of culture material," "Vessels and instruments used in cultivation," "Methods of insulation," &c.]

2nd ed., xii. and 201 pp., 116 figs., 8vo, London, 1885.

KONINCK, L. DE.—**Essais microchémiques par voie sèche, procédé de Bunsen. Résumé à l'usage des Laboratoires d'Instruction.** (Microchemical assays by the Bunsen dry method. *Résumé* for the use of laboratories.)

7 pp. and table, 8vo, Liège, 1885.

MATTHEWS, J. D.—See Ewart, J. C.

MCCALLA, A.—**The Working Session.**

[Remarks on its usefulness—also in reply to the criticisms on his claim to be the originator of it, *ante*, p. 366.]

The Microscope, V. (1885) pp. 77–81 and 89.

"MEDICINÆ DOCTOR."—**Mounting Bacteria.**

[Comments on F. Grant's note, *supra*.]

Engl. Mech., XLI. (1885) p. 238.

MEYER, A.—**Ueber die Mikroskopische Untersuchung von Pflanzenpulvern, speciell über dem Nachweis von Buchweizenmehl in Pfefferpulver und über die Unterscheidung des Maismehles von dem Buchweizenmehle.** (On the

microscopical investigation of vegetable powders, especially with regard to the detection of buckwheat flour in pepper powder, and on the discrimination of maize flour from buckwheat flour.) [*Supra*, p. 562.]

Arch. d. Pharm., CCI. (1883) p. 912.

Michelson, P.—**Ueber die Verwerthung der Säure-fuchsinfärbung (nach Weigert) für dermatologische Zwecke.** (On the application of Weigert's acid fuchsin staining in dermatology.)

Monatsschr. f. prakt. Dermatol., II., No. 12.

Mojsisovics v. Mojsvár, A.—**Leitfaden bei zoologisch-zootomischen Präparirübungen.** (Guide to zoological-zootomical preparation.)

2nd ed., xii. and 259 pp., 127 figs., 8vo, Leipzig, 1885.

Nelson, E. M.—**Dr. Koch's Comma Bacillus.**

[Denial of the suggestion, *ante*, p. 383, that Brittain and Swayne discovered this thirty-five years ago. The art of staining micro-organisms was then unknown, and the "microscopy" of that day could not have been equal to the occasion."]

Engl. Mech., XLI. (1885) p. 82.

Neville, J. W.—**Crystals for the Polariscope.**

[Remarks on their instability.] *Sci.-Gossip*, 1885, p. 115.

Nicholson, W. O.—See Carpenter, II. S.

Otto, J. G.—**Untersuchungen über die Blut-Körperchenzahl und dem Hämoglobin Gehalt des Blutes.** (Researches on the number of blood-corpuscles and the amount of hæmoglobin in the blood.)

Arch. f. d. Gesammt. Physiol., XXXVI. (1885) pp. 12–72 (6 figs.).

Pelletan, J.—**Sur l'emploi du baume de Tolu pour les préparations de Diatomées.** (On the employment of balsam of tolu for diatom preparations.)

[Copy of M. Amann's note, *ante*, p. 353, and caution against using Tolu.]

Journ. de Microgr., IX. (1885) pp. 131–2.

Pergens's Picro-carmine. [*Supra*, p. 558.]

Amer. Natural., XIX. (1885) p. 428, from Carnoy's *Biologie Cellulaire*, 1884, p. 92.

Queen, J. W.—["Stratena" (glue made fluid by the addition of a small quantity of acetic or nitric acid) recommended for protecting slides against the oil of immersion lenses, and as a cell-substance and finish for objects mounted in various oily media.]

Micr. Bulletin, II. (1885) p. 12.

Ribbert.—**Ueber Spaltpilzfärbung mit Dahlia.** (On staining Schizomycetes with dahlia.) [*Supra*, p. 558.]

Verh. Nat. Ver. Preuss. Rheinl. u. Westfalens, XLI. (1884)—SB. pp. 244–5.

Salmon, D. E., and T. Smith.—**Koch's method of isolating and cultivating Bacteria, as used in the Laboratory of the Bureau of Animal Industry, Dept. Agriculture.** *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 81–4.

Satterthwaite, T. E.—**Manual of Histology and Histological Methods,**

2nd ed., 8vo, New York, 1884.

Seaman, W. H.— See *Gierke, H.*

Slack, H. J.—**Pleasant Hours with the Microscope.** [Molecular motion.]

[Seeds and Carter's box of seeds for the Microscope.]

Knowledge, VII. (1885) pp. 318–9, 408–410 (2 figs.).

Smith, T.—See Salmon, D. E.

Solla, R. F.—**Ueber zwei wahrscheinliche Mikrochemische Reactionen auf Schwefelcyanallyl.** (On two probable micro-chemical reactions of sulphocyanate of allyl.) *Bot. Centralbl.*, XX. (1884) pp. 342–5.

Stowell, C. H.—**The Student's Manual of Histology.**

3rd ed., 370 pp., 8vo, Ann Arbor, 1885.

[Stowell, C. H., and L. R.].—**"Anything to win."**

[Polemical remarks on the controversy as to White Zinc cement.]

The Microscope, V. (1885) pp. 88–9.

Tiemann.—**Untersuchung des Wassers auf entwicklungsfähige Mikroorganismen.** (Investigation of Water for Micro-organisms capable of developing.) [*Supra*, p. 560.]

Verhandl. Deutsch. Gesell. f. öffentl. Gesundheitspflege zu Berlin, 1883.

TOLDT, C.—**Lehrbuch der Gewebelehre mit vorzugsweiser Berücksichtigung des menschlichen Körpers.** (Text-book of Histology, with special reference to the Human Body.) 2nd ed., xiv. and 679 pp. (195 figs.), 8vo, Stuttgart, 1884.

VÉTILLART, M.—**Method of Analysis of Fibres, Tissues, &c.**

[Arrangement in tabular form of the more prominent characteristics which distinguish twenty fibres from each other.)

Amer. Mon. Micr. Journ., VI. (1885) pp. 47–52, from *Études sur les Fibres.*

VINES, S. H.—See Bower, F. O.

VORCE, C. M.—**The Working Session of the American Society of Microscopists.**

[Scheme of work for demonstration at the next Session, under twenty-four heads.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 34–5.
The Microscope, V. (1885) pp. 40–1.

WALTERS, H. A.—**A Net for Microscopists.** [*Supra*, p. 535.]

Sci.-Gossip, 1885, pp. 78–9.

WHITNEY'S (J. E.) **Preparations of Plant-hairs.**

Amer. Mon. Micr. Journ., VI. (1885) p. 58.

WIENACK, L.—**Anleitung zur Erkennung organischer und unorganischer Beimengungen im Roggen- und Weizenmehl.** (Introduction to the recognition of organized and unorganized admixtures with rye-flour and wheaten-flour.)

64 pp. and 2 pls., 8vo, Leipzig, 1884.

WORMLEY, T. G.—**Micro-Chemistry of Poisons,** including their physiological, pathological, and legal relations, with an appendix on the detection and microscopic discrimination of blood, adapted to the use of the medical jurist, physician, and general chemist.

2nd ed., 784 pp., 17 pls. and 1 table, 8vo, Philadelphia, 1885.

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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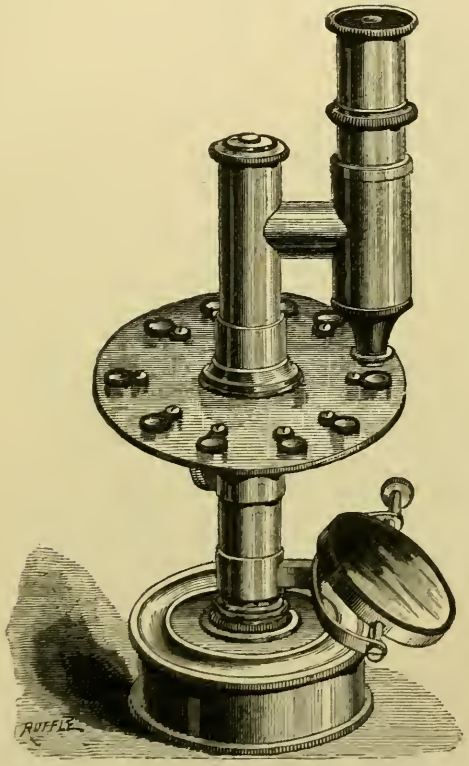
1885.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Revolving Stage Microscope.—This instrument (fig. 136) appears to have anticipated those of Klönne and Müller and of Mirand figured in this Journal, Vol. III. (1880) p. 144, and Vol. III. (1883) p. 897. No definite date can be assigned to it, but it bears the appearance of

Fig. 136.



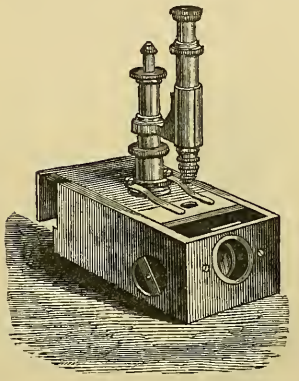
having been made at least twenty-five years ago. It was apparently designed for some special purpose, as the rotating stage is only 4 in. in diameter, and is not adapted to take even the smallest-sized slides. The objects were placed in ten circular apertures (5/16 in. in diameter)

* 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.

in the stage, the bottom of each being closed by a piece of glass. They were protected by a cover-glass, which was held in a pivoted frame, so that it could be turned away from the cell when desired. The instrument is of French workmanship.

The arrangement for focusing is peculiar, the arm carrying the body being raised and lowered by the milled head below the stage at the back.

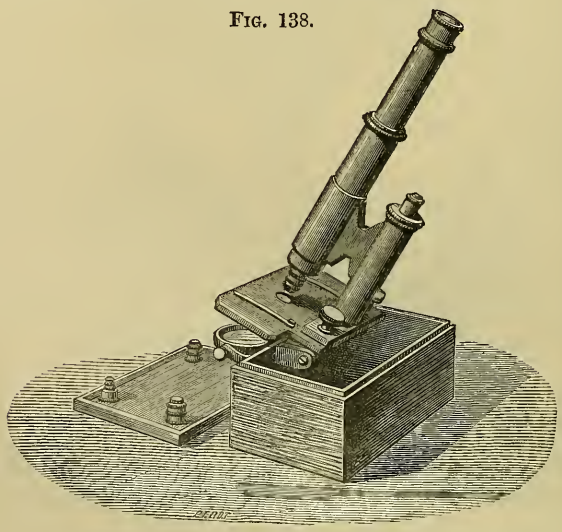
Fig. 137.



Portable Microscopes. — The following forms complete, we believe, the history of portable Microscopes, many of which have been already illustrated in the Journal.

Nachet's Pocket and Portable Microscopes —The original form of M. Nachet's Pocket Microscope for powers up to 1/8 in., constructed in 1854, is shown in fig. 137. The metal box into which it is packed measures $3\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{5}{8}$ in. In use the Microscope was screwed to the box, as shown in the fig. The mirror is seen through the opening in front, which is closed by a disk of glass. It has a fine adjustment, and for oblique light it is sufficient to slide back the lid of the box as shown in the fig.

Fig. 138.

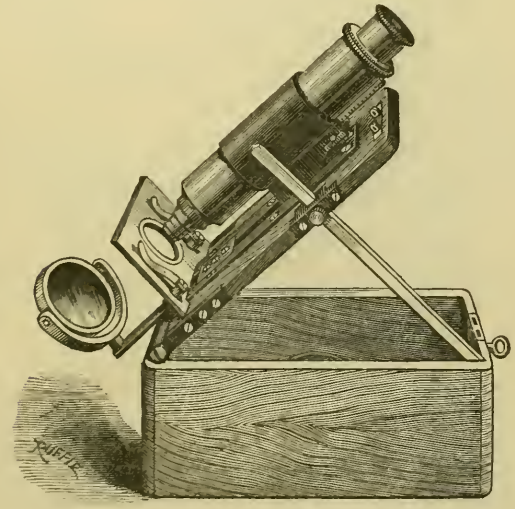


To meet the demand for a portable Microscope of larger size, M. Nachet devised the newer model shown in fig. 138. This when closed

is $5\frac{3}{4} \times 3\frac{1}{4} \times 2\frac{3}{4}$ in. The Microscope is screwed to a metal plate which turns on a hinge joint at the side of the box. This plate forms the stage, and carries a mirror beneath. When the Microscope is removed and placed in the box the plate is turned back on the top of it. A rackwork coarse adjustment has since been added. The Microscope can be inclined, as shown in the figure, or used vertically. To prevent overbalancing, the bottom of the box is provided at each end with a flat brass slide, which can be extended 2 in. in front of the box.

Collins's Portable Microscope.—The peculiarity of Mr. C. Collins's portable Microscope (fig. 139) is that it is permanently attached to the

Fig. 139.



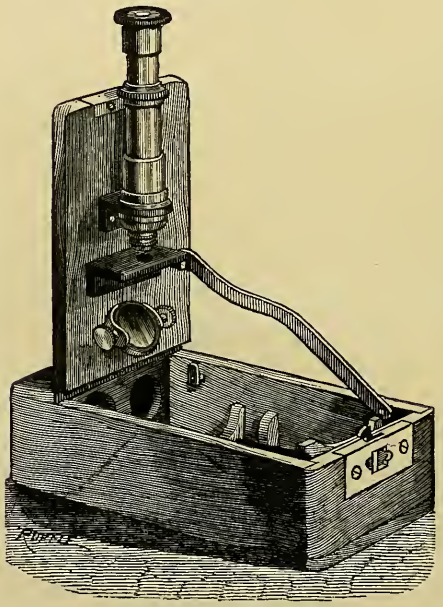
lid of the box, so that no time is lost in screwing it to its support as in other cases. The lid itself is fixed to the box, and has a hinge joint at its lower end by which it can be inclined. A small clamp-screw acting on the brass support fixes the lid, and with it the body-tube, at any desired degree of inclination.

To replace it in the box the mirror is pushed up to meet the stage, the body-tube racked down, and the inclined support withdrawn and allowed to fall into the box. The lid is turned a half-circle on a pivot at the centre of its lower end, so that the Microscope now faces the inside of the box, into which it can then be dropped by means of the hinge on the lid.

Box Microscope.—The instrument shown in fig. 140 was purchased in Paris, and was apparently made some twenty-five years ago. Like that of Mr. Collins, the Microscope is fixed to the lid, and when not

in use the body-tube is removed and divided, and the two pieces packed in the box, which can then be closed by the lid. It can only be used upright, as there is no provision for inclining it.

Fig. 140.

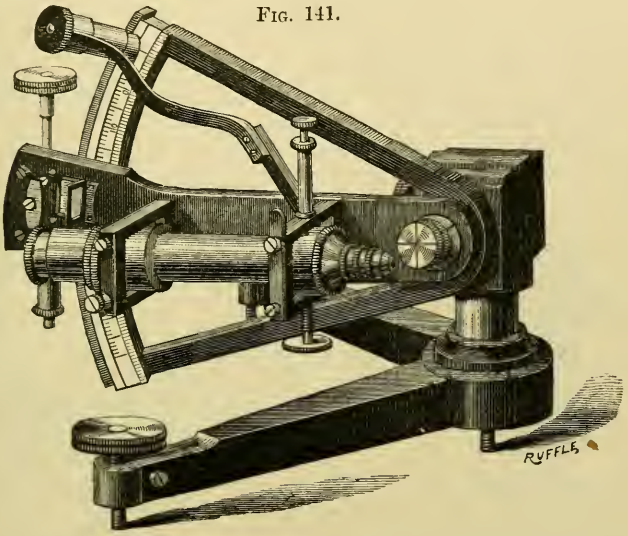


Pfaff's Microgoniometer.* — Dr. F. Pfaff's microgoniometer (fig. 141) is practically a theodolite in which the telescope is replaced by a Microscope. A short pillar carries a large block to which the arc, graduated to 58°, is attached. The block has two sockets in faces at right angles to each other, so that the arc can be set vertically, as in the fig., or horizontally. The alhidade can be clamped at any point of the arc by a screw behind the latter, a slight movement being still capable of being imparted to the alhidade by the other milled head. The vernier reads to 4″. The lens is for reading the angles. The Microscope rests in the two frames attached to the alhidade, shown in the fig., and can be depressed or raised at the lower end by a spring screw (so that its axis coincides in direction with a radius of the arc), or moved nearer to or further from the centre of the circle by loosening the side screws in the frames. For microscopic objects a stage (fig. 142) is provided, the bent arm of which

* Pfaff, F., 'Das Mikrogoniometer: ein neues Messinstrument, und die damit bestimmten Ausdehnungscoëfficienten der Metalle,' 20 pp. and 1 pl. 8vo, Erlangen, 1872.

slides in the guides at the top of the block. The milled heads at the end of the feet are for levelling the instrument.

Fig. 141.

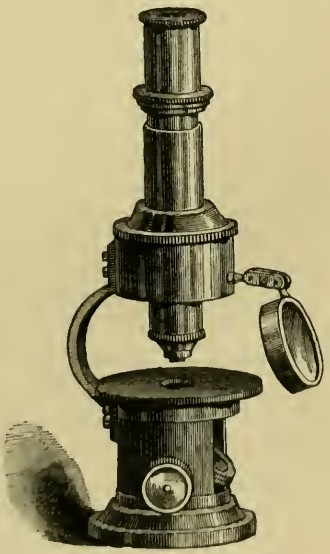


The author claims that the instrument will measure to 1/100,000 of a millimetre, and gives a table showing the dimensions of an object

Fig. 142.

(at a distance of 1 mm. from the centre of the circle) for angles from 4″ to 5°. Directions for use are also given, with remarks on the determination of the coefficients of expansion of the metals.

Fig. 143.



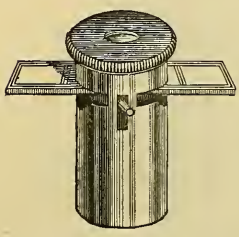
Double-Drum Microscope. — In this form (fig. 143), the peculiarity is found of two drums, the one serving as the base of the Microscope, and the other as the support of the

socket for the sliding body-tube. This latter application of the drum has no *raison-d'être* that we can discover, adding nothing to the convenience or stability of the instrument.

Theiler's "Universal (Achromatic) Pocket Microscope."—The commendations of Microscopes and microscopic apparatus by what we may term the "lay" press are often very wonderful, and after reading the following descriptions it was not perhaps surprising that we should have become somewhat eager to possess the instrument.

"We have received from Messrs. Theiler and Sons a specimen of their Universal Pocket Microscope, which magnifies 50 diameters. It is a very admirable contrivance, and should be in the hands of all young people."

FIG. 144.



"This instrument is a virtual Microscope, giving beautifully well-defined images, and may be used either by the aid of day- or lamp-light. No one having any interest in microscopy should leave home unaccompanied by such a small and so efficient an instrument. Its cost may be measured in the inverse ratio to its utility and value."

The instrument when received (from Messrs. M. Theiler and Sons, of London) turned out to be the familiar "Taschen-Mikroskop" of the German opticians supplied for many years past. It is shown in fig. 144. The slide is inserted in the slit of the tube by pressing down the spring which keeps it in place. The adjustment of focus is effected by screwing the lens in or out. Some of the German makers supply the instrument to take ordinary 3 × 1 slides.

Eye-piece Micrometers.*—Mr. H. L. Tolman records that for some months past he and Dr. M. D. Ewell, having been working at micrometry and the relative advantages of the eye-piece and cobweb micrometers, decided to make a series of independent measurements to see which method was superior.

Two slides of fresh blood were prepared under the same circumstances, as nearly as possible, the blood was dried about half an hour in the air of a well-warmed room, and then sealed in a cell, so that the degree of desiccation would be the same, and the measurements were made the same evening, independently. Dr. Ewell used a 1/10 Spencer (homogeneous immersion, N.A. 1·35) with an amplifier and a 1 in. eye-piece, giving a power of about 2000, and Mr. Tolman a 1/10 Spencer (homogeneous immersion, N.A. 1·25) with a 3/4 in. eye-piece, power 1562. The former measured twenty-five corpuscles, the average being 1/3138 in., and the latter measured fifty with an average of 1/3139 in., the difference between the measurements being only 1/985,000, an amount far too little to measure. Mr. Tolman feels pretty well convinced, therefore, that the cobweb micrometer does not offer sufficient advantage in point of accuracy to compensate for its additional cumbersomeness and expensiveness.

* Amer. Mon. Micr. Journ., vi. (1885) pp. 115–6.

In another report* of the measurements the matter is thus dealt with.

"While of course these measurements have no tendency to prove the possibility of identifying blood by the diameter of the corpuscles, they are admissible to show that under exactly the same conditions there is an average diameter of the blood-corpuscles of an individual which varies within exceedingly narrow limits, and that this diameter may be measured with very great accuracy. The limits of error certainly fall within the 1/200,000 in., and probably within the 1/250,000. Whether this average diameter varies from time to time is a question not yet determined."

Boecker's Holder for Analysing Prism and Goniometer.—This (fig. 145) serves not only to hold the analysing prism, but can also be used for a Leeson's goniometer.

Fig. 145.

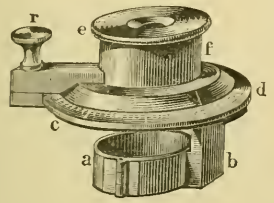
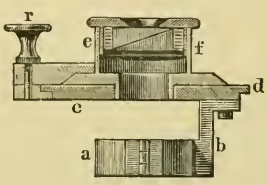


Fig. 146.



The apparatus is attached to the body-tube by the ring *a b*, over which is fixed the divided circle *c d*. Within the latter turns concentrically the tube *e f*, with a bevelled plate on which is the index-mark. This tube receives either an analysing prism or the doubly-refracting achromatic quartz prism of Leeson's goniometer (fig. 146). The rotation of the tube can be prevented when desired by the clamp screw *r*.

"An Improvement in Objectives."†—This is another paper by Mr. E. Gundlach, which we reproduce in its original form:—

"Eight years ago I presented to the American Association for the Advancement of Science a description of a new quadruple objective for astronomical telescopes.‡ The general acknowledgment with which the paper was received, and the high estimation of the theoretical principles of the invention by scientific authorities of this country as well as Europe, encourage me to present to this Society a description of another improvement in objectives, which I expect will be of equal value for both the telescope and the Microscope. Although I have unfortunately not had sufficient opportunity for properly executing an objective of the above-mentioned description, and thus practically demonstrating its advantages, I must confess that during the time I have become conscious of a practical defect,

* The Microscope, v. (1885) pp. 113-4, from 'Legal News.'

† Proc. 7th Ann. Meeting Amer. Soc. Microscopists, 1881, pp. 148-52.

‡ See this Journal, ii. (1879) p. 75.

which is, the increased number of lenses. I am now of the opinion that any improvement of objectives which requires additional lenses will always be objectionable, however valuable the improvement may otherwise be.

"The objective which I now wish to describe is free from this defect. It consists of two lenses only, one of crown and one of flint glass, like the ordinary objective. But the formula is based upon a new principle. In my description of the quadruple objective I have spoken of the so-called aberrations of higher order. Let me briefly review this for the better understanding of the following description.

"We know that the flint glass lens of an objective acts merely as a corrector of both the spherical and chromatic aberrations of the crown glass lens; but, owing to this double action, the said correction is, even in its best possible form, imperfect in so far as, when the part or zone lying about midway between the centre and the periphery is just right in correction, then the central part leaves a small remnant uncorrected, while the peripheric zone is already overcorrected. These unremovable remnants or so-called aberrations of higher order are the only cause of those imperfections of the achromatic objective which are dependent on the figure or curvature of the lens, and therefore the best formula for an objective will be that by which these aberrations are mostly reduced. Since the discovery of achromatism nothing has been spared to find by the aid of mathematics the best possible form for the flint glass lens for the correction of the aberrations of the crown glass lens; but for the finding of the proper form, or to better the proportion of curvatures of the crown glass lens itself, there never was a special rule adopted nor theoretical law found after which to obtain the most favorable result. But the calculations were based upon the principle that for any positive crown glass lens a negative flint glass lens can be found, combined with which it will form an achromatic objective in the common sense, and according to this principle no special pains were taken to find the proper form of the crown glass lens.

"My object in this paper is to show that for the best possible construction of an achromatic objective the proper figure or proportion of curvatures of the crown glass lens is an important factor, submitted to a positive theoretical law, and that, as a consequence of the neglect of this law, the present objective is far from having the best possible form. The angular aperture, or, in other words, the proportion of aperture to focal distance of an objective, is limited by the spherical aberration of the crown glass lens, because the latter greatly increases with the increase of the angular aperture, and consequently the aberrations of the higher order are increased. But this limit can be extended, if the spherical aberration of the crown glass lens can be, without change of focal length and diameter, reduced by a mere change of curvature, because this reduction involves a corresponding reduction of the aberrations of higher order. According to this we can imagine two achromatic objectives which are equal in focal distance and aperture, but although the flint glass lens of both have the best possible form for correction of the aberrations of their

respective crown glass lens, one of the lenses is superior to the other in the correction of the aberrations of higher order, because the spherical aberration of the crown glass lens is less than that of the other.

"We now arrive at the question whether the spherical aberration of the crown glass lens of the present achromatic objective can be reduced by a mere change of proportion of curvature, and if so, what is the theoretical law after which this proportion must be found? This law, which I have found by careful study, may be expressed as follows:—The spherical aberration of a lens for rays of given direction will be a minimum if the proportion of the curvatures of the refracting surfaces is such by which the angle of refraction of the medium ray at the interior surface is equal to that at the emerging; or, in other words, by which the angle of the perpendicular inclination of the medium ray at the entering surface is equal to that of the emerging surface. If the rays entering a lens are parallel or nearly so, as is the case with the telescope, then they will, after having passed through the lens, be changed by refraction to a converging direction toward the focal point of the lens, and to be equal in perpendicular inclination upon their respective surfaces. The entering or first surface will certainly have to be of correspondingly shorter curvature than the emerging or second surface. For a lens of a relative focus and diameter, as the crown glass lens of the present telescope, the radius of the curvature of the inner surface will have to be about twice as long as that of the outer surface, to fulfil the condition of minimum spherical aberration. But we are familiar enough with the construction of our present objective to admit that just the contrary is the case, that is, the curvature of the outer surface of the crown glass lens is by far the longest. If the crown glass lens is reversed, so that the inner or shorter curved surface is brought outside, toward the parallel rays of the object, then the form of the lens would much nearer fulfil the conditions of minimum spherical aberration. But then, of course, the flint glass lens will no longer have the proper form as a correcting lens; it would now over-correct the spherical aberration of the crown glass lens, and therefore a more flat long curved form of the same would be required. If the exact form or curvature of minimum aberration of the crown glass lens, as well as that of the correcting flint glass lens, as found by calculation, is compared with the present objective, it will be found that the aberrations of higher order in the new objective are reduced to about one-third of the old one, and a corresponding gain in the definition and reduction of colour, or otherwise an extension of the limit of aperture must be the result. Let me right here mention another idea as a further step for improvement of the objective in the same direction as described, that is, a further reduction of the aberrations of higher order.

"I have in my foregoing description given the law after which a lens of minimum spherical aberration for rays of a given direction has to be constructed, and I will here complete this law by adding that: The absolute minimum of spherical aberration of a lens is

obtained, if the refracting surfaces of the same are equal in curvature, and the rays entering the lens are coming from a certain point of the optical axis, being in distance from the lens a little over twice that of its nominal focus, thus meeting at the other side at an equal distance and forming a cone equal to that at the entering side. Now there is a simple way to give the rays, coming from a distant point or object, before entering the crown glass lens of the telescope, a direction which will be nearly adequate to the first-mentioned condition, namely, if the flint glass lens is placed in front of the crown glass lens. The parallel direction of the rays will then, by the negative flint glass lens, be changed into such diverging direction as would correspond with a cone, being only a little shorter than that required for an equal-sided crown glass lens, and the latter will then for minimum spherical aberration have to be very near equal-sided, thus allowing the aberration of higher order to be in higher degree reduced than in the before described objective. But, however, as an objection to this arrangement, it may be mentioned that the flint glass lens will be directly exposed to the external air and liable to oxidation.

"In my foregoing description I have, for the purpose of avoiding complications and giving a clearer understanding, referred to the telescope only; but as the construction of this instrument is submitted to the same theoretical laws as that of the Microscope, little remains to be said about the application of the described new principle to the Microscope. Our present Microscope objectives are all achromatic in the common sense, but they differ widely in angular aperture, and accordingly in definition and resolving power. But the angular aperture is dependent on the correction of the aberrations of higher order; the latter again on the spherical aberrations of the crown glass lenses of the system. If the crown glass lenses are transformed according to the described principle and law of minimum spherical aberration, and then the flint glass lenses so changed as to properly correct the aberrations of the crown glass lenses, the same result will be obtained as with the telescope objective. The extension of the limit of angular aperture will admit of giving the low power objective with long working distance a definition and quantity of light which at present are united only in considerably higher powers of short working distance."

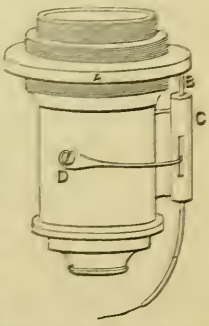
Care and Use of Objectives.*—Mr. W. Wales uses only an old, soft, silk handkerchief, a small stick of soft wood, a phial of alcohol, and a watchmaker's glass of two powers. A camel's-hair brush can neither completely nor safely remove the film of dust with which the exposed surface of the back combination of an objective is sometimes found to be coated. It will make a series of rings on the surface of the lens, and it may, if grit be present, scratch the glass. Nor should the handkerchief, either wet or dry, be introduced into the tube of any but a low-power objective. The cells must first be unscrewed from their mountings, and then the cleaning can be done properly.

* Journ. N. York Micr. Soc., i. (1885) pp. 113–6.

But an objective ought never to be taken apart by any one but its maker. He has the lathe upon which it was made, and he alone, when the parts have been separated, can replace them in their original adjustment to the optical centre. Any other person will be likely to screw in the cells either too tightly or not tightly enough, and will thus throw the combinations out of their necessarily delicate relations to one another. Besides, unless skill and care be exercised in screwing the parts together, the front and the middle combinations will sometimes be brought in contact, and the flint glass, which is very thin at the centre, will be broken. The screw-thread of the cells is very delicate. Yet some persons, after failing to catch it, apply force enough to break it.

"A large angle oil-immersion lens gets out of order easily. If you find the definition of such objective to have lost its sharpness, you may know that the front lens is out of centre. It has come in contact with the slide. A very slight pressure is sufficient to work the mischief. This susceptibility to injury is unavoidable, as every optician will tell you. It is incident to the requirements of high-angle construction."

Fig. 147.



Griffith's Mechanical Finger Objective.—Mr. E. H. Griffith thus describes this apparatus.

The collar A (fig. 147) moves on a fine thread and forces down the bristle-holder B. A slit in C keeps B in position. On turning A back, the spring D lifts the finger. The jacket to which C and D are attached turns on the objective, so that the diatom can be turned as desired. By lifting D the finger can be removed.

The bristle makes a good indicator also.

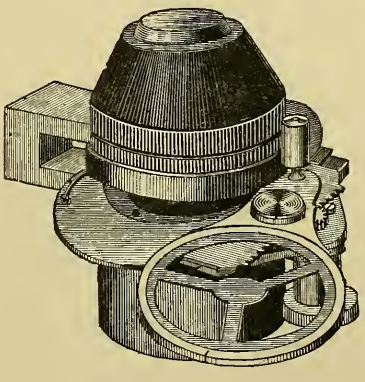
Right-angled Prism instead of a Plane Mirror.*—Mr. G. Hunt, in reference to Mr. E. M. Nelson's remark †—"Right-angled prisms "are used in telescopes for the purpose of economising every particle "of light; in the Microscope, however, even with a 1/2 in. wick, there "is more light than one knows what to do with"—points out that it is not the *quantity* of the light (which can easily be controlled), but the *quality* which renders the prism preferable. He believes the reflected rays from the posterior silvered surface and from the front unsilvered surface prevent the light from being brought accurately to focus on the object on the stage. This belief is founded on the following experiment.

In the winter time, when the leaves are off the trees, he placed the Microscope with a prism and achromatic condenser at an open window opposite an old oak, about 250 ft. distant. With a little management, the reduced image of the oak formed at the focus of the condenser was viewed by a 1/5 objective. With suitable apertures

* Eng. Mech., xli. (1885) p. 414.
† See this Journal, *ante*, p. 338.

in the diaphragm of the condenser, and in an iris diaphragm fitted on to the lower portion of the condenser between it and the prism, a most exquisite image of the tree was seen. The definition of this was charming, every little twig and incipient bud being distinctly visible. Then, nothing else being altered, a plane mirror was substituted for the prism. "What a change! The larger branches were there indeed, but the slender twigs were involved in hopeless 'fuzz,' which no amount of manipulation could eliminate." The experiment was varied by forming the image of a net window-curtain about three yards distant from the Microscope. With the prism, the picture of the network and pattern was perfect, every detail being exquisitely shown. With the plane mirror, the image was very markedly inferior, though less so than in the former experiment.

Fig. 148.



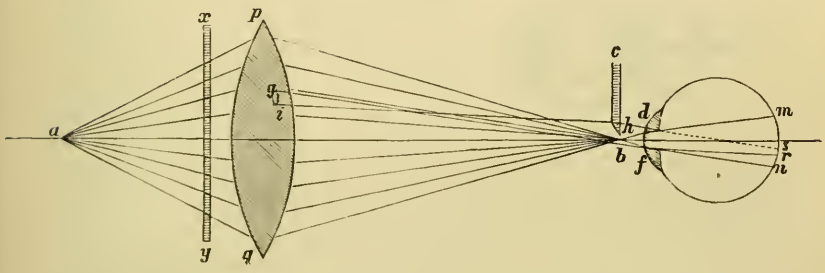
Zentmayer's Abbe Condenser.*—A simple and inexpensive mounting for the Abbe condenser (shown in fig. 148) has been devised by Mr. Zentmayer, by means of which it can be used with any substage. The milled head, seen below on the right, moves the plate which carries the diaphragms.

Töpler's Illuminating Apparatus.†—In the interior of microscopical objects many parts escape observation, not only on account of their small size, but also because very frequently their density differs too little from that of their surroundings, and consequently they influence but slightly the path of the rays. Dr. A. Töpler drew special attention to this subject in 1864,‡ when he described an apparatus called by him "*Schlieren*" (streaks) apparatus, on account of its use for the examination of streaks in glass. *a* (fig. 149) is a point of light sending rays to the lens *p q*; these will be refracted to *b*. To an eye *d f*, which receives all these rays, and is so accommodated that it clearly sees the lens, the latter will appear brightly illuminated. If, however, a diaphragm *c h* is moved towards the point *b*, then at the moment that it passes the point the rays will be entirely shut off and the lens will appear dark. If, however, there is a more strongly refracting point in any part of the lens, e. g. in *g i*, the rays, passing through this point, will not meet the axis at *b*, but nearer to or further from the lens, or will not meet it at all; these rays will then pass by the side of *b*. When the diaphragm is moved forward it will cut off part of the rays before the normal rays are affected, and the spot in question will

* Amer. Mon. Micr. Journ., vi. (1885) p. 84 (1 fig.).
† Zeitschr. f. Instrumentenk., ii. (1882) pp. 92–6 (3 figs.).
‡ 'Beob. nach einer neuen optischen Methode,' Bonn, 1864.

appear somewhat darker than the other portions of the lens; the difference, however, in the intensity of light is so slight, that it would not generally be remarked. At the instant, however, that the diaphragm passes *b* and the lens becomes dark, only those rays remain which in the figure are seen to pass below *b*, and *g i* will appear

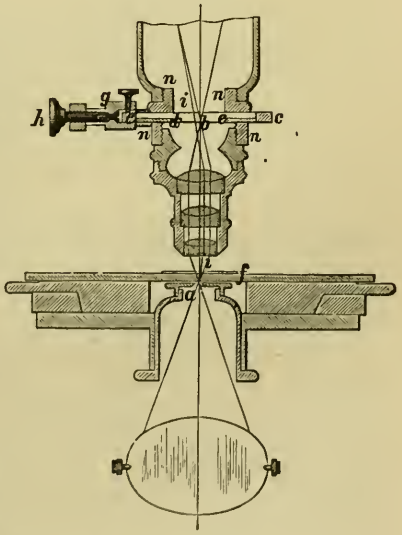
Fig. 149.



brightly illuminated on a dark ground. If *g i* is not in the lens but in a medium before or behind it, as *x y*, the result is precisely similar. The same effect is produced if *g i* has a lower refracting power than the other part of the lens.

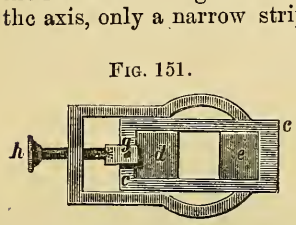
Professor Töpler recently drew Herr W. Seibert's attention to the fact that the same principle might be employed for Microscopes, and the latter has accordingly constructed an apparatus which he says acts admirably with low powers. The semicircular diaphragm *a*, fig. 150 (the straight edge perpendicular to the plane of the paper), is so placed, that its inverted image appears in *b*, at which point a frame *c c* moves in a lateral slit in the nose-piece *n n*. This frame has at *d* a glass plate, unpolished on the under side, and at *e* a thin metal plate with a bevelled edge. The space between *d* and *e* is open, so that in placing the frame in position, as in the figure, all rays proceeding from the object pass without hindrance. The screw *g* holds the frame in position; if it be loosened, the latter can be moved by the hand. The final adjustment is effected (after *g* has been screwed up) by the fine screw *h*. Fig. 151 is a front view of the frame. In ordinary vision through the Microscope the field is brightly illuminated by the rays which,

Fig. 150.



passing the object *f*, reach the objective. All these rays must pass the point at *b* within the diaphragm image. Therefore, by pushing the frame from right to left, when the edge of the plate *e* approaches the axis, only a narrow strip of light from the diaphragm-image will remain, and this will also disappear by a further movement of the frame. At the same instant, the field becomes dark, but the rays remain which deviate in the object towards the left—as in Fig. 150 the ray *i*—and the corresponding points appear bright. Spots in the object are thus easily recognized which would otherwise pass unnoticed in consequence of the brightness of the field. Only those rays are effective which are deflected at right angles to the edge of the frame. The apparatus must therefore be so adjusted that the object can be turned round the optic axis, while all else remains immovable.

Fig. 151.



The manipulation of the apparatus is as follows :—The frame *c c* is placed in a central position so that the open space between *d* and *e* is in the optic axis, and the Microscope is accurately focused on the object. The latter is then pushed aside, so that there is now an open space in the stage under the objective, and the glass plate *d* is brought into the axis. The semicircular diaphragm is now so adjusted that its image appears clearly on the glass, and the straight edge in this image exactly parallel with the edge of the plate *e*, but turned away from it, so that on moving the frame the convex side is first shut off, and finally only a narrow line of light remains. The adjustment of the diaphragm is effected by sliding it up and down. The position of the tube must not be altered, or else, if it is again adjusted to the object, the image of the diaphragm will no longer lie in a plane with *e*, which is an absolute necessity. The frame being now so adjusted that the rays can pass through it unhindered, the instrument is ready for observation. The frame is moved slowly by the screw *h* till the edge *e* meets the optic axis and the direct rays are cut off. The field is now dark, but all points in the object which have a greater or less refractive power are brightly illuminated on the dark ground. If the frame be moved still more, these rays also disappear. The proper moment for observation is, therefore, when all direct light is shut off.

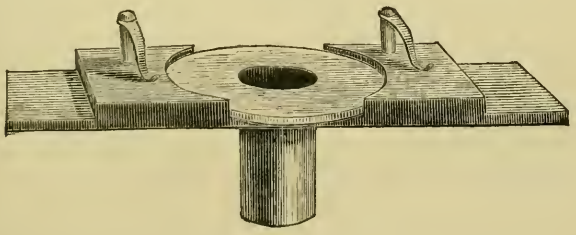
This apparatus is only suitable for low powers ; with high powers many inconveniences arise. The frame must of necessity be brought quite close to the lenses, for if the whole is to be obscured at once, the frame must be exactly at the place where the image of the diaphragm is formed ; if it is further away, only half of the field is effective. The nearer to the lens, however, the greater is the spherical aberration, because the objectives are properly corrected only for an image distance, equal to the length of the tube ; the image of the diaphragm will not be very sharp, and the rays diverted in the object mingle with the indistinct margins of this image. A further inconvenience arises from the fact that in objectives having a focus of 3 mm., the distance between the object and the diaphragm must be so

small, that an ordinary slide cannot be used; and a cover-glass must be used instead. With still higher powers, particularly those with correction, where the frame cannot be brought so near to the lenses, the apparatus is unsuitable. This inconvenience might be avoided by causing a larger, brightly illuminated diaphragm to cast an image and from this to produce a second at *c c*; the first image could then be brought nearer to the object if desired, and the action would be the same as if a real diaphragm were in the place of the image. The author, in order to use the apparatus for higher powers, also describes a modification by which the frame is placed above the eye-piece, where a second image of the diaphragm is formed; but he adds that "this arrangement also is capable of improvement."

In observations with the apparatus, it was remarked that when the field of view was obscured, there was greater penetration. With a bright field, for instance, individual bacteria could only be seen when exactly in the plane of the focus; those in an inclined or perpendicular plane were only seen as points. When, however, the field was darkened by means of the frame, each individual could be followed in its movements.

Bausch and Lomb Optical Company's "Universal Accessory."—This (fig. 152) is mainly intended as a remedy for the want of a substage. It consists of a brass base-plate to be laid on the stage,

Fig. 152.



having a central opening surrounded by a countersunk bed, which holds a polarizing prism shown in position in the figure. This can be rotated by the milled edge of its broad circular top. On removing the polariscope a hemispherical lens can be dropped into the opening in the plate, and serves as a condenser or, with a stop placed on it, as a paraboloid. An ingenious arrangement has been adopted to enable the lens to be retained in place. A disk of thin glass of slightly larger diameter than the plane face of the lens is cemented to it (fig. 153) so as to leave a projecting rim. This rim rests on the margin of the opening, and prevents the hemisphere passing through.

Fig. 153.

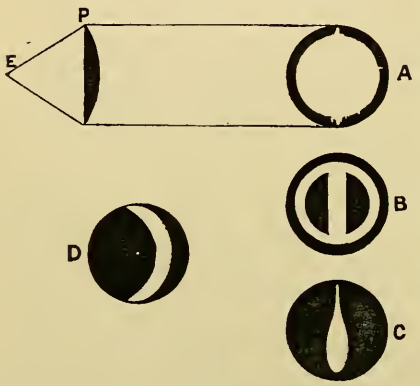
Illumination.*—Mr. E. M. Nelson writes as follows:—The first step in studying the principles of illumination for the Microscope is to grasp thoroughly the various effects produced by a bull's-eye.

* Engl. Mech., xl. (1884) p. 68 (2 figs.); pp. 157-8 (3 figs.); p. 263 (6 figs.); p. 282 (6 figs.).

A (fig. 154) shows the *effect* produced by centering or placing the edge of a flame (from 1/2-in. paraffin wick) in the exact focus of a plano-convex bull's-eye P.

It is necessary to explain the meaning of the word "effect," for if a piece of card were held in the rays proceeding from P, the picture as shown at A would not be seen; but, instead of it, an enlarged and inverted image of the edge of the flame. Then, one will naturally ask, How do you get the picture A? By simply putting your eye in the rays and looking at the bull's-eye.

Fig. 154.



As this is often disagreeable, by reason of the strength of the light, a more pleasant way of examining the picture is by placing in the rays a condensing lens (the field-glass of a 2-in. eye-piece) and focusing the image on a card. It should be noticed particularly that the *diameter* of the disk A depends on the diameter of the bull's-eye P; but the *intensity* of the light in A on its focal length. The shorter the focus the more intense the light. In making these experiments the condensing lens is presumed to be at a fixed distance from the bull's-eye P.

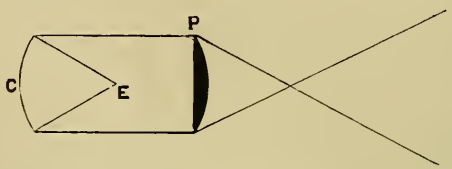
B represents the picture when the edge of the flame E is centered, but *within* the focus of P.

C the picture when E is centered, but *without* the focus of P.

D the picture when E is focused, but *not centered.*

Fig. 155 shows an error often perpetrated, viz. that of putting a

Fig. 155.



concave mirror C at the back of a bull's-eye P, to increase its effect. The rays are brought to a focus and then scattered.

The method of obtaining a critical image with transmitted light by objectives of 1/2-in. focus and less is shown at fig. 156, where E is the edge of the flame from a 1/2-in. paraffin wick, S substage condenser, and P the object. S is centered to, and the image E focused by S on, P. Fig. 157 shows the same thing with the addition

only of the plane mirror *m*. Fig. 157 gives results as critical as fig. 156, it is, however, a little more troublesome to set up, and therefore fig. 156 will be found preferable where the instrument is sufficiently tucked up on its trunnions to permit of its being so used.

Fig. 158 A shows a substage condenser S, and an objective O, focused on the same point; the condenser being of an aperture equal to that of the objective. On removing the eye-piece and looking at the back lens of the objective, it will be seen to be full of light as at C.

Fig. 158 B shows the same thing, but with the aperture of the condenser cut down by a stop. Now only a portion of the back lens of the objective is filled with light. (See D.)

It does not follow that because the back lens of the objective is full of light, as at fig. 158 C, that therefore *the field* ought to be full of light. The field only shows a bright image of the edge of the flame; but it is in the plane of that image where the picture is critical.

If the condenser be racked either within or without the focus, the whole field will become illuminated. At the same time, however, a far smaller portion of the objective will be utilized. On removing the eye-piece, and examining the back lens of the objective, a picture like fig. 154 C, p. 714, will be seen.

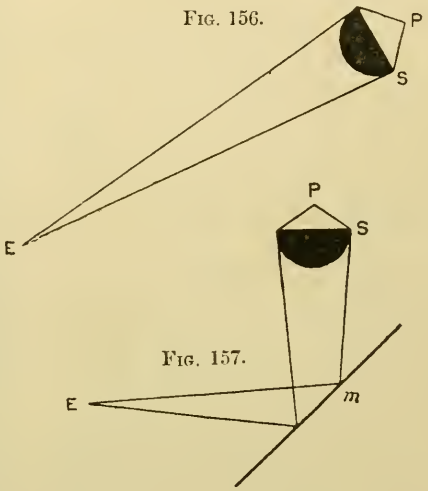


Fig. 156.

Fig. 157.

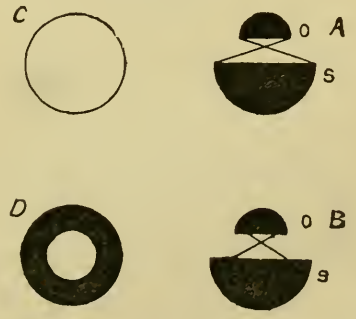


Fig. 158.

Fig. 158 A shows the most severe test that can be applied to a Microscope objective, viz. to fill the whole of the objective with light, and so test the marginal and central portions *at the same time*. Few, indeed, are the objectives that will stand this ordeal. Some fog when half full of light; most when one-third full; and not one in one hundred will bear three-quarter filling.

We now come to some very obvious points—so obvious, indeed,

that one would hesitate to mention them, unless frequently confronted with error.

Fig. 159 shows the correct method of illuminating with diffused day-light, no substage condenser being used. P the plane of the object. C the concave mirror. The mirror is placed at the distance of its principal focus from the object.

Fig. 159.

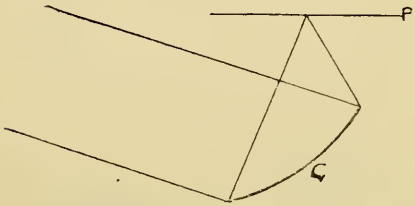


Fig. 160 shows the rough and ready and, I am sorry to say, too often, the usual style.

Fig. 160.

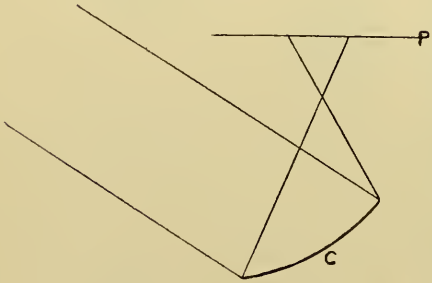


Fig. 161 shows the correct method of illuminating for dark ground, with substage condenser and stops. E, edge of flame; B, bull's-eye; *m*, plane mirror; S, substage condenser.

Fig. 161.

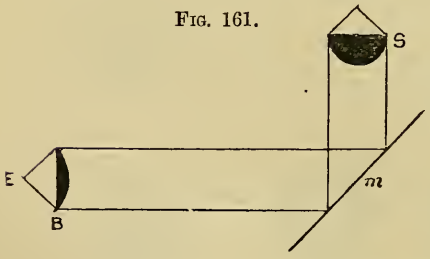
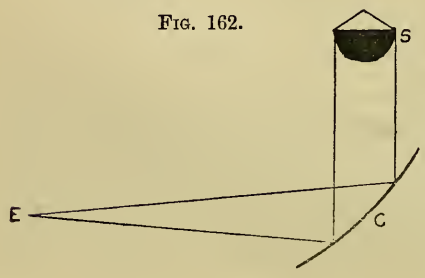


Fig. 162 is another correct method of doing the same thing by using the concave mirror and no bull's-eye. It is seldom used, as it is very difficult to set up.

Fig. 163 shows the error of using the concave mirror with the bull's-eye. Many do it, thinking that they get more light.

Fig. 164 shows the error of not having the edge of the flame E in the principal focus of the bull's-eye B. This teaches how important it is to have the bull's-eye fixed to the lamp, so that both may be moved together, and not independently. The author's own bull's-eye is so made that when it is pushed home in its slot, the lamp flame is in its principal focus.

Fig. 162.



To set up fig. 161 correctly, with a bull's-eye

on a separate stand, would take an experienced microscopist a quarter of an hour or more, an inexperienced one an evening.*

The following are a few hints on dark-ground illumination :— Let us, by way of example, take a definite object, thresh that out thoroughly, then afterwards show what alterations in the method will be required for other objects. The necessary apparatus is an *achromatic* condenser, and a lamp with a bull's-eye *fixed to it*.

Fig. 163.

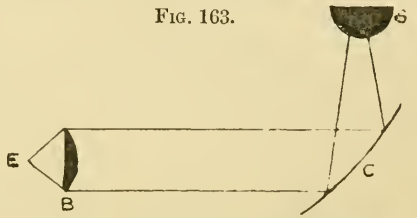
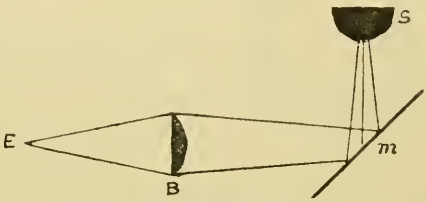


Fig. 164.



It is, in Mr. Nelson's opinion, most important that the condenser should be *achromatic*. It will be urged by many eminent microscopists that an achromatic condenser is quite unnecessary. Also there are those who prefer a paraboloid, spot-lens, &c. He does not, however, go into this question for fear of making his paper too long; the scope of it being a method of showing critical images on a dark ground by means of an achromatic condenser; the test of criticalness being the visibility of the dots in the hexagonal areolation of the larger *Triceratia* with a 2/3 of 0·21 N.A. (= 32½° air angle). Let us, therefore, take this as our experimental object.

We must first adjust our lamp and bull's-eye as described on p. 714 and get the edge of the lamp expanded to a disk as in fig. 165. Place a small aperture in the condenser, and a *Triceratium* on the stage with the 2/3 in. objective on the nose-piece. The Microscope having been put in the proper position, the lamp should be placed on the left-hand side of it. The lamp should now be arranged as to height, so that the rays from the bull's-eye may fall fairly on the plane mirror; the plane mirror being inclined to reflect the beam on the back of the substage condenser.

Now, with any kind of light, focus and centre the *Triceratium* to the field, fig. 166. Then rack the condenser until the small aperture in its diaphragm comes in focus; centre this to the *Triceratium*, fig. 167. Rack the condenser closer up until the bull's-eye is in focus, fig. 168 Here it happens that the bull's-eye is not in centre, and is not uniformly filled with light as in fig. 165, but has instead two crescents of light. This is a case which often occurs; but, of course, it may be more or less filled with light, and may or may not be more nearly centered.

* Mr. Nelson thinks it would be a good plan if microscopists would always use the term "bull's-eye" instead of "condenser," to designate that piece of apparatus; leaving the term condenser for the substage condenser only.

We next have to centre the bull's-eye to the *Triceratium* by moving the *mirror*, fig. 169. It will be noticed that centering the bull's-eye does not put the light right. This must be done by moving the *lamp with its attached bull's-eye*. This movement must be a kind of rotation of the lamp in azimuth round the wick as an ideal axis. The relative positions of the lamp and bull's-eye must on no account be altered. It is taken for granted that the bull's-eye is fixed to the lamp, and was adjusted at the first so that the picture, fig. 165, was obtained by direct inspection without any Microscope.

Fig. 165.

Fig. 166.

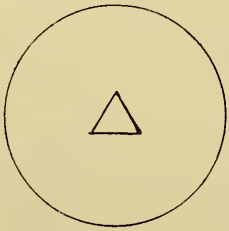


Fig. 167.

Fig. 168.

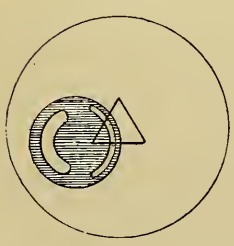


Fig. 169.

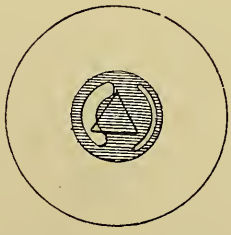
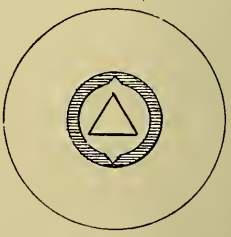


Fig. 170.



This adjustment being satisfactorily carried out at first, is not disturbed. By "moving the lamp round the wick as an axis," is meant the moving of the whole thing as a solid mass. This is a very simple thing to demonstrate practically; but it is not easy to describe even such a simple movement so as to preclude the possibility of error. A very slight movement in the right direction will produce the picture fig. 170.

Any one having the necessary apparatus, by following out precisely this plan, will arrive with very little trouble at fig. 170.

All that need now be done is to open the full aperture of the condenser, and put in the smallest opaque central stop; if this does not stop out all the light in the bull's-eye, then a larger one must be tried. It is of the greatest importance that the stop be as small as possible; a very little difference in the size of the stop makes a great difference in the quality of the picture. Condensers ought, therefore, to be supplied with as many opaque central stops as open apertures.

On account of some residual spherical aberration, the condenser will probably have to be racked up a little to secure the greatest amount of light.

In fig. 170 the expanded edge of the flame covers the *Triceratium*. When the whole aperture of the condenser is opened the size of that disk will not be altered. Its intensity only will be increased. When the central stop is placed at the back of the condenser, only in that part of the field represented by the disk of light will the objects be illuminated on a dark ground. But some will say: Suppose the disk does not cover the object; what is then to be done? Simply this: bring the lamp nearer the mirror.

The size of the disk of light depends on three things.

1. The diameter of the bull's-eye.
2. The length of the path of the rays from the bull's-eye to the substage condenser.
3. The magnifying power of the condenser.

If 1 and 3 are constant; the only way of varying the size of the dark field is by 2, as already stated.

The intensity of the light in the disk depends also on three things.

1. The initial intensity of the illuminant.
2. The angular aperture of the bull's-eye.
3. The angular aperture of the substage condenser.

Mr. Nelson has elsewhere insisted that the power and aperture of the substage condenser should bear some proportion to the power and aperture of the objective used, and does not enlarge upon this, but merely alludes to it, as it does not legitimately come within the range of his paper. Finally, he says he prefers to make the disk of light no larger than necessary. If the whole field is required, he fills it; but if only a portion is wanted, then he reduces the size of the disk accordingly.

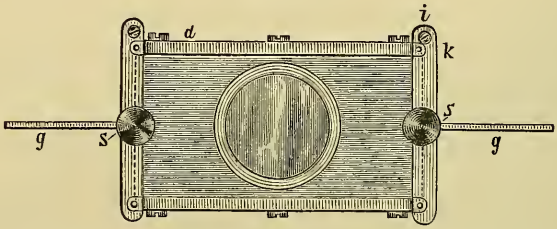
Mr. A. C. Malley* strongly disputes Mr. Nelson's recommendation of a bull's-eye fixed to the lamp, and prefers one mounted on a separate stand, which is easier reached and moved, and by which tremor is avoided. The bull's-eye should be placed about $3\frac{1}{2}$ in. from the centre of the flame, the lamp being surrounded by a tin shade having a small plane mirror behind the flame, and an orifice the size of the bull's-eye in front. The bull's-eye is formed of two plano-convex lenses ($3\frac{1}{2}$ in. focus) with their convex faces together. He also uses a cell of ammonio-sulphate of copper in front of the mirror.

Hawkins's Observatory Trough.†—Mr. R. Hawkins suggests an improvement on Dr. Giles's Live-cell,‡ which he thinks will make the apparatus so simple, that any one can make half-a-dozen in an hour or less without extraneous aid. The arrangement consists in the use of clips, to keep the glass cover on, made of a piece of brass wire bent to fit the slide, and so as to have sufficient power to hold the cover well in position.

* Engl. Mech., xl. (1884) p. 299.
† Sci.-Gossip, 1885, p. 135 (1 fig.).
‡ See this Journal, *ante*, p. 135.

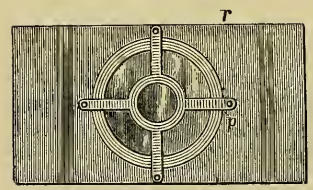
Pringsheim's Gas Chambers.*—In order to make experiments with different gases, Professor N. Pringsheim had gas chambers constructed by Schmidt and Hänsch, for use with his Photo-chemical Microscope,† which differ from those hitherto used, and which combine great firmness and durability with easy management. As those of glass are very difficult to fix, besides having other disadvantages, the new ones (Figs. 171 and 172) are of metal, and very firm and secure. The base is of strong glass (or metal with an aperture closed with glass), the sides and cover *d* of metal. The latter has a circular

Fig. 171.



aperture in the centre, beneath which a glass cover is cemented for the reception of the hanging drops in which the object is placed. It can be firmly pressed down by the arm *k* (movable at *i*) and the screw *s*. By a mixture of wax and vaseline at the joints and tightening the screws, the chambers can be made completely air-tight, and will even bear a considerable pressure of gas. This is conducted through the tubes *g*. The base of the chamber is kept covered with a thin stratum of water. As the temperature of the drop, particularly in white light, may become higher than the object can endure without injury, it may be cooled by filling the chamber with ice, and by placing on it, instead of *d* (Fig. 171), the cover *r* (Fig. 172), which can then also be covered with ice. In the latter case, a quick conductor of heat from the drop to the ice can be obtained by means of the platinum cross *p*.

Fig. 172.



Test for the Hand-Lens.—Mr. J. Deby points out that "while many tests exist for high- and medium-power objectives, none are on record for that most useful instrument to the naturalist, the hand-lens." The best test he considers to be the elytron of *Gyrinus marinus*, a not very rare water-beetle. The lens must not only show the longitudinal rows of large dots, but also the fine intermediate punctations. None but a first-rate lens will show them. The male has finer punctations than the female, and is more difficult of resolution.

* Zeitschr. f. Instrumentenk., i. (1881) pp. 332–3 (3 figs.).

† See this Journal, ii. (1882) p. 395.

Aperture Puzzle.—A problem which much troubled the older generations in regard to aperture, was this:—

"Aperture" meaning essentially the "opening" of the objective, or its capacity for transmitting a greater or less amount of light, the following seemed to be paradoxical.

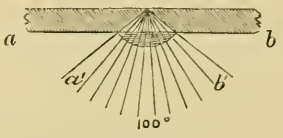
In fig. 173 a dry objective is used, and the object can receive light from the whole hemisphere of 180°. If, for instance (as the matter was put with the view of bringing it within reach of the meanest capacity!), 180 candles were placed in a semicircle *a b*, light from every one of the candles would reach the object.

Suppose now, that instead of a dry objective, whose aperture cannot exceed 180° or 1·0 N.A., an immersion objective is used with an aperture exceeding 1·0 N.A., a hemispherical lens being employed for the illuminator, as in fig. 174.

It is suggested that in this case we have less light reaching the object, for, continuing the example of the candles, only those between

Fig. 173.

Fig. 174.



a' and *b'* (or say 100 out of the 180) are effective, none of those between *a* and *a'*, or between *b* and *b'* illuminating the object, and they might as well not be lighted.

The objective which has the smaller aperture, therefore, receives, it is suggested, the light of eighty more candles than the objective which has the larger aperture!

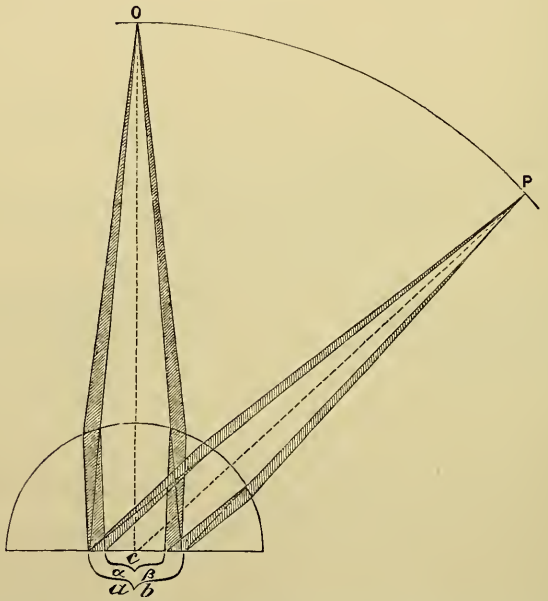
The explanation of the seeming paradox is simply that the effect of the spherical surface in the second case has been disregarded, as was so constantly the case in the old aperture discussions.

The action of the hemisphere in fig. 174 may be illustrated by fig. 175, which shows the course of the rays from a luminous surface O P to a definite surface element *a b*.

Take the inner lines of the fig. as representing the pencil which, in air and without the interposition of the hemisphere, would reach the surface *a b*. If the hemisphere is interposed, the pencil, instead of continuing in a straight line as before, is compressed (refracted), and is now thrown on the smaller surface $a\ \beta$. It is obvious that the two surfaces *a b* (in air) and $a\ \beta$ (in glass) must each receive the same amount of light, for the pencils which reach them are identical in their origin. If now we take within the hemisphere a surface *a b*, which is larger than $a\ \beta$, the former (*a b* in glass), will be illuminated, as the fig. shows, by a pencil which, in its origin, is larger than that illuminating the latter ($a\ \beta$ in glass); and as $a\ \beta$ in glass is, as we have seen, identical in illumination with *a b* in air, *a b* in glass will receive a larger pencil than *a b* in air, the excess

being represented by the shaded space in the fig. In other words, the total quantity of light which in air is thrown upon the element $a\ b$, is by means of the hemisphere condensed upon the *smaller* element $\alpha\ \beta$, so that the hemisphere will admit to the element $a\ b$, *wider* pencils from the points O P than are admitted to it in air. Though the

Fig. 175.



angle O c P is the same in both cases, the quantity of light conveyed within this angle to one and the same surface element is greater in glass than in air.

As to the measure of the increase of light, it may be shown that $\frac{\alpha\ \beta}{a\ b} = \frac{1}{n}$; i. e., if $n = 1{\cdot}5$ (the refractive index of glass), $\frac{\alpha\ \beta}{a\ b} = \frac{2}{3}$, or $a\ b$ is half as large again as $\alpha\ \beta$. The increase of light is therefore as 9 : 4, or $2\frac{1}{4}$ times (n^2). This is in agreement with the expression for the numerical aperture in the cases of air and glass, which, for the same angles, are always as 2 : 3.*

Discovery of Pseudoscopy.†—Under the title of the "Discoverer of a Singular Optical Illusion," Prof. Govi says, "Of all optical illusions, that is certainly not one of the least remarkable by which, in looking at objects in slight relief or slightly depressed (as coins, seals, &c.) with a compound Microscope or a telescope which reverses the image,

* See also on this subject this Journal, i. (1881) p. 329.

† Atti R. Accad. Lincei—Transunti, vii. (1883) pp. 183-8.

the parts in relief appear hollow, and that which is hollow assumes the appearance of perfect relief. It is indeed true that the illusion is not always, nor with all persons, equally successful, and that sometimes the appearance is alternately that of hollow and of relief to the same eye and with the same object; but, in general, the inversion of form does not lead to deception, not being able to overcome either the knowledge of the object which the observer possesses nor that of the reversal of the image brought about by the instrument. Physicists admit that in this case the illusion proceeds from the observer's knowing the direction from which the light comes, and seeing in the image the lights and shades of the prominences or cavities on the side opposite to that which, having regard to the direction of the light, they ought to occupy; so that, in the absence of any final test of the comparison to aid the judgment, one argues from the position of the lights and shades that what is really hollow is in relief, and *vice versâ*. In fact, if every part of the object is illuminated, or if (as Brewster has suggested) a pin is placed upright by the side of it, and one observes the direction of the shadow which it throws on the object, the illusion suddenly vanishes and the object is seen as it really is, and not as one's erroneous first impression had represented it. Almost all who have written upon the subject of vision, or the illusions of the senses, refer to this curious phenomenon, and attribute its discovery now to one, now to another person, according to the patience, erudition, and perhaps the nationality of the writer; for, with regard to the priority of discoveries, the factors on which the final judgment depends are numerous. Joblot, in 1718, believed himself to have observed it for the first time, not referring to any one who had preceded him. Gmelin does the same in 1745, in a paper on a kindred subject, printed in the 'Philosophical Transactions.'

I do not know the purport of Rittenhouse's communication of 1786, because I have not hitherto succeeded in procuring the 'Transactions of the American Philosophical Society,' which contains a work by that author on some such subject, but it is probable that, like Joblot and Gmelin, he too has believed himself to be the discoverer of the phenomenon. Muncke, in 1828, in the article "Gesicht," in Gehler's 'Dictionary of Natural Philosophy,' attributed the discovery to Joblot (written *Jablot* by him).

David Brewster, in publishing, in 1831, his 'Letters on Natural Magic,' dedicated to Sir Walter Scott, alludes to an observation of this nature made by the members of the Royal Society of London in one of the first and earlier meetings of that society, and perhaps mentions it as well in an article in the 'Edinburgh Scientific Journal,' which I have been unable to consult. In 1838, Charles Wheatstone, in the publication and description of his wonderful 'Stereoscope,' alludes to the Royal Society of London as having first called attention to the strange phenomenon, without, however, giving the year or stating the manner in which it happened. Helmholtz, in his 'Physiological Optics,' reproduces Muncke's citations, and seems to adhere to Joblot as the discoverer of the illusion. Schröder, writing on the subject in 1858, stops at Gmelin, and attributes the discovery to him.

Although there is much disparity in the opinions, it is only the older observers who are really in competition for the honour of the discovery; that is, Joblot and the Royal Society, but it does not appear clearly from the known records which of the two preceded the other.

The 'Philosophical Transactions' do not speak of any such observation, but, consulting the 'History of the Royal Society,' written by Birch, in which are found described with great care almost all the experiments, letters, communications, and discussions which the English *savants* did not think worthy to appear in the volumes of their 'Transactions,' we may read there in the second volume the following passages:—

Under the date of the 11th of February (Thursday), 166$\frac{8}{9}$ (counting *ab incarnatione*, and according to the Julian calendar): 'The operator was ordered to speak to Mr. Hooke, that the great Microscope of Mr. Christopher Cock's making be brought to the Society at the next meeting.' And the 18th of February 166$\frac{8}{9}$ (Thursday), 'Mr. Christopher Cock produced a Microscope which he said he had made for the Society if they liked it, with five glasses, of which the four eye-glasses were plano-convex, two and two so put together as to touch one another in a point of the convex surface. Various observations being made therewith, it appeared to do very well, but there being a guinea put in it and looked upon, some of the members saw the image depressed, others embossed. The workman referred himself to the Society for the price of this Microscope, and the Society referred it to the Council.'

Then the Council decides on the 22nd of February (Monday): 'That the Treasurer pay to Mr. Christopher Cock 8*l.* for a large Microscope made by him for the Society.' It does not appear that the Society or any of its members made any further investigation after this into the singular illusion discovered on the 18th (28th according to Gregorian style) of February 1669, although the 202 Italian lire (8*l.*) paid for the Microscope which had demonstrated it attest the importance attributed to Mr. Christopher Cock's instrument. The date of the first observation of the English academicians being thus established, Joblot's priority disappears, unless it is wished to uphold it on the ground that the discovery remained unpublished in the records of the Royal Society until the time of its publication by Birch (1756).

In any case, even recognizing the priority of the English, we are able justly to claim for an Italian countryman of ours the credit, not only of having anticipated the Royal Society in the discovery of the curious illusion, but of having forestalled those physicists who subsequently endeavoured to explain it. Eustachio Divini, of San Severino (the ancient Septempeda), on the frontier, was the most skilled manufacturer of lenses and glasses of all kinds of his time, and in the year 1649 had conceived the idea of placing in a telescope which he possessed, some fine threads crossed, substituting a convex ocular lens for the concave ocular used by Lippersheim and Galileo, in order to see the network and thus sketch with ease the image of the moon which, with all its markings, was depicted upon it,

thus anticipating the first micrometers of Gascoigne, Montanari, and Huyghens.

Now this same Eustachio Divini, in a letter which has been printed, addressed to Count Carlo Antonio Marozini on the 15th of July, 1663, wrote thus:—'Now that we are upon the subject of telescopes fitted with the single lens, I ought to tell you of a remarkable matter; I have seen strange things. While looking at some object, such as a bas-relief or those arms carved in stone which are commonly put upon walls, their plane parts appeared depressed and level with the wall, while all the rest of the arms were devoid of relief.

But the curious thing is, that the relievos which I have mentioned are seen as if hollowed out, whereas they are really raised up. When I discovered this, I showed it to other persons of enquiring disposition, and by looking several times at the same place, finally convinced myself that I had been deceived by the light which it received from the sun, for in the morning it appeared hollow, in the evening in relief, and in other parts in relief in the morning and hollow in the evening. The Microscopes with two glasses, which also show the objects to me reversed, usually do the same with a difference in the glasses, which I do not as yet understand. They magnify a thousand times, and by the conditions of this power cannot be applied to objects which are rather large; therefore I have sometimes added another lens with a curvature considerably greater than that of the small lens, taking away the latter and inserting the former, which does not magnify so much, but serves for rather large objects, and with them produces a most beautiful effect with the greatest clearness. With this apparatus I have looked at an old coin in order to see letters which could not be read. Sometimes I have seen the places in relief reversed and, changing their position (so to speak), stand on the right-hand side of the Microscope, and if I place myself on the left I see in relief that which when on the right I considered to be hollow. But what seemed to me altogether strange, and has happened to me more than once is, that when looking at another object in relief, I see it hollow, and on changing my position I still see even the part in relief hollow. However, I leave all this to distinguished intellects to speculate upon, and return to our telescope.'

The 15th of July (Gregorian notation), 1663, is earlier by 5 years 7 months and 15 days than the 18th of February (Julian notation), 1669; by this period, therefore, does Divini have precedence of the English academicians in the discovery of the *pseudoscopy* of reliefs, and by a still greater time is he beforehand in the endeavour to explain the phenomenon, for he attributes it to 'deception of the light,' and as his microscopical observations left him somewhat perplexed as to such a reason, he referred the matter to distinguished intellects, which, however, have not known how to find a better one, and repeat (only in a better form and somewhat aided by experiments) the same explanation which Divini had proposed two centuries ago." *

* A Bibliography of eleven of the books and papers referred to is appended.

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["On a slide prepared by H. H. Chase, with a refractive index of 2·42, I have succeeded in clearly resolving *A. pellucida* with a dry 1/5 in. of 135° air angle."]
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„ „ **The Ocular Micrometer** (and additions by R. H. Ward).
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Carpenter, W. B.—**Wallich Condenser.**
[Remarks on the very great increase of focal depth with the Binocular.
"There was one very curious thing about the Binocular Microscope, that it did increase very greatly the focal depth. He had tried this under every condition, and had always found it to be so. It was to be explained to a certain extent by the binocular prism halving the aperture of the objective. That, however, did not explain it altogether; because having asked a friend to look through the binocular with one eye only, the prism being in its place, and to focus the objective for what he considered to be a medial distance, on then asking him to open the other eye, the difference in the depth of focus had been at once observed; indeed, it was considered that the increase amounted to at least five times. He had talked the matter over with his friend Sir Charles Wheatstone, but they could never come to any satisfactory conclusion."]
Journ. Quek. Micr. Club, II. (1885) pp. 145–6.

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[Description of details of construction.]
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[*Supra*, p. 719.] *Sci.-Gossip*, 1885, p. 135 (1 fig.).

HERVEY, A. B.—See Behrens, J. W.

[HITCHCOCK, R.]—**Silvering Glass Reflectors.**
[Formula of Mr. J. Browning for silvering glass specula.]
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HOLMES, E. A.—**Polarized Light as applied to the Microscope.**
[Paper read before the Hackney Microscopical Society.] 8 pp., 6 figs.

HUNT, G.—**The Right-angled Prism instead of a Plane Mirror in the Microscope.**
[*Supra*, p. 709.] *Engl. Mech.*, XLI. (1885) p. 414.

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[Exhibition only. "Made to go close up under the object."]
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JADANZA, N.—**Sui punti cardinali di un sistema diottrico centrato e sul cannochiale anallattico.** (On the cardinal points of a centered dioptric system, &c.) *Atti R. Accad. Sci. Torino*, XX. (1885) pp. 917-33 (8 figs.).

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[Contains a description of a new Microscope devised by the author for mineralogical-petrological researches, pp. 436-43. *Post.*]
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[Remarks as to the priority of Prof. Abbe and others in regard to the original paper *ante*, p. 532.]
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[Directions for making lenses, with description and figures of tools.]
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from *Scientific American Supplement.*

M'ALLISTER.—**Slide showing Path of Electric Spark.**
[A slide, after being smoked over a small gas-jet, is placed centrally between the terminals of an induction coil, and at right angles to their direction. The terminals are held about 3/8 in. apart. A strong current is required.]
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Engl. Mech., XLI. (1885) pp. 298, 359-61.

Monoyer, M. F.—**Zur Theorie der Fernrohre. Allgemeine Theorie centrirter dioptrischer Systeme.** (On the theory of the telescope. General theory of centered dioptric systems.) (*In part.*)
Centr.-Ztg. f. Optik u. Mech., VI. (1885) pp. 121–3, 133–6, abstracted by G. Fischer from *Séances de la Soc. Franç. de Physique*, 1883, pp. 148–75.

Moore, A. Y.—**The Microspectroscope.**
The Microscope, V. (1885) pp. 101–6 (3 figs. and 1 pl.).

Nelson, E. M.
[Reply to inquiry as to a condenser. Also statement that "the amount of flint in an object-glass depends entirely on the formula by which it is made, i. e. the idiosyncrasy of the maker."]
Engl. Mech., XLI. (1885) p. 283.

„ „ **Stop for an Abbe Achromatic Condenser.**
[Not described.]
Journ. Quek. Micr. Club., II. (1885) p. 148.

„ „ **Rotating Nose-piece Condenser.** [*Ante*, p. 324 and p. 327.]
Ibid., II. (1885) pp. 153–4.

Queen, J. W.—**Remarks on using Oil-immersion Objectives.**
[General instructions sent out with his 1/15 in. objective.]
Micr. Bulletin (Queen's) II. (1885) p. 22.

Queen's (J. W. & Co.) **New Class Microscope.** [*Post.*]
Proc. San Francisco Micr. Soc., 22nd April, 1885.

"Rob. Crus."—**The Micro-objective. III., IV., V.**
Engl. Mech., XLI. (1885) pp. 302 (3 figs.), 327–8, 413–4.

Scherrer, J.—**Der Angehende Mikroskopiker, oder das Mikroskop im Dienste der Höhern Volks- und Mittelschule.** (The young Microscopist, or the Microscope in the higher, primary and middle schools.)
xv. and 206 pp., 134 figs. 8vo, Speicher, 1885.

Schoolroom, Microscope in the.
["No person who has not made the trial can form an adequate conception of the mental quickening occasioned by an exhibition of selected microscopic objects to classes in the schoolroom. The scales on the butterfly's wing, the hexagonal facets of the compound insect-eye, the transformation, as it were, of seemingly shapeless grains of sand into structure of exquisite beauty, the cyclosis of protoplasm in plant cells, and the movement of blood-corpuscles in the foot of the frog—reaching the mind through the eye, make and leave an impression, and give an understanding, which books and diagrams are powerless to produce. The Microscope, frequently and intelligently used, makes nature pellucid. There ought to be an excellent one under skilful manipulation in every school."]
Journ. N. York Micr. Soc., I. (1885) p. 110.

Schott.—**Ueber optisches Glas.** (On optical glass.)
[Title only.]
SB. Jenaisch. Gesell. f. Med. u. Naturwiss. for 1884 (1885) p. 32.

Sollas, W. J.—**On the Physical Characters of Calcareous and Siliceous Sponge-spicules and other Structures.**
[Contains description of an arrangement for determining the density of minute objects under the Microscope. *Post.*]
Scientif. Proc. R. Dublin Soc., 1885, pp. 374–92 (7 figs. and 1 pl.).

Stokes—Watson Spark Apparatus. [Vol. IV. (1884) p. 964.]
Nature, XXXII. (1885) p. 208.

[Stowell, C. H. and L. R.]—**Long Papers v. Short Papers.**
[Advocates papers of not more than twenty minutes in length.]
The Microscope, V. (1885) p. 136.

„ „ See Walmsley, W. H.

Textile Microscopical Association.
["A National Textile Microscopical Association was formed last Saturday by members of the Corresponding Societies of Boston and New York."]
Science, V. (1885) p. 472.

Theiler and Son's (M.) **Demonstration Microscope.**
[Same as Waechter's or Engell's, Vol. II. (1882) p. 398.]
Knowledge, VII. (1885) p. 491 (1 fig.).
Nature, XXXII. (1885) p. 112.

„ „ **Universal Pocket Microscope.** [*Supra*, p. 704.]
Ibid., p. 491. *Ibid.*, p. 112.

Tolman, H. L.—**Eye-piece Micrometers.** [*Supra*, p. 704.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 115–6.
See also under "Measurements of Blood-corpuscles,"
The Microscope, V. (1885) pp. 113–4, from the *Legal News*.

Van Brunt, C.—**Diatoms mounted in Prof. Smith's newest medium—Photographs of same.** *Journ. N. York Micr. Soc.*, I. (1885) pp. 102–3.

Wales, W.—**The proper care and use of Microscope Lenses.** [*Supra*, p. 708.]
Ibid., pp. 113–6 and 123.

Ward, R. H.—**Recent progress in the Improvement of the Microscope.**
from *Annual Cyclopedia for* 1884 (New York, 1885) pp. 499–522 (42 figs.).

„ „ See Behrens, J. W.

Westien, H.—**Apparat zur Vergleichung symmetrischer Stellen der Schwimmhaut des rechten und linken Fusses vom Frosche.** (Apparatus for the comparison of symmetrical parts of the webs of the right and left feet of the frog.)
[*Post.*] *Zeitschr. f. Instrumentenk.*, V. (1885) p. 198 (1 fig.).

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

Preparing Embryos.*—The method of examination which Dr. L. Löwe employs is as follows:—The embryos are placed, according to their size, in a 1 per cent. to a saturated solution of bichromate of potash, which is frequently changed. They remain in this for several months or a year. After being thoroughly washed in water they are stained in a 1 per cent. solution of carmine, which is renewed as soon as its ammoniacal odour is lost, then again washed, soaked in glycerin-jelly in an incubator (1–4 weeks), and hardened in alcohol. Sections are then cut with a microtome.

Methods of Investigating Animal Cells.†—The methods of examining living animals, e. g. *Amœbæ*, Infusoria, &c., under the Microscope, are first described by Dr. A. Brass. When they have been studied in their natural state, various reagents are applied to the living object; e. g. a mixture of chromic acid, 1; platinum chloride, 1; concentrated acetic acid, 1; water, 400–1000; hyperosmic acid, picro-sulphuric acid, or concentrated solution of corrosive sublimate. Brass believes, however, that better results are obtained by studying protozoa without reagents or staining.

The free cells of the animal body are examined in the living state on a warm stage in lymph fluid, vitreous humour, iodized serum, or 0·6–0·7 per cent. salt solution. The ova of mammalia are examined on a warm stage in lymph, to which a trace of sodium carbonate has been added.

Animal tissues are examined in the fresh state in 0·6–0·7 per cent. salt solution, iodized serum, or lymph fluid. The application of water is to be avoided, as it alters the cells. Tissues, of which the internal structure is to be examined, are washed, after treatment with

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 585–6.
† Ibid., pp. 39–51.

reagents, in water, to which alcohol or a few drops of acid have been added. Small animals, and embryos of higher animals, especially those which have not a strong external skeleton, are put alive into a 1/8-1/2 per cent. solution of chromic acid till they are dead, then treated with several drops of concentrated chromic acid, and finally washed, first in 30 per cent. alcohol, and then in gradually increasing strength up to absolute.

As staining reagents, borax-carmine, ammonia-carmine, and log-wood are used.

By starving or exposing to a low temperature the lower animals, insects, worms, &c., Brass has discovered that the granular substance inside the cells is dissolved and reabsorbed, and that finally the nuclear corpuscles disappear by degrees.

To study this process in the higher Vertebrata—parrots, mice, rabbits, &c.—they were infected with tuberculosis. The chromatic substance of the cells disappeared more or less, especially in those of the ovum, in which the changes were very marked, as ascertained from sections of the ovary.

Demonstrating the Nuclei in Blood-corpuscles.* — Herr M. Ladowsky recommends for the demonstration of the nuclei in white blood-corpuscles treatment with solutions of osmic acid (1 per cent.), or weak solutions of picric or chromic acid, and subsequent staining with rosanilin, saffranin, or better methylen-green. The latter is also useful for demonstrating the stroma and nucleus of red corpuscles. The author shows that the white corpuscles are not sticky by injecting watery solutions of indigo-blue, eosin, or even distilled water into the blood, which make the plasma cells aggregate in heaps, whereas the white corpuscles circulate unchanged.

Demonstration of Karyokinesis in Epithelial Tissues.†—Signor Tizzoni employs the method of fixing the tissue with Müller's fluid, hardening, preserving in ordinary alcohol, and staining with alum-carmine, which differentiates the chromatic figures of cell-nuclei in a state of division with the same distinctness as logwood and saffranin; the resting nuclei assume a violet colour, those which are dividing a ruby-red colour. This difference of staining points to a difference in chemical composition. The alum-carmine which the author uses is made by adding to Grenacher's formula a trace of sodium sulphate, which increases its staining power.

Investigating the Structure of the Central Nervous Organs.‡— Dr. J. Stilling recommends that pieces of brain hardened in chromium salts should be placed, after washing, in red or rectified pyroxylic acid or artificial pyroxylic acid (glac. acet. ac. 100 g.; ordinary water 800 g.; kreasote 30 minims). The connective tissue swells, and is quite macerated, so that the nerve-fibres, which remain intact, can be prepared under water with needles and forceps. The specimens can afterwards be stained with picro-carmine.

* Virchow's Arch. f. Path. Anat., xcvi. (1884) pp. 60–100.
† Bull. Sci. Med. Bologna, 1884, p. 259.
‡ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 586–7.

Application of Borax-methylen-blue in the Examination of the Central Nervous System.*—Dr. H. Sahli recommends the following formula: Distilled water 40, saturated watery solution of methylen-blue 24, borax solution (5 per cent.) 16. Mix, leave for 24 hours, and then filter. Sections are stained in this solution for 10 minutes to several hours, and then washed in water or alcohol, until the grey substance is clearly distinguished from the deeply blue-stained white substance, dehydrated, clarified in cedar oil, and mounted in balsam, either pure or mixed with cedar oil. The ganglion cells appear pale greenish, and are clearly differentiated from the blue-stained nuclei of the neuroglia. The most delicate nerve-fibres are stained.

The author obtains better results with this solution than with the ordinary alkaline methylen-blue in the examination of the central nervous system for the presence of micro-organisms.

Preserving Sections of the Nervous System Treated with Bichromate of Potash and Nitrate of Silver.†—To obviate the difficulty of preserving preparations, Signor C. Golgi places a drop of dammar varnish on the section, and allows it to dry in an even layer. He uses slides which have a square hole in the centre, which is closed below with a cover-glass. The section covered with dammar is placed on this, and when the varnish is dry the specimen can be examined on both sides.

Study of Fat Absorption in the Small Intestine.‡—Herr Th. Zawarykin makes use of the following method:—A piece of intestine is treated with hyperosmic acid, washed in water, and placed in spirit for 24 hours. A small portion is then cut between two pieces of elder-pith, in which it is placed in such a way that the villi are turned towards one half and the serous coat towards the other half of the pith. The razor should be wetted with alcohol. The sections can be stained with picro-carmine.

Preparing the Cloacal Epithelium of Scyllium Canicula.§—To isolate the goblet-cells, Herr J. H. List uses Müller's fluid and alcohol. The preparations are then imbedded in celloidin, cut, and stained with eosin and methylen-green. The epithelial cells are in this way stained rose-red, the goblet-cells green.

Preparing Embryos of Amaræcium proliferum.‖—MM. C. Maurice and A. Schulgin employ the following methods:—The whole, or better pieces, of the Ascidian are laid in water with an equal quantity of picro-sulphuric acid. After half-an-hour they are placed in alcohol, the strength of which is gradually increased. They can be stained whole with alum-carmine, or treated as follows:—The isolated ova or embryos are stained with borax-carmine for 15–18 hours, treated with hydrochloric acid, washed in 70 per cent. alcohol, and transferred to a very weak solution of Lyons blue for 15–20

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 49–51.
† Arch. per le Scienze Mediche, viii. (1884) p. 53.
‡ Arch. f. d. Gesammt. Physiol. (Pflüger) xxxv. (1884) pp. 145–57.
§ SB. K. Akad. Wiss. Wien, xc. (1884).
‖ Ann. Sci. Nat.—Zool., xvii. (1884).

hours. They are then quickly imbedded in paraffin, to which ceresin is added. They are cleared with oil of bergamot or cloves. A long stay in alcohol abstracts the colour. By this method the nuclei are stained red, the plasma blue. The three layers of the embryo are clearly differentiated. The ectoderm is a darker blue than the endoderm. The mesoderm shows the least blue staining, as its cells possess a large (red-stained) nucleus, against which the blue plasma stands out in contrast.

Mounting Insects without Pressure.*—Mr. R. Gillo describes the process which he uses for this object, and which is a selection and combination of somewhat well-known methods.

"Let us suppose that the object to be mounted is an ordinary ground-beetle, perhaps 1/2 in. long. The first thing to be done is to steep it in liquor potassæ (full strength), and for this purpose I use a test-tube. When the solution becomes dark-coloured, it must be poured away and fresh added. After being in this for ten days or a fortnight, the insect must be transferred to water in a tea-saucer (distilled or soft water should be used), and whilst holding it steady with a camel's-hair brush, gently squeeze the body with another, giving the brush at the same time a kind of rolling motion, thus driving the contents of the abdomen towards the anus, from which it will presently be discharged. The beetle should now be removed to clean water, and left for an hour or so, when the squeezing process with the two brushes must be repeated as before, when more of the abdominal contents will be ejected. Again place the insect in clean water, and in this way, by several soakings and squeezings, the whole of the contents of the viscera will be removed without the least injury to any of the internal organs.

Throughout this process, however, the insect will be seen to be as opaque as it was at first. It is, therefore, necessary to bleach it; and to effect this it must be placed, until sufficiently transparent, which may take a week or more, in the following solution:—A saturated solution of chlorate of potash, to which is added ten or twenty drops or more of strong hydrochloric acid to each ounce of solution. A shallow but large-mouthed corked bottle is best for this purpose. The chlorine, which is slowly liberated in the solution, attacks the chitine, and thus gradually bleaches it and renders it transparent.

It is now necessary to wash all this solution out of the insect, which is best accomplished by placing it in a small pomatum pot filled with *distilled* water, and after an hour or so to change the water, repeating the process four or five times."

"For the next part of the process, a nest of china saucers or palettes, such as are used by water-colour artists (these fit sufficiently accurately one on the other to hold spirit for a day or two without its evaporating), will be required. In an empty palette place the insect on its back, and arrange its legs in the positions they are intended to retain when finished. Now gently pour methylated spirit over it,

* Journ. of Microscopy, iv. (1885) pp. 151-4.

so as completely to cover it, noticing that the legs are not displaced, for if they are right during this part of the process, they will naturally assume the same position in the final stage of the mounting. After several hours, or next day, change the spirit for fresh, and again, after several hours, pass the insect into ether, but as this is such a volatile fluid, it should be used in a test-tube tightly corked. There need be no anxiety about the position of the legs in this stage, as they have been already stiffened by the spirit, and if displaced now will spring back again into their original position. After soaking some hours in ether, pass into turpentine, in which it may be allowed to remain any length of time."

Directions for mounting in a cell with balsam in benzole follow, and for cementing, and it is pointed out that among other advantages insects thus mounted polarize brilliantly, probably owing to the action of the bleaching solution on the different tissues.

Mounting the Proboscis of the Blow-fly in Biniodide of Mercury.—Mr. H. Sharp describes his method as follows:—The apparatus necessary consists of two pieces cut from a glass slip, 1 in. by $1\frac{1}{2}$ in., a weak spring clip, and a wide-mouthed bottle containing methylated spirit.

Kill the fly by dropping it into boiling water, cut off the head, place it on one of the pieces of glass, and squeeze it with the finger until the tongue protrudes and the lobes expand. Then gently nip it with the other piece of glass, and put on a weak clip to hold it in position. Place the whole in the methylated spirit, and leave it there for an hour or more. On releasing the proboscis from the glasses the lobes will remain expanded; cut off the proboscis and place it in spirit till all the air is removed. Then put it in water for half-an-hour, and then in weak solution of biniodide of mercury (half water and half saturated solution) for two or three hours; then in the full strength solution for 12 hours.

When the proboscis is put in the weak mercury solution the lobes will most likely curl up, to prevent which place it on a slide when taken from the water, and put on a cover with a weak clip to hold it in position, and then run the weak solution of mercury under the cover. Do the same when transferring from the weak to the full strength solution.

Mount in a shellac cell, and use shellac for securing the cover.

Mr. Sharp finds it safe to use for the final mounting a solution of the biniodide of mercury slightly weaker than saturation, as if of full strength crystals will develope in very cold weather.

Preparing Luciola italica.*—To investigate the seat of oxidation which produces the light, Dr. C. Emery kills the living animal in a solution of osmic acid, which stains the luminous plates of the still living and light-developing animals brown. The parts which are to be further examined are macerated for a long time in water, the development of fungi in which is prevented by the addition of

* Zeitschr. f. Wiss. Zool., xl. (1884) pp. 338-54.

crystals of thymol. The osmic acid is especially reduced at the bifurcations of the blind ending tracheal capillaries within the luminous plates, and in the tracheal branches before the bifurcation.

Another method of preservation consists in injecting corrosive sublimate solution into the animal, and subsequent treatment with alcohol.

Preparing Embryo of Peripatus Edwardsii and P. torquatus.* —To obtain the embryos uninjured, Prof. J. v. Kennel removes them with the uterus from the chloroformed mother-animal, and places them, partly in concentrated solution of corrosive sublimate, partly in 1 per cent. osmic acid solution, and subsequently hardens them in alcohol. Alcohol alone, chromic, picric, or picro-sulphuric acid cannot be used for hardening, as they alter the object. The uterus is rendered transparent by turpentine, and cut with its contents, or the embryo is taken out and cut alone.

Preparing Diatoms from the Stomachs of Mollusca and Crustacea.†—Mr. E. S. Courroux recommends that in the case of mussels and cockles, the stomach should be cut out and steeped, or even boiled, in nitric acid until it is dissolved, and the resultant deposit washed and cleaned after one of the methods recommended in the text-books. A little special care, however, in the treatment of shrimps' stomachs will not be thrown away. On removing the shelly skin at the back of the head, the stomach will be seen as a small, dark-coloured body, the size of a small pea. Its position may generally be detected in the perfect shrimp from the dark appearance at the back of the head. The stomachs may be detached with the point of a knife, and when some 12 or 20 or more (as the deposit obtained from them is small) have been collected, they should (taking care that the skin of each stomach is cut or broken) be boiled for a few seconds in a weak solution of washing-soda or ammonia, and then immediately be thrown into a beaker of cold water. By these means we get rid of grease, &c., and render the subsequent treatment by acids more easy. The empty skins of the stomachs will float, and may be picked out of the solution.

The residue which collects after the solution has stood for some time should first be washed free from alkali, and then treated with acids in the usual manner.

The method of separating deposits into different densities is very useful here as with many other gatherings of diatoms, inasmuch as the large forms are then more easily isolated. The often advised whirling in a large evaporating dish in order to separate the diatoms from sand and débris may be frequently practised with success. In the washings of all diatoms, the author has found it of the utmost advantage to perform the later rinsings in distilled water. The diatoms are thus more effectually cleaned from salt, &c., and present less attraction to moisture in the case of dry mounts.

* Arbeit. Zool.-Zoot. Inst. Würzburg, vii. (1884) pp. 1–222.
† Journ. of Microscopy, iv. (1885) pp. 196–8.

The operator may be reminded that the material, even from a considerable number of stomachs, is of course very small in quantity, and must be handled carefully, and, as the most beautiful forms are often the lightest, it is of the utmost importance to let the deposit settle thoroughly in the washings of the lighter portions of the gatherings. The water holding the diatoms in suspension should be allowed to stand at least half-an-hour for every inch of its depth, and hence time will be saved by using watch-glasses and shallow dishes for the purpose.

Bayberry Tallow for Imbedding.*—This substance is obtained from the ordinary bayberry-bush, and is used by furniture manufacturers for oiling the sliding surfaces of bureau-drawers, &c. It is claimed for the bayberry-tallow that it is cheaper and better than celloidin, and far superior to paraffin and other kinds of wax heretofore used. A special feature claimed for it is non-solubility in alcohol, except when warmed to about the temperature of the body or a little above it, and hence the specimens may be kept indefinitely in alcohol at ordinary temperatures. Another point to the credit of the tallow is that tissues injected with it or imbedded in it can be shaved in thinner sections than those allowed by other materials, and that on account of its firmness it allows of a more even cut. After making a section the tallow may be removed from the specimen by simply placing it for a few minutes in a bath of warm alcohol.

Imbedding and Examining Trematodes. — Dr. P. M. Fischer † recommends soap, fifteen parts dissolved in 17·5 parts of alcohol (96 per cent.) as a good imbedding medium for *Opisthotrema cochleare*. Glycerin is used in the examination of the sections. The whole animal can be hardened in absolute alcohol, stained with picro-carmine, logwood, or ammonia-carmine, clarified in oil of cloves, and mounted in Canada balsam in chloroform.

For the investigation of the embryonic sheath of living *Cercariæ* in snails, Dr. J. Bichringer ‡ employs the blood-fluid of the snail itself. Many facts, e. g. the origin of the accessory membrane of the sporocyst, can only be brought to light in this way.

Hatfield's Rotary Section-cutter.§ — Rev. J. J. B. Hatfield's section-cutter is rotary in all its moving parts except the specimen-carrier in its approach to the knife, and the horizontal frame A, supported by the standard B, the lower end of which is a clamp C, for fastening on a table near a corner to give the driving-wheel clearance.

D is the circular knife, mounted on the shaft E, which is rotated by the pulley G and belt F, from the driving-wheel H. I is a hollow shaft, and contains the nut and feed-screw. On the free end of the

* Amer. Mon. Micr. Journ., vi. (1885) p. 98 (from 'Louisville Med. News').

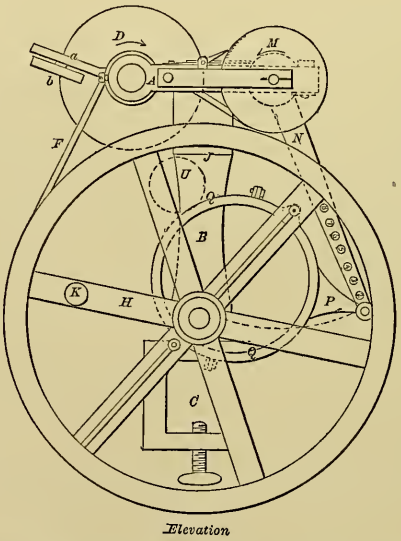
† Zeitschr. f. Wiss. Zool., xl. (1884) pp. 1–41 (1 pl.). See this Journal, iv. (1884) p. 384.

‡ Arbeit. Zool.-Zoot. Inst. Würzburg, vii. (1884) pp. 1–28 (1 pl.). See this Journal, iv. (1884) p. 571.

§ Proc. Amer. Soc. Micr., 7th Ann. Meeting, 1884, pp. 171–2 (2 figs.).

shaft I is mounted the carrier-arm J, which is kept from turning by a spline working in the slot L, and is rigidly connected with the nut (which is 4 in. long) by the screw *e d* passing through the sleeve and spline and screwing into the nut. M is the feed-wheel mounted on the right-hand end of the feed-screw. N is a lever, the upper end embracing the shaft I, the lower end connected with the projecting arm P of the eccentric, which, by its revolution with the driving-wheel, communicates the necessary vibratory motion to the carrier-arm, as may be seen in dotted lines in the elevation at I. The eccentric can be given any throw within its compass by sliding along

Fig. 176.



Elevation

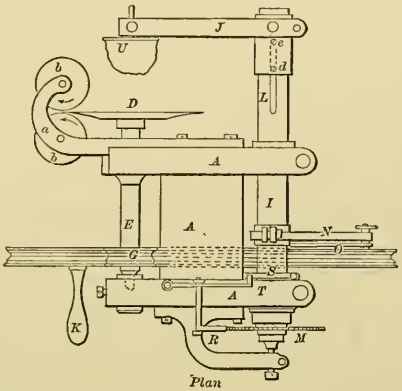
the slotted arms of the driving-wheel. The throw may also be varied by connecting the eccentric with the vibrating lever N, at the various points 1, 2, 3, 4, &c. When making a cut, all the parts connected with the shaft I rotate in the direction of the arrow on the feed-wheel M, but in the return stroke the pawl R catches in the teeth of the feed-wheel, and holds it while all the other parts continue the return motion to the end of the stroke; this causes the screw to turn in the nut, or rather the nut to turn on the screw, and advance the carrier and specimen to the knife. S is a cam embracing the shaft I, and may be set in any position around the shaft, and by its action on the part T of the pawl determines the number of teeth that will be taken at each stroke.

The feed-screw has twenty threads to the inch, and the wheel one hundred teeth; the finest feed is therefore two thousand to one inch.

The two wheels *b b* on the plan and *b* on the elevation, supported

by the bar *a*, constitute the automatic sharpener. Their surfaces are covered with leather, which is supplied with tripoli or rouge from time to time as needed. These wheels are set at a slight angle with the radius of the knife, as shown in elevation, and while the knife may have a very rapid revolution, the wheels move but slowly. When not

Fig. 177.



needed the bar *a* and wheels may be turned up out of the way. After the specimen is imbedded by dipping or casting, one side is cut flat, the plate U is heated and held in contact with the flattened surface a short time, and the stem put into the carrier-arm and turned. If the specimen is to be kept in book form, put a piece of tissue-paper on the lower side of the cast and cut to it.

Notes on Section-cutting.*—Mr. E. L. Mark, of the Museum of Comparative Zoology at Cambridge, Mass., U.S.A., writes as follows:—

"My only apology for the present communication is the hope that it may prove a saving of time to those who have encountered the difficulties of cutting eggs, which are composed largely of yolk-corpuscles liable to crumble in the ordinary paraffin method. The difficulty I have experienced lies not alone in the impossibility of making sections—even from eggs very thoroughly permeated by the paraffin—which will not crumble during the removal to the prepared slide, but also in the fact that sections successfully transferred to the slide are liable to have portions of the yolk-granules loosened and floated over other portions of the section during the removal of the paraffin. While by the ordinary methods of mounting (Giesbrecht, Schällibaum) those elements of the section which lie on its *under* side, and therefore come in immediate contact with the fixative, are safely held in place, it may happen that many from the *upper* surface are loosened and washed away, because the fixative does not penetrate the whole thickness of the section.

* Amer. Natural., xix. (1885) pp. 628-31.

This obstacle may be entirely avoided by the proper use of collodion.

We are indebted to Mason,* so far as I am aware, for the first suggestion of the use of collodion in this connection. But the method employed by Mason has serious objections. A *drop* of collodion on the surface of a paraffin-imbedded preparation softens the object to such an extent that cutting is a very slow process, and thin sections are not easily attainable. The thickness of the collodion film, moreover, interferes more or less with accurate study of the mounted object, even if the sections are inverted when applied to the slide. The gradual drying of the surface of the film also causes the section to roll into a hollow cylinder with its collodion surface innermost, so that the inversion of the section becomes difficult, if not altogether impossible. The consistency of the collodion to be used is stated by Mason, but this is of little value, since even a short exposure to the atmosphere often repeated will quickly change the condition of the collodion in the bottle.

All these impediments—but for which, I believe, the method would have come into more general use—may be largely if not entirely obviated by using *a very small amount of a rather thin collodion.*

The criterion which serves me is: *the collodion must dry almost instantly* (within two or three seconds after being applied) *without leaving a trace of glossiness on the surface of the paraffin.*†

In this collodion process I use at present the following method:—

The object, imbedded in paraffin in the ordinary way, is placed in a receiver of a Thoma's microtome and the paraffin cut away to within 1 mm. to 2 mm. of the object on four sides, leaving a rectangular surface of paraffin, two edges of which are parallel to the edge of the knife.

A slide prepared by being painted with *a thin coat* of Schällibaum's mixture of collodion and clove-oil is placed at the left of the microtome.

At the right of the latter, handy to the right hand, is a small bottle half-full of the thin collodion, into which dips the tip of a camel's-hair brush; the quill of the brush is thrust through a hole in a thin flat cork, which serves at once as a temporary cover to the bottle and a support to the brush, the latter being adjusted to any height of the collodion by simply pushing it up or down through the hole in the close-fitting cork. Near by is a small bottle of ether, with which the collodion is thinned as soon as it begins to leave a shining surface on the paraffin.

The operator should sit *facing the light*, so that he may judge

* N. N. Mason, 'Use of Collodion in cutting thin Sections of Soft Tissues, Amer. Natural., xiv. (1880) p. 825.

† Judging from the effects, I am inclined to think that by this method the collodion penetrates the preparation to a certain depth, fixing the parts in their natural relations without producing a superficial film. At any rate, if the sections are made sufficiently thin (e. g. 5 μ) there is no curling, whereas with much thicker sections, the superficial portion of which alone contains in that case the collodion, there is often a tendency to roll. This I have attributed to the slight shrinkage in the upper or collodion-impregnated portion of the section.

accurately of the condition of the surface of the paraffin, which reflects the light. Everything being in readiness, the brush is lifted and wiped on the mouth of the bottle to *remove most of the collodion*, and then the paraffin and the object are *at once* painted by *quickly drawing the brush across the surface*, care being used that it is evenly applied and that the collodion is not carried on to the vertical faces of the block. The temporary moistening vanishes like a cloud from the surface of the paraffin; the brush is then returned to the bottle; the knife is drawn and returned, leaving the section on the edge of the blade. The object in the block is then painted again, but before drawing the knife a second time the first section is removed with a scalpel and placed on the slide with its *upper face in contact with the fixative*. Then the knife is drawn again, and the other steps of the process repeated. Thus the collodion has time to dry thoroughly before the section is made. If the precautions above given are observed it will not be necessary to wait for the drying of the collodion, but the section may be cut at once, i. e. within five seconds after painting. It is thus possible to cut as fast as one can paint the surface, and with some practice it becomes possible to cut *continuous ribbons* of sections, which may be transferred at intervals. Practically I find it most convenient to cut enough to form one row or half a row of sections at a time and transfer at once to the slide, rather than to cut the whole object without interruption, as is done in the ordinary method.

The following precaution may prove serviceable:—Especial care should be exercised to prevent the painting of the vertical face nearest the operator, since the section is then liable to cling along its whole edge to this vertical film and be carried *under* the knife-blade. If by chance this should occur, the section should be removed from the block *before the knife is moved back*, as it is liable to be caught and lacerated between the face of the block and the under surface of the returning blade. The possibility of the section being thrown under the knife-blade may, however, be obviated either by carefully trimming the vertical face in case it is accidentally painted (to allow of which the *hither margin* of the paraffin may be left broader than the other three), or by drawing the knife *slowly*, so that the first indication of a failure to cut through the vertical film may be recognized and the section held in place on the blade by a slight pressure with a soft brush, whereupon the knife will cut through the film and leave the section free.

If by chance the paraffin block has been painted with too much collodion or with collodion which is too concentrated, thus leaving a shiny surface, the film should be at once broken by pressing it gently two or three times in quick succession with the end of a rather stiff, blunt, *dry* brush. This enables the collodion to dry quickly, and thus prevents the softening of the paraffin.

If the sections have a tendency to curl they may be flattened out on the slide by means of a brush, for a section thus impregnated with collodion may be handled during the first few seconds after contact with the Schällibaum mixture with much greater impunity than one

not so treated. If the collodion has been too much thinned with ether the fact will become apparent from the softening of the paraffin, and may be remedied by waiting for the evaporation of the ether or by adding thicker collodion.

This process can in no way be considered as a substitute for the ordinary method of cutting objects, since it requires more time and closer attention to details, but for those cases where there is a liability to crumbling, or where sections of sufficient thinness cannot be procured free from folds, it will doubtless be found very serviceable."

Sections in Series.*—Herr F. Spee remarks that the success of cutting sections depends on the quality of the imbedding mass, on the shape which is given to the paraffin around the object to be cut, and on proper manipulation in cutting. His imbedding mass consists of paraffin with a melting-point of 50° C., which is prepared by melting it in an open porcelain dish over a spirit-lamp flame, and further heating it until it assumes the colour of yellow wax or honey. When cool, it appears as a homogeneous mass without air-bubbles; its cut surface feels soapy and greasy. This material has the advantage that sections made with a microtome adhere firmly together by their edges at the ordinary temperature of the room.

To imbed specimens, they are placed in the mass at a temperature of 60°–65° C. for 4–6 hours till they are thoroughly permeated by the paraffin, which is then allowed to cool. To cut sections, the superfluous paraffin is cut away and the remaining piece of paraffin so arranged that the edges of the sections which are made pass over each other and adhere together. This end is attained by giving the paraffin the shape of a parallel sided prism, of which the base is a right angle. The paraffin is melted on to a cork by a hot spatula, and fastened on to the object-carrier of the microtome in such a way that its broad side is parallel to the edge of the razor. As a rule, a layer of paraffin about 1/2–1½ mm. thick should be left round the specimen. No section should be thicker than 1/100 mm., and all the sections should be as nearly as possible of equal thickness. If thicker than 1/100 mm. they roll easily, while too great unevenness interferes with the continuity of the ribbon. The best ribbons are obtained with specimens which have a small surface. For practical purposes the ribbons should not be longer than 15–20 cm. To fix them on the slide the author uses the gum solution of Flögel with good results.

New Carmine Solution.†—For the investigation of Protozoa, Medusæ, Echinodermata, *Lumbrici*, *Podura*, &c., Dr. O. Hamann uses a solution which is made as follows:—30 grms. carmine are mixed with 200 grms. concentrated ammonia, and glacial acetic acid is added until the solution is neutral or only faintly acid. The filtered solution is ready for use in two to four weeks. Dr. W. Krause recommends it, used warm, for staining the retina, nervous system, and glands of Vertebrata.

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 6–12.

† Internat. Monatsschr. f. Anat. u. Histol., i. (1884) Heft 5.

Method of Preparing Hæmatoxylon Staining Fluid.*—Dr. S. J. Hickson states that the best method of preparing hæmatoxylon fluid is to follow Mitchell's instructions, taking some further precautions.

Take 56 grammes of the logwood extract, and thoroughly pound it in a mortar. Then place it on a filter, and pour about a litre and a half of ordinary tap water through it. The filtrate may be thrown away, and the residue allowed to dry. In the meantime prepare a solution of alum as follows:—Take 25 grammes of alum, and after they have been thoroughly pounded in a mortar pour them into 250 cc. of distilled water. To this solution add strong potash until a precipitate is formed which will not dissolve upon stirring and standing. Pour the alum solution upon the hæmatoxylon residue, and allow them to macerate together for three or four days in a warm room. Then filter the hæmatoxylon solution into a bottle provided with a closely fitting stopper, and add to it 10 cc. of pure glycerin and 100 cc. of 90 per cent. spirit. The residue need not be thrown away, for it can be macerated again with alum solution for a week or more, and a good strong stain obtained as before. When the solution is thus made it should be well shaken, and allowed to stand for some weeks before being used. This solution of hæmatoxylon improves considerably with age. The oldest which the author has was made about twelve months ago, and is by far the best.

The hæmatoxylon stain produced by this recipe possesses several advantages over others. In most cases it differentiates the tissues admirably; nuclei stain deeply, cell-protoplasm faintly; it seems to last a long time without showing signs of fading, and, as it penetrates well, it is very useful for staining in bulk.

Staining for the Study of Red Blood-corpuscles.†—In the study of red blood-corpuscles in bone-marrow, Professors G. Bizzozero and Torres employ as a staining reagent salt solution of varying strength (in Reptilia 0·55–0·60 per cent.) to which 1/10 per cent. methyl or gentian violet is added. No other stain contrasts so sharply with the ground-stain of the hæmoglobin-containing stroma. In animals with very large blood-corpuscles, subsequent treatment with 0·5 per cent. acetic acid must be adopted to render the cell-substance transparent.

To study the process of division in the blood of Anura larvæ, they must be examined in the living state, and rendered motionless by placing them before observation in 0·5 per cent. solution of curara.

New Double Stain for the Nervous System.‡—Dr. H. Sahli finds the following an excellent method.

The sections, which should not be in water for more than five to ten minutes after they have been cut, are placed for several hours in a concentrated watery solution of methylen-blue, washed in water, and transferred to a saturated watery solution of acid fuchsin for about five minutes. They are then quickly washed in water and

* Quart. Journ. Micr. Sci., xxv. (1885) p. 244.
† Arch. Ital. de Biol., iv. (1883) pp. 309-29.
‡ Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 1-7.

placed for a few seconds in a 1 per cent. alcoholic solution of caustic potash, and washed in a large quantity of water. The white substance then appears to the naked eye blue or violet, and the grey substance red. With high powers one can see in transversely divided fibres the axis-cylinder red, while in some fibres the whole medullary sheath is composed of "cyanophilous," in others of "erythrophilous" substance, or, again, the sheath is composed of concentric layers of blue and red stained substances. In the grey substance of the spinal cord Gerlach's network of delicate fibres is stained blue or violet on a red ground.

New Method of Staining the Spinal Cord.*—Prof. A. Adamkiewicz finds that by staining with saffranin and methylen-blue, individual segments of the cord can be differentiated. These "chromoleptic zones" are situated in general round the grey substance, following the outer contour of the cord. They also occupy the internal part of the posterior fasciculus, and the part of the lateral fasciculi which occupies the angle between the anterior and posterior cornua. The non-chromoleptic zone forms a ring round the periphery of the cord.

Staining the Axis-cylinder of Medullated Nerve-fibres.† — As the result of his investigations, Dr. C. Kupffer finds that the axis-cylinder contains the nerve-fibrils, which float loose in nerve-serum. A compact axis-cylinder is an artificial product. To demonstrate the nerve-fibrils in the axis-cylinder, the nerve is fixed on a cork and placed for two hours in a 1/2 per cent. solution of osmic acid, washed for two hours with distilled water, stained for 24–28 hours in a saturated solution of acid fuchsin, washed for 6–12 hours in absolute alcohol, clarified with oil of cloves, imbedded in paraffin, and cut. The fibrils in the axis-cylinder are stained bright red, and appear in cross section as stained points.

Staining Desmids.—Mr. W. B. Turner sends us the following process for staining desmids without contraction of the endochrome.

When quite fresh gathered, wash and place in a solution of chromic acid, so weak that it requires three days to decolorize a large desmid. When the colour has gone, wash well in at least two waters and stain with anilin. Fix with a little tartaric or weak nitric acid. Then wash and mount in camphorated or carbolized water (about 10 to 90 per cent. distilled water).

All fresh-water algæ seem to do well under this process, including the delicate *Draparnaldia*, which entirely fail after a little time in the ordinary fluids.

Boro-glyceride for Mounting.‡—Mr. A. P. Wire has for two years experimented on this substance, and with, at present, such good results, that he considers it worthy of extended trial. Boro-glyceride is composed of boracic acid and glycerin, and exists in two forms, the

* SB. K. Akad. Wiss. Wien, lxxxix. (1884) p. 245.

† SB. K. Bayer. Akad. Wiss., 1884, pp. 466–75.

‡ Journ. of Proc. Essex Field Club, iv. (1885) pp. lxxix.–lxxx. Sci.-Gossip, 1885, pp. 139–40.

glacial and the hydrated. For mounting, a saturated solution of glacial boro-glyceride is used, made by dissolving the substance in warm water—using about one part to twelve of water—and allowing the surplus to crystallize out and settle. It is excellent for vegetable tissues. It does not act on them in any way, grains of chlorophyll even remain unchanged. It does not destroy the anilin colours used for staining, although the delicate colours of flower petals appear to bleach in the solution. It answers for mounting insects whole and without pressure. Gold size or brown cement does for fixing the upper glass of the cell.

Litharge and Glycerin as a Cement.—Mr. J. C. Douglas writes that if sifted dry litharge powder is mixed with glycerin, it forms a cement which hardens rapidly in air and water, bears 275° C., and is very resistant to reagents. It is stated to be adhesive to all materials, the articles to be cemented being preferably moistened with glycerin. The cement will probably be found well suited to many purposes of the microscopist.

Hamlin's Ideal Slide.*—Mr. F. M. Hamlin considers an "ideal slide" to be one where the slide and cell are of *one* piece of glass, thus doing away with all cement except that required to secure the cover-glass.

When a cell of ordinary depth is required, an excavation could be made in a slide of usual thickness, which could not only contain the object, but the cover-glass, so that the upper surface of the latter should be even with the surface of the slide, thus protecting it from

Fig. 178.

being displaced by accident. (This plan was suggested by Mr. B. Piffard last year. See this Journal, Vol. IV. (1884) p. 655.) The diameter of the excavation for the cell should be a little less than that for the cover-glass, so as to form a ledge for it to rest upon (fig. 178).

When a cell of greater depth is required than an ordinary slide will permit, a very different case is presented, unless a slide of unusual thickness is used. To secure in the middle of the slide the necessary thickness, the glass could be cast in a mould which would, at the same time, form the cell and the ledge for the support of the cover-glass (fig. 179).

There are difficulties in the way of carrying out these ideas, but

Fig. 179.

the author cannot think them insuperable, or, if overcome, that they will render such slides too expensive for general use.

Apart from the saving of time and labour, the chief advantages would be in the perfect safety and imperishability of the mount, for

* Proc. Amer. Soc. Micr. 7th Ann. Meeting, 1884, pp. 179-80 (2 figs.).

the object practically would be sealed hermetically in glass; the contact of the media with the cement would be so slight as to be hardly worth considering. Objects thus mounted would, it is claimed, be as permanent as the glass itself.

Finish for Slides.*—Dr. J. E. Hays recommends the following as a handsome finish for slides.

Take one of the packages of "gold or silver paints" put up by Wells and Richardson, of Burlington, Vt., and sold in connection with their "diamond dyes," and add it to 1/2 oz. of the best dammar varnish, warming the varnish so as to make the paint mix with it well, and apply with a fine brush. The paint will settle to the bottom upon standing, but by warming a little and shaking well it is diffused again. This makes a very pretty finish, and adds strength to the cover cement as well.

Counting of Microscopic Objects for Botanical purposes.†—M. E. C. Hansen recommends the application to botany of the method of counting blood-corpuscles adopted by physiologists. The apparatus devised by Hayem and Nachet is equally applicable to the counting of yeast-cells, as well as in examinations of air, water and soil for microbes. It is also useful for making pure cultures when it is necessary to ascertain the number of micro-organisms in a given quantity of liquid to determine the extent of the dilution required. In a similar way Jörgensen determined the proportions of each substance in a mixture of rye and wheat flour.

Styrax and Balsam.—Prof. A. B. Aubert's‡ experience with styrax has proved that in most cases it can be used instead of Canada balsam—indeed, that it is superior to balsam, showing the finer part of objects more clearly. He has entirely discarded balsam for diatoms. Cartilage, when properly stained, shows very well, better in his opinion than in glycerin-jelly. For histological objects generally, he anticipates it will be a welcome addition to the present stock of mounting media. Tooth, bone, and other sections would undoubtedly show to better advantage in this medium than in balsam.

Mr. C. V. Smith, the well-known mounter of botanical objects, to whom he sent specimens of the gum, spoke very highly of it for botanical mounts, and said that he never tried any medium which showed aleurone-grains in section of castor-oil plant so satisfactorily. It also shows the mycelia of fungi more clearly than most other media.

Objects mounted a year ago show no sign of deterioration, and there is every reason to believe that it will prove an excellent medium for permanent mounts, preferable to balsam, not only on account of its highly refractive index but also because it seems somewhat less brittle. When the solutions kept in capped bottles become thick by evaporation, it is best to transfer them to a common bottle and add the proper amount of solvent. This will cause a flocculent precipitate.

* The Microscope, v. (1885) p. 112.
† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 191–210 (6 figs.).
‡ Amer. Mon. Micr. Journ., vi. (1885) pp. 86–7.

Let stand for several days, filter back into capped bottle, when a clear solution, ready for use, will be obtained.

On the other hand, Mr. J. Deby finds that styrax never dries completely, and he considers that, except for tests, the old balsam mount is the safest and longest-lived of all.

Bureau of Scientific Information.*—With a view to the more general dissemination of the results of scientific investigation, and facilitating the work of the student in natural history, certain members and officers of the Academy of Natural Sciences of Philadelphia have associated themselves into a "Bureau of Scientific Information," whose function is the imparting, through correspondence, of precise and definite information bearing upon the different branches of the natural sciences. It is believed that through an organization of the kind considerable assistance can be rendered to those who, by the nature of their surroundings, are precluded from the advantages to be derived from museums and libraries. The scope of the organization does not embrace considerations of a purely professional character—such as mineral or chemical analyses—nor the determination of collections, except by special agreement. Dr. J. Leidy undertakes the Mycetozoa, Rhizopoda, Entozoa, &c.; E. Potts, pond life, freshwater sponges, and Bryozoa; Dr. B. Sharp, worms and histology; and Dr. J. Gibbons Hunt, microscopical technology.

A New Departure.†—The following advertisement is appearing: "Microscopic objects for hire, histological, botanical, geological, by the best mounters. Let out on most moderate terms."

ADAMKIEWICZ, A.—**Neue Rückenmarkstinctionen. I. Ergebnisse am normalen Gewebe. II. Ergebnisse der Saffraninfärbung am kranken Rückenmarksgewebe.** (New stains for spinal cord. I. Results with normal tissue. II. Results of saffranin staining in diseased tissue.) [*Supra*, p. 742.]
SB. K. Akad. Wiss. Wien, LXXXIX. (1884) p. 245 (3 pls.).
Anzeig., 1884, No. 10. See also *ante*, p. 428.

ADY, J. E.—**The Microscopic Study of Rocks. V., VI.**
[Mounting, finishing, and storing.]
Illus. Sci. Monthly, III. (1885) pp. 163–6, 198–202.

„ „ **Observations on the Preparation of Mineral and Rock Sections for the Microscope.** *Mineral. Mag.*, VI. (1885) pp. 127–33 (2 figs.).
Abridgment in *Engl. Mech.*, XLI. (1885) pp. 342–3 (2 figs.).

Bacterial Pathology.
[A series of papers on the exhibits at the biological laboratory of the Health Exhibition, with figures showing the appearance of the bacteria and the apparatus used in preparing and cultivating them.]
40 pp., 30 figs. 8vo, New York, 1885 (reprinted from *Lancet*).

BASTIN, E. S.—**Directions for Preparing and Mounting Sections of Stems and Leaves.** *Western Druggist.* Noted in *Bot. Gazette*, X. (1885) p. 264.

BOOTH, M. A.—**Why do dry mounts fail?** [*Post.*]
Micr. Bulletin (Queen's) II. (1885) pp. 17–8.

BOTTONE, S.—See Volvox.

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* Science, iv. (1884) p. 108. † Nature, xxxii. (1885) p. xxix.

Burrill, T. J.—[Stains for Vegetable Sections.]

[His stain for tubercle bacillus is excellent also for vegetable sections, being remarkably selective in regard to the different tissues.]

Micr. Bulletin (Queen's) II. (1885) p. 21.

Castellarnau, J. M. de.—**La Estacion zoologica de Napoles y sus procedimientos para el examen microscopico.** (The zoological station at Naples and its processes for microscopical examination.)

[An elaborate and ably prepared report to the Spanish Director General of Agriculture, Industry, and Commerce, forming a classified description of processes for preparing objects.]

xiii. and 207 pp. 8vo, Madrid, 1885.

Cole, A. C.—**Studies in Microscopical Science.**

Vol. III. Sec. I. Part 5, pp. 17–20. The Sexual Reproductive Organs of *Chara*. Plate V. Part 6, pp. 21–4. Structure of Archegonium in *Marchantia*. Plate VI. *Marchantia* showing its sexual organs and sporogonium.

Sec. II. Part 5, pp. 17–20. The Integument. Plate V. V. S. of Skin of Frog. Stained Carmine. × 75. Part 6, pp. 21–4. Integumentary Appendages. Plate VI. Tail-feather of young Starling (*in situ*). T. S. × 100.

Sec. III. Part 5, pp. 17–20. Interstitial Pneumonia. Plate V. × 200. Part 6, pp. 21–4. Tubercle, Pulmonary Tuberculosis. Plate VI. Miliary Tubercle × 200.

Sect. IV. Part 5, pp. 17–20. Leeches (*concld.*). Hair. Plate V. Hair of Peccary (Dicotyles). Tr. Sec. × 210. Part 6, pp. 21–4. The tail of a Puppy (including methods of preparation (*post*). Plate VI. T. S. double stained × 30.

Collins's (C.) **Slides of Parasites of Birds, &c.** *Sci.-Gossip*, 1885, p. 140.

Cooke, M. C.—**Collecting, Examining, and Preserving Freshwater Algæ.**

[Demonstration.] *Journ. Quek. Micr. Club*, II. (1885) pp. 148–50.

Courroux, E. S.—**On Diatoms in the Stomachs of Shell-fish and Crustacea.** [*Supra*, p. 734.] *Journ. of Microscopy*, IV. (1885) pp. 196–8.

Doane, L. G.—**Gold and Silver Ferns.**

[Upon a slip of glass put a drop of liquid auric chloride or argentic nitrate, with half a grain of metallic zinc in the auric chloride, and copper in the silver. A growth of exquisite gold and silver ferns will form beneath the eye.]

The Microscope, V. (1885) p. 112.

Draper, E. T.—**Graphic Microscopy. XVIII. Seeds of Love-lies-bleeding** (*Amaranthus caudatus*). **XIX. Section of Shell of Barnacle.** (*Balanus sulcatus*).

Sci.-Gossip, 1885, pp. 121–2 (1 pl.), 145–6 (1 pl.).

Embedding in Bayberry Tallow. [*Supra*, p. 735.]

Amer. Mon. Micr. Journ., VI. (1885) p. 98, from *Louisville Med. News*.

Fabre-Domergue.—See *Klein, E.*

Flahault, C.—**Récolte et préparation des Algues en voyage.** (Collection and preparation of algæ when travelling.) 12 pp., 8vo, Montpellier, 1885.

Fol, H.—**The Cultivation of Microbes.** *Science*, V. (1885) pp. 500–4 (10 figs.).

Transl. and abridged from the article in *La Nature*.

[Frazer, P.]—**Report of Microscopical Examination of Thin Transverse Sections of Carbons.**

[With five photo-collotypes through the Microscope of thin sections of electric light carbons.]

Reports of Examiners on Electric Lamps and Carbons for Arc Lamps. International Electrical Exhibition of the Franklin Institute, 1884, pp. 22–5 (1 pl.). (*Supplt. to Journ. Franklin Inst.*, 1885.)

Gierke, H.—**Staining Tissues in Microscopy. III.** [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) pp. 106–7. Transl. from *Zeitschr. f. Wiss. Mikr.*

Gillo, R.—**On Mounting Beetles and other Insects without pressure.** [*Supra*, p. 732.] *Journ. of Microscopy*, IV. (1885) pp. 151–4.

Goodwin, W.—**Double-staining Vegetable Tissues.**

Proc. and Trans. Nat. Hist. Soc. Glasgow, I. (1885) pp. v–vi.

GRANT, F.—**Mounting Bacteria—Comma Bacilli.**
[Reply to "Medicinæ Doctor," *ante*, p. 565.]
Engl. Mech., XLI. (1885) p. 324.

„ „ See Volvox.

GREGORY, J. W.—**Microscopical Examination of Rocks.**
[Abstract only.]
8th Ann. Report Hackney Micr. and Nat. Hist. Soc., pp. 20–1.

HAACKE, W.—**Ueber die Verwendung von Kühleimern beim Sammeln von Seethieren.** (On the use of coolers in the collection of marine animals.)
[*Post.*] *Zool. Anzeig.*, VIII. (1885) p. 248.

HARE, A. W.—See Woodhead, G. S.

HAYS, J. E.—**A Handsome Finish for Slides.**
[*Supra*, p. 744.] *The Microscope*, V. (1885) p. 112.

HEURCK, H. VAN.—**Synopsis des Diatomées de Belgique.** (Text.)
[Contains chapters on the drawing, collecting, and preparation of diatoms.]
235 pp. and 3 supplementary plates, 8vo, Anvers, 1885.

HILGENDORF, F.—**Eine Methode zur Aufstellung halbmikroskopischer Objecte.** (A method of preserving semi-microscopic objects.) [*Post.*]
SB. Gesell. Naturf. Freunde Berlin, 1885, pp. 13–6.

Hinton's (E.) **Type Slide of Blood.**
[Blood-corpuscles of man, frog, bird, fish, and snake on one slide.]
Sci.-Gossip, 1885, p. 139.

[HITCHCOCK, R.].—**Postal Club Boxes.**
[List of preparations, with remarks.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 117–8.

HORNER, J.—**Work for the Microscope.**
[I. Introductory. II. The Collecting of Objects.]
Our Corner, V. (1885) pp. 361–5; VI. (1885) pp. 34–8.

IHL, A.—**Ueber neue empfindliche Holzstoff- und Cellulose-Regentien.** (New reagents for Lignin and Cellulose.) *Chemiker-Ztg.*, IX. (1885) No. 14–15.

JACKSON, E. E.—See Walmsley, W. H.

JACOBS, F. O.—**New Freezing Microtome.** [*Post.*]
Amer. Natural., XIX. (1885) pp. 734–6 (2 figs.).

James, F. L.—**Ciment de blanc de zinc pour construire les Cellules.** (White zinc cement for making cells.) [*Post.*]
Journ. de Microgr., IX. (1885) pp. 209–12,
Translated from article in the *National Druggist*.

JENKINS, A. E.—**Methods of Work. II.**
[The preparation of animal tissues (Killing. Osmic Acid. Chromic Acid. Picric Acid. Nitric Acid and Acetic Acid). Mixtures of various acids (Osmic-acetic Acid. Chromic-acetic Acid. Chromo-osmic-acetic Acid. Chromic-nitric Acid. Merkel's fluid).]
The Microscope, V. (1885) pp. 126–31.

JOHNE, —.—**Ueber die Koch'schen Reinculturen und die Cholera-bacillen.** (On Koch's pure cultures and the cholera bacillus.)
[Contains complete directions for cultivation and observation.]
2nd ed., 28 pp. and 1 fig., 8vo, Leipzig, 1885.

Klein, E.—**Microbes et Maladies. Guide pratique pour l'étude des micro-organismes.** (Micro-organisms and Disease. Practical guide to the study of micro-organisms.)
[*Transl.* by Fabre-Domergue.] 292 pp. and 116 figs., 8vo, Paris, 1885.

LATHAM, V. A.—**The Microscope and how to use it. II., III. On Mounting Microscopic Objects.**
Journ. of Microscopy, IV. (1885) pp. 96–104 (1 fig.), 186–98.

Le Pelley's (C.) **Dipping Tubes.**
[Exhibition only—"of a superior kind."]
Journ. Quek. Micr. Club, II. (1885) p. 161.

LOOSS —.—**Neue Lösungsmittel des Chitins.** (New medium for dissolving chitin.) [*Post.*] *Zool. Anzeig.*, VIII. (1885) pp. 333–4.

MARK, E. L.—**Notes on Section-cutting.** [*Supra*, p. 737.]
Amer. Natural., XIX. (1885) pp. 628–31.

MARSHALL, W. P.—**Pennatulida. Microscopic Sections and the mode of Automatic Section-cutting and Mounting.**
[Description of the accepted processes.]
Midl. Natural., VIII. (1885) pp. 191–3.

Mayer's (P.) **Carbolic Acid Shellac.** [*Post.*]
Amer. Natural., XIX. (1885) p. 733.

M'CALLA, A.—**The Working Session.**
["Further thoughts in its favour."]
Micr. Bulletin (Queen's) II. (1885) p. 19.

MONDINO, C.—**Sull' uso del bicloruro di mercurio nello studio degli organi centrali del sistema nervoso.** (On the use of bichloride of mercury in the study of the central organs of the nervous system.) [*Post.*]
Giorn. R. Accad. Med. Torino, 1885, pp. 38–47.

NOLL, E.—**Eau de Javelle, ein Aufhellungs- und Lösungsmittel für Plasma.** (Eau de Javelle, a clearing and dissolving medium for protoplasm.) [*Post.*]
Bot. Centralbl., XXI. (1885) pp. 377–80.

PELLETAN, J.—**Microtome à triple pince.** [*Post.*]
Journ. de Microgr., IX. (1885) pp. 171–4 (1 fig.).

PERAGALLO, H.—**Diatomées du Midi de la France.** (Diatoms of the south of France.)
[Containing chapters on the collection, preparation, and examination of diatoms, pp. 201–34.]
Bull. Soc. D'Hist. Nat. Toulouse, XVIII. (1884) pp. 189–272.

QUEEN, J. W.—**Glass Disc for Arranging Diatoms.**
["For arranging diatoms in symmetrical patterns, a good device is a glass disc with radial and concentric lines to fit to the eye-piece."]
Micr. Bulletin (Queen's) II. (1885) p. 24.

REX, G. A.—**The Myxomycetes—their Collection and Preservation.**
["Few of the lower orders of plants equal these in beauty as microscopic objects, whether viewed in their entirety with the binocular, or in their structural details with high powers. Some genera, as *Diachea* and *Lamproderma*, display a brilliant metallic or iridescent lustre of the sporangia walls. Others, of the Physaraceæ, are characterized either by snowy crystals or highly coloured granules, orange, scarlet, lilac, or purple, of calcium carbonate. Still others, of the Trichiaceæ and Arcyriaceæ, by their beautiful spore and thread-markings and sculpturing, are worthy objects for the use of the higher lenses of the Microscope."]
Bot. Gazette, X. (1885) pp. 290–3.

RICHARD, J.—**Nouveau réactif de fixation des animaux inférieurs.** (New fixing agent for the lower animals.) [*Post.*]
Zool. Anzeig., VIII. (1885) pp. 332–3.

ROHRBECK, H.—**Neuerungen an bakteriologischen Apparaten.** (Improvements in bacteriological apparatus.) *Gæa*, XXI. (1885) Heft 6.

ROMITI, G.—**Une noticina di technica embriologica.** (Note on technical embryology.) [*Post.*] *Boll. Soc. Cultori Sci. Med. Siena*, III. (1885).

SLACK, H. J.—**Pleasant Hours with the Microscope.**
[The minute structure of the anthers of plants—"Blight" Insects and Mites.]
Knowledge, VII. (1885) pp. 548–50 (1 fig.), VIII. pp. 91–2 (3 figs.).

SMITH, E.—**Varnish for "Ringing" Slides.**
[Evaporate Canada balsam by gentle heat until it sets hard when cold; then dissolve it in as much benzole as will allow it to flow freely from the brush.]
Journ. of Microscopy, IV. (1885) p. 122.

STOWELL, C. H.—**The Microscope in Medicine.**
[In the diagnosis of disease. In the detection of fraud. In the detection of adulteration of powdered drugs. In correcting diagnoses. In the differential diagnosis of the new formations.]
The Microscope, V. (1885) pp. 121–6.

TATE, A. N.—**Microscopical Examination of Potable Water.**
[Paper read to Liverpool Microscopical Society.]
Engl. Mech., XLI. (1885) p. 145.

TAYLOR, T.—**Discrimination of Butter and its Substitutes.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) p. 115.

Tea, Microscopical Examination of.
Amer. Mon. Micr. Journ., VI. (1885) pp. 101–2 (2 figs.).

THURSTON, E.—**The Staining of Bacteria for Micro-photographic purposes.**
The Microscope, V. (1885) pp. 138–40, from *Photographic News.*

VAN BRUNT, C.—**Diatoms fastened by heat.**
[When diatoms are thus fastened to the cover-glass, only so much heat should be applied as is found to be really necessary. Least heat is required when the diatoms are taken from a solution of alkali.]
Journ. N. York Micr. Soc., I. (1885) p. 123.

Volvox globator, keeping alive and mounting.
[Replies by S. Bottone and F. Grant to query.—Mount in a mixture of equal bulks of methylated spirits, water, and glycerin (S. Bottone). Solution of osmic acid, anilin-green, magenta, and Hantsche's fluid, "The result is a double stain which is distinctive but not very effective" (J. Grant).]
Engl. Mech., XLI. (1885) p. 440.

WALMSLEY, W. H.—**The Merits of White Zinc Cement.**
[Commendation of it. Also note by editors and E. E. Jackson.]
The Microscope, V. (1885) pp. 135–6, see also p. 137.

WALTERS, W. H.—**Histological Notes for the use of Medical Students.**
vi. and 65 pp., 8vo, Manchester, 1884.

WARLOMONT, R.—**Note sur la technique microscopique de l'œil.** (Note on the microscopic technique of the eye.) [*Post.*]
[Description of the processes used at the Royal Ophthalmic Hospital, Moorfields.]
Bull. Soc. Belg. Micr., XI. (1885) pp. 201–8.

WEDDING, H.—**Properties of Malleable Iron.**
["Microscopical investigation had led him to modify the explanation of welding he had given some years ago. He had now come to the conclusion that the strength of a finished piece of iron depends on the sectional area of the mass of iron it contains. From the total sectional area of a piece of weld iron, the slag conclusions, and in the case of ingot iron the blow-holes, must be deducted. This calculation is decidedly in favour of the ingot iron, though he pointed out it can only be superficially effected, even with our present knowledge of microscopy."]
Science, V. (1885) p. 492.

WHITMAN, C. O.—**The Uses of Collodion.** [*Post.*]
Amer. Natural., XIX. (1885) pp. 626–8.

WILLIAMS, C. F. W. T.—**Crystals for the Polariscope.**
[Recommends mounting in castor-oil as a remedy for the instability referred to by Mr. J. W. Neville, *ante*, p. 566.]
Sci.-Gossip, VII. (1885) p. 140.

WIRE, A. P.—**Note on a new Medium for Mounting Moist Vegetable Tissues for the Microscope.** [*Supra*, p. 742.]
Journ. of Proc. Essex Field Club, IV. (1885) pp. lxxix.–lxxx.
See *Sci.-Gossip*, 1885, pp. 139–40.

WOODHEAD, G. S., and A. W. HARE.—**Pathological Mycology. An Enquiry into the Etiology of Infective Diseases. Sec. I. Methods.** [*Supra*, p. 698.]
x. and 174 pp., 60 figs., 8vo, Edinburgh, 1885.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Deby's Twin Microscope. — Mr. J. Deby, C.E., sends us the following description of a new selecting and mounting Microscope devised by him:—

"Being myself in the position of many other lovers of the Microscope in regard to the few occasional hours I can find time to spare for its enjoyable employment, I hope I may be rendering a service to some of my fellow-workers by publishing the description of a labour-saving selecting and mounting instrument which I recently designed for the purpose of making the most of my time, and which has been most carefully constructed for me by Messrs. Beck.

The Microscope, which I propose to call the "Twin Microscope," consists of the following parts (fig. 180):—

1. Two independent parallel tubes attached to the same stage; the axis of each of the tubes corresponding to the centre of one of the eyes of the observer. Each tube has its independent rack motion by a milled head.

2. Two mirrors, one for each tube, with swinging bars and usual motions.

3. A fixed stage of large size, with necessary clamps for holding two parallel glass slides, one under each of the tubes.

4. A movable substage, placed immediately below the upper stage, having a considerable range of rectangular mechanical motions by means of two milled heads.

5. A mechanical finger attached anteriorly to the movable substage. This finger is provided with universal motions by a ball-and-socket arrangement. It is suited for carrying a bristle-holder, needle-holder, or small scalpel. A small milled head permits of the rotation of these holders independently of the ball and socket which holds them.

6. Eye-pieces and objectives, either similar or dissimilar, for both the tubes.

The directions for the use of the instrument may be summed up as follows:—

a. Clamp a slide with the material to be operated upon under one of the tubes, and clamp another clean slide under the other tube.

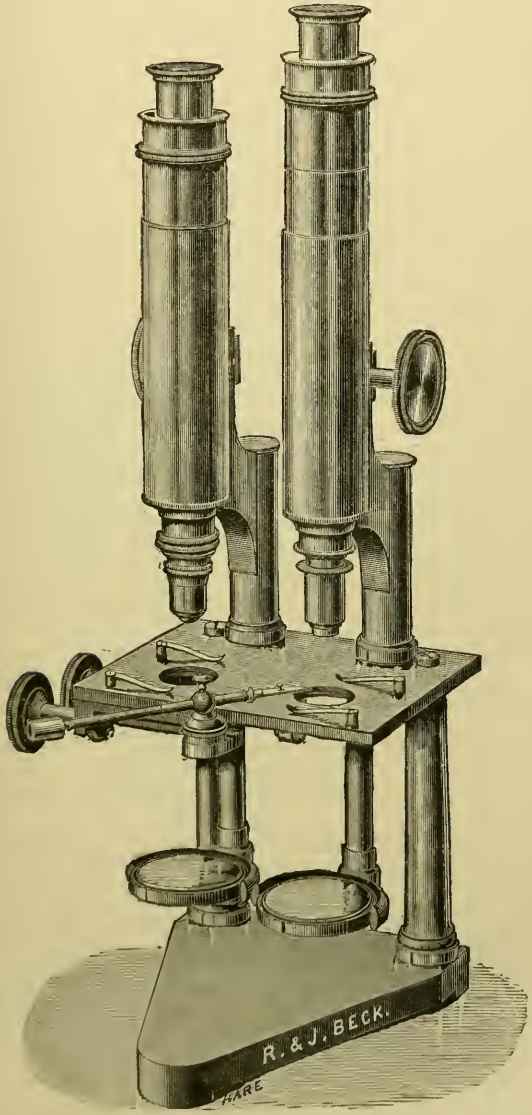
b. Dissect or pick-up the desired object from slide No. 1 by using one eye only, that over tube No. 1.

c. Close this eye and open the other, looking down the tube No. 2.

d. Swing the object rapidly round by means of the mechanical finger till it appears under the other eye.

* 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. 180.



Deby's Twin Microscope.

e. Lower the object till it nearly touches the slide, and by means of the mechanical motions of the substage place it exactly where it is wanted, when a slight touch at the lever-end of the bristle-holder will deposit it permanently.

d. Return the point of the bristle-holder to the first slide, and recommence the above operations as long as may be desired.

Objects may be searched for and selected under a low power, such as a 1 in., a 1/2 in., or a 2/3 in., and if very small may be deposited under the other tube under a 4/10 in., a 1/4 in., or a 1/5 in. Those who cannot use their eyes alternately, may shift one eye from one tube to the other with insignificant loss of time.

The principal advantages of the instrument consist in the rapidity with which it becomes possible to pick up and put down small objects, and in the great precision of the manipulations. By employing duplicate slides of a same material, one being placed under each of the tubes, it becomes easy to use the Microscope for comparative observations in polariscopy and spectroscopy by adapting the micro-polariscope or the micro-spectroscope to one tube alone, leaving the other to be used as an ordinary monocular Microscope. Many comparative and biological researches may also be conducted under the Microscope without the need of the frequent changes of lenses and shifting of the slides so irksome in many cases to the working naturalist.

For the dissection of minute animals or plants, for histological researches in general, in the hunt for nematodes or other minute forms of life, for the picking-up of desmids, diatoms, protophytes, &c., and for the grouping of these objects easily, rapidly, safely, and elegantly, I believe that the twin Microscope remains as yet unrivalled.

I sincerely hope that others may derive as much satisfaction from the use of the instrument as I have myself, and that it may lead to increased results both in useful and in beautiful work."

Klein's Mineralogical and Petrological Microscopes.*—Prof. C. Klein in the instrument shown in fig. 181, has combined all the most valuable of the recent suggestions for this class of Microscope.

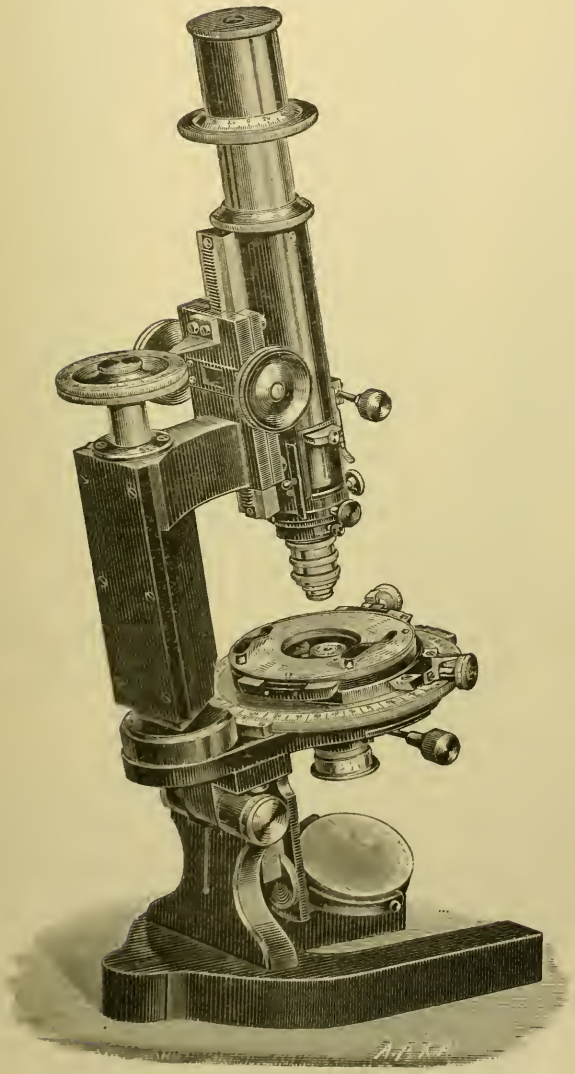
The body-tube has the arrangement of M. Bertrand's stand† for introducing above the objective a quartz plate, a quarter undulation plate, a Nicol prism, Bertrand lens, &c. The objective can be centered by two screws at the nose-piece. The stand can be inclined, and has both coarse and fine adjustments, the latter reading to 1/500 mm. The graduated stage can be moved in rectangular directions, and the amount of movement read to 1/100 mm. It can be rotated by rack-work or by the hand. The polarizer fits in a tube beneath the stage, and can be adjusted by rack and pinion.

Two smaller forms are shown in figs. 182 and 183.

* Nachr. K. Gesell. Wiss. Göttingen, 1884, pp. 436–43. The Microscopes are made by Messrs. Voigt and Hochgesang, of Göttingen.

† See this Journal, iii. (1883) p. 413.

Fig. 181.



Klein's Mineralogical and Petrological Microscope.

Fig. 182.

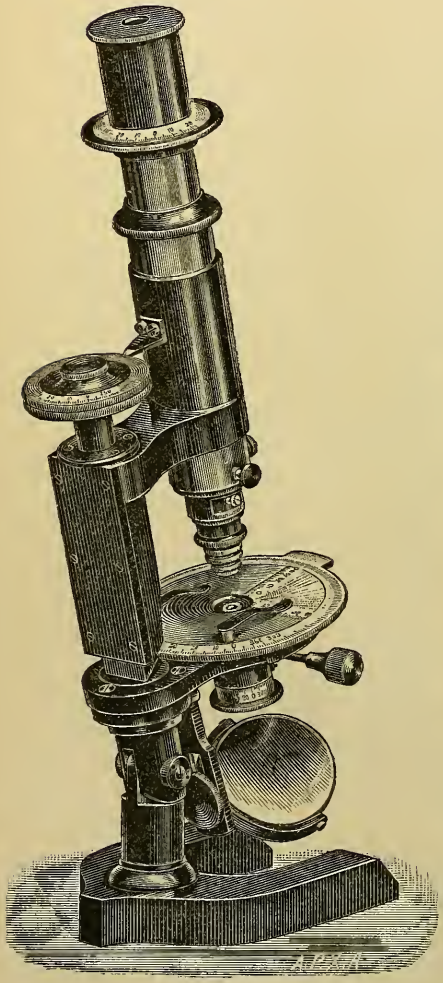
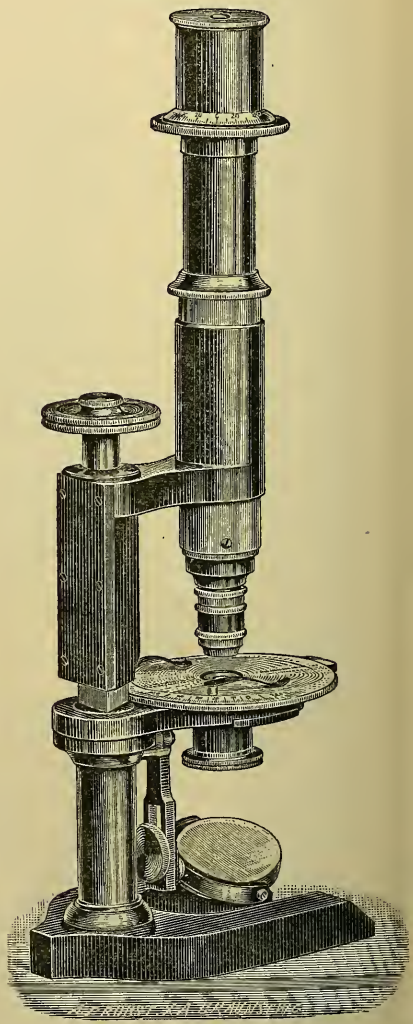
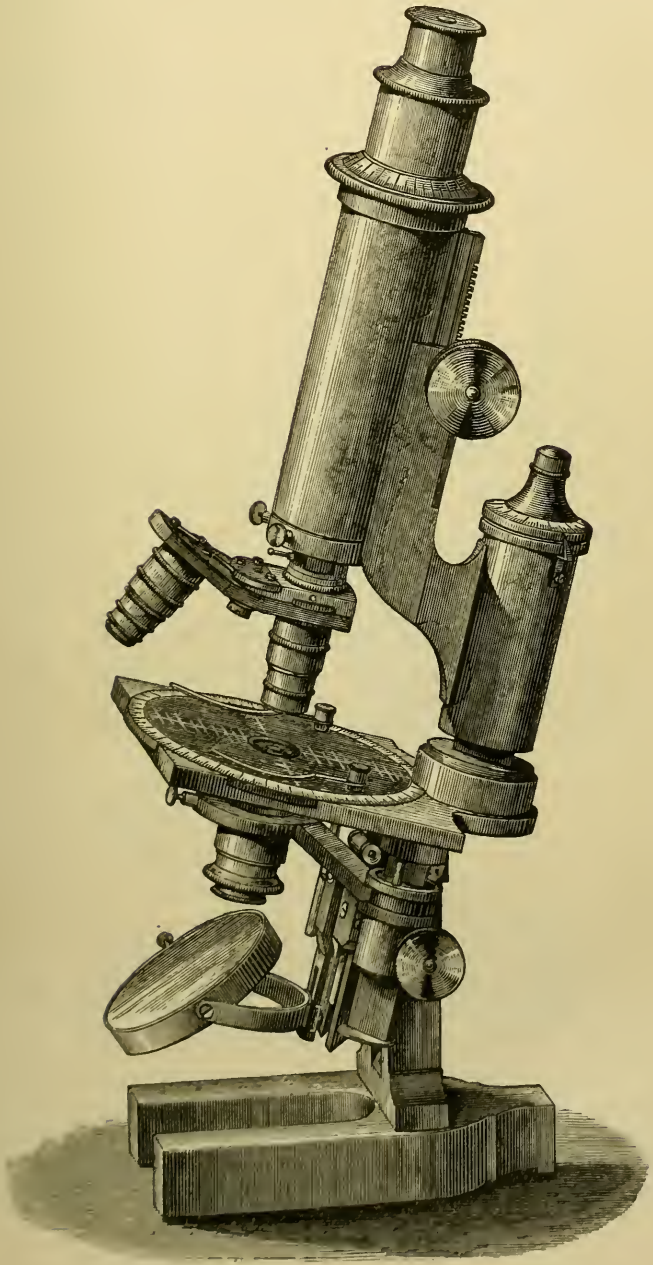


Fig. 183.



Reichert's Mineralogical-Geological Microscope.—This, fig. 184, in its general features resembles some of the forms already recorded, especially that of Dr. Zeiss. It differs from the latter, however, in the mode in which the quartz plate is inserted above the objective, and in the two millimetre graduations of the stage intersecting in the centre at right angles. The polarizer is on a movable arm so that it can be rapidly turned away. Each 90° of rotation of the analyser is marked by a spring catch.

Fig. 184.

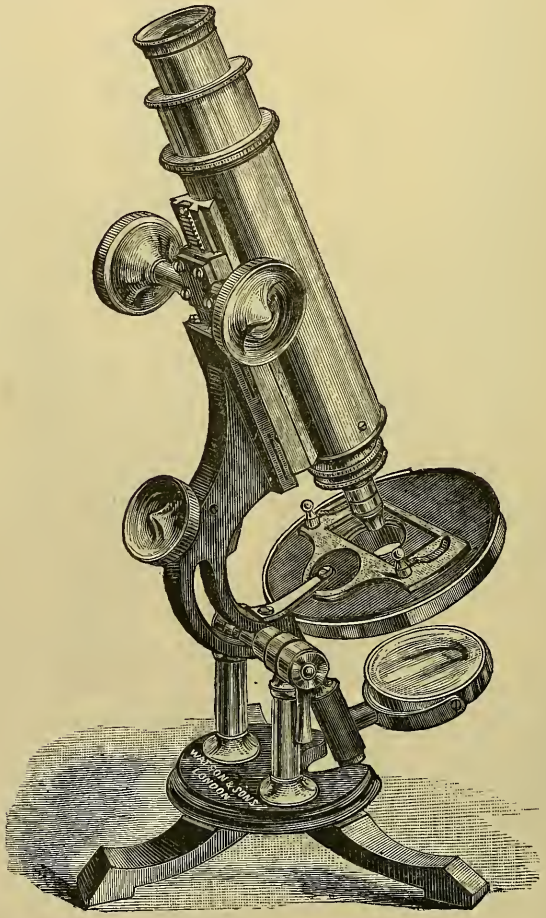


Reichert's Mineralogical-Geological Microscope.

Watson-Wale Microscope.—Fig. 185 shows a modification of G. Wale's "Working Microscope," * devised by Messrs. Watson and Sons.

Instead of the limb sliding between jaws, as in the original form, the new instrument has a slot cut through the limb, which slides on

Fig. 185.



the axis of inclination, a clamp-screw fixing it at the required position. The limb may also revolve on the inclining axis without sliding upward or downward, but in this case the instrument is less stable.

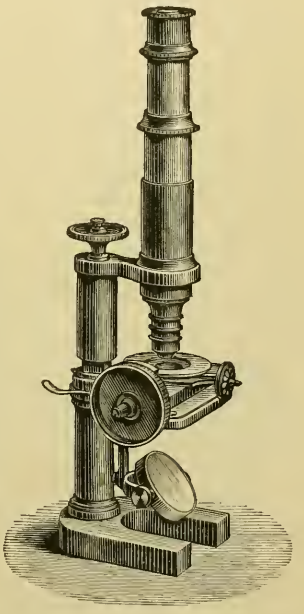
The "Zentmayer" system of fine adjustment is applied. The stage rotates completely and has a glass surface on which Tighl-

* See this Journal, iii. (1880) p. 1045.

mann's friction-stage works, and a rotating disk of diaphragms is fitted within the thickness of the stage. A substage-tube is applied beneath by means of a horizontal bayonet-joint.

Schieck's Microscope with Screw Stage-Micrometer.—The micrometer attached to this instrument (fig. 186) differs somewhat from English models in having a rotating plate* for the object, and a second movement from back to front, actuated by a screw at right angles to the motion of the micrometer-screw. The position of the object to be measured can thus be readily centered when the Microscope has no mechanical movements to the stage. The micrometer-screw registers 1/5 mm. to each revolution of the drum-head, the whole turns being read on an engraved scale on the edge of the moving plate, whilst the drum-head is graduated in 100 divisions, and by means of a fixed vernier tenths of these divisions can be read. (In the fig. one of the clips is shown turned back away from the stage.)

Fig. 186.



Microtome-Microscope.† — "Mr. "C. P. Hart described [to the Section "of Histology and Microscopy of the "American Association for the Ad- "vancement of Science] a clever "manner of making a Microscope into "a microtome, by using the tube to "carry the imbedded object, and the "movable stage to carry the razor; the object to be cut is moved by "the fine adjustment."

Duboscq**'s Projection Microscope.**‡—MM. T. and A. Dubosc**q** describe their apparatus as follows: —

"This apparatus consists of a system of lenses, or condenser, to converge the illuminating rays and cause them to pass through an achromatic objective serving to project the images on a screen.

The novelty of our apparatus consists in the addition which we have made to the condenser for the projection of microscopic objects. There is a stage furnished with a lens which shortens the focus of the condenser and concentrates the greatest amount of light on the object.

* Zeiss's stage-micrometer (see this Journal, iii. (1883) p. 573) has a rotating plate, and we have seen a similar arrangement to the above on a Microscope constructed forty years ago by Plössl; we are informed, however, that the plan was originally devised by Schieck.

† Science, vi. (1885) p. 228.

‡ Comptes Rendus, ci. (1885) pp. 476–7.

Hitherto, projection Microscopes have given a relatively large magnifying power, but with a definition insufficient for the wants of science. This arises from the quality of the objectives which are employed, and also from the way in which the illumination is obtained. We have recognized that according to the dimensions of the microscopic objects to be projected and the magnification desired, it is necessary to vary the form of the convergent pencil which illuminates the object, consequently the focus of the additional lens must be modified. The apparatus is therefore provided with lenses of different foci to be used with the condenser, according to circumstances.

We have, morever, arranged to employ the objectives used for ordinary Microscopes. Thanks to these and to the perfection of our condensing system we are able to project microscopic objects with high powers and with a clearness as perfect as that obtained with the ordinary Microscope."

Polarizing prisms can be used, also a rotating stage, so that sections of rocks and crystals can be projected.

"Twin" Simple Microscope.—Fig. 187 shows a peculiar arrangement of two simple Microscopes mounted side by side on one plate. One of them is fitted with a power of about 1 in., and the other about 1/4 inch, and both have Lieberkühns. The object is held by forceps pivoted beneath the lens-carrier, so that it can be readily examined by either power without having to alter the lenses, as is ordinarily the case.

FIG. 187.

The instrument must have been made a considerable time, for we have seen an exactly similar one in the "Cabinet de Physique" of the University of Louvain, where we were informed it had been for upwards of 30 years. The workmanship suggests a French origin.

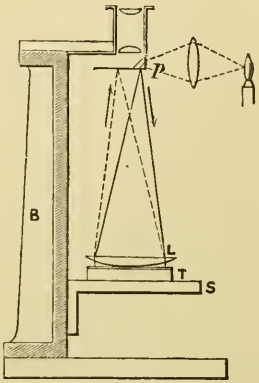
Laurent's Apparatus for registering the Curvature and Refraction of Lenses.*—M. L. Laurent's apparatus consists of a vertical frame B (fig. 188), in which slides a rectangular carrier S controlled by a chain; the position of the carrier is shown by a vernier, and the lenses to be tested are placed on a plate rotating horizontally on the carrier. On the top of the frame is an eye-piece having a diaphragm (shown in front view at D, fig. 189) divided in two parts: the right half is covered by an illuminating prism; its horizontal face is silvered, and squares are ruled on the silver, which are viewed either by refraction or reflection; the image of the squares is seen in the plane of the diaphragm.

A plane plate of glass T is put on the carrier S, and the vernier is adjusted to zero at the point p where the plane is seen to touch the squares. The lens L is placed on the plane; the light emerging

* Comptes Rendus, c. (1885) pp. 903–5 (4 figs.).

from the squares traverses the lens, is reflected on the plane and directed upwards again and focused in the plane of the diaphragm. The carrier is moved until the image is seen sharp in the eye-piece, and the focal plane of the lens L coincides with the plane of the diaphragm; the reading of the vernier is taken, allowance being made for the shape of the lens, its thickness, &c.

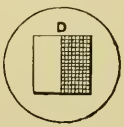
Fig. 188.



The image, consisting of luminous lines on a black ground, is easily seen; the light traverses the lens twice, and doubles its defects. The focus is very precise, so that by covering up portions with small screens, the variations in the curves can be estimated by the differences in their acuteness, and the sharpness will indicate the quality of the lens tested.

White or monochromatic light is used for illumination. Reflected light enables each surface to be tested separately, while the estimation of the combination of surfaces and media is effected by means of the refracted image.

Fig. 189.



Instructions are also given for using the apparatus for concave mirrors, diverging lenses, convex surfaces, spheres and cylindrical surfaces.

The author claims that the apparatus is an accurate focimeter, of general application to all *curved* surfaces; the precision may be carried to a high degree where necessary, and in ordinary cases it provides ready means of seeing at a glance and without preparation the *quality* of an optical system.

Gundlach's Improved Objectives.* — The Gundlach Optical Company are now making objectives "after the new principle discovered by Mr. Gundlach."†

"The water-immersion objectives have a very long working distance and the aberrations of higher order are corrected to a much higher degree than was heretofore possible in a water-immersion objective; hence, these objectives have a definition and resolving power found in oil-immersion objectives only. This series of objectives may therefore be regarded as a new improvement in the field of microscopic apparatus, a water-immersion objective of highest optical quality having also a long working distance."

Series of Objectives.—Mr. J. C. Stodder sends us the following note of the late R. B. Tolles's views of the best series of four or five objectives, to cover as far as possible the whole range of "general microscopy."

"For four only—3 in., 1 in. (30°), 4/10 in. (110° dry), 1/10 in.

* Amer. Mon. Micr. Journ., vi. (1885) pp. 130–1.

† See this Journal, *ante*, p. 705.

oil-glycerin-water immersion which will work through 1/100 in. covers, and with a balsam angle of not much less than 120° for best results. An excellent and useful lens to add to the above series would be a 1/5 in. (110° or 120° dry)."

Right-angled Prism instead of a Plane Mirror.*—Mr. E. M. Nelson replies to Mr. G. Hunt's remarks † as follows:—"I can see no possible advantage in going to the expense of a right-angled prism, as in the commonest Microscopes I find the mirrors quite good enough. One mirror I have gave me four or five images of the flame, which would, of course, be fatal to good definition. This, however, was corrected by turning the mirror round in its cell until a point was found where all the images overlapped. Another mirror I have is a concave, of about 10 ft. focus. I find no difference for ordinary work. Any concavity in a plane mirror is bad, and ought to be avoided, because it shortens the focus of the condenser, which will be quite short enough, if it has any angle in it, without any further shortening.

I cannot say I can mention any definite object or object-glass in which I could perceive any difference with mirror or lamp direct. If any one is doing very special work, and fancies some error due to the mirror, then turn it aside, and use the lamp flame direct. I cannot see any advantage in a prism, which cannot possibly be so good as nothing at all. One special advantage in using the lamp flame direct is that one is not so liable to get the light out of centre. When a mirror or prism is used, a slight touch, or shake of the table even, is apt to throw it out of centre."

Hélot-Trouvé apparatus for Electrical Illumination.‡—Dr. H. Van Heurck observes that the electric illumination of the Microscope, hitherto little used, has just entered upon a new phase through the new and thoroughly practical Trouvé apparatus, which realizes all that can be desired for the most difficult investigations in microscopy and photo-microscopy.

The battery consists of a small ebonite box, fig. 190, 15 cm. × 10 cm. × 18 cm., the inside of which is divided for two-thirds of its height into six compartments, communicating at the bottom by a small aperture between each. The elements, each consisting of two rods of amalgamated zinc placed between three carbon rods, are attached to the cover, being coupled in tension, and may be let down into the liquid (potassium bichromate, sulphuric acid, and water) or withdrawn therefrom, or more or less immersed according to the power required at the time.

The illuminating apparatus (fig. 191 in section), attached to the front of the battery (fig. 190), or made to slide with universal joint on a standard (fig. 192), so as to throw its light in any direction desired, is the Hélot-Trouvé photophore, originally devised for surgical operations and the examination of the cavities of the body. The

* Engl. Mech., xli. (1885) p. 523.

† See this Journal, *ante*, p. 709.

‡ Heurck, H. Van, 'Synopsis des Diatomées de Belgique,' Texte, 1885, pp. 219–22 (3 figs.). See also Journ. Soc. Arts, xxxiii. (1885) p. 1005.

photophore consists of a nickelized brass tube, in which the incandescent lamp, of special form with a straight filament, occupies the

Fig. 190.

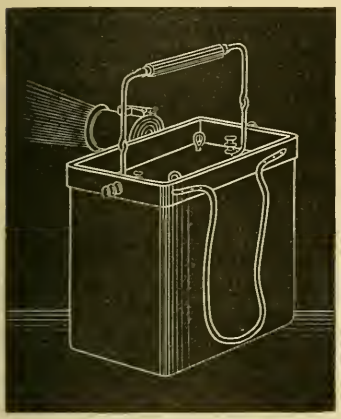


Fig. 191.

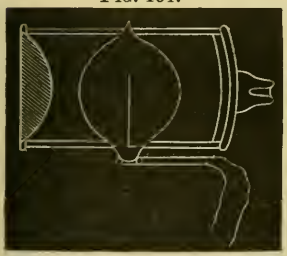
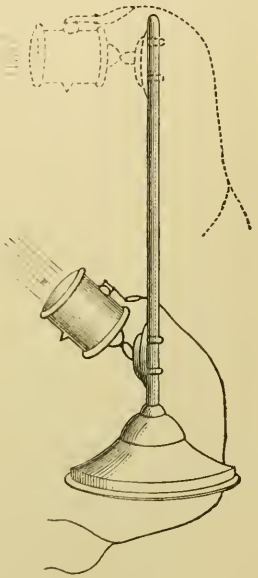


Fig. 192.



middle. At the back is a reflecting mirror, and at the front a condensing lens in an adjustable sliding tube, by which converging, diverging, or parallel rays may be obtained. As the light from the reflector might be objectionable in very delicate observations, a small blackened disk is added for covering the reflector, and a diaphragm may be placed on one or other side of the lens for intercepting the light from its margin.

The battery is capable of maintaining the lamp for two hours, producing a light which may be utilized in certain cases of photomicrography, but which is much too intense for ordinary microscopic research. By a slight modification of the battery, however, suggested by Dr. Van Heurck, by which only 4 or 5 of the elements are coupled, and the rest added as the battery becomes exhausted, or by employing a lamp of less power, the exact degree of light required may be obtained. The battery evolves no fumes, and the expense of maintenance is very slight, that is to say 1*d.* per hour, including loss of zinc, or less than a halfpenny an hour if the small Stearn lamp be used.

Dr. Van Heurck concludes as follows :—"It is seen then that the

electric light is really now brought to every one's door, and we cannot too strongly advise microscopists, especially diatomists, to whom the electric light is indispensable, to provide themselves with one of these apparatuses, the price of which is very moderate. An experience of more than three years has shown us that when the electric light has been once tried and the really marvellous facility noted with which it resolves at the very outset the most difficult details of structure, it cannot be given up again, and the expensive lamps with which we were so recently content are thrown aside."

Illumination for Projection Microscopes.*—M. d'Arsonval describes an improvement in the illumination of projection apparatus by the employment of a petroleum lamp with three burners, of which the middle one heated by the two lateral ones "allows of an enormous intensity of light, augmented moreover by a reflector at the back." In addition to the fact that this apparatus gives an illumination nearly equal to that of the largest projection apparatus, it is much less costly. The use of napthalin increases still more the light and favourably modifies its nature.

MM. Malassez and Hénocque lay stress on "the enormous advantage to be obtained from naphthalin, which gives a white light, very useful for microscopical or spectroscopical examinations."

Lantern Transparencies.†—Mr. C. M. Vorce says that where a considerable number of lantern slides are desired, as for distribution among co-workers, they can be made considerably cheaper by the use of the carbon process than by using dry plates. The process is very cheap and not difficult of application; for the author's description of it the original must be referred to.

Lantern transparencies when prepared to show microscopic objects very highly magnified are best made from camera enlargements of a less highly magnified negative, as follows:—Prepare a negative showing the desired points by means of an objective of as low power as will clearly show all the desired details. This negative will be smaller than is required, but will be a better one than one made of the desired size by a higher power, because the penetration of the objective will give sharper projection than if a higher power were used. Place the negative in a copying camera and enlarge it to the desired size if possible; if not, a second enlargement would be required, but is seldom if ever necessary. The second plate, that is, the enlargement of the first negative, is a positive, and if well done may be mounted as a lantern slide; but first a negative is made from this by contact printing, and from this negative not only paper prints but other lantern positives may be made at will. It should be noted that if any retouching in the original negative is required it must be done with care and skill, as any errors would be exaggerated by the enlargement, but the enlarged positive may be freely retouched before being used for contact printing, and thus letters, figures, names, &c.,

* Journ. Soc. Scientifiques, i. (1885) p. 140. (Soc. de Biologie, 1885, March 21st.)

† Amer. Mon. Micr. Journ., vi. (1885) pp. 84–5.

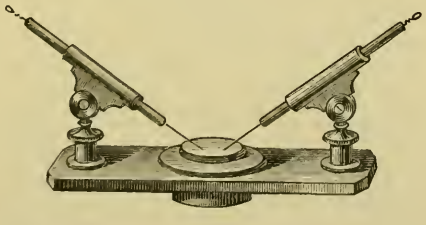
may be introduced into the lantern slides prepared from the last negative, which also may be retouched if necessary like any other negative. The superiority of such enlargements over negatives made originally of the same size is often very marked.

Microscopical Electrical Apparatus.—It appears to be but very rarely that in this country any use is made of the electric current in microscopical examinations. We have never seen any apparatus for the purpose in the hands of any English microscopist, and our text-books on the Microscope make no reference to the subject. Nearly all the standard German treatises, however, contain drawings of apparatus intended specially for use with the Microscope for observations on the influence of the electric current on blood, living tissues, microscopical organisms, &c., and from these and from English text-books on Physiology we have compiled the following summary of the various forms that have been devised. In regard to the utility of such investigations, Dr. Dippel says,* "The use of electric currents is not less important for many microscopical objects than the application of high temperatures. This physical reagent has in modern times acquired a high (if here and there exaggerated) importance, and scarcely any microscopist who concerns himself with the minute anatomy of plants and animals can afford to neglect its use."

The simplest apparatus† consists of two needles which can be readily joined to the wires of a battery and with which any given parts of the object can be touched. They can be hooked to be more readily attached.

Plössl's Discharger‡ (fig. 193) is simply the ordinary discharger reduced to microscopical dimensions. The conducting wires are con-

Fig. 193.



nected with the two platinum wires shown in the figure, the latter being insulated by being inclosed in capillary glass tubes which slide through sprung brass tubes attached to the upright supports by hinge joints, which can be rotated or set at different inclinations. The object is placed on the glass plate in the centre. The apparatus cannot, however, be conveniently made available for covered objects on account of the inclination at which the wires must be set, or for

* Dippel, L., 'Das Mikroskop und seine Anwendung,' 1882, p. 656.

† Robin, C., 'Traité du Microscope,' 1877, p. 679. See also Robin's remarks on the effect of electricity on the circulation of the blood, &c., ibid., pp. 680–1.

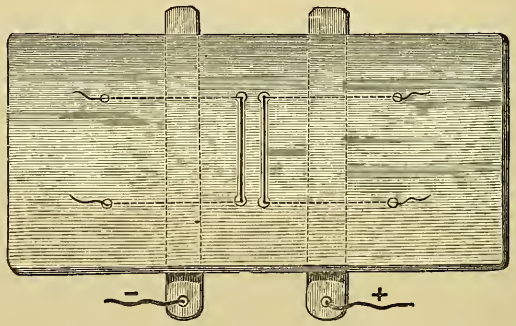
‡ Chevalier, A., 'L'Étudiant Micrographe,' 1865, pp. 141–2 (1 fig.). Dippel, op. cit., p. 656 (1 fig.). Harting, P., 'Das Mikroskop,' 1866, ii. p. 145, iii. p. 404.

high powers, and its use is practically therefore limited to large uncovered objects, such as the larger Infusoria, Rotatoria, &c.

Schacht's * plan was simply to cement two platinum wires to the slide extending beneath the cover-glass.

Jendrássik and Mezey's † (fig. 194) is now used in the Buda-Pest physiological laboratory. It consists of a slide which has two

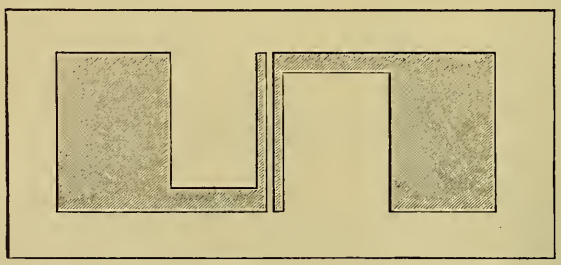
Fig. 194.



parallel grooves about 3·5 mm. apart. At both ends of these small holes are bored, through which thin platinum wire is passed, so as to fill the grooves and be in contact beneath with two metal plates attached to the stage of the Microscope; these plates are connected with the poles of a battery. The designers used this apparatus for the microscopical examination of the contraction of muscle-fibre.

Another plan ‡ is to take a piece of silvered looking-glass and remove the quicksilver in the centre, leaving two narrow strips.

Fig. 195.



Kühne § attached to the slide pieces of platinum foil of the form shown in fig. 195, placing upon them small leaden blocks which were connected by wires with the battery.

* Dippel, op. cit., pp. 656–7.

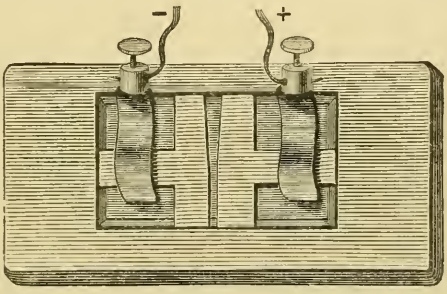
† Thanhoffer, L. v., 'Das Mikroskop und seine Anwendung,' 1880, pp. 91–2 (1 fig.). Dippel, op. cit., pp. 658–9 (1 fig.).

‡ Dippel, op. cit., p. 657.

§ Ibid., p. 657 (1 fig.).

Thanhoffer's * (fig. 196) was formerly much used in the laboratory of the Buda-Pest University, and has been somewhat modified to answer Prof. L. v. Thanhoffer's purpose. Two T-shaped strips of platinum are fixed to a small piece of glass by Canada balsam. To prevent their coming off, they are bent back and fastened to the other side of the glass. The slide thus prepared is placed in a wooden or

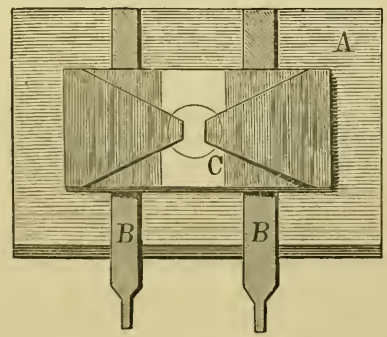
Fig. 196.



hard indiarubber frame. At one side of the frame two copper plates with copper screws are fixed. These plates, which are somewhat curved, lie upon the platinum strips. The poles of the battery are connected with the screws.

Brücke's † (fig. 197) consists of a plate of wood A with an opening in the centre, on either side of which copper bands B B are let in and

Fig. 197.



are connected with the poles of a battery. The slide C lies on these bands, and is covered at both ends, above and below, with tin-foil.

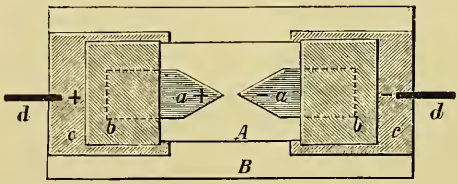
* Thanhoffer, op. cit., p. 91 (1 fig.). The name of the original designer is not given.

† Thanhoffer, op. cit., pp. 90–1 (1 fig.). Dippel, op. cit., p. 657 (1 fig.). Stricker's 'Manual of Human and Comparative Histology.' Transl. by Power, 1870, pp. xx.–xxii. (1 fig.).

The tin-foil on the upper surface ends in blunt points above the opening in the plate at a distance apart of about 5 mm. The object is laid on these points and covered with a cover-glass.

Ströbelt's * apparatus is described by him as follows:—Cut two pieces of tin-foil, *b b*, fig. 198, of about 20 mm. in breadth and 35 mm. in length, and place them upon the ends of a slide A so that their longest side is parallel with the shortest side of the slide, the ends being doubled underneath. If the tin-foil is not too thin it will adhere to the slide of itself; under these can be inserted other strips

Fig. 198.



of tin-foil with pointed ends *a a*, the distance of which from each other can be varied according to desire. The slide is placed upon a larger glass plate B, on which two strips of tin-foil *c c* are cemented, the latter being connected with the battery by the conducting wires *d d*.

The advantage claimed for this apparatus over the older forms, in which the strips of tin-foil *b b* and *a a* are formed of one piece cemented upon the slide, consists in the fact that (1) the space between the pointed ends *a a*—the positive and the negative poles—can be increased or diminished at pleasure; (2) tin-foil with blunter or sharper ends can be easily inserted; (3) the apparatus can be fixed on the same slide on which the object has been first examined, so that the frequently tiresome work of transferring it is avoided; and (4) when the influence of the electricity has been observed, the further treatment of the object and in many cases the mounting also can be done upon the same slide, after the tin-foil has been removed.

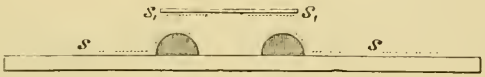
Stricker describes † his apparatus as follows:—"It is not practicable to carry out the examination of tissues under the influence of electrical currents with the same elegance of detail as can be accomplished when a simple slide only is employed. The single circumstance that the tin-foil in adhering to the glass makes the surface irregular and uneven renders it necessary that the sections of the preparation should be thicker, and proportionately interferes with the investigation by means of high powers. I endeavour therefore to combine my researches with electrical currents with those conducted in the gas-cell (made by forming a ring of putty on a slide with two tubes passing through it). By this means I am

* Zeitschr. f. Instrumentenk., ii. (1882) pp. 274–5 (1 fig.). Dippel, op. cit., p. 660 (1 fig.).

† Op. cit., p. xxiii.

able to avoid the inconvenience alluded to; for it is quite possible to place the electrodes in close proximity with the preparation which is on the inner side of the cover, and to examine it in consequence with high powers. I attach to each side of the slide a strip of tin-foill which passes over the putty and reaches its inner side (*s s*, fig. 199).

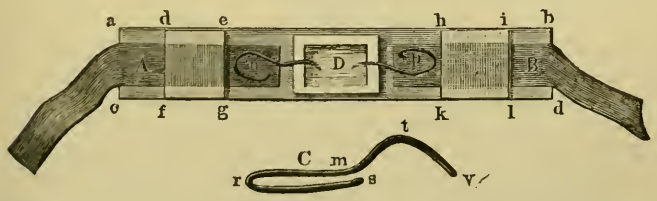
Fig. 199.



Cemented to the cover are also two small strips of tin-foil *s' s'*, which running in the axis of the cover, leave between them a space of a few millimetres in diameter. The object is placed at this spot, and the cover is so disposed on the wall of putty that the metallic strips of the cover lie on the strips covering the putty, and the cover is then firmly pressed down on the soft putty. The cell being now complete, the electric current is conducted by the strips of metal to the object, through which it passes at the same time; this lies immediately beneath the cover, and can therefore be examined with the highest powers. It is, moreover, no small advantage to combine the application of electricity with researches on the influence of gas, because we can neutralize or aid the effects of the current by the introduction of different gases."

Harting's * (fig. 200) is a glass slip *a b c d*, about 100 or 120 mm. long and 30 mm. wide, to which are attached by starch paste two pieces of somewhat narrower tin-foil A and B, with a space between them of about 25 or 30 mm. The tin-foil projects beyond the ends of the slip as shown in the figure. Over the tin-foil two thick cover-

Fig. 200.



glasses *d e f g* and *h i k l* are cemented by marine glue or a mixture of pitch or rosin for the stage clips to rest upon. The platinum wires *n* and *p* are loose, and are bent in the form shown at C. The part *m r s* rests on the tin-foil and the other curved portion *m t v* dips into the fluid in the cell D. They can be brought close together if required. If they are to be used for covered objects they must be bent so as to lie horizontally and be as thin as possible: the

* Harting, op. cit., ii. pp. 145-6 (1 fig.). Dippel, op. cit., pp. 657-8 (1 fig.). Frey, H., 'Das Mikroskop,' &c. Transl. by Cutter, 1880, p. 102 (1 fig.).

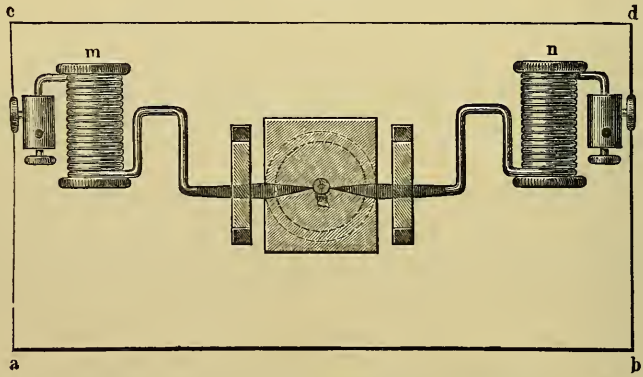
projecting ends of the tin-foil are connected with the wires of a battery.

For researches on blood-corpuscles Rollett * used a modification of this apparatus made by bringing the strips of tin-foil nearly to meet in the centre. The blood-corpuscles were placed between them and spread out so as to touch the margins.

Dippel's † (fig. 201) was devised to obviate the inconveniences of Harting's, attendant upon its length, and upon the fact that the connection with the battery wires is very loose, and that the bent wires are liable to be easily disturbed by the hands.

It consists of a not too thin glass plate *a b c d*, of the same size as the stage, on each side of which is fixed a small coil of covered copper wire (*m* and *n*), the wire being wound on glass tubes. The inner end of this wire is (to obtain greater facility of movement) bent at right angles in a horizontal plane, and the end either hammered

Fig. 201.



flat or soldered to a piece of platinum so as to allow it to lie easily under a cover-glass, and not to raise the latter so much that high powers cannot be used. In order to prevent the ends of the wires from shifting, and to enable them to be adjusted to the object, they are carried under two small strips of glass so that they cannot be easily moved. The free ends of the wires are attached to a holder which also receives the wire from the battery, both wires being fixed by screws.

The apparatus can either be held on the stage of the Microscope by the stage clamps, in which case it will be more or less movable, or it can be dropped into a brass frame having two pins beneath fitting into the holes for the spring clamps.

Schäfer's ‡ (figs. 202–4) does not differ essentially from some of those already described. The glass slide (fig. 202) has two strips

* SB. K. Akad. Wiss. Wien, l. (1865) p. 178.

† Dippel, op. cit., pp. 659–60 (1 fig.).

‡ Schäfer, E. A., 'A Course of Practical Histology,' 1877, pp. 37–9 (2 figs.).

of gold-leaf or tin-foil attached to it by shellac varnish, with pointed ends which almost meet in the middle of the slide. One strip passes

Fig. 202.

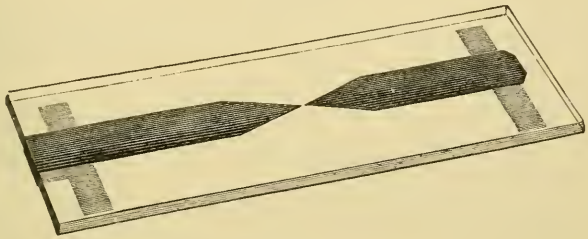


Fig. 203.

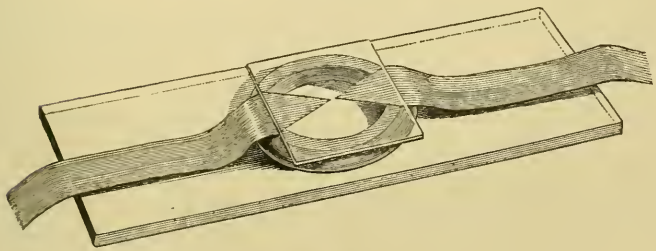
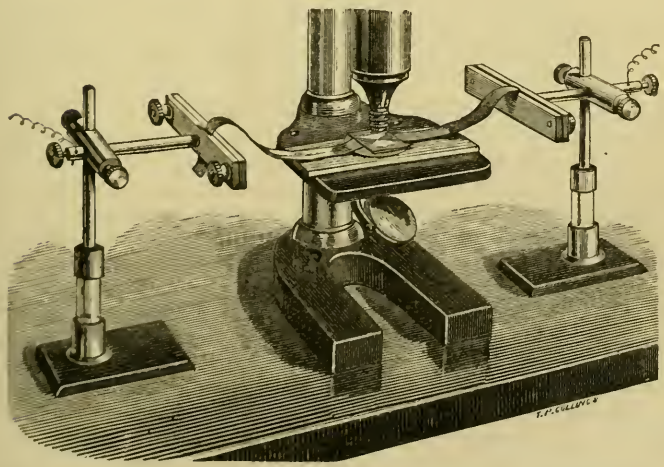


Fig. 204.



round to the under surface, where it rests on the brass stage of the Microscope, and the other is isolated from the stage and may be connected with the outer coating of a Leyden jar, the charge of which is made to pass between the points by connecting the knob of

the jar with the brasswork of the Microscope. On the right a small piece of the foil is fixed to the under surface of the slide, so that this end shall be level with the other.

Fig. 203 shows a combination of the apparatus with a moist chamber for the examination of blood. In this case the cover-glass has two strips of tin-foil cemented to its under surface, and the drop of blood being spread out in a thin layer between the points is quickly inverted over the ring of the cell.

The tin-foil slips are kept isolated by the glass slide from the brasswork of the Microscope, and their free ends are clamped to isolated metal supports as shown in fig. 204, and can be connected with a Leyden jar or an induction coil.

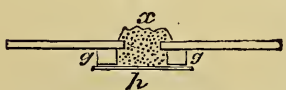
The ends of the wires or slips can also be made to dip into cups of mercury placed on the table, into which the terminal battery wires can also be led.

Engelmann * also devised an arrangement for electricity (figs. 205 and 206) in connection with his gas-chamber. The glass top is

Fig. 205

pierced with two apertures at x x, through which is inserted clay steeped in 1 per cent. salt solution, so as to fill the space between the top and the glass plates g g and h h (which form a channel for it) and to extend to the sides of the drop suspended from the under surface of the cover-glass, which closes the aperture in the chamber. The points of the Du Bois non-polarizable electrodes are placed on x x.

Fig. 206.



According to Rollett † it is advisable in using electrical discharges, that the tin-foil points should be 6 mm. apart. The Leyden jar should have a surface 500 sq. cm. and give a spark 1 mm. long.

Stricker also points out ‡ that the distance of the laminæ of tin-foil from one another is of importance in regard to the transmission of the current. As a general rule, they should not be separated from one another to a greater extent than a few millimetres. He prefers to see the two electrodes at the sides of the field, because then the position of the object in regard to them and to the middle line is simultaneously visible. It is a matter of very great moment to observe and distinguish between the effects of the current in the immediate neighbourhood of the poles and at some distance from them; for the effects of electrolysis are produced on breaking the current in the vicinity of the electrodes, and the tissues become altered, as

* Jenaisch. Zeitschr. f. Naturwiss., iv. (1868) pp 331–3, 385 *et seq.*

† Klein, Burdon-Sanderson, Foster, and Brunton, 'Handbook for the Physiological Laboratory,' 1873, p. 17.

‡ Op. cit., p. xxi.

they would be were they subjected to the action of weak acids or alkalies.

At parts more remote from the electrodes changes also occur which, however, are not so remarkable as those which are induced by the chemical processes above alluded to. The effects, which may be trusted as being really due to electricity, should occur quickly after the passage of the current, and not be limited to the part in the immediate neighbourhood of the electrodes. If the current be allowed to pass for some time, that is to say, for more than a few seconds, through the tissue, the products of electrolysis first extend over the whole surface lying between the electrodes, and then the intensity of the current becomes extraordinarily reduced, frequently indeed to zero, on account of the pole becoming covered with bubbles of gas. On this account the employment of constant currents for microscopic investigation is scarcely to be recommended, for with the closure of even very weak currents so violent a development of gas occurs, that but little confidence can be placed in the results that are observed to follow their passage. The amount of electrolysis that occurs with induction currents is much smaller, and they have therefore been most generally employed. The arrangement in which there is a single shock on opening and closing of the current is particularly advantageous. The shocks obtained from a Leyden jar are infinitely superior to the constant currents, because the instantaneity of the shock causes the disturbing influence of the evolution of gas bubbles to be altogether abolished.

With regard to induction currents, he also points out that on breaking the current, heat is developed in the tissue. If an uncovered drop of blood is under examination with strong ordinary lenses, these become dimmed at the instant of the passage of the current, but after a short period they again become clear. The preparation, however, very soon dries up. It is requisite in such cases to determine what are the effects of the sudden elevation of temperature, and what are those of the electric current alone.

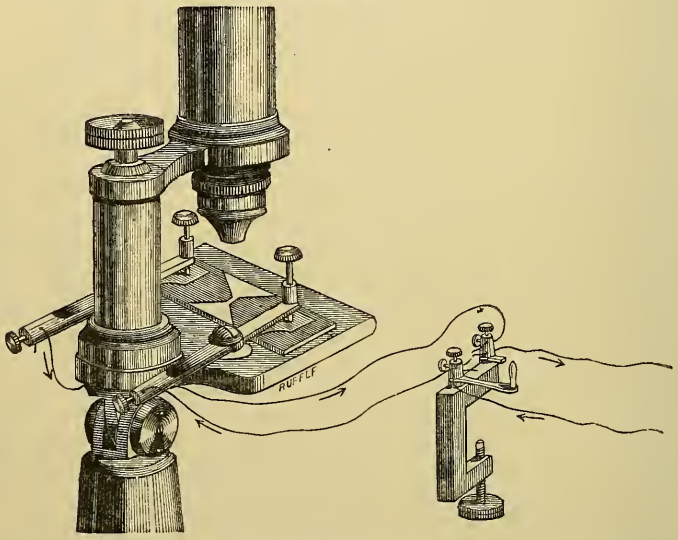
Stricker's electrodes * are shown in fig. 207. The slide (covered with tin-foil as previously described) is held in position by the electrodes, each of which is insulated by being screwed into an ivory knob let into the stage-plate of the Microscope. The electrodes are connected (with the interposition of a key) with the secondary coil of a Du Bois Reymond induction apparatus. In the woodcut the key is represented open.

Mr. R. T. Lewis states † that when investigating the disruptive effects of the electric spark—more especially with regard to the peculiar shape of the perforations made by it through various materials —many experiments were carried on upon the stage of the Microscope, and he found that a very simple and convenient method of holding and insulating the terminal wires was to pass each through a small glass tube held by a brass spring-clip, mounted upon a jointed pillar

* Klein, Burdon-Sanderson, Foster, and Brunton, 'Handbook for the Physiological Laboratory,' 1873, p. 17 (1 fig.). † Engl. Mech., xlii. (1885) p. 19.

at the corner of the stage in the same manner as the stage forceps. The pointed end of a glass dipping-tube answered the purpose admirably. When it was desired to pass sparks vertically through

Fig. 207.



an object in focus, a glass stage-plate was used. This consisted simply of two pieces of glass, about an inch longer than the brass stage, cemented together with a wire between them, the point of which turned up at right angles in the centre of a hole drilled through the upper plate. The other terminal, mounted as above, could then be adjusted over it in any required position. A small induction coil was used for the purpose, giving about a 1/2 in. spark with a single bichromate cell. If a Leyden jar was placed in the circuit, discharge sparks of much greater size and brilliancy were obtained, giving beautiful effects when viewed through the micro-spectroscope. "Caution is desirable in conducting experiments of this kind, since manipulation, during observations which engage the attention closely, is apt occasionally to produce very startling results."

Apparatus for watching the phenomena that animals subjected to great pressure present.*—As previously recorded,† Dr. P. Regnard has experimented on the conditions of life at high pressure. With apparatus designed by M. Cailletet, he has subjected aquatic animals to enormous pressure, such as prevails in the depths of the ocean, and has examined the results when those inhabiting the surface are suddenly placed at great depths.

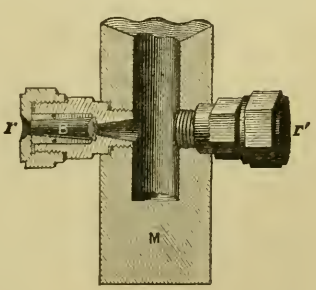
* Comptes Rendus, c. (1885) pp. 1243–4 (1 fig.). Nature, xxxii. (1885) pp. 399–400 (2 figs.), from 'La Nature.'

† See this Journal, iv. (1884) p. 362.

Since his first experiments Dr. Regnard has invented an ingenious method by which he can see, notwithstanding the great pressure, what goes on inside the apparatus. Hitherto the operator simply placed the animals on which he experimented in the iron block of the Cailletet pump, and subjected them to the pressure corresponding to a given depth; he then released them, sometimes very slowly (after several days), sometimes rapidly and even instantly, and examined, physiologically and microscopically, the effects produced. But all the intermediate stages between the introduction of the animals and the time they were taken out escaped the observer. Now, however, the apparatus shown in figs. 208 and 209 allows him to follow each minute the effects.

Two holes are pierced through the lower part of the Cailletet block M (fig. 208). In these are inserted two tubes at *r* and *r'*. These are hollow, and in each of them is solidly fixed a cone of quartz B, the end of which comes as far as the edges of the hole which is pierced in the screw-nut. A ray of light thrown in at the orifice *r* will thus traverse the apparatus and emerge at *r'*. Experiments have shown that the apparatus will resist easily a pressure of 650 atmospheres, which represents that of the greatest depths that have been dredged—about 6500 metres. Through one of the quartz cones are sent the concentrated rays of an electric lamp. These rays cross the block (full of water), and emerge on the opposite side, where they are received by an achromatic object-glass which projects them on a screen. The observer therefore works at a distance from the apparatus, where he is sheltered from all danger. The arrangement has another advantage. The orifice pierced at *r* is hardly half a centimetre in diameter, and small organisms can be experimented with in the vessel immersed in the block M, which are invisible to the naked eye. By projecting them with a lens they are so enlarged, and appear with such transparency, that we can follow on the screen the movements of their branchia, and even of their heart, during the experiment. In the experiment represented in fig. 209, one of the operators is occupied in regulating the electric lamp and in setting the Projection Microscope, while the other applies the pressure.

Fig. 208.



Dr. Regnard is pursuing his studies on life under high pressures. He showed last year that the unequal compressibility of the liquids and solids of the organisms caused the latter, after a long pressure, to be soaked with water, become turgid, and consequently lose their functions. But with the apparatus here described, he has been able to follow the phenomena which precede this. At the pressure of 1000 metres (about 200 atmospheres) the object shows inquietude; at 2000 metres it falls to the bottom of the vessel struggling; towards

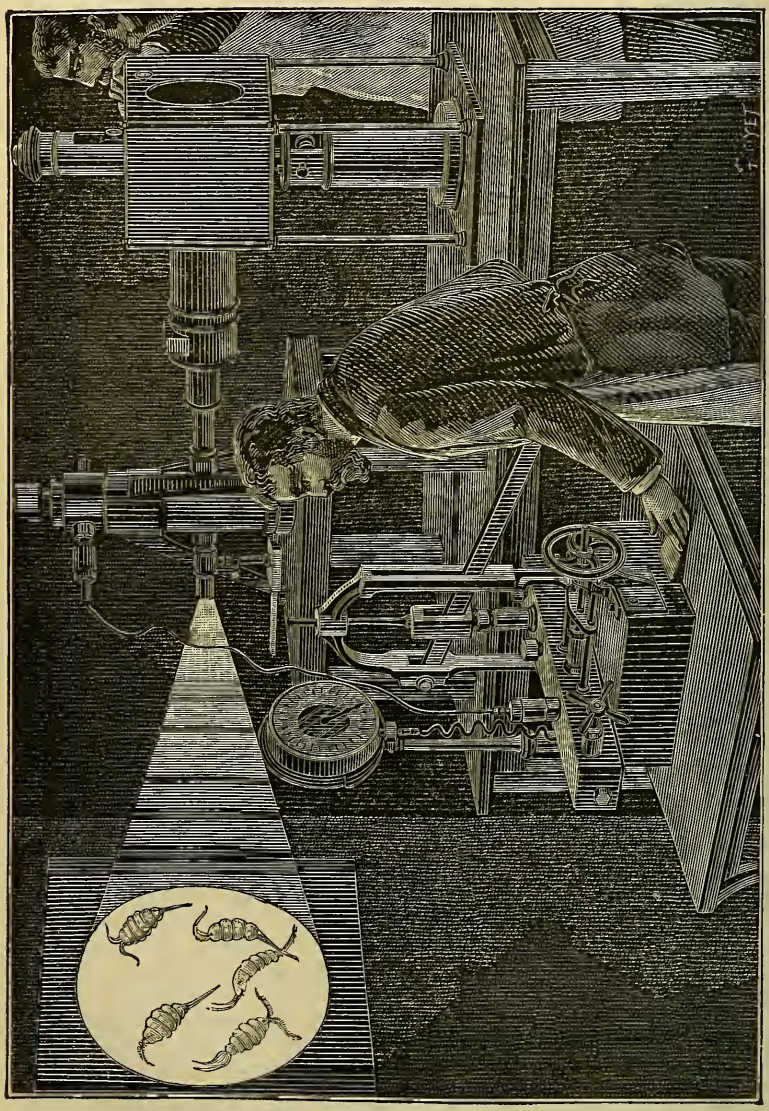
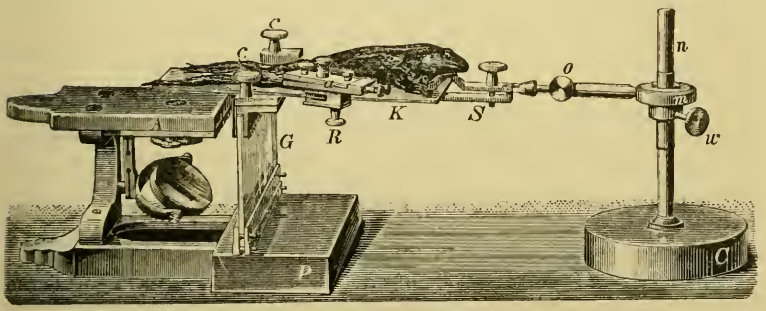


FIG. 209.—GENERAL VIEW OF DR. REGNARD'S APPARATUS.

4000 it remains inert and benumbed. When its normal pressure returns it recommences moving, unless the pressure has been prolonged and its tissues are soaked. This seems to show that the effect is a compression of the nervous system.

Westien's apparatus for comparing symmetrical parts of the webs of the right and left feet of a frog.*—The apparatus of Herr H. Westien (fig. 210) consists of a glass plate holder C, the stand P, and the Microscope A (upper part omitted). The ring *m*, movable on the upright *n*, is fastened by the screw *w* and carries the bar *o*, to which the clamp S is attached. The glass plate K is clamped into this, and on it the frog is laid, and its extremities and toes fixed with threads which are fastened in holes bored in the glass plate.

Fig. 210.



The plate K rests on the glass-plate G, on which it can be easily and quickly pushed in a horizontal plane up to the clamps *c c* which are fastened on the upper border of the glass plate G. By proper adjustment of the glass plate K on a certain spot, e. g. a small artery of the left foot, the corresponding spot of the right foot can be placed in the field by pushing the plate up to the clamp *c*. The apparatus for producing stimuli *a* is attached to the glass plate K by the clamp R.

Apparatus for Determining the Specific Gravity of Minute Objects under the Microscope.†—Prof. W. J. Sollas found the difficulty of determining the specific gravity of calcareous sponge spicules by the method of weighing insuperable, as they are so small and so difficult to free completely from air, even with an air-pump. Sonstadt's solution appeared to offer the best chance of success; but here again the small size of the spicules was a difficulty. This, however, was overcome by adapting the Sonstadt method for use with the Microscope.

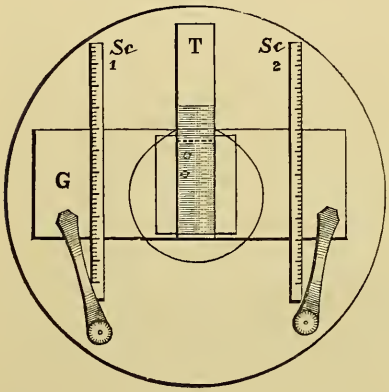
An ordinary collecting tube (fig. 211, T), about 2 in. long and 3/8 in. in diameter, was cemented with plenty of Canada balsam to a glass slide G. The object of using excess of balsam was to destroy

* Zeitschr. f. Instrumentenkunde, v. (1885) p. 198 (1 fig.)

† Scientif. Proc. R. Dublin Soc., 1885, pp. 374-92 (7 figs. and 1 pl.).

optically the curvature of the side of the bottle. As the refractive indices of Sonstadt's solution and balsam are not very different, this plan succeeded admirably. A thin cover-glass was similarly cemented to the opposite side (front face) of the bottle, which was thus optically flattened front and back. Some Sonstadt's solution (sp. gr. 2·77) being introduced, a fragment of aragonite (sp. gr. 2·9) was dropped in; it at once, of course, sank to the bottom. Next a piece of calcite (sp. gr. 2·7) was added; it floated on the surface. The spicules lying in water, were freed as far as possible from air by boiling, and with the air-pump. With a dipping-tube the water and spicules together were taken up and added to the top of the Sonstadt's solution, where they floated. The tube was then left to stand in order that diffusion might take place. After some hours the water and Sonstadt's solution had become gradually mixed, giving a column of fluid with a specific gravity of about 2·4 at the top and 2·77 at the bottom. The calcite and the spicules floated at different levels (the spicules being above) in layers of fluid having respectively the same specific gravity as themselves. A fragment of pure quartz (sp. gr. 2·65), and another of adularia felspar (sp. gr. 2·58) were next added; the quartz sank to a level below the spicules, the felspar remained above. As the contents of the tube could be easily examined under the Microscope with a 1 in. or even a 1/2 in. lens (Zeiss's C), one could make certain of the absence of air-bubbles, vacuoles, or other troubles; and as the spicules could be seen individually, it was possible to determine the specific gravity of a single one. The spicules did not all lie at exactly the same level, but formed a zone thickest towards the middle, and thinning off above and below; a few stragglers were seen at some distance on either side, but this was owing either to adhesion to the side of the tube, or attached impurities.

Fig. 211.

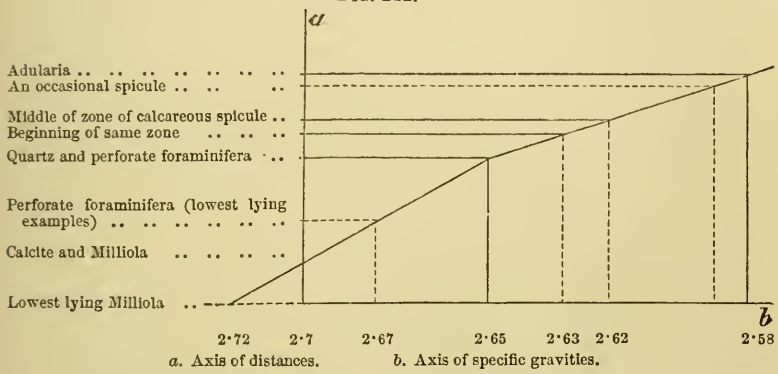


The specific gravity could now be exactly determined. Two rectangular axes are ruled, fig. 212; on one distances are taken to represent the densities of the calcite, quartz, and felspar; on the other the exact distances between the middle line of each fragment as it floats in the tube are measured off.

These distances were obtained by gumming two scales divided into millimetres on the stage of the Microscope at right angles to the glass slide carrying the experimental tube, i. e. parallel to this tube (fig. 211, Sc_1 and Sc_2). The calcite was brought into focus, and the position of one edge of the glass slide read off on the scales; the

slide was then moved down till the quartz came into view, and the position of the slide again read off on the scales. The object of

Fig. 212.



a. Axis of distances. *b*. Axis of specific gravities.

having two scales is obviously to ensure parallelism in the movements of the glass slide.

The specific gravities and distances being indicated on the rectangular axes, one constructs a curve which gives the change in density from one mineral to another in the tube.

The height of the zone of spicules being now indicated on the axis of distances, a line is drawn parallel to the other axis through it; from the point where it cuts the curve a perpendicular is let fall on the axis of specific gravities, and the point where it meets the axis gives the specific gravity. In this way the specific gravity of the spicules was determined to be from 2·61 to 2·63. They are plainly, therefore, not aragonite, and, arguing from the specific gravity alone, probably consist of calcite. The slight difference between it and them in specific gravity is no doubt due to the presence of organic matter; for within, a minute canal, filled with some kind of organic material, possibly spongin, occurs in the axis of the spicules; and without they are surrounded by a thin sheath of a probably similar material. Prof. Sollas finds by calculation that allowing for the organic matter a specific gravity of 1·5, it would require to be present to the extent of $6\frac{2}{3}$ per cent. to reduce the total specific gravity of the spicules from 2·7 (supposing them to consist chiefly of calcite) to 2·62, the density found.

Keeping both Eyes open in Observation.*—Mr. E. M. Nelson considers that the unused eye should be shut when the weaker light is in the Microscope, both eyes being kept open only when the object is in the stronger light. Thus by diffused daylight the light in the instrument is the weaker, and the other eye must be shut. By artificial light in a dark room both eyes can be kept open. "One hour of steady hard work with the Microscope by diffused daylight

* Engl. Mech., xli. (1885) p. 523.

will tire you more than a whole day's work in a dark room by lamplight."

Aperture Puzzles.—Another puzzle turns on the statement sometimes made that it is not necessary to have an objective of 1·0 N.A. (180° air) to resolve 96,000 lines to the inch as shown by the Aperture Table; that it can be effected by a dry objective of say 0·50 N.A. (60° air).

The way in which this feat is supposed to be accomplished is by attaching a truncated cone A to the cover-glass as shown in fig. 213, the connection being made by balsam, oil, &c. Here the first diffrac-

Fig. 213.

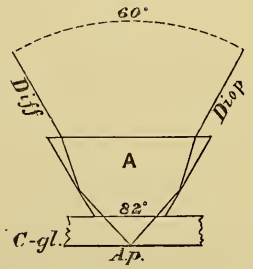
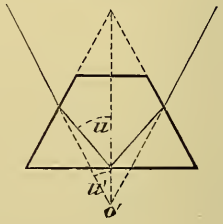


Fig. 214.



tion spectrum and the dioptric beam which leave the object (*Amphipleura pellucida*) at an angle of 82° *in glass* emerge from the cone at an angle of only say 60° in air, and are therefore collected by a dry objective of approximately that aperture.

The explanation simply is that by connecting the cone with the cover-glass we have an immersion objective, with the difference that (1) instead of using a hemispherical piece of glass to cause a pencil of 82° in the glass to emerge as one of moderate air angle, to be taken up by a dry objective above it, a conical one has been substituted, and that (2) in place of attaching the extra piece of glass once for all to the rest of the optical combination, as in an ordinary immersion objective, it has to be attached to each slide examined, at a great sacrifice of convenience! The cone has, moreover, the disadvantage, as compared with the hemisphere, that whilst the latter will readily collect to a focus the whole pencil of 82°, and thus allows of the real delineation of all kinds of objects, the cone will only collect two very narrow partial pencils of equal and opposite obliquities and will not bring these to a proper focus. The problem is in fact only another mode of stating the old mare's-nest of the "hemisphere puzzle," disguised by the substitution of a truncated cone for the hemisphere.

The same effect, though with more dispersion, can be obtained by refraction (instead of reflection) through a truncated prism of isosceles section and suitable inclination of the refracting faces (fig. 214), and whatever form is employed the only essential conditions are that two infinitely narrow beams (the incident beam and the first diffraction pencil) shall have equal and opposite inclinations u to the axis within the front medium, and that they should be deflected, by

refraction or reflection, in such a way that they emerge into air under equal and opposite inclinations u', smaller than the semi-angle of aperture of the dry objective above, which is focused to the point o' of vertical intersection of the two beams. Every device which conforms to these conditions will act as an immersion front-lens in regard to the particular pair of beams in question.

The conical or prismatic front will, moreover, like the hemisphere, increase the power of the optical combination. This power may be determined by the formula $N = \frac{n \sin u}{\sin u'}$ where n is the index of the glass front, u the internal angle of obliquity, and u' the angle of obliquity after emergence into air. In the ratio of the quotient N to unity the power of the objective will be increased (or its focal length diminished) in regard to the delineation of the particular set of lines from which the two opposite pencils originate. For any other set, of different closeness, u and u' will require different values, and the power of the same cone or prism will be different.

The 'Times' on the Microscope.—The following leading article appeared in the 'Times' of the 26th August:—

"We publish this morning an article descriptive of some of the progress which has been made during late years in the construction and cheapening of Microscopes and of their accessory apparatus—a progress so marked that it has become time for all who are engaged in the work of instruction to consider carefully to what extent the improved instruments of the present day can be employed for the furtherance of the general work of teaching. If we may adopt Paley's definition of education, as 'comprising every preparation that is made in our youth for the sequel of our lives,' we shall be prone to admit that few of these preparations can be of greater importance, or of greater ultimate utility, than the training of the eye to observe natural phenomena, and the training of the mind to appreciate the meaning of these phenomena and their relations to one another. It was a great day during the childhood of many who have now passed the meridian of life when the lecturer with an oxy-hydrogen Microscope was announced as being about to exhibit and to discourse at the town hall; and the huge transparency in which the insect life of a drop of water was displayed in full activity became a wellspring of new thoughts and of increased mental activity to nearly all of those who gazed in wonder at the presentment of rapid movement, of abounding life, and of continual destruction. The sight which was then to be seen only on rare occasions, and as a sort of entertainment, is now at the daily command of every school-master, or of every parent who can spare only a small amount of money, and who possesses sufficient intelligence and manual dexterity to learn the use of the instrument which, more than any other, has led to increased knowledge of the structure of man and animals, and to modern improvements in the healing art. The powers now at the disposal of the *savant* far surpass any which were attainable only a few years ago; but the use of these high powers requires the devotion

of much of a lifetime to the study of learning how to see, and how to interpret what is seen. No persons are more certain to fall into gross errors than the untrained possessors of powerful Microscopes; and the conduct of actual research, of the business of carrying knowledge a step in advance of its former boundaries, must always be limited to the few. When, in 1854, the late Dr. William Budd announced that cholera was dependent upon the presence of a minute intestinal fungus, there were probably not three observers in England who were capable of pronouncing a trustworthy opinion as to whether a given speck was a microscopic fungus or not; and there was little doubt that the so-called 'fungi' of many persons were nothing more than fine particles of chalk, derived from medicine which had been administered to the patient. Since that time vast strides have been made in the methods of conducting such investigations, together with corresponding improvements in the instruments by which they are conducted; and almost every beginner now thinks himself qualified to prattle about microbes. In the case, unfortunately, of those who may be presumed to be the most skilled observers, talk and observation do not always seem to be conducive to agreement.

It is not, however, for the sake of prosecuting original inquiry, but for the sake of making known to the young what has already been established, that the Microscope should commend itself to educationists. It reveals and displays plainly to the sense of sight two great facts—the fact of the wonderful complexity and beauty of the structure of the smallest and apparently the most insignificant creatures, and the fact that all living things of appreciable magnitude, whether they be plants or animals, are built up by the aggregation of myriads of minute organisms or cells, each of which possesses independent life, and each of which fulfils a purpose in the corporate body by its own inherent and independent activity. If a Microscope is given to children as a toy, and if all that is done for them is to permit them to look through it at something the nature of which they do not understand, it will do them no more good than seeing a conjuring trick, perhaps hardly so much; but if children are encouraged to examine first the more simple vegetable structures, making their own sections and proceeding gradually from low powers to higher ones, from coarse to minute and complex structure, they can hardly fail, if capable of enlightenment at all, to obtain such new notions of the universe in which they live as will never wholly cease to influence their minds. The lore actually gained may perhaps be comparatively small; but the true gain will be in the power to think about occurrences, to discover real resemblances between things which are externally different, and to perform that wonderful work of ratiocination through which two ideas, similar or contrasted, become the parents of a third. It is difficult to believe that a child who was not only permitted to work with a Microscope, but who was assisted to do so in a rational way, encouraged to collect his own objects, to examine them in his own fashion, to try to overcome his own difficulties and doubts, would ever grow up into an entirely stupid man or woman. There are but few who are gifted with the infinite patience

and the love of truth for its own sake which form the raw material, so to speak, of the philosopher; but the instances are at least equally few in which the lessons in observation and reflection, which even a small Microscope is calculated to afford, would not serve to raise the mind of the user to a higher level, and to develop a higher degree of intelligence than could have been obtained without such help.

In a few very good schools, chiefly for the children of the more wealthy classes, natural history teaching by the aid of Microscopes is systematically conducted, the classes collecting their own specimens, and being expected to give the best account they can of them before being assisted towards a better one by the teacher. Our argument is that all this should be done much more widely and generally; education, in fact, being made to advance along a road which is rendered comparatively smooth by the perfection of modern appliances. The tasks of school, in too many cases, appeal to the memory rather than to the understanding, and cultivate stupidity rather than intelligence. It is impossible to doubt that much which is taught, say in Board schools, might be relinquished without any appreciable loss to the intellectual development of the scholars, and that by such relinquishment time might be gained for instruction of a more fruitful kind. As for the material, even in towns, it is present in immeasurable abundance. There is a legend that an ardent naturalist once determined to write a complete account of the plants and animals which he found in the garden of Lincoln's-inn-fields, but that the magnitude of the task was such as to place insuperable obstacles in the way of its accomplishment. An attempted history of the insect life alone was abandoned for the same reason; and a second Gilbert White might have found ample occupation in observing and recording the habits of the various denizens of the narrow space. It is, perhaps, too much to hope that the officials of a public department will ever so far emancipate themselves from the trammels of routine as to take the initiative in the promotion of better nature teaching; but it is not impossible that they might learn to follow if they were clearly shown the way. The parochial clergy in old times were the pioneers of improvement on all educational questions; and there is no reason why they should not seek to regain something of the leadership which has to so great an extent slipped away from their grasp. Could they not, especially in rural districts and in country towns, do something towards the promotion of a reform which would render the younger members of their congregations more observant, more thoughtful, more careful of animal life, less ready to be over sure about problems the solutions of which are not yet known to mankind, but on which so many people are prone to be dogmatic in precise proportion to their ignorance? The modern Microscope might form one of many levers by which the minds of future generations might be guided towards the attainment of knowledge and the cultivation of modesty and charity."

The article referred to was as follows (under the head of "Recent Microscopical Science"):—

"A glance at the Journal of the Royal Microscopical Society,

which is edited by Mr. Frank Crisp, with the assistance of several Fellows of the Society, shows that activity in microscopic science is incessant. Last year the Journal included 1008 pages of matter, most of it consisting of summaries giving the essential features of all important papers bearing on microscopical science published throughout the world. This year 756 pages of the Journal have already been issued, and students who use the Microscope are thus better off than the devotees of most other departments of science. It is to be noted as to the Microscope itself, that improvement is not now rapid as regards fundamental principles and their application to the less powerful lenses with which the average student is chiefly concerned, but that considerable advances have been made in the last few years in the theory and practice of the construction of lenses of high powers. Thus under the eye of a skilled observer an excellent objective of 1/10 in. focal length will now accomplish as much as or more than an objective of 1/25 in. not many years ago; while those now made of the very high power signified by 1/50 in. focal length, and capable of magnifying from 2000 to 10,000 diameters, according to the eye-piece used, greatly surpass in all important qualities lenses of the same power sold by the best makers less than five years ago. Moreover, for some kinds of work the adoption of the principle of immersing the surface of the objective in distilled water or in very pure oil has proved of great value. Thus many delicate points of detailed structure, formerly discoverable only by the most persistent efforts and careful manipulation, can now be demonstrated with comparative readiness.

It is obvious that if the educative influence of microscopical study is to be very widely diffused, much depends upon the cheapening of good apparatus. This is especially the case if schools are to employ to any considerable extent recent biological methods. Cheap forms of Microscope have hitherto been more or less unsatisfactory. Either they were cumbrous to work, they readily got out of order, they became unsteady, or they did not long continue to magnify clearly or without introducing inopportune colours into the field of view. All the leading makers, however, have recently brought out cheap instruments of improved construction. Among others, Messrs. Beck, whose name stands high for finish and reliability of workmanship, have recently brought out a so-called 'Star' Microscope, which combines solidity and steadiness with good magnifying powers (1 in. and 1/4 in. in focal length respectively), suitable for average students and for research within limits. The tube can be inclined at any angle, there is a fine adjustment, the stand is solid and firm, and a diaphragm with apertures of various diameters under the stage can be rotated so as to regulate the admission of light.

Marked improvements continue to be made in the lantern Microscopes used for magnifying objects for public lectures and demonstrations. Mr. Lewis Wright has brought to great perfection a lantern Microscope which throws large-sized and exceedingly clear views of minute objects on to a screen free from distortion or colour. Structures so complex as the minute anatomy of the human tongue, the

wood of an elm tree, and even the circulation of the blood in the web of a living frog can be exhibited with perfect sharpness of definition up to the very margin of the illuminated field of view. The importance of this for scientific lecturing is evident.

In no department of microscopic work has more ingenuity recently been applied than in the construction of microtomes. These are instruments for cutting numerous very thin sections of substances parallel to one another, either for distribution to large classes or for obtaining successive adjacent portions of a structure, so as to secure an exhaustive examination of it. The somewhat complex instrument devised a couple of years ago by Messrs. Caldwell and Threlfall, of Caius College, Cambridge, and manufactured by the Cambridge Scientific Instrument Company, was made to deliver its thin sections in a continuous riband at the rate of 100 per minute, or even twice as many when a water motor was used. They were delivered in consecutive order and with the same side upwards. Uniform thinness could also be obtained by an ingenious screw. The great novelty of the instrument consisted in the use of an endless band to receive the sections as they came from the razor. When imbedded in suitable material the sections adhered to one another and came off the razor in a continuous riband. As soon as a sufficient length was cut, the end was picked up by a needle or scalpel and placed on the band, which was adjusted so as to be moved forward, at each throw of the object-carrier, through a distance equal to the breadth of the surface which was being cut.

Many persons were soon at work to improve and simplify this method and to reduce its cost. This object seems to have been best accomplished by the Cambridge Instrument Company itself. Its improved instrument is called the rocking microtome, a rotary instead of a sliding motion of parts having been employed. Its cost is less than one-sixth of that of the original instrument, and instead of being lifted on to a continuous silk band, the riband of sections falls by its own weight directly from the razor on to a sheet of paper, or on to the glass slide on which the sections are to be finally mounted. Sections as thin as the 1/40,000 of an inch are said to be obtained by this plan. It is much easier to work, is less liable to get out of order, easily packed, and very portable.

One result of the increased facility of instruction and study in microscopical science appears to be the rapid multiplication of memoirs and papers dealing with isolated portions of subjects. We do not note in this country that the number of men of real power who devote themselves to these studies and patiently elaborate systems and build up sure edifices of enlightenment increases very greatly. Rather there is a multiplication of men of the second or third rank, who catch the jargon of the reigning school, make respectable researches on a few points, and become absorbed in teaching or in other money-earning pursuits. There is a fashion in microscopy as in other things, and it is the fashion to study bacteria and bacilli, just as it formerly was the thing to pore delightedly over test-slides of diatoms. The bacteria will yield a more fruitful harvest, certainly,

in the hands of scientific workers, but the path is toilsome and the goal distant. There is reason in this devotion. When we know the very little, how it lives and moves, and what it can do, we shall be much more ready to comprehend how similarly minute elements combined work in larger organisms."

AGEN, F. D'.—**Microscopical.**

[As to air-bubbles in the back combinations of objectives. Also as to the resolution of *A. pellucida* by a dry 1/5 in. of 135°. (Cf. *ante*, p. 726.)]

Engl. Mech., XLII. (1885) p. 37.

American Association for the Advancement of Science.

[Remarks on the abolition of the Section of Histology and Microscopy. "This anomalous Section finding its end near, proceeded with dignity to request the Association to kill it: the request has been granted." "This change has been urged for some time by those who do not think a special science of Microscopy exists, but that the Microscope is a tool used by scientific men in various branches." "It is to be hoped that Dr. Minot's suggestion of forming a Microscopical Club within the Association will be carried out, to insure the cultivation of technique among the members interested."]

The Microscope, V. (1885) pp. 181–2.

See also *Amer. Mon. Micr. Journ.*, VI. (1885) p. 175.

American Society of Microscopists.—Our Eighth Annual Meeting.

[Urging that papers, speeches, and sessions should be short. "We must insist upon being relieved and upon relieving our fellow-sufferers from the lengthy uninteresting papers read by parties who have become monomaniacs on their pet subjects."]

The Microscope, V. (1885) pp. 180 and 181.

See also *Amer. Mon. Micr. Journ.*, VI. (1885) p. 157, and *Micr. Bulletin* (Queen's), II. (1885) p. 25.

" " " Report of Cleveland Meeting. (*In part.*)

Amer. Mon. Micr. Journ., VI. (1885) pp. 165–7, 175.

AMYOT, T. E.—**Direct Vision Microscopes.** [*Post.*]

Sci.-Gossip, 1885, pp. 201–2 (1 fig.).

ARSONVAL, D'.—**Simplification des Appareils à projection.** (Simplification of projection apparatus.) [*Supra*, p. 866.]

Journ. Soc. Scientifiques, I. (1885) p. 140.

(*Soc. de Biologie*, 21st March.)

BANKS, C. W.—**Electric spark under the Microscope.**

[Mr. Banks showed, under the Microscope, the electric spark in its passage between the terminals of a 1/4 in. spark induction-coil attached to a Grenet bichromate solution battery. Two vulcanite slides had been prepared, on which were fastened adjustable platinum strips connected with the battery wires and terminating in brushes of platinum wires of extreme tenuity. The electric fluid, in its passage from one terminal to the other, formed a very attractive object under the Microscope. One of the slides was used to show the effect on the electric spark of interposing films of soot of different thicknesses. In its passage through these the current was deflected into meandering lines, around which scintillated showers of sparks. The particles of soot could be seen arranging themselves in symmetrical groupings around the terminals.]

Proc. San Francisco Micr. Soc., June 10th, 1885.

See *Micr. Bulletin* (Queen's), II. (1885) p. 30.

BAUSCH, E.—**Manipulation of the Microscope.**

[Contains chapters on Simple Microscopes, The Compound Microscope, Objectives and Eye-pieces, Requisites for work, How to work, Advanced Manipulation, Substage Illumination, Care of a Microscope, and Considerations in testing Objectives.]

96 pp. and 27 figs., 8vo, Rochester, N.Y., 1885.

BEECHING, S.—**Amateur Lens-grinding.**
Engl. Mech., XLI. (1885) pp. 498–9 (1 fig.).

BLES, E. J.—**Opaque Illumination.**
[Mainly an historical summary of the various appliances.]
Trans. and Ann. Rep. Manchester Micr. Soc., 1884–5, pp. 23–6.

BURRILL, T. J.—**Photographs of *Amphipleura pellucida*.—New Heliostat.**
[Good photographs obtained by Dr. H. J. Detmers with a common coal-oil lamp.—Note of the construction of a new Heliostat of simple mechanism for photo-micrography.]
Science, VI. (1885) p. 228.

C., L. P. DE.—**Le Microscope grande modèle de Hartnack et Prazmowski.** (The large model Microscope of Hartnack and Prazmowski.)
[Description of it, with the modifications introduced by their successors Bézu, Hausser & Co.—principally an excentric diaphragm in place of a sliding one, and an adapter for changing objectives.]
Journ. de Microgr., IX. (1885) pp. 262–3.

CAPLATZI, A.—See "Orderic Vital" and "Rector."

COOPER, W. A.—**Daylight v. Lamplight for microscopical observation.**
[Quotation of Dr. Carpenter's views in favour of daylight as against Mr. Nelson's.]
Engl. Mech., XLI. (1885) p. 564.

DUBOSCQ, T. and A.—**Nouvel appareil de grandissement pour la projection, soit des tableaux de grandes dimensions, soit des objets microscopiques.** (New magnifying apparatus for the projection of large pictures or microscopic objects.) [*Supra*, p. 861.] *Comptes Rendus*, CI. (1885) pp. 476–7.

DUDLEY, P. H.—**Triceratium Davyanum.**
[3 photo-micrographs × 408, representing the diatom when viewed in 3 different focal planes.]
Journ. N. York Micr. Soc., I. (1885) pp. 145–6, and p. 157 (3 photographs).

DURAND, W. F.—**A practical method of finding the optical centre of an objective and its focal length.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) pp. 141–5 (1 fig.).

Dynamo-electric Machines.
[Exhibition of two small machines, one operated by the foot and the other by hand. "For microscopical illustration [a dynamo] can be used with great advantage, especially in photography."]
Journ. N. York Micr. Soc., I. (1885) p. 156.

Fasoldt's (C.) Detaching Nose-piece.
[See this Journal, IV. (1884) p. 959.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 149–50 (1 fig.).

GRANT, F.—**Microscopical.**
[Whether daylight or lamplight is the better for illumination "can be settled only by experience."—Measuring amplifying power of the Microscope and angle of aperture of objectives.—Advantages and disadvantages of large apertures.—Explanation of numerical aperture.]
Engl. Mech., XLII. (1885) pp. 57–8.

Gray's (S.) Water Microscopes.
[Claim by "the ghost of Stephen Gray" that Hippisley's Pocket Field Microscope *infra* is an inferior form of Gray's Water Microscope.]
Engl. Mech., XLI. (1885) p. 520.

Gundlach's Improved Microscope Objectives. [*Supra*, p. 863.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 130–1.

HART, C. P.—**Making a Microscope into a Microtome.** [*Supra*, p. 861.]
Science, VI. (1885) p. 228.

HASTINGS, C. S.—**On the Colour Correction of double Objectives.**
Engl. Mech., XLI. (1885) pp. 559–60; XLII. (1885) pp. 8–9; from *Amer. Journ. Sci.*, XXIII. (1882).

HÉNOCQUE.—**Appareils destinés à l'examen du sang.** (Apparatus for the examination of blood.) [*Post.*]
Journ. Soc. Scientifiques, I. (1885) p. 24. (*Soc. de Biologie*, 11th Jan.)

HEURCK, H. VAN.—**Eclairage artificiel: Eclairage électrique par incandescence.** (Artificial illumination: Incandescent electrical illumination.) [*Supra*, p. 864.]
Synopsis des Diatomées de Belgique. Texte. 1885, pp. 219–22 (3 figs.).
Cf. *Journ. Soc. Arts*, XXXIII. (1885) p. 1005.

HIPPISLEY, J.—**A pocket field Microscope.**
["Magnifying 100 diameters, useful in the search for infusoria, &c., and which may be constructed, lens and all, in a few minutes.
Bend a slip of thin metal 5 in. or 6 in. long and 1/2 in. wide into the form of the letter V, make two circular holes 1/10 in., one in each arm, opposite each other, so that when the arms are sprung together by pressure the holes shall meet exactly. Place a drop of water in one hole, taking care not to wet more than its interior circumference. The water will assume the form of a perfect double convex lens, of focal length varying from 1/8 to 1/10 in. according to the quantity of water introduced. Such lens, though by evaporation its focal length is gradually increased, maintains its efficiency for a time quite sufficient for the examination of a drop of water or other substance in the opposite hole. The end of one arm of the V is bent inward so as to form a "stop," which when they are pressed towards each other to effect the focal adjustment, prevents a contact which would destroy the lenticular form. The definition of these water-lenses is excellent, and their magnifying power is from 80 to 100 diameters, according to the quantity of water in the lenticular drop."]
Engl. Mech., XLI. (1885) p. 502.

„ „ **Microscopic.**
[It is very easy to make glass globules for microscopic use of ordinary glass. The difficulty is in using them as Microscopes. Besides the instrumental difficulty of focal adjustment for such small lenses, the light of so small a pencil of rays is quite inadequate, except with "violent" illumination. "But lenses by melting glass may be made to much better purpose of more useful focal lengths — not globular— but double-convex lenses, in the following manner, which, I believe, is new, or was so when I first made them, say 30 or 40 years ago. Take a bit of fine binding wire, iron (not brass or copper), make, by twisting it round a taper wire for mandrel, a nicely circular loop; flatten it so that the loop is all in one true plane. The loop may vary in diameter from any desired smallness up to 1/4 in. (which is nearly the largest size my glass-melting apparatus will conveniently manage). Place a square piece of glass—thicker or thinner, according as it is desired to have a lens of more or less convexity, but large enough to completely cover the loop. Then, holding it in a suitable blowpipe flame (which should be a vertical, not a horizontal one), the glass assumes in melting a doubly-convex lenticular form. A form, moreover, in which the spherical aberration of a globule tends to be corrected, and a larger proportion of the field is flatter than it is with an ordinary double-convex lens." "Such lenses are made in a few minutes, and perform most admirably when a suitable instrumental apparatus is used."]
Engl. Mech., XLI. (1885) pp. 540–1.

HITCHCOCK, R.—**Optical arrangements for Photo-micrography and remarks on Magnification.** [*Post.*] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 168–70.

[HITCHCOCK, R.]—**The Postal Club.**
[Comments on its position.] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 134–5.

„ „ —**Testing Objectives.**
[Recommendation of the Abbe test-plate.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 177–8.

International Inventions Exhibition. XII. Philosophical Instruments and Apparatus.
[Includes Microscopes and Apparatus.]
Engl. Mech., XLI. (1885) pp. 444–5.

JAMES, F. L.—**American v. Foreign Microscopes.**
The Microscope, V. (1885) pp. 164–5, from the *National Druggist*.

KLEIN, C.—**[Horizontales Erhitzungsmikroskop.]** (Horizontal heating Microscope.) [*Post.*] *Nachr. K. Gesell. Wiss. Göttingen*, 1884, pp. 133–4.

LACAZE-DUTHIERS, H. DE.—**Note accompagnant la présentation d'Appareils d'éclairage électrique pour les travaux des naturalistes, chimistes, micrographes, &c., construits par M. G. Trouvé.** (Electrical illuminating apparatus for naturalists, chemists, microscopists, &c., constructed by G. Trouvé.)

[1. Glass jar with a silvered glass bottom and a silvered parabolic reflector over the mouth, having in the centre an incandescent lamp illuminating the interior of the jar. 2. Modified apparatus for fermentations. 3. Modified Hélot and Trouvé electric photophore.]

Comptes Rendus, CI. (1885) pp. 405–7 (1 fig.).

LEWIS, R. T.—**Electricity in the Microscope.** [*Supra*, p. 875.]

Engl. Mech., XLII. (1885) p. 19.

MALCOLM.—**On Binocular Glasses adjustable to eyes having unequal focal lengths.** [*Post.*]

Proc. Phys. Soc. Lond., VII. (1885) pp. 80–1.

M'CONNEL, J. C.—**Notes on the use of Nicol's Prism.**

[1. On the error in the measurement of a rotation of the plane of polarization caused by the axis, about which the Nicol turns, not being parallel to the incident light. 2. On a new method of obtaining the zero-reading of a Nicol circle.]

Proc. Phys. Soc. Lond., VII. (1885) pp. 22–39 (7 figs.).

NELSON, E. M.—**Microscopical.** [*Supra*, p. 864.]

Engl. Mech., XLI. (1885) p. 523.

Nicol Prism, repairing.

[Nicol prisms which have become scratched and dull may be restored by cementing a thin cover-glass over the ends with clarified gum-damar. The prisms should first be carefully cleaned with a very soft brush and soap, to which may be added a little precipitated chalk. They should then be rinsed with distilled water and carefully dried, pains being taken to remove every particle of dust and dirt from within the scratches. The cover-glass, which should be thin and perfectly clean, should then be applied in the usual way, exactly as in making a balsam mount. When carefully done, not a vestige of the scratches can afterwards be detected.]

The Microscope, V. (1885) pp. 188–9.

"ORDERIC VITAL."—**New Optical Glass.**

[Feil's "extra dense flint, No. 1738." Also remarks by A. Caplatzi.]

Engl. Mech., XLI. (1885) p. 519; XLII. (1885) p. 15.

Perfect Laboratory Microscope.

[Four questions for "Professors and others who have had large experience in microscopical work" to answer, as to the model of Microscope generally preferred by educational institutions.]

Micr. Bulletin (Queen's), II. (1885) p. 25.

Queen's (J. W. & Co.) Resistance Coil.

[Designed especially for use with micro-electric lamps.]

Micr. Bulletin (Queen's), II. (1885) p. 30 (1 fig.).

"RECTOR, F.R.A.S."—**The Optical Lantern.**

[Queries as to improvements. (Four wick lamps burning best kerosene oil give as much light as can possibly be obtained from that medium.) Also facetious reply by A. Caplatzi, mainly as to the excessive heat of such lamps.]

Engl. Mech., XLII. (1885) pp. 62 and 84–5.

"ROB. CRUS."—**The Micro-objective.**

[On mounting the lenses of eye-pieces and objectives.]

Engl. Mech., XLI. (1885) pp. 563-4 (2 figs.).

See also p. 526.

ROCHER, B. DU.—**De la Mégaloscopie.** (On Megaloscopy.) [*Post.*]

Comptes Rendus, CI. (1885) pp. 329–30.

Royal Society of South Australia, Postal Microscopical Section of.

["A box of microscopical objects has been received from Victoria and duly circulated among the members of this section, and a box of South Australian objects has been made up in this colony and forwarded to Victoria and New South Wales."]

Trans. and Proc. and Rep. R. Soc. S. Australia, VII. (for 1883–4), 1885, p. 130.

STOKES, G. G.—**On Light as a means of Investigation.** Burnett Lectures. Second Course. 114 pp., 8vo, London, 1885.

The "Times" on the Microscope. [*Supra*, p. 883.]
Times, 1885, August 26th. Cf. also February 16th.

VERRALL, G. H.—**Micro-photography for illustrating the neuration of transparent winged insects.**
[Note of successful experiments.] *Proc. Entomol. Soc. Lond.*, 1885, p. iv.

Walmsley's (W. H.) Photo-micrograph of Rinnbach's arranged Diatoms. [Cf. *ante*, p. 530.]
The Microscope, V. (1885) p. 181.

WARD, R. H.—**The Binocular.** [*Post.*]
Micr. Bulletin (Queen's), II. (1885) pp. 28–9 (1 fig.) from *The Microscope in Botany* (Behrens).

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

Method for Observing Protoplasmic Continuity.*—M. L. Olivier recalls that three years ago he pointed out that photography applied to the study of minute objects revealed details of structure which made no impression on the retina, and that in support of this he instanced a photograph which showed on the walls of the cells markings and perforations invisible under the Microscope. He now further illustrates the matter by reference to the canals which traverse the cell-walls of plants.

The existence of these canals escapes the ordinary processes of investigation, but can be shown by the employment of photography.

Thin transverse sections are made of living tissues whose growth is complete. A direct photograph is taken of the sections, with an amplification of 300 to 700. On these negatives, examined with a lens, the cell-membranes seem to be in a very surprising state of complication: perforated in various ways, with canals, some transverse, others longitudinal, that establish a communication between the contents of the cells. It seems impossible to explain by a phenomenon of diffraction this appearance of canals on the photographic plates.

After having made out this structure on the negatives, the author endeavoured to see them by direct vision and examined the preparations under an amplification of 700–900, in a dark chamber into which the Microscope was introduced, in such a way that the eye received no other impression than that of the light coming from the instrument. Under these conditions he succeeded in distinctly seeing the interruptions of the cell-walls in many plants.

Direct observation is, however, in most cases quite insufficient, and the author obtained a better result by staining, either the cell-membranes of his preparations, or the protoplasmic elements after fixing, turgescence or contraction by means of appropriate reagents. In the first case the septa presented here and there colourless lacunæ, at least in certain species of plants. In the second case the walls of the cells were white against the coloured ground; the canals which traverse the septa are then visible, since they are coloured like

* Comptes Rendus, c. (1885) pp. 1168-71.

the protoplasm itself. M. Olivier also attempted to cause a fluid, capable of colouring the protoplasm, to penetrate under gentle pressure into the organs; transverse sections were then made. The injection rarely succeeded; but when it took place in a fairly regular manner, this process led to a result identical with the preceding.

Eau de Javelle as a Medium for Clarifying and Dissolving Plasma.*—Dr. F. Noll finds that eau de Javelle (an alkaline hypochlorite solution) destroys and then dissolves the whole of the plasma of the cells in preparations which have been preserved in alcohol. A similar, but more or less imperfect solution of the plasma-contents occurs in tissues which have been treated with glycerin, Müller's fluid, picric or chromic acid. It is not necessary that alcohol should be present during the operation of the reagent; if a drop of the water is placed on a section made through young cells rich in plasma, this is soon dissolved, with development of small bubbles of gas. If the action takes place in the open air, a soft pellicle quickly forms on the drop, consisting of calcium carbonate, which can be readily dissolved in acetic acid. The formation of this pellicle can be prevented by placing a cover-glass over the drop, under which the process can be studied step by step. In a very short time, usually 3–4 minutes, the plasma is converted into a clear fluid. When the section is sufficiently clear, it is washed in water, so as to remove the bubbles of gas. The superfluous granules of calcium carbonate are removed by acetic acid, and the section is then ready to be placed in glycerin. The water acts on cuticular membranes in the same way as Schultze's macerating fluid, but only slightly and after some time (1 hour or more). Calcified membranes should be first treated with acetic acid to dissolve the mineral constituents, washed, and treated with the water in the usual way. Starch-granules swell in the water, so as to become invisible.

Cocaine for Mounting Small Animals.†—Prof. J. Richard describes a new way of fixing Hydroids, Bryozoa, &c., in an expanded condition, which is as follows. A number of the animals are placed in a watch-glass with 5 c.cm. of water when they are fully expanded. A 1/2 per cent. solution of chlorhydrate of cocaine is added drop by drop till it forms a fifth part of the entire fluid. Half a c.cm. of the drug is then added, and the animals become so completely fixed that it is necessary to touch them very roughly with a needle in order to induce them to contract; ten minutes after, they are quite dead, and can be mounted in the ordinary way. This reagent is superior to all others, because it requires no delicate manipulation; it is not certain yet whether its effect upon marine animals is equally strong in all cases.

Preparing Tissues to show Cell-division.‡—Dr. C. Rabl objects to Flemming's chrom-osmic-acetic acid mixture, on the ground that the preparations soon become darkened; and to the 1/2 or 1/3 per cent. solution gold chloride, that in summer reduction takes place and the

* Bot. Centralbl., xxi. (1885) pp. 377–80.
† Zool. Anzeig., viii. (1885) pp. 332–3.
‡ Morphol. Jahrb., x. (1884) pp. 214–330 (6 pls.). See this Journal, *ante*, p. 217.

cell-substance is coloured violet. The best results are obtained from solutions of chromo-formic acid and platinum chloride. Formula for chromo-formic acid:—1/2 per cent. solution chromic acid, 200 grm.; concentrated formic acid, 4–5 drops. The mixture is always to be freshly prepared for use. Small pieces of fresh specimens are to be used. After 12 to 24 hours, wash in water and then transfer to 60 or 70 per cent. alcohol, and after 24 or 36 hours more to absolute alcohol. A 1/3 per cent. solution platinum chloride has the same effect as gold chloride, and this without being reduced by light or heat. Specimens should remain in this solution 24 hours, they are then washed and treated as before. The one method supplements the other, as chromo-formic acid causes certain fibres to swell, while platinum chloride has a somewhat shrivelling effect.

Method for showing the Distribution and Termination of Nerves in the Human Lungs.*—Dr. E. F. Beckwith, aware of the futility of hoping to obtain good results from any known manner of preparation and staining of the nerves of the lungs, sought a new method, and the following modification of a process lately promulgated in Germany for staining brain-tissues was found to answer.

Harden fresh lung for about ten days in the following solution:—Bichromate of potash 2·5 per cent., to which is added sulphate of copper C. P. to the amount of 0·5 per cent. The tissue is then frozen and suitable sections made, which are treated with gold chloride 0·5 per cent., 2–10 minutes in the dark. Washed with distilled water. Sodium hydrate 1–5, until cleared up. Potassium carbonate 10 per cent., 30–60 minutes. Dried with absorbent paper. Potassium iodide 10 per cent., 15 minutes, when gold will be nicely reduced.

The nerves and ganglia in sections thus prepared are of a deep red or violet colour, occasionally shading off into a blueish green, the other tissue being red. The differentiation in colour is sharp, so that nerve-tissue may be recognized by its colour alone whenever seen.

The above method differs very little from the German process, with the exception of the potassium carbonate, which the author believes essential to success, as the unmodified process failed to give good results, when used on lung tissue. A great advantage of the method consists in the fact that the reduction of gold always takes place in a uniformly even manner; and with little practice, perfect staining can be accomplished with every section. Unfortunately, as in other gold preparations, the specimens spoil in a short time unless preserved in the dark in 40 per cent. alcohol, and when examined should be temporarily mounted in glycerin.

Preparing Tail of Puppy.†—Mr. A. C. Cole's method of preparation is to first harden the tail in methylated spirit for a week, then soak in water, then place in a considerable quantity of a 1/6 per cent. solution of chromic acid, to every ounce of which five drops of nitric acid are added. This mixture should be frequently changed.

* The Microscope, v. (1885) pp. 148–52 (3 figs.).

† Cole's Studies in Micr. Sci., iii. (1885) Sec. 4, p. 24.

When the bone is softened, the tail is to be soaked in water to remove the acid and reharden in spirit.

Transverse sections are cut from the tail and stained in the ordinary borax-carmine solution; when sufficiently stained they are transferred to methylated spirit, and then placed in a mixture of five parts spirit and one part hydrochloric acid; from this they must be removed as soon as they attain a brilliant scarlet tint, and be again placed in spirit until no trace of acid remains. The sections are then to be stained in sulph-indigotate of soda—two drops of a saturated aqueous solution of which are added to one ounce of spirit—and in this the sections should remain for from four to six hours. They are then to be finally and carefully washed in spirit, cleared in oil of cloves, and mounted in Canada balsam.

Demonstrating Spindle-shaped Bodies in the Yolk of Frog's Ova.*—Dr. O. Hertwig states the best method is to place the ovary for two or three minutes in a mixture of 0·3 per cent. osmic acid and 0·1 per cent. acetic acid, and then in order to prevent over-blackening transfer to iodized serum or bichromate. Osmic acid causes ova to coagulate homogeneously, so that they are transparent. Very dilute acetic acid on the other hand clearly shows up the contours of germinal vesicle and nucleoli. Excessive blackening by osmic acid may be removed by peroxide of hydrogen. Thus treated, ova retain all their details after six months. Only teasing out is required.

Microscopical Technique of the Eye.†—Dr. R. Warlomont describes the method of preparing specimens of eyes for microscopical examination which is used at the Moorfields Ophthalmic Hospital. The whole eye is placed in Müller's fluid for 3–4 weeks, and then cut with a sharp knife into two symmetrical parts, which are washed in water to remove the yellow colour. The decoloration is hastened by placing them for several minutes in a 1 per cent. solution of chloral. They are then placed for a day in ordinary alcohol, and transferred to absolute alcohol for 24 hours. They are next placed for 24 hours in celloidin dissolved in equal parts of sulphuric ether and absolute alcohol, and laid in a paper box, which is filled with the celloidin solution. When this has become changed into a gelatinous elastic mass, it is placed in ordinary alcohol (70–80), in which it acquires the necessary hardness, and in which it can be preserved indefinitely. The sections are cut with Katsch's microtome beneath alcohol, stained with Ehrlich's logwood or other solution, washed in water and alcohol, clarified in oil of bergamot, and mounted in balsam.

Preparing Eyes of Gasteropods.‡—Concentrated solution of perchloride of mercury is found by Dr. C. Hilger to keep the rods in good condition for hardening in Müller's fluid. Picric acid or alcohol may be used. The best stain is hæmatoxylin. First overstain, then decolo-

* Morphol. Jahrb., x. (1884) pp. 337–43 (1 pl.).
† Bull. Soc. Belg. Micr., xi. (1885) pp. 201–8.
‡ Morphol. Jahrb., x. (1884) pp. 351–71 (2 pls.).

rize with weak alum solution for a period of several hours to some days. Nuclei and cell boundaries are well shown. Cut in paraffin. For macerating, a 2 or 3 per cent. solution of chromate of potash, or it may be concentrated and diluted with a weak oxalic acid solution or Müller's fluid.

Fresh material is ready in a few hours; hardened material in a few weeks. It is recommended to dissociate the macerated and stained specimen when in section, and to separate its elements by tapping on the cover-glass.

Method of Softening Chitin.*—Dr. Looss describes a new method of dissolving the chitinous skeletons of Arthropoda, &c. The reagents used are hypochloride of potassium and sodium; the latter can be purchased in chemists' shops under the name of Eau de Laberraque. The percentage of the solution has not been definitely settled. The chitinous skeletons of insects are rendered completely transparent, and the nerves and muscles uninjured by the use of the reagent diluted 4–6 times with water.

Demonstrating Nerve-end Organs in the Antennæ of Myriopods.†—In order to demonstrate the origin and the articulation of the olfactory bulb in the antennæ of Chilognatha, Dr. B. Sazepin first washes the antennæ in alcohol, and then, in order to remove the pigment from the chitinous tissues, immerses in chloroform to which one drop of strong nitric acid has been added. After being placed in absolute alcohol they are treated with 1/2 per cent. solution of osmic acid. The nervous tissue becomes brown in about 20 hours. The processes previous to cutting are to place the antennæ in absolute alcohol and next in picric acid for a day. After washing frequently in 75 per cent. spirit, transfer to absolute alcohol and stain with Grenacher's alum-carmine. Wash for a whole day in water; for another in 75 per cent. spirit; then absolute alcohol, chloroform, paraffin, and cut.

Sources of Error in the Examination of Fresh Tissues.‡—Dr. Heller draws attention to two sources of error in the examination of fresh tissues, each of which can, however, be obviated by adopting proper precautions.

1st. The red blood-corpuscles are in a great many cases destroyed by the cold temperature when the sections are cut with a freezing microtome. This can, however, be prevented by placing the pieces of tissue, before cutting, for a short time in a weak solution of bichromate of potash.

2nd. When a large number of sections have to be examined, a development of micro-organisms may occur before there is time to carry out the examination. This, too, can be prevented by placing the sections in salt solution (3/4 per cent.) to which 1 per cent. chloral hydrate has been added. An addition of 1/2 per cent. chloral

* Zool. Anzeig., viii. (1885) pp. 333-4.
† Mém. Acad. Imp. Sci. St. Petersbourg, xxxii. (1884), 20 pp. and 3 pls.
‡ Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 47–8.

prevents the development of the Schizomycetes, but not of the moulds. A solution stronger than 2 per cent. acts unfavourably on many tissues.

Mounting Media for Nematodes.*—The following is recommended by Dr. M. Braun as a medium in which unstained preparations of small nematodes may be mounted:—Gelatin 20, glycerin 100, water 120, carbolic acid 2. The preparations are treated beneath the cover-glass (after previous treatment with Müller's fluid and distilled water) with weak alcohol (first 25 per cent. and then 40 per cent.). This is removed by placing at the edge of the cover-glass glycerin diluted with an equal part of water; by the evaporation of the water pure glycerin remains. The cover-glass is then lifted up, and the gelatin, rendered fluid by warming, applied. A sealing varnish is not necessary.

Preparing Myzostoma.†—As preserved specimens did not give favourable results, their development was chiefly studied by Mr. J. Beard on the living animal. If plenty of naturally impregnated *Comatula* with adult *Myzostoma glabrum* can be obtained, the arms are cut off by the calyx and placed in a vessel filled with sea water. On the following day the *Comatula* are removed, and at the bottom of the glass the ova or larva of *Myzostoma* will be found. They can be kept alive from 4–5 days. But as only a few ova can be obtained, and the *Comatula* die in a few days, ova artificially impregnated are used. A number of adult *Myzostoma* are removed from their host and placed in a watch-glass containing 2–3 teaspoonfuls of freshly filtered sea water. They are then torn with needles and left for two or three hours. The pieces of *Myzostoma* are then fished out; the ova which remain at the bottom of the vessel are supplied with fresh sea water every other day and also with air by means of Andres' apparatus. Most larvæ die in about six days. For the later stages of development the *Comatula* are placed in a vessel containing a mixture of sea water with 10 per cent. of alcohol. By this they are slowly killed. On shaking the vessel *Myzostoma glabrum* and *cirriferum* fall to the bottom. Alcohol is then gradually added until it reaches 90 per cent. In this they are preserved.

Sensitive Tests for Wood-fibre and Cellulose.‡—Dr. A. Ihl finds that besides the well-known reagent phloroglucin, other phenols stain lignin in a characteristic way. An alcoholic solution of orcin acidulated with hydrochloric acid stains woody fibre a beautiful dark red. Cellulose remains unchanged. Resorcin with alcohol and hydrochloric acid gives a blue violet stain. Resorcin with alcohol and sulphuric acid (1 part C_2H_6O to 1/3 part H_2SO_4) gives a dark blue violet stain. To cellulose a reddish hue. α-naphthol, alcohol, and hydrochloric acid produce a greenish hue: α-naphthol, alcohol (1 part), sulphuric acid (1 part), impart a dark-green colour to wood, to cellulose a red-violet

* Braun, M., 'Die thierischen Parasiten des Menschen nebst einer Anleitung zur praktischen Beschäftigung mit der Helminthologie, für Studirende und Aerzte.'

† Zeitschr. f. Wiss. Mikr., ii. (1885) p. 231.

‡ Chem. Ztg., 1885, p. 266.

colour. Pyrogallic acid, alcohol, and hydrochloric acid give, with heat, a blue-green stain. Carbolic acid, alcohol, and hydrochloric acid a yellowish green.

Modification of Semper's Method of making Dry Preparations.* —Prof. O. P. Hay, finding that preparations made according to Semper's method often present a dingy, weatherbeaten aspect, recommends that the method should be completed by saturating the preparation with a solid that fills up the pores and binds the parts together. The solid which he employs is a mixture of Canada balsam, paraffin, and vaseline, but it is probable that a soft paraffin will in most cases do quite well. It is necessary that the mixture shall melt at about 46° C.

Freeing Objects from Air.†—D. S. W. recommends the following plan for mounting objects containing a considerable quantity of air :—

"Take, for example, a collection of *Isthmia*, or some other diatom. The valves enclose so much air as to cause them to float upon water, and it must be extracted, for until they sink it is impossible to wash them. Drive from water all the air you can by a good boiling for about five minutes, allow the water to cool so as to be in condition to absorb air, and without delay drop in the diatoms. The water will extract the air from them and they will go to the bottom. Then add to the water a little dissolved chloride of soda, and with an occasional shake up, you will find the material pretty well cleaned and bleached in one hour. Wash thoroughly in several changes of water.

Take a drachm of redistilled alcohol and add thereto two drops of dissolved gum arabic. With a sharpened stick place a small quantity on the centre of a cleaned slide. It will spread out and the alcohol will quickly evaporate, leaving a very thin film of the gum. On this gummed spot place a drop of your cleaned diatoms, and see that they are thoroughly dried by time or heat. Of course, they are now filled with air, and are firmly enough attached to the slide, and can be covered in a cell if a dry mount is desired.

To mount in balsam, however, the air must be again extracted, and at this stage the boiled water prescription cannot be administered. Have Canada balsam made quite tough by age or heat, and then dissolved in benzole. Put around the objects which have been dried on the slide a few fragments of cover-glass, and on them, as legs to a stool, place a clean cover-glass. A drop of the pure benzole will quickly run under the cover-glass, and very promptly take the place of the air in the diatoms; and a drop of the balsam at one edge of the cover, and a corner of blotting-paper at the other, will quickly substitute the balsam for the benzole. Time or gentle heat will harden the cement, and the specimen is safe."

Cleaning and Preparing Diatom Material—Mounting Diatoms.— Herr E. Debes, in an article of 17 pages,‡ describes the necessary

* Amer. Natural., xix. (1885) p. 526.
† Amer. Mon. Micr. Journ., v. (1884) p. 18.
‡ Hedwigia, xxiv. (1885) pp. 49–66.

processes both in the case of recent and fossil forms. In a later article of 16 pages * Herr Debes describes the various mounting media, and gives directions for mounting diatoms. The articles cannot be usefully abstracted.

Gowen's Microtome.†—Mr. F. H. Gowen, considering that the use of paraffin for imbedding is attended with difficulties on account of its becoming loose in the microtome, has made a microtome in which the difficulties are overcome.

A hole is turned about half-way through the table of a microtome, and into this a tube is screwed, forming the well. The hole through the remainder of the table, forming the mouth of the well, is turned with sufficient "gather," or taper, to take up the shrinkage of the paraffin. On the upper side of the piston a dovetailed groove is turned. The column of paraffin receives no support from the tube, but is securely held by the piston at one end and by the contracted mouth of the well-hole at the other. (Diameter at the top, 0·9 in., tapering from diameter of 0·92 in. Length of taper, 0·15 in.)

Jacobs's Freezing Microtome.‡—Dr. F. O. Jacobs has devised the freezing-microtome shown in figs. 215 and 216. It consists of a copper rod A, 2 in. or more in diameter, and 6 in. high, inclosed by

Fig. 215.

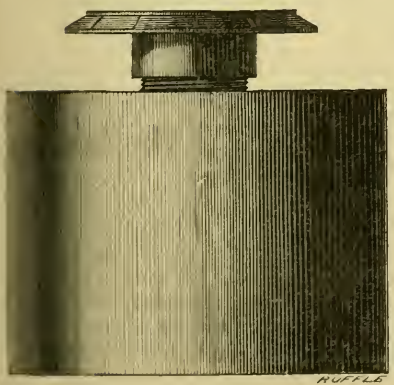
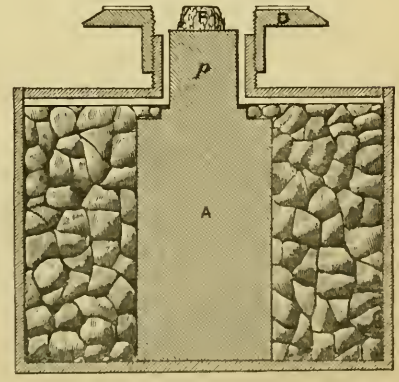


Fig. 216.



an inner zinc and an outer brass tank. Above is the table D, working on a fine screw. Through the centre of the table passes a narrower portion of the copper rod *p*.

When the inner tank is filled with a mixture of salt, ice, and water, the temperature of the copper rod is so reduced as to freeze any object F placed on its upper end. The size of the rod is such that its temperature will remain very steady for from four to six hours, without any further care on the part of the operator.

* Hedwigia, xxiv. (1885) pp. 151–66.
† Amer. Mon. Micr. Journ., vi. (1885) p. 156.
‡ Amer. Natural., xix. (1885) pp. 734–6 (2 figs.).

By this arrangement objects can be easily frozen, and without any slop.

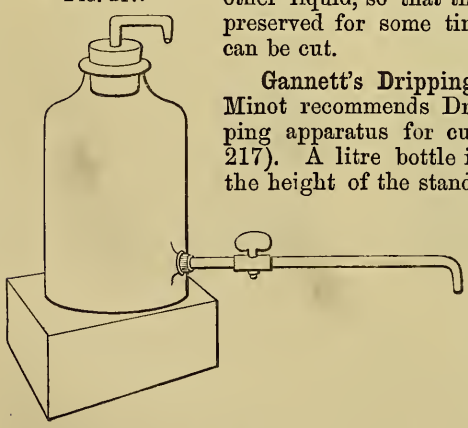
The imbedding medium is composed of:—gum arabic, 5 parts; gum tragacanth, 1 part; gelatin, 1 part. The mixture is dissolved in enough warm water to give it the consistency of thin jelly when cold. A little glycerin (1:6) is added to the water.

Eternod's Microtome with Triple Pincers.*—The instrument of Dr. A. Eternod consists of a brass cylinder terminating above in a polished nickel-plated platform, on which the razor is directed. The cylinder is composed of two drums screwed one over the other so that the lower drum being fixed, if the upper drum is turned round its axis it is gradually raised. The edges of the upper drum are divided into 100 parts. Each entire revolution of the drum raises or lowers the platform 1 mm.; if it is moved through only one division, the platform is displaced to the extent of 1/100 mm.

The object is fixed in the axis of the microtome by a triple pincer consisting of three pieces of brass set on the base-cylinder, which can be separated or approximated by means of a screw beneath the instrument. If the screw is turned from right to left, the three pieces are separated and the specimen can be interposed, imbedded in cork, elder-pith, &c. If the screw is now turned from left to right, the pieces are approximated, and the specimen can be firmly fixed. It is easy with this microtome to cut sections 1/200–1/400 mm. thick.

Dr. A. Eternod, in writing † to claim to be the originator of the microtome, points out several advantages not noticed in the above description. It can be filled with alcohol or other liquid, so that the object to be cut can be preserved for some time. Objects 4 cm. long can be cut.

Fig. 217.



Gannett's Dripping Apparatus.‡—Dr. C. S. Minot recommends Dr. W. W. Gannett's dripping apparatus for cutting under alcohol (fig. 217). A litre bottle is convenient in size, and the height of the stand should be such as to bring the end of the dripping-tube about 1 in. above the blade of the knife, on which the alcohol is allowed to fall continuously. To regulate the flow an 1/8 in. globe-valve is found to be the most convenient.

Staining for Microscopical Purposes.§—In further continuation of his excellent articles, Dr. H. Gierke deals with (1) the treatment

* Journ. de Microgr., ix. (1885) pp. 171–4.
† Ibid., pp. 264–7.
‡ Amer. Natural., xix. (1885) p. 916 (1 fig.).
§ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 497–557, and ii. (1885) pp. 13–36.

of specimens with various metal salts, such as chloride of palladium, oxide of iron, &c. (2) Staining methods in which carmine is combined with other reagents, e. g. picric acid, indigo-carmine, and metal salts. (3) Methods in which logwood is used in combination with various other reagents. (4) The combination of anilin dyes with each other and with metal salts. (5) The combination of the gold and silver methods. Not the least important and interesting part of the articles is the historical description of the development of the employment of anilin dyes in staining technique, commencing with mauvein and fuchsin in 1856. The author well observes that those who are engaged in histological research with the aid of staining materials should be thoroughly acquainted with the chemistry of the dyes with which they work, and a description is given of the source, manufacture and properties of the anilin dyes as well as alizarin, logwood, indigo, carmine, and others.

In his concluding article,* Dr. H. Gierke has drawn up elaborate tables respecting the anilin pigments. The first table gives the ordinary nomenclature, chemical formulæ, remarks on the solubility, reactions, and preparation of the various anilin stains. The second table, arranged according to colour, gives the solubility in water or alcohol and the behaviour with acid and alkalis.

The rest of the paper is chiefly occupied with a discussion as to whether, when a preparation becomes coloured, the colour is due to imbibition of pigment, or is the result of chemical changes effected in the tissue by the pigment. The author maintains that though histological staining depends for the most part on the physical processes of diffusion and imbibition, the occurrence of chemical combination in staining cannot be denied. On the contrary, such combinations are of frequent occurrence and, as micro-chemical reactions, are of the greatest importance. The histological stain, so far as it imparts a permanent dye, depends on the physical process of surface attraction. Chemical processes should be suspected when a pigment is discharged or changes to a different shade. We may, therefore, speak of chemical processes when one and the same pigment stains different tissue elements of a preparation in different ways. Double staining by the simultaneous or consecutive use of several dyes only in part depends on chemical processes. In greater measure they are effected by the unequally developed attraction-force of various tissues. It is also shown by the fact that one pigment is able to remove another from certain tissue elements, but not altogether from the same preparation. If a section of any organ, rich in various tissues, be laid in a mixture of several pigments, each histological element is stained by that for which it possesses the greatest attraction. If a certain part have for two or more dyes an exactly similar attraction, it then takes up both or all, and a mixed colour is the result. Examples of staining by chemical processes are, among others, the various reactions on amyloid substance. When Curshmann employed methyl-green for staining amyloid-degenerated nerves, all the normal parts were coloured green, the hyaline cylinder light blue, and the amyloid substances

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 164-221.

violet. The latter, therefore, entered into chemical union with the pigment, the new body only showing a colour differing from that of the dye. Thus, too, the rose-orange staining of red blood-corpuscles by eosin may be regarded as the result of a chemical reaction.

The author concludes by expressing the opinion that the staining problem of the future will be solved by the aid of chemical reaction.

Staining Methods.*—Dr. J. H. List discusses some double stains which he has used for a long time with excellent effect, especially on gland and epithelium.

1. Bismarck-brown and methyl-green stain is prepared according to Weigert's method, i. e. 5 grm. of pigment to 100 c.c. aq. destil. The sections are left in the brown solution for from two to fifteen minutes. They are then washed and removed to the green stain, where they remain until they have assumed a dark-green colour. They are again washed and placed in absolute alcohol. Experience is the only guide as to when they should be taken out of alcohol, but as soon as a sap-green hue appears the sections may be withdrawn and placed in bergamot, xylol, &c., to clarify. The advantage of this method is that Bismarck-brown gives with methyl-green a beautifully distinct sap-green colour, while for goblet-cells and mucous membrane it is especially valuable, because the intracellular network is coloured brownish green or dark brown, and stands out with a sharpness as in no other staining combination.

2. Bismarck-brown and anilin-green may be used in an exactly similar manner.

3. Eosin and methyl-green were first used by Calberla, who dissolved a mixture of 1 part eosin and 60 parts methyl-green in 30 per cent. warm alcohol. The author uses the stains separately. The sections are first placed in an alcoholic solution of eosin made by mixing 5 c.c. of a watery solution of eosin (0·5 grm. to 100 c.c. aq. dest.) with about 15 c.c. absolute alcohol. Two to five minutes suffice to stain deeply. Wash again and transfer to absolute alcohol, from which it is usual to remove the sections when the eosin is perceptible. They are then placed in the clarifying medium. This method of staining may be recommended for epithelium, mucous membrane, and cartilage.

4. Eosin and anilin-green. Schiefferdecker was the first to employ this method of double staining. The following modification may be employed with excellent results for cartilage and glands. An alcoholic solution of eosin is prepared as in No. 3. After remaining in this solution for fifteen minutes or so, the sections are washed in alcohol, and are then transferred to an alcoholic solution of anilin-green. After remaining in this for fifteen minutes, they are removed to absolute alcohol, where they remain until the eosin stain begins to show itself.

5. Hæmatoxylin-glycerin and eosin. Renaut's method† of double staining, somewhat modified, produces splendid preparations. Three or four drops of Renaut's hæmatoxylin-glycerin are mixed with 1/4

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 145–50.

† Comptes Rendus, lxxxviii. (1879) p. 1039. See this Journal, ii. (1879) p. 763.

litre of aq. dest. In this the sections are left for 24 hours. Then wash and transfer to an alcoholic solution of eosin (as in No. 4) for several minutes. Wash in alcohol, and clarify. This method produces a beautiful nuclear stain, the nuclei are coloured deep violet, the rest of the tissue a beautiful rose red.

6. Hæmatoxylin-glycerin and rosanilin nitrate. The sections are placed in the dilute hæmatoxylin-glycerin (No. 5) for 24 hours; then for ten minutes in a solution of rosanilin nitrate; after washing in water, dehydrate and clarify.

7. Methyl-green and rosanilin nitrate. The sections are left in the No. 1 solution of methyl-green for ten minutes, then after washing are placed in solution of rosanilin nitrate for fifteen minutes; wash again, dehydrate, clarify.

The first three methods may be modified by using very dilute solutions and staining for 24 hours. For hardening, the author always employed absolute alcohol; and Müller's fluid or chromic acid for material to be imbedded in celloidin.

Staining Nerves in Muscle.* — To obtain good images of the ramification of nerves in muscle, Dr. K. Mays gives the following process. For small muscles, lay freshly prepared portions in a recently made mixture of 1/2 per cent. alkaline solution of gold chloride, 1 grm.; 2 per cent. osmic acid, 1 grm.; water, 20 grm., until the arborescent nerve ramifications can be perceived; then in the following mixture: glycerin, 40 grm.; water, 20 grm.; 25 per cent. hydrochloric acid solution, 1·0 grm., for about a day. This prevents them from becoming too dark.

Thicker muscles are placed for 12 hours in a 2 per cent. solution of acetic acid, then into a freshly made mixture of 1/2 per cent. alkaline solution of gold chloride, 1 grm.; 2 per cent. osmic acid, 1 grm.; 2 per cent. acetic acid, 50 grm. In this they remain for two or three hours and are then placed in the glycerin mixture. The muscle becomes transparent and amber-coloured, the nerve black-brown. By this method the nerve-end-plate is stained, but not the hypolemmal parts of the nerve.

Anilin-green.† — Dr. J. H. List controverts Schiefferdecker's statement that anilin-green requires exposure to light before it is fully capable of staining cell-structures. He finds that solutions of methyl-green and anilin-green (0·5 grm.–100 c.c. distilled water) always colour, even when freshly prepared, the reticulum of goblet and other cells. He also recommends Bismarck-brown and rosanilin nitrate, either in union or alone for the same object.

In reply to List, Dr. P. Schiefferdecker‡ maintains that the former has confused the reticulum which is perfectly apparent even in unstained specimens, with the reticulum only demonstrable by anilin-green solution which has undergone certain changes from lapse of time and exposure to light. The latter reticulum is much thicker than that which is described by List, but otherwise there does not seem to be much difference between them.

* Zeitschr. f. Biol., xx. (1884) pp. 449–528 (5 pls.).
† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 222–3. ‡ Ibid., pp. 223–4.

Perchloride of Mercury in the study of the Central Nervous System.*—Golgi's methods for staining nerve-elements black are based on the action of nitrate of silver and perchloride of mercury following the use of bichromate of potash. The mercurial salt, however, does not give a real black colour, but renders the elements opaque and causes them to appear black under the Microscope. For small pieces the method is to immerse in a 2 per cent. solution of bichromate or in Müller's fluid for a month. They are then transferred to a 0·5 per cent. solution of perchloride, which is daily renewed until all colour traces of bichromate have disappeared.

Dr. C. Mondino applies the foregoing method to whole brains by injecting through a carotid (the other and the vertebrals being tied) Müller's fluid by the pressure-bottle process. The excess fluid passes out by the jugular veins, and when the stream has become very slow or stopped, the brain may be transferred to Müller's fluid, where it should remain for a couple of months, though a longer period is not harmful. The carotid injection process is not absolutely necessary, as the brain after removal from the body may be placed in Müller's fluid at once. In this case the membranes must be stripped off. Directly after removal from the fluid, the brain must be placed in a 1/2 per cent. aqueous solution of perchloride and this must be continually changed so long as the solution is stained by the bichromate. It is proper to leave the brain in the perchloride solution for at least two or three weeks after all trace of bichromate has disappeared.

Sections are best made by Gudden's microtome. It is unnecessary to soak these brains in paraffin; owing to their consistence, imbedding alone is found to be sufficient. Out of a whole brain not more than twenty sections will be lost.

While by other methods thin sections are a *sine quâ non* for observation, in this, thick slices are almost necessary, the chief advantage of which is obviously that any fibre can be followed throughout its course in the brain. When a section has been made it is placed at once on a slide and then washed with water to remove any bits of paraffin. It is then dried with blotting-paper. Next a little pure creosote is placed on the centre of the section, which is thereby rendered quite transparent in a few hours. After draining away the excess of creosote, the specimen is covered with dammar. No cover-glass is used.

The author claims the following advantages for this method. It is the only one which shows the course of nerve-fibres throughout the brain. It is extremely simple. In all other methods, the specimens must be thin, require to be stained after section, and to go through many processes; all this renders them liable to injury. It is inexpensive, as the reagents used are very cheap when compared with those required for other methods.

Macroscopically, in other methods there is diminution of volume, disappearance of difference between white and grey matter, while brains prepared in perchloride show the difference between the white

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 157–63.

and grey substances even more markedly than in the fresh state. Moreover, if we wish to have them dry they are merely placed in glycerin for a few days, and on removal the excess of glycerin is allowed to drain off.

Decalcification and Staining of Osseous Tissue.*—After alluding to methods for obtaining specimens by grinding and by section of bone decalcified by acids, Dr. G. Pommer advocates the advantage to be derived from using bone softened by osteo-malachic or rachitic changes. He states that Müller's fluid possesses properties hitherto unnoticed by previous writers; and that by an extensive series of experiments on bones softened by disease, he has been enabled by the use of certain anilin dyes to distinguish with precision between those parts of bone out of which the salts have been removed artificially, and those parts from which the salts are naturally wanting.

This important property of Müller's fluid apparently depends on the fact that its acid salts decalcify less completely than pure acids.

Decalcification by acids produces many deceptive appearances from shrinkage, &c., and these are altogether obviated by the use of Müller's fluid, which while allowing the bone to be easily cut, does not produce any of these deficiencies or dangers. These advantages are in no way lost from long immersion or frequent change of fluid.

The author's method of staining with anilin dyes depends on the fact that those parts which have at one time contained lime salts become coloured, while those which have never been impregnated remain unaffected.

The dyes, six in number, are the blue and red methyl-violets, dahlia, Parma violet, safranin, and methyl-green. The strength of the solution is for the violets ·02 per 1000; for dahlia ·04 per cent.; for safranin ·1 and ·16 per cent.; and for methyl-green ·3 per cent. The sections are allowed to remain in solution from 12 to 18 hours. The first five give a dark stain, the last only a pale green.

Staining the Nucleus of the Germinal Vesicle in Arthropoda.†—Though the methyl-green and acetic acid solution recommended by Mayzel and Strasburger usually produces a good nuclear stain, Dr. v. Wielowiefski states that the nucleus of the germinal vesicle in Arthropoda, and as he suspects in all animals, is absolutely, or almost, unstainable even though the cell be completely isolated in order that the staining fluid may have certain access to the nucleus. Only a few cell nuclei, e.g. the nuclei of nerve-cells and of Gregarinæ, show this peculiarity.

Double Injections for Dissecting Purposes.‡—Professor H. F. Osborn's method for double injections § was to fill the whole vascular system with a thin coloured injection-mass. When this has passed through the capillaries and well filled the veins, there is forced into the artery a differently coloured plaster mass which pushes the

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 151–6.
† Biol. Centralbl., iv. (1884) pp. 360–70.
‡ Amer. Natural., xix. (1885) pp. 526–7.
§ See this Journal, iv. (1881) p. 325.

previously injected thin mass before it until the plaster has reached the capillaries, where its onward movement is arrested. Prof. O. P. Hay uses the following method, based on the same principle.

A canula is fitted into the aorta of a cat, and a gelatin mass coloured with carmine injected until it is seen to flow from the right side of the heart; then the tube conveying the red mass being detached, a tube conveying a blue gelatin mass is slipped over the same canula, and the pressure again applied. Into this blue mass had been mixed thoroughly a quantity of starch, preferably from wheat. This starch-bearing mass pushes the carmine mass before it until the starch-grains enter the capillaries and effectually plug them up. The arteries are thus left blue and the veins red, and so well is the work accomplished that a lens of considerable power must be used to discover any admixture of the colours in the smallest vessels of thin membranes.

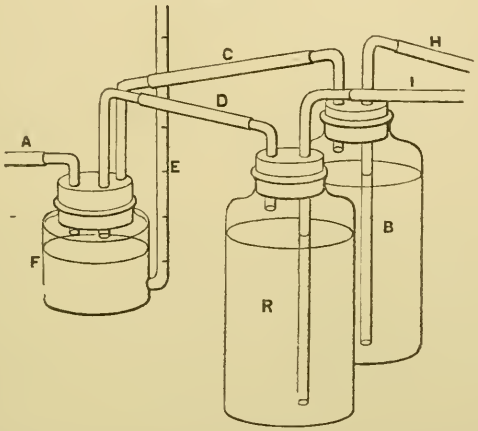
Double Injections for Histological Purposes.*—Prof. O. P. Hay refers to the usual method of producing a double injection of the blood-vessels preparatory to making sections for the Microscope, by injecting first a gelatin mass of one colour into the artery until the increasing pressure gives notice that the mass is entering the capillaries, and immediately after to inject a differently coloured mass into the vein. The injection being thus accomplished, one of two things, it seems to him, is likely to happen; either the vessels will not be well filled, or the mass intended for one set of vessels will be driven through into the other.

To avoid these accidents he has practised the method of filling both sets of vessels at the same moment and under exactly the same pressure. This pressure is kept low at the beginning, so that all the arteries and veins shall be thoroughly filled before either mass begins to enter the capillaries. Then as the pressure is increased the differently coloured masses meet each other in the capillaries; and if the pressure on each is equal, the vessels may be filled as full as compatible with safety, without danger of either colour being driven from one set of vessels into the other. The desired pressure is secured by allowing a stream of water from a hydrant or cistern to flow into a tight vessel. As the water flows in, the air is forced out through a rubber tube A (fig. 218) into the wide-mouthed bottle F, whose tightly fitting cork gives passage to two other glass tubes. These extend below just through the cork, and above connect respectively with the rubber tubes C and D. Into the side of F near the bottom is fitted another tube E, reaching to a height of ten inches or more, open above, and graduated into inches. If preferred, this tube may also pass through the cork, and extend down well into the mercury with which F is partly filled. B is a bottle of suitable size in which is contained a blue injection-mass for filling the veins, and R a similar bottle containing a red mass for the arteries. The interiors of these bottles are connected with the bottle F by the tubes D and C. Each of the bottles B and R has a tube which, starting from near the bottom, passes through the cork, and is, a little above this, bent at

* Amer. Natural., xix. (1885) pp. 527–9 (1 fig.).

right angles. With these are connected the rubber tubes H and I. When water is allowed to flow into the reservoir mentioned above, the air is forced out through A into F, and thence along the tubes D and C into B and R. As soon as the pressure in these bottles becomes sufficiently great, the liquids which they contain will be driven out

Fig. 218.



through the tubes H and L. If there should be any obstacle to the escape of these fluid masses, the pressure in all the vessels will rise and be registered by the height of the mercury in E.

If now it is desired to inject, for instance, the kidney of a pig, a canula made of a glass tube must be fitted securely into the renal artery, and a similar one into the renal vein. The canulæ must be of such a size that the rubber tubes H and I will fit them well. Heat the gelatin-masses in the bottles B and R to the proper temperature, and keep them so heated until the injection has been finished. Special care must be taken with the tubes H and I, to prevent the gelatin passing through them from becoming frozen. Having clamped the tube H, have an assistant turn on a small stream of water until the gelatin begins to flow slowly from I. If the diameter of the canula is not too small it may be held with the free end directed upward and filled with gelatin allowed to drop from the mouth of I. Then slip I over the canula. Unclamp the tube H, and when the gelatin from B has begun to flow, slip it over the canula inserted in the vein. Then increase the pressure gradually until it has reached as high a point as experience has taught to be safe for the organ operated on.

By this apparatus double injections may easily be made of any organs whose veins are not provided with valves. Triple injections of the liver may be made by first injecting the hepatic artery with a green mass until the whole liver assumes a green tint, and afterwards injecting the portal vein and the hepatic vein with red and blue as above directed.

Double-sided Slide.—Dr. C. V. Zenger suggests that for viewing both sides of an object the slide should be pierced through in the centre, and the aperture surrounded on the upper and under side by countersunk rings for the cover-glasses to rest on, level with the surfaces of the slide.

It is to be feared that this plan, though theoretically very perfect, would be too difficult of execution to be practical, though Dr. Zenger writes that "the feat of turning out the slides in their centre without breaking numbers of them is not so difficult as it may seem, if they are well centered and cemented to a cork plate fastened centrally to avoid lateral irregular pressure." He adds, "Such a slide will do extremely good service to the microscopist as well as to the biologist, and amply repays the amount of labour spent on its construction."*

Dr. W. Krause has also suggested what appears to be a similar arrangement.†

Uses of Collodion.‡—Mr. E. L. Mark gives an historical account of the development of the use of collodion in histological technique.

The concentration of the collodion was rendered capable of variation by Merkel, through the use of celloidin dissolved in absolute alcohol and ether in equal parts. Schiefferdecker has shown that by dehydrating sections with 95 per cent. alcohol, and clarifying in oil of origanum or bergamot, they can be mounted in balsam. In combination with oil of cloves collodion can be used as a fixture for sections in series, which can be stained after they have been arranged and fixed on the slide.§ Gage || applies the collodion and oil of cloves separately, first coating a number of slides with collodion, which is poured on to one end of the slide and allowed to flow quickly over it and back into the bottle, and then adding a wash of oil of cloves. In order to remove any cloudiness that may arise in the collodion-film a little oil of cloves is added to the balsam. The use of collodion to prevent the crumbling of brittle sections originated with Mr. N. N. Mason,¶ who applied it by means of a fine brush, taking up a small drop and placing it in the centre of the object, so as to allow it to flow out on all sides. After being allowed to harden for a minute, the section may be cut and placed on the slide with the film of collodion underneath.

The following formulæ are given for the preparation of celloidin injection-masses.

A. *Asphalt celloidin.* 1. Pulverized asphalt placed in a well-closed bottle of ether and allowed to remain 24 hours, with occasional shaking.

2. The brown-coloured ether is turned off, and small pieces of celloidin dissolved in it until the solution flows like a thick oil.

* See also this Journal, *ante*, p. 377.
† Internat. Monatsschr. f. Anat. u. Histol., i. (1884) p. 353.
‡ Amer. Natural., xix. (1885) pp. 626–8.
§ Arch. f. Mikr. Anat., xxii. (1883) p. 689.
|| Med. Student, Nov. 1883, p. 14.
¶ Amer. Natural., 1880, p. 825.

B. *Vesuvin celloidin.* 1. Make a saturated solution of vesuvin in absolute alcohol.

2. Dissolve in this pieces of celloidin until the desired consistency is reached.

C. *Opaque celloidin.* 1. Dissolve celloidin in absolute alcohol and ether in equal parts.

2. Add vermilion or prussian blue.

Mounting in Cells with Canada Balsam.*—Mr. H. Sharp describes a method which obviates many of the difficulties usually experienced.

A cell of paper or card of the requisite thickness is cemented on the slide with gum, and a small piece cut away on opposite sides of the ring.

The object (which has never been allowed to dry, but has been transferred from the medium in which it was arranged, into strong spirit and thence into oil of cajeput, into benzine and finally into turpentine) is next placed in the centre of the cell with a single drop of turpentine on it to keep it moist, and the cover-glass is put on the gummed surface of the cell. When the gum has set and the cover is quite firm a little benzine is taken up with a pipette and applied to one of the openings cut in the card cell, when the benzine instantly runs in and fills up the cell, and in a few minutes the card is thoroughly soaked with it without any effect on the gum. The benzine is then all drawn away with blotting-paper, and balsam applied to one of the openings. When the slide is gently warmed, this soon fills the cell and shows freely at both openings. When the balsam is sufficiently hardened the slide is put on the turntable and trimmed up, leaving a ring of balsam. The final finishing touch is done by holding the slide, cover side down, and giving it a circular sweep over a flame so that the latter just touches the balsam ring all round for an instant, leaving it as even and smooth as glass.

A great advantage of the method is claimed to be that when once the cover is in its place and the gum has set there is not the least danger of the cover shifting or the object being displaced when finishing and cleaning the slide.

Monobromide of Naphthalin and Tribromide of Arsenic.—Dr. C. V. Zenger finds that a concentrated solution of tribromide of arsenic in monobromide of naphthalin has a mean refractive index of 1·72, nearly approaching the index of the tribromide itself (1·78).†

The author says that the "aspect of Diatomaceæ mounted in this substance is simply surprising both as regards the crispness of the images and the amount of light received from the more minute details of the valves."

Mayer's Carbolic Acid Shellac.‡—Finding that clove oil and creosote produce fine granulations when used in the ordinary shellac method, Dr. P. Mayer has adopted a new method of dissolving the

* Journ. and Proc. Roy. Soc. N.S. Wales, xvi. (1883) pp. 286–8.

† See also this Journal, *ante*, p. 377.

‡ Amer. Natural., xix. (1885) p. 733.

shellac, by which an excellent fixative is obtained that never shows any traces of granulation. The fixative is applied by a fine brush to the *cold* slide.

Mayer prepares the solution in the following manner:—

1. Dissolve one part of bleached shellac in five parts of absolute alcohol.

2. Filter the solution and evaporate the alcohol on a water-bath. A yellowish residue quite stiff when cold is thus obtained. If any cloudiness arises during evaporation, the solution must be filtered again.

3. Dissolve the shellac residue in pure carbolic acid on a water-bath. A concentrated solution of carbolic acid is obtained by exposing the crystals to the air until they dissolve, or by adding a small amount of water (about 5 per cent.).

The quantity of acid should be sufficient to give a thickish liquid when cold.

This fixative is painted on to the cold slide with a brush, at the time of using. The sections are then put in place, and the slide left in the oven of a water-bath for some minutes (10–15 minutes is found sufficient). The carbolic acid is thus evaporated, leaving a perfectly transparent stratum of shellac on the slide. The sections are next freed from paraffin in the ordinary way and mounted in balsam.

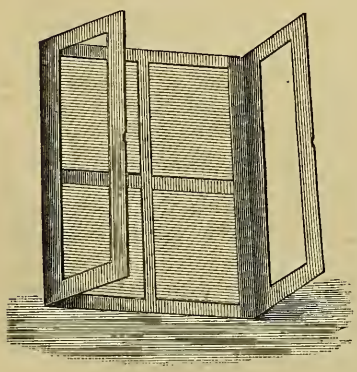
This method is considered to be the best and simplest for fixing *stained* sections.

The shellac can be dissolved directly in carbolic acid, but then the fluid must stand a long time in order to become clear, as it cannot be filtered. For this reason it is preferable to dissolve first in alcohol.

[According to a note just received, Mayer now prepares the shellac as follows:—

The shellac is pulverized and heated with crystals of colourless carbolic acid until it dissolves. In filtering, the funnel should be heated over a flame. It will filter slowly but quite well. If it is too thick, crystals of carbolic acid may be added until the desired consistency is reached.]

Fig. 219.



Slide-Boxes. — Messrs. Beck have supplied us with one of the most convenient slide-boxes that we have yet met with, and very economical in price (8*s.* 9*d.*). It consists of a cloth-covered pasteboard box 15 in. × 8½ in. × 3½ in. which contains twelve trays of the form shown in fig. 219, holding twenty-four slides each (or 288 in all). The bottom of the tray is divided into four parts by two cross-pieces, and the slides are prevented from shifting by shutting down the two

hinged frames (also of cardboard) which cover the ends of the slides and keep them in place.

Chapman's Mould for Cells.*—This mould is a convenient implement for making cells out of such plastic material as shellac, sealing-wax, or paraffin. It consists of a cylindrical core, and a removable collar concentric with it—both of brass. A rounded or bevelled shoulder inside the collar shapes the top of the cell, and a small shoulder on the core moulds a countersink suitable for the reception of the cover-glass. As a single mould is intended for one size and one depth of cell, several are necessary to an outfit.

Selection and Preparation of Objects for Photographing.†—Dr. G. M. Sternberg has found that success in making photo-micrographs depends quite as much upon the selection of suitable objects and upon their proper preparation with reference to photography, as upon the optical apparatus used and the technical skill of the operator as a microscopist and photographer, and he accordingly indicates the kind of objects most suitable for making photo-micrographs, and the methods of preparation which have given him the best results.

Micrococci require a high power for their detection. When properly stained, they may be photographed with a good 1/10 in. objective; but a higher power is better. The author has obtained his best results by the use of the 1/18 in. homogeneous-immersion objective of Zeiss.

It is well to adopt a standard amplification for each class of objects, so that they may be readily compared as to dimensions by a simple inspection of the photo-micrographs made at different times and places. The standard adopted by the writer for bacterial organisms is 1000 diameters. A less amplification than this will not show the smallest *micrococci* in a satisfactory manner, and a greater is not necessary for a majority of the Bacteria. The method of mounting bacterial organisms in general, for the purpose of photographing them, is essentially to spread out a drop of the fluid containing them upon a very thin and perfectly clean glass cover. This is allowed to dry, and the bacteria are thus attached to the cover in a very thin and tolerably uniform layer.

The aim of the operator in preparing unicellular organisms or vegetable and animal tissues for photography should always be to secure a single layer of cells; for when the cells are piled upon each other, those in the background are necessarily out of focus, and interfere with the beauty of the picture.

Amœbæ.—Especial attention is called by the author to the photo-micrograph of an *Amœba* from life, as it illustrates the fact that transparent objects are the best suited for photography inasmuch as they alone show interior details of structure in a satisfactory manner.

Transparent objects which have a different refractive index from that of the medium in which they are placed, do not usually require to be stained; for the increased photographic contrast which is obtained

* Journ. N. York Micr. Soc., i. (1885) p. 188.

† 'Photo-micrographs and how to make them,' 1883, pp. 91–117.

by staining destroys the natural appearance, and the picture no longer conveys the idea that the object is transparent. It is consequently brought nearer to the level of a woodcut and to a certain extent loses its value as a photo-micrograph.

Unicellular Algæ.—These should be mounted for photography in very shallow cells, made by turning a circle of white-zinc cement upon a slide. Their colour and natural appearance will be preserved in an aqueous medium, such as weak carbolic-acid water or camphor water. Unfortunately, photography cannot reproduce the rich ruby colour of *Protococcus nivalis*, or the bright green of *Protococcus viridis*. The deeply coloured protoplasm of the former arrests light entirely, and we have in a positive print only a uniformly black mass with circular outline, surrounded by another line representing the cell-wall, to delineate the beautiful little ruby sphere with its more or less granular contents. The green colour of *P. viridis* is better adapted for photography.

Infusoria.—Many of the Infusoria may be successfully photographed, but it will be necessary to exercise great care in the preparation of slides for this purpose. Generally but a single individual should be in the field of view, and this should be a perfect specimen; for it is difficult to obtain fields containing several individuals all in the same plane, and in order to show cilia, flagella, and interior details of structure, high powers and very careful focusing will be required.

Occasionally a living Infusorian may be quiet long enough to have its photograph taken; but usually the Infusoria are in rapid motion, and it will be necessary to arrest this motion by means of some chemical agent fatal to their vitality. A weak solution of iodine does this very effectually, and at the same time stains the protoplasm a brownish colour. A ciliated Infusorian killed by adding a drop of this solution (iodine 1 gr., potassic iodide 2 grs., water 100 grs.) to a drop of the fluid in which it is swimming, remains for a time as if suddenly frozen, with its cilia rigid, and projecting like rays, from the surface of the body. This is a favourable time for photographing the creature, as, later, it is liable to undergo changes which destroy the internal structure.

Another method is to place a drop of fluid containing the Infusoria in the centre of a clean glass slide, and to invert this over the mouth of a bottle containing a 1 per cent solution of osmic acid. A very brief time is sufficient to destroy the life of the Infusoria, which may then be selected under a low power and transferred to a drop of clean water. They must be mounted in the thinnest possible stratum of fluid, otherwise they are likely to change position while the exposure is being made.

As a general rule, transparent objects, like *Amœbæ* and the Infusoria generally, should be mounted in an aqueous medium for photography, as this gives better photographic contrast than does a medium having a higher index of refraction, such as glycerin.

Spores of Fungi.—The spores of many of the fungi are suitable microscopic objects to photograph, and a photographic method could

not fail to be of value to one especially interested in the study of the fungi.

The deep brown colour of some of these spores, however, causes them to arrest the actinic rays so completely that the photograph does not show plainly the internal septa which are characteristic features of certain species (Coniomycetes).

The spherical or oval spores of moulds and mildews (*Penicillium*, *Aspergillus*, *Botrytis*, &c.,) are better adapted for photography than are the more deeply coloured septate spores referred to. They may be dusted upon the surface of a slide and photographed, dry, without the use of a cover-glass, or they may be mounted in an aqueous medium, or in glycerin, in a very shallow cell. The latter method gives the best results.

To get rid of air-bubbles, which will give great trouble if the attempt is made to introduce the spores at once into water or glycerin, it is best first to wet them thoroughly with alcohol, and before this has entirely evaporated, to place them in the medium which has been selected.

A good plan is to place a drop of alcohol in the centre of a glass slide, and to bring in contact with it a patch of mould in full fruit. The spores will be detached upon contact with the alcohol, and will sink to the bottom of the drop. By a little agitation of the slide they will be distributed in a tolerably uniform layer upon the surface of the glass. When they are nearly dry, in consequence of the evaporation of the alcohol, this is replaced by a drop of distilled water, or of glycerin, and the thin glass cover is applied. The superfluous fluid is removed with blotting-paper (Swedish filtering-paper is the best), and a circle of zinc cement may be turned around the edge of the glass to prevent evaporation while the exposure is being made, or if the intention is to preserve the preparation. A circle of cement is not used to support the margin of the glass cover, as the aim should be to have as thin a stratum of fluid as possible, in order to prevent the spores from floating about. It may be that mounting in glycerin-jelly would be a good plan for the spores having some colour, and this method would have the advantage of retaining them in position.

Scales.—The scales of Lepidoptera—butterflies and moths—are suitable objects for photography. They may be mounted dry, and extemporaneous preparations are quickly made by applying the wing or body of a lepidopterous insect to the surface of a clean glass slide.

Blood-corpuscles.—The blood-corpuscles of man and the lower animals are among the objects most suitable for photography. Comparatively high powers will be required; and, for purposes of comparison as to dimensions, it is well to adopt a standard of amplification, say 1000 diameters. The author's best results have been obtained with the 1/12 and 1/18 homogeneous-immersion objectives of Zeiss.

The corpuscles are spread upon a thin glass cover in as uniform a layer as possible, and are allowed to dry *in situ*. They do not require staining, and are mounted, dry, over a circle of cement. The simplest method of spreading them is to place a small drop of blood

on one edge of a glass cover resting upon a smooth surface, and to draw the end of a glass slide, held obliquely, across the face of the cover. No pressure must be used, or the delicate corpuscles will be crushed and distorted.

In selecting a field for photography, the aim should be to obtain one in which the circular form of the red corpuscles is preserved, in which they do not overlie each other, and in which one or more white corpuscles are to be seen. Unfortunately, an ideal field is hard to find, and the patience of the operator will often be sorely tried in the effort to find one.

The white corpuscles being larger than the red, and spherical in form, are very commonly drawn to the edge of the stain in the operation of spreading. Care must be taken that the blood-stain is quite dry and the circle of cement upon which the cover is to be mounted quite hard, before it is placed in position on the slide; for moisture, or chloroform from the cement, would injure the preparation.

A series of photo-micrographs of blood-corpuscles, made with a standard amplification, would not only be interesting and instructive, but might also be useful for reference, to those who are called upon to examine blood-stains for the purpose of giving expert medico-legal testimony.

The photographic method would also be useful for recording differences in the form and appearance of blood-corpuscles due to disease, if any constant peculiarities of this kind were associated with particular diseases. But the Microscope does not reveal any such peculiarities of a sufficiently definite character to justify the expectation, at one time extensively entertained, that its use, in the examination of the vital fluid, might prove of value in deciding questions of diagnosis. Differences in the relative proportion of the white and red corpuscles are, however, shown in a rough way, and the depth of colour of the red corpuscles is indicated, to a certain extent, by the photographic contrast with the ground; or, better still, with white corpuscles in the same field. The presence of foreign elements—parasitic organisms—is shown very satisfactorily in photographs; and if a sufficient power is used, their absence is rendered apparent when there are none.

The method is therefore especially useful for recording facts of this kind, as the observer is able to substantiate the truth of his statements, positive or negative, by unimpeachable evidence, and at the same time to show that his skill as a microscopist is sufficient to give confidence in his ability to manipulate the higher powers with which such observations are necessarily made.

For example, the photo-micrograph of yellow-fever blood given by the author, in which the amplification is nearly 1500, and in which the white and red corpuscles are well defined, may be taken as evidence that there were no parasites in the blood of the patient from whom this specimen was obtained; and a sufficient number of similar photo-micrographs of blood from different patients, and drawn at different stages of the disease in question, would prove the absence of any foreign elements, demonstrable with the power used, from the

blood of yellow fever. This has been demonstrated by the author in the manner indicated for the disease in question.

Pollen-grains.—Not all of these objects which it would be most desirable to photograph are suitable objects to be photographed by transmitted light, for the reason that the bright yellow colour and comparatively large size of some render them practically opaque. Doubtless this difficulty in the case of pollen-grains, the deeply coloured spores of fungi, &c., can be overcome by special methods of preparation,—the use of decolorizing agents, mounting in media of high refractive index, &c. The limits of the author's volume do not, however, permit him to go very extensively into details with reference to the preparation of objects, even if the technique were completely worked out, which is far from being the case. The general statement may be made, however, that objects which, in water, are not sufficiently transparent for photography, should be mounted in media having a higher refractive index, of which the most useful are glycerin and Canada balsam.

Some pollen-grains swell up and the membranous envelope is ruptured when they are immersed in water. For this reason, as well as for that already given, glycerin is commonly a more suitable fluid in which to mount them. When first placed in glycerin, the cell-wall becomes collapsed from exosmosis of the watery contents; but after a time the natural form is recovered by endosmosis and the fluid within and without is of the same density.

To prevent the trouble arising from the presence of air-bubbles, which are apt to adhere tenaciously to the pollen-grains, it is best to immerse them first in alcohol, as recommended for the spores of fungi. A drop of alcohol is placed in the centre of a glass slide, and the ripe anthers, held in slender forceps, are brought into contact with it; the pollen is detached, and falls to the bottom of the drop. A little agitation of the slide causes it to be distributed in a stratum consisting of a single layer of cells. When the alcohol is nearly evaporated, a drop of glycerin is put in its place, the thin cover is applied, and the superfluous fluid removed with bibulous paper.

Plant Hairs.—Some ingenuity will have to be exercised in preparing objects of this kind for photography. Hairs that are closely applied to the surface of the leaf may be photographed *in situ* by mounting the epidermis, or by reflected light. Others will require to be detached, and may be shaved off with a razor, and mounted in a very shallow cell in water or in glycerin. It is always desirable to obtain a field in which the objects do not overlie or cross each other; and with long plant hairs, like cotton, this is not an easy matter unless they are carefully arranged one by one. A good plan both for long plant hairs and animal hairs is to place several side by side on a dry glass slide, fixing the ends to the edges of the slide with sealing-wax. When they are adjusted in position the central portion is wet with alcohol, then with water, and finally with glycerin, if it is to be used. A thin glass cover is then applied.

Animal Hairs.—A series of photo-micrographs of animal and vegetable hairs would be extremely interesting and instructive.

Reagents will often be required to show the structure of animal hairs, which is not so simple as that of those from the vegetable kingdom. The thickness of these hairs makes it desirable that photo-micrographs should be made with low-power objectives, as these have the greatest penetrating power. At the same time, good definition is required to show the outlines of the imbricated cells in wool, for example. Wool, ready dyed, of any shade required, is to be had by picking out a little end of coloured worsted.

Sections of Vegetable Tissues.—Photo-micrographs are especially well adapted as illustrations of vegetable histology; and the ease with which sections of vegetable tissues are made and mounted for the purpose, as well as the beauty of the result, cannot fail to make this one of the most popular applications of the art.

Sections—transverse, oblique, or longitudinal—are quickly made with a sharp razor from the petioles of leaves; from succulent stems, like the new growth of asparagus, geranium, &c.; from bulbous roots and tubers; from endogenous plants, such as canna, maize, &c.; and from recent sprouts on exogenous trees and shrubs. No section-cutter is required for this purpose; and every one engaged in work of this kind should make himself an expert in free-hand section-cutting, as many of the best photographs are made from extemporaneous preparations.

The proportion of mounted preparations in animal and vegetable histology to be found in every collection which are *not* suited for photographing, will surprise one who attempts to save himself the trouble of mounting his own specimens for the purpose.

The first requisite is a very *thin* section; the second, a very *clean* specimen, free from dirt or air-bubbles. To secure cleanliness, wash the leaf or stem or tuber perfectly clean before commencing to make sections, and place the sections in filtered water when they are made. Use a very sharp instrument, and cover the face of the stem, or whatever it may be, with water or alcohol; the razor also should be wet before making each cut.

"Be extravagant in the number of sections cut, and select only the best. The selected sections will often require soaking for a considerable time in alcohol, to get rid of the air-bubbles. They are to be mounted in water, solution of acetate of potash, glycerin, or Canada balsam. A little experience will enable the operator to judge whether a section, examined under the Microscope in water, requires a medium of higher refractive index in order to render it more transparent. Cells in which the cellulose envelope is comparatively thin, as in the pith of exogenous stems, the epidermis of thin-leaved plants, &c., will show better in water. Thin longitudinal shavings of the wood of the Coniferæ—pine, cedar, &c.—may be mounted in glycerin, after being soaked in alcohol to remove air from the cells. Of course water and glycerin may be mixed in any proportion which seems desirable, to secure a refractive index between the two; and it may be that the addition of chloride of cadmium, or chloral hydrate, to glycerin, for the purpose of obtaining a fluid of still higher refractive index, would in certain cases give still better results."

"There is ample room for experiment and improvement of the technique, and the author can commend this fascinating art to those who have patience and are fond of overcoming difficulties, as one well worthy of occupying their leisure time. Moreover, the knowledge of histology gained in searching for suitable objects to photograph will be of a practical kind, like the knowledge of anatomy gained in the dissecting-room, and the time expended in this way will not be lost."

Diatoms are especially well adapted for photo-micrography. When a considerable number are arranged upon a single slide, it is impossible to make satisfactory photographs of all at one exposure, as the focal adjustment and time of exposure which would be best for one is not the best for others. In this case the aim should be to get the best average result.

The photographic method is well adapted for the illustration of a work upon the Diatomaceæ; but as a matter of economy it would be necessary to arrange several species upon a single plate. The best results would be obtained by making a separate negative for each diatom. These might be made with an amplification considerably above that admissible in the published work, and afterwards reduced to the proper size. For this purpose, silver prints of uniform tone should be made, and the diatoms should be cut out and pasted on a large white sheet of cardboard. A reduced negative should then be made from this, from which the gelatine plate used in heliotype printing could be prepared.

Another method would be for an expert to mount selected diatoms for each plate, with special reference to uniformity as to amplification and exposure required.

When a number of negatives are used to make up a single plate, these should have as nearly as possible the same tone-printing quality, and they will require to be skilfully cut for the purpose.

Diatoms should be mounted in balsam for photography, and the amateur will do well to obtain a slide of arranged diatoms by a skilled preparer.

Insects.—Small insects which are not too deeply coloured, mounted in balsam, are very good objects to photograph with low powers. The wings, tracheal tubes, feet, antennæ, &c., may also be photographed with higher powers. The suggestion is made that photo-micrographs of the larger insects might be made by reflected light with a lens of comparatively long focus but good defining power, and that the enlargement might be made from the first negative, in which the image should be even less than the natural size of the object.

Dolley's Technology of Bacteria Investigation.*—This work is divided into three parts: (*a*) General Directions, (*b*) Special Methods of Investigation, and (*c*) Formulary. Under the first we have the

* Dolley, C. S., 'The Technology of Bacteria Investigation; explicit directions for the study of Bacteria, their culture, staining, mounting, &c., according to the methods employed by the most eminent investigators.' xii. and 263 pp., 12mo, Boston, 1885.

study of microscopical preparations, both living and stained, by means of photography, by culture experiments, inoculation, and biological analysis. Following each topic is the literature pertaining to it. The second part treats of the special methods used by different investigators in studying anthrax, cholera, glanders, hog cholera, hydrophobia, leprosy, malaria, septicæmia, syphilis, tuberculosis, typhoid fever, diphtheria, erysipelas, yellow fever, &c., each being followed by the literature of the subject. The third part contains forty-six formulæ for the preparation of stains, reagents, culture media, &c.

The descriptions are short and sometimes quite inadequate; there are no illustrations, which in many instances would be as valuable as descriptions; the work is evidently compiled from literature alone without that fulness of detail which the author could only give from personal knowledge of the manipulations; there is no index.*

Discrimination of Butter and its Substitutes.†—Dr. T. Taylor, microscopist of the Department of Agriculture (U.S.A.), records some discoveries he has recently made while experimenting with butters and the various forms of butterine and oleomargarine. He first boiled a number of samples of pure butter for the purpose of crystallizing their fatty acids. After a lapse of twenty-four hours, during which time they were laid away in a cool place to crystallize, on placing small portions of each under the Microscope, using cotton-seed oil as a mounting medium, he discovered that the crystals of pure butter were sometimes globular and sometimes ellipsoidal in shape, and on turning the polarizer so as to cross the analyser there appeared on each a well-defined cross, having equal arms, like that known as the St. Andrew's cross, and that on rotation of the polarizer the cross rotated in like manner. He found also that the crystals of butterine and of oleomargarine, beef and swine fats, are of stellar forms, and differ from each other. These do not exhibit the cross spoken of in the case of true butter, and do not follow the rotation of the polarizer. In this way butters may be distinguished from oleomargarine made of beef or swine fats.

Dr. Taylor states that only in fresh butter has he been able to detect the cross in perfect form, and that in butter that has been kept for some time, or butter of inferior quality, when boiled and viewed under the polarizer, the crystals present a rosette form, generally four-lobed, and these rotate on the turning of the polarizer as do those in fresh butter—conditions not observed in any other fatty bodies, animal or vegetable.

In connection with Dr. Taylor's non-microscopic test,‡ Mr. J. B.

* Bot. Gazette, x. (1885) p. 315.

† Amer. Mon. Micr. Journ., vi. (1885) p. 115. Cf. also this Journal, *ante*, p. 356.

‡ See this Journal, *ante*, p. 357. "The test is a very simple one. If a few drops of sulphuric acid be combined with a small quantity of pure butter, the butter will assume first an opaque whitish-yellow colour, and after the lapse of about ten minutes it will change to a brick red. Oleomargarine made of beef fat when treated in the same manner, changes at first to a clear amber, and after a lapse of about twenty minutes to a deep crimson."

Betts describes * his examination of samples of butter, in all of which some other fat was present.

Microscopical Observations on the Constituents of Clouds.†—Herr R. Assmann during a stay of three weeks on the Brocken in November 1884, made some microscopical observations on the constituent elements of clouds, which has furnished for the first time a number of what he considers to be exhaustive and reliable facts on the subject.

On 3rd November at sunrise the Brocken was completely enveloped in cloud, the weather having been very warm, and the mountain clear for several days previously. The higher cloud-line sank however rapidly, and at 7.30 Herr Assmann's body was completely enveloped in thick clouds while his head was above them. The surface of this sea of cloud was kept tolerably even by a gentle south wind, portions rising to the height of some metres were driven slowly by the wind. A quarter of an hour later the boundary of the cloud had sunk low enough to leave the highest summit of the Brocken uncovered. This state of things continued throughout the day and the cloud-line remained 5 metres below the summit.

The Microscope was placed on a rock, a carefully cleaned glass slide used, and observations with direct illumination made with a power of 200. After some time a cloud rose and covered the summit for a space of two metres. Three or four small drops fell on the glass, but evaporated immediately. Others soon appeared, and these it was possible to observe for some time, as the glass had gradually assumed the temperature of the air. Careful measurements, which were considerably facilitated by the use of oblique illumination, gave the following results:—

The smallest drops of water observed had a diameter of 0·014 mm. when spread out on the glass slide. This was the usual size as long as the observations were made near the upper cloud-line; none were found larger than 0·018 mm. Ten metres lower down the smallest drops were much more rarely found, the predominating size being 0·02 mm.; the clouds were here thick and the sunlight remarkably diminished. Another observation made 20 metres lower down showed a complete disappearance of the smallest drops. Besides those of 0·02 mm. in diameter, many others were observed of 0·03 mm. After a further descent of 50 metres the lower cloud-line was reached, and here the drops found were of the largest diameter observed, being 0·035 mm. In ascending to the former points of observation which had been previously visited, Herr Assmann found generally somewhat larger drops than in descending: at the highest point, however, the smallest drops again predominated. The upper cloud-line did not alter one metre in height during the two hours that the observations lasted. The ratio between the height and the diameter of the small drops was calculated by the author at 1:12 to 1:8.

* Micr. Bulletin (Queen's), ii. (1885) pp. 23–4.

† Meteorolog. Zeitschr., ii. (1885) p. 41. See Naturforscher, xviii. (1885) pp. 129–30.

Herr Assmann took the opportunity, with a power of 400, to test Aitken's theory as to the condensation of the vapour in the air to solid particles. The smallest drops evaporated slowly in from 10 to 15 seconds under the Microscope, without leaving the slightest trace of any residue. A particle of the size of 0·005 mm. could not have escaped observation under the favourable conditions of light and during the many hundred separate observations.

At 2 o'clock the wind veered from W. to N.W. and became cooler, the air being 1° colder, the relative dampness greater, and the clouds higher and thicker. Under the Microscope large drops of a diameter of 0·04 mm. were almost exclusively to be observed, and they lay so close that the entire field of view was covered with water. At 3 o'clock a fine rain fell.

In a subsequent ascent of the Brocken on 31st December, undertaken for the purpose of studying the formation of hoar-frost, Herr Assmann fixed his Microscope by allowing it to freeze to a lump of ice, attached a fine woollen hair to the glass slide, and soon saw very small drops of water fall on the glass, when the summit was quite hidden by clouds. These drops were all liquid in spite of the temperature being at − 10° C. and they evaporated comparatively quickly. The smallest forms predominated. Not a single crystal of ice or snowflake was visible among the drops of water. Small drops that did not evaporate in 5–10 seconds froze to ice of the same size. These were entirely transparent and devoid of air.

Micro-chemical Test for Brucin and Strychnin.*—Dr. O. Lindt has examined the seeds of *Strychnos nux-vomica* and *Strychnos ignatii* micro-chemically for the above alkaloids. Nitric acid and Erdmann's reagent cannot be employed for detecting brucin, as the former gives the xanthroproteic acid reaction, and the latter the sugar-albumin reaction. If, however, the section to be examined is first treated with light petroleum to remove the fat, and a mixture of selenic and nitric acids is afterwards added, the cell-walls assume a bright red colour which gradually changes to orange, and then to yellow, whilst the parts containing no brucin remain uncoloured. In order to detect strychnin, the fat, grape-sugar, and brucin are removed by maceration with light petroleum and with absolute alcohol, and then a solution of cerium sulphate in sulphuric acid is added; this produces a violet-blue coloration in the cell-walls, and afterwards a red coloration inside the cells.

Micro-chemical Examination of Minerals.†—If in a section a mineral has been found which cannot be recognized by its optical properties, morphological aspect, cleavage, &c., Dr. A. Wichmann recommends that the cover-glass should be removed, and the whole slide together with the section smeared over with a thin fluid solution of Canada balsam in ether by means of a soft brush. If it is not put on too thickly, it is sufficiently dry in a few hours for further treatment. The mineral to be examined is laid bare with a strong needle, or the

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 237–40.
† Ibid., pp. 417–9.

point of a knife, and a drop of the acid, which is to be applied, placed on it. In the application of hydrochloric acid Wichmann allows it to dry, redissolves in another drop, and brings the solution by means of a capillary pipette or platinum spatula to a part of the slide away from the region of the section. If one is dealing with fluo-silicic acid, the drop is removed with a platinum spatula as soon as it has half dried. In this case it is judicious to hasten the decomposition by previously adding a drop of watery fluoric acid.

For dealing with isolated particles of a mineral in a powder, it is best to cover a carefully cleaned slide with the balsam in ether, and before it has dried sprinkle a small quantity of the powder on it, so that the particles adhere to it. The balsam is allowed to dry, and one then searches for the granules of the mineral under the Microscope, and covers over all the others with more balsam solution. The granules thus isolated can be treated in the usual way.

Isolating Minerals in Sections for Micro-chemical Examination.*—Dr. A. Streng uses cover-glasses which are prepared by dipping them into melted wax, and, when this is cold, making an opening (1/2–1 mm.) with a pin in the middle of the wax. The spot so laid bare is covered with a drop of concentrated hydrofluoric acid, until it is perforated, and the remaining wax is then removed. To examine a given mineral chemically, one side of the perforated cover-glass is covered round the opening with a thin layer of heated Canada balsam, and this side is, when the balsam has set, laid on the section in such a way that the opening is over the mineral to be tested. By means of a heated wire the balsam is melted. The opening thus filled with balsam is made free by a brush dipped in alcohol, and test solutions can be applied to the mineral. By warming the slide, the cover-glass can be lifted off, and the various reactions studied on it.

The Microscope in Geology.†—Mr. G. H. Williams, in an article on this subject, recurs to what we have before commented on, viz. the comparatively limited appreciation among Englishmen of the microscopic study of rock-sections. He refers to what he terms the "surprising fact that the appreciation of it among English-speaking people has been so slow, that not one reliable text-book on the subject of petrography exists in the language of the man who gave the first impulse to its modern development," forgetting, however, Mr. Rutley's 'Study of Rocks.'

He also points out that "heretofore microscopical petrography has been essentially a branch of mineralogy, but its future certainly lies in the far wider sphere of geology. The mere laboratory study of isolated rock specimens, which has served so good a purpose in the perfecting of delicate and accurate methods, no longer possesses any significance, now that these are so thoroughly developed. What in Germany has been secured by years of patient labour may now be learned in a comparatively short time. Geologists have only to know and realize its application to their field of work in order to eagerly

* Ber. Oberhess. Gesell. f. Natur. u. Heilk., xxii. (1883) p. 260.
† Science, v. (1885) pp. 190–1.

avail themselves of such an important aid. The use of the Microscope alone will in future produce but little that is new; but its possibilities in geology, when intelligently employed in connection with the most detailed and careful field-work—the necessity of which has been increased, not diminished, by its introduction—cannot be easily overrated.

What palæontology has done for the fossiliferous deposits, this, and even more, the Microscope must do for the crystalline rocks. The less altered forms of igneous masses have thus far been almost exclusively studied; and, although they still have much to teach us, it is not by their investigation that the Microscope is destined to yield its greatest assistance to geology. The changes, structural and chemical, which go on in rocks after they are first formed, leave behind them more or less distinct traces which it is the special province of the Microscope to follow out and interpret. . . . It is by dealing with such problems as Lossen, Renard, and Lehmann in Europe, and Wadsworth in this country [U.S.A.] have especially pointed out that the Microscope in geology can in future render its best service. The manner in which this can be accomplished is by the patient following, step by step, of unchanged rocks into their most completely altered equivalents, and carefully comparing the condition of each constituent at every point. In this manner the succession of changes which they undergo may be as completely worked out as though we could see the process actually going on before our eyes. . . . What is especially to be desired are detailed studies of many small areas where the same rock, whether eruptive or sedimentary, can be traced from its original form to its more altered state and a comparison of the results obtained in each. This Lossen has recently attempted for the southern Hartz, and has thereby indicated what is perhaps the most promising field for microscopic work in geology."

Application of the Microscope to Practical Mineralogical Questions.*—In examining an argentiferous mineral which was found in Wales, and known there as "blue stone," it became desirable to determine whether the mineral was a definite double sulphide of lead and zinc, or whether it was a fine mechanical mixture of the two well-known minerals galena and blende. Prof. Tichborne found that on gradually powdering the mineral and examining it from time to time under the Microscope, a point was at length reached when half the particles became transparent and transmitted light, whilst no amount of powdering would render the other particles transparent. To try such an experiment it was necessary to view with very strong transmitted light (a 1/2 in. object-glass) and to cut off all reflected light. From this experiment he came to the conclusion that the mineral was an intimate mixture of fine crystals of blende and galena, the blende being the transparent particles and the galena the opaque. Although both these minerals possess a certain degree of metallic lustre, galena is one of the most perfectly opaque substances known, whilst blende in very thin layers is perfectly transparent.

* Ann. and Mag. Nat. Hist., xvi. (1885) p. 145.

Microscopical Examination of Volcanic Ash from Krakatoa.*—Mr. J. Joly in preparing this dust for the Microscope found that mere shaking up with water, and pouring off before complete settlement, served only to remove the lighter fragments of pumice, and that complete separation was only readily effected by the following method:—

Into a glass tube 1 m. long and about 4 cm. in diameter, closed at one end and filled with water to the brim, the partially cleansed dust is introduced and allowed to settle. A strip of glass is now pressed on the open end, and the whole rapidly inverted into a shallow dish containing water. The denser particles descending most rapidly through the column of water in the tube, reach the dish first. When the more slowly moving particles are observed to have nearly attained the dish, a movement of the tube to one side effects the desired separation.

The author found that the constituents of the ash presented under the Microscope a spectacle of the most extreme interest and beauty, especially with polarized light.

Examination of Potable Waters.† — The method recommended by Herr J. W. Gunning for the chemical examination of water consists in adding to a litre of the water enough ferric chloride to correspond with about 5 mgrms. of iron. The ferric chloride should be as nearly neutral as possible. Under these conditions, ammonia, nitrites and nitrates are left in solution, whilst other nitrogenous substances are carried down with the precipitate of ferric hydroxide. By heating this with soda-lime the nitrogen of these compounds is obtained as ammonia. By this treatment cloudy water is completely clarified and yellow moor-water decolorized. The process has been applied with success on a large scale in Holland for the purification of drinking-water, especially during diarrhœa and cholera epidemics.

In the bacteriological examination of water, the author prefers to develope a pure culture in a liquid medium rather than in the solid medium recommended by Koch. The water to be tested is mixed with a clear sterilized yeast decoction. By sterilizing this again, certain bacteria are either killed or rendered inactive, while the others from their superior vitality survive and develope. By a process of progressive sterilization, beginning at low temperatures and gradually ascending, pure cultures are obtained.

Removal of Micro-organisms from Water.‡—Dr. P. F. Frankland has investigated the efficiency, as regards the removal of micro-organisms, of methods of water-purification depending upon (*a*) filtration; (*b*) agitation with solid particles; (*c*) subsidence, and (*d*) chemical precipitation (Clark's process). The method of investigation consisted in determining the number of organisms present in a given volume of the water before and after treatment, the determinations being made by Koch's process of gelatin-culture on glass plates.

* Scientif. Proc. R. Dublin Soc., iv. (1885) pp. 291-9 (2 pls.).

† Chem. Centr., 1884, pp. 151-2. See Journ. Chem. Soc.—Abstr., xlviii. (1885) p. 841.

‡ Proc. Roy. Soc., xxxviii. (1885) pp. 379-93.

The filtering materials were greensand, silver sand, powdered glass, brickdust, coke, animal charcoal, and spongy iron. These materials were all used in the same state of division, being made to pass through a sieve of 40 meshes to the inch. Columns 6 in. in height were used.

It was found that only greensand, coke, animal charcoal, and spongy iron wholly removed the micro-organisms from water filtering through them, and this power was in every case lost after the filters had been in operation for one month. With the exception of the animal charcoal, however, all these substances, even after being in action for one month, continued to remove a very considerable proportion of the organisms present in the unfiltered water, and in this respect coke and spongy iron occupy the first place.

The results obtained by agitating water with various solid materials show that a very great reduction in the number of suspended organisms may be accomplished by this mode of treatment, and the complete removal of all organisms by agitation with coke is especially worthy of notice.

Again, the results obtained with Clark's process show that we possess in this simple and useful mode of treating water a means of greatly reducing the number of suspended organisms.

Thus, although the production in large quantities of sterilized potable water is a matter of great difficulty, involving the continual renewal of filtering materials, there are numerous and simple methods of treatment which secure a large reduction in the number of organisms present in water.

Ady, J. E.—**The Microscopic Study of Rocks. VII., VIII. Petrographical Demonstrations.**

Illus. Sci. Monthly, III. (1885) pp. 227–9 (1 fig.), 259–62 (1 fig.).

Bacillus tuberculosis, modified method of staining.

[The method which, according to the 'Deutsche Militär - Aertzliche Zeitung,' is taught the medical officers of the army. Also Baumgarten's method.]

The Microscope, V. (1885) pp. 189–90. from *Western Medical Review.*

Beckwith, E. F.—**Some observations on the Distribution and Termination of Nerves in the Human Lungs.**

[Methods. *Supra*, p. 894.]

The Microscope, V. (1885) pp. 148–52 (3 figs.).

Bizzozero, G.—**Manuel de Microscopie clinique, Microscopie légale, Chimie clinique, Technique, Bactérioscopie.** (Manual of clinical microscopy, legal microscopy, clinical chemistry, technique, bacteriology.)

2nd French edition, translated by C. Firket. xviii. and 568 pp., 7 pls. and 103 figs., 8vo, Bruxelles, 1885.

Chapman's Mould for Microscopical Cells. [*Supra*, p. 911.]

Journ. N. York Micr. Soc., I. (1885) p. 188.

Cole's (A. C.) **Studies in Microscopical Science.** (Parts VII. and VIII., pp. 25–8, 29–32.)

Sect. I. The Structure of Antheridia in *Polytrichum*. Plate VII. Antheridia and Sporogonium of a Moss.—Non-sexual organs of reproduction in Vascular Cryptogams. Plate VIII. V. S. of Sorus of *Scolopendrium*. × 75.

Sect. II. Respiratory Organs. Plate VII. Gill of Anodon. V. T. Sec. with

glochidia *in situ*. × 75. Plate VIII. Structure of Gills of Lamellibranchs (after Holman Peck).

Sec. III. Phthisis. Pulmonary Consumption. Brown induration of the Lung. Plate VII. Phthisis. × 185. Plate VIII. Lung (Brown Induration). × 36.

Sect. IV. The Frog. Plate VII. Mouth of Tadpole. × 70. Plate VIII. Tracheæ of Silkworm (*Bombyx mori*). × 46.

Cox, C. F.—**Hard-rubber Cells.**

[Made from hard-rubber tubes about 1 ft. long, and of the exact sizes necessary, when made into rings, to take 1/2 in., 5/8 in. and 3/4 in. cover-glass. By means of a turning lathe the tubes may be easily and evenly cut into cells of any desired depth.]

Journ. N. York Micr. Soc., I. (1885) p. 188.

Davis, J. J.—**A Simple Cover-compressor.**

["Divide a small cork transversely and cut a notch in one end of one of the pieces. Pass an ordinary stationer's rubber elastic ring over the end of the slide; put the piece of cork under it, the ring resting in the notch; then draw it along until the under side of the ring will rest under the point to which the pressure is to be applied, then lower the cork on the cover. If more pressure is desired a second ring may be placed over the first. Pieces of cork of different lengths give more or less pressure, and those of different diameters apply it over more or less space. The slides can be laid away side by side."]

The Microscope, V. (1885) p. 36.

Day, E. G.—**Hints on Microscopical Mounting.**

[Wax cells (readily made by using a pair of dividers). White zinc cement excellent for shallow cells. Fungus growths prevented by carbolic acid. Cleaning cover-glasses with nitric acid.]

Journ. N. York Micr. Soc., I. (1885) pp. 190–1.

Debes, E.—**Die Herstellung von Diatomaceen Dauerpräparaten.** (Making permanent preparations of diatoms.) [*Supra*, p. 898.]

Hedwigia, XXIV. (1885) pp. 151–66, 171–2.

Dolley, C. S.—**The Technology of Bacteria Investigation:** explicit directions for the study of Bacteria, their culture, staining, mounting, &c., according to the methods employed by the most eminent investigators. [*Supra*, p. 917.]

xii. and 263 pp., 12mo, Boston, 1885.

Draper, E. T.—**Graphic Microscopy.** XX. Small Brittle Star-fish. XXI. Group of Foraminifera.

Sci.-Gossip, 1885, pp. 169–70 (1 pl.), 193–4 (1 pl.).

Eternod, A.—**Le Microtome à triple pince.** (The microtome with triple pincers.) [*Supra*, p. 900.]

Journ. de Microgr., IX. (1885) pp. 264–7.

Ewell, M. D.—**Measurement of Blood-corpuscles.** [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) pp. 150–1.

The Microscope, V. (1885) pp. 183–6, from *Chicago Legal News*.

Firket, C.—See Bizzozero, G.

Frankland, P. F.—**The Removal of Micro-organisms from water.** [*Supra*, p. 923.]

Proc. Roy. Soc, XXXVIII. (1885) pp. 379–93.

Gage, S. H.—**The Limitation and Value of Histological Investigation.**

[Abstract of address to the section of Histology and Microscopy of the Amer. Assoc. Adv. Sci.]

Science, VI. (1885) pp. 226–7, 228.

Gierke, H.—**Färberei zu mikroskopischen Zwecken.** (Staining for microscopical purposes.) (*Concld.*) [*Supra*, p. 901.]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 164–221.

Gierke, H.—**Staining Tissues in Microscopy. III., IV.**

[Transl. by Prof. W. H. Seaman from 'Zeitschr. f. Wiss. Mikr.']

Amer. Mon. Micr. Journ., VI. (1885) pp. 151–3, 152–6.

Gowen, F. H.—**Improved Microtome.** [*Supra*, p. 899.]

Amer. Mon. Micr. Journ., IV. (1885) pp. 15–6.

HAACKE, W.—**Ueber die Conservation der Medusen.** (On the preservation of Medusæ.) [*Post.*]
Zool. Anzeig., VIII. (1885) pp. 515–6.

HAUSHOFER, K.—**Beiträge zur Mikroskopisch-Chemischen Analyse.** (Contributions to Microscopical-Chemical Analysis.)
[*Post.* A small filtering apparatus is also described and figured.]
SB. K. Bayer. Akad. Wiss. München, 1885, pp. 206–26 (1 fig.).

[HITCHCOCK, R.]—**Prof. H. L. Smith's New Mounting Medium.**
[Defence of Prof. Smith for not having published the formula. "We are not at present authorized by Prof. Smith to make any statement concerning this matter, but from what we know, and have learned from conversation with Prof. Smith some time ago, we are assured that there are excellent reasons why the composition is still withheld from the public."]
Amer. Mon. Micr. Journ., VI. (1885) p. 157.

" " **Microscopical Exhibitions.**
[Reply to a correspondent who insists that the "general public does not want to be instructed as much as it wants to be amused." "Before we reach a conclusion so uncomplimentary to the intelligence of the public as that of our correspondent, we should at least try the experiment of making interesting to the mind objects not specially attractive to the eye. The experiment has yet to be systematically tried. The criticism to be made upon our exhibitions generally is that they are mere displays of fine objects, and those who look at them are not able to learn what they are. Even the wing-case of the diamond-beetle gains in interest by a few words of explanation, especially if the scales of a butterfly's wing are shown beside it and their relation to it briefly stated."]
Amer. Mon. Micr. Journ., VI. (1885) pp. 158–9, 160.

HOYLE, W. E.—**Preserving Eggs of Cephalopoda, and Preparing Blastoderms.** [*Post.*]
Nature, XXXII. (1885) p. 506 (Report to British Association).

JAMES, F. L.—**Arrangement of Work-table.**
[Brief suggestions for the places of instruments, &c., "so that no time is lost in putting the hand directly upon the desired instrument or object."]
The Microscope, V. (1885) pp. 190–1, from *National Druggist.*

" " **Elementary Microscopical Technology.**
[Bell's Cement. Seiler's Cement. Casein Cement. Marine Glue. Chrome Cement.]
Micr. Bulletin (Queen's), II. (1885) pp. 25–6, from *National Druggist.*

JULIEN, A. A.—**The Sealed Flasks of Crystal.**
[Fluid-cavities in quartz. Directions for preparing the material and for examination under the Microscope. Detection of the chemical nature of the contained liquids and gases—*post.* Immersion warm stage—*post*—&c.]
Journ. N. York Micr. Soc., I. (1885) pp. 129–44.

KÜKENTHAL, W.—**Die mikroskopische Technik im zoologischen Praktikum.** (Microscopical technique in practical zoology.)
37 pp. and 3 figs., 12mo, Jena, 1885.

LANGTON, W.—**Thoma's Microtome.** Its practical and theoretical advantages.
Trans. and Ann. Rep. Manchester Micr. Soc., 1884–5, pp. 29–31.

LATHAM, V. A.—**The Anatomy of the Cockroach.**
[Directions for bleaching and mounting wing, gizzard, eyes, &c.]
Sci.-Gossip, 1885, pp. 210–1.

LENDENFELD, R. v.—**The method of Section-cutting, with some improvements.** [*Post.*]
Proc. Linn. Soc. N. S. Wales, X. (1885) pp. 23–4.

LEUCKHART, R.—**Mittheilung.**
[In praise of the preservative methods in use at the Naples Zoological Station; the skill of Salvatore in preserving with all their natural appearances such delicate creatures as Siphonophora having conferred a great boon upon working zoologists by rendering it possible to study these creatures in a museum as well as when living in the sea.]
Zool. Anzeig., VIII. (1885) p. 333.

List, J. H.—**Zur Färbetechnik.** (On staining methods.) [*Supra*, p. 902.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 145-50.

„ „ **Zur Anwendung des Anilingrüns.** (On the use of anilin green.) With remarks by P. Schiefferdecker. [*Supra*, p. 903.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 222-4.

Minot, C. S.—**Some histological methods.**
[Müller's fluid.—Beale's carmine.—Eosin in alcohol.—Imbedding in celloidin, *post*.—Dripping apparatus for cutting under alcohol, *supra*, p. 900. —Benzole.—Balsam.—Alcohol.—Oil.—Paraffin.—Picric acid carmine.]
Amer. Natural., XIX. (1885) pp. 828-30 (1 fig.), 916-7 (1 fig.).

Möller, J.—**Die Mikroskopie der Cerealien.** (The microscopy of cereals.) [*Post.*]
Pharmaceut. Centralhalle f. Deutschland, 1884, Nos. 44-8.

Nachtrieb, H. F.—**A new Water-bath.** [*Post.*]
Amer. Natural., XIX. (1885) pp. 917-9 (3 figs.).

Osborn, H. F.—**A simple method of injecting the arteries and veins in small animals.** [*Post.*]
Amer. Natural., XIX. (1885) pp. 920-1 (1 fig.).

Queen's (J. W. & Co.) Prepared Diatoms in fluid ready for mounting.
["Recognizing the fact that the mounting of diatom-slides from the dry material is not always satisfactory (to put it mildly), we are now prepared to offer something better, consisting of eight gatherings thoroughly cleaned and put up in equal parts of alcohol and distilled water (in homœopathic vials). They are of the right density or proportion for mounting, and as they have *never been dried* since cleaning they will not exhibit that annoying tendency to cling together in masses when dried on the slide or cover."]
Micr. Bulletin (Queen's), II. (1885) p. 29.

Pommer, G.—**Ueber Methoden, welche zum Studium der Ablagerungsverhältnisse der Knochensalze und zum Nachweise kalkloser Knochenpartieen brauchbar sind.**
[*Supra*, p. 905.] *Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 151-6.

Ryder, J. A.—**A cheap Bell-glass for the Laboratory table.** [*Post.*]
Amer. Natural., XIX. (1885) p. 920.

Sachs, J.—**Preparing leaves to show starch-grains.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) p. 178.

Savastano, L.—**Tecnica microscopica vegetale. Trattamento delle gemme fiorali di agrumi con l'acido picrico.**
[Microscopical technique of plants. Treatment of the flower-buds of Aurantiaceæ with picric acid.]
Rivista Ital. Sci. Naturali, I. (1885) p. vii.

Schäfer, E. A.—**The Essentials of Histology,** descriptive and practical, for the use of students.
[Each of the forty-two lessons commences with a short statement of methods for the microscopic examination of the tissue described in the lesson.]
x. and 245 pp., 281 figs., 8vo, London, 1885.

Schiefferdecker, P.—See List, J. H.

Seaman, W. H.—See Gierke, H.

Selenka, E.—**Zur Paraffin-Einbettung.** (On Imbedding in Paraffin.) [*Post.*]
Zool. Anzeig., VIII. (1885) pp. 419-20 (2 figs.).

Slack, H. J.—**Pleasant Hours with the Microscope.**
[Aphides—*Phylloxera*.]
Knowledge, VIII. (1885) pp. 129-30 (3 figs.), 174-6 (4 figs.).

Smith, H. L.—**Mounting Media of high Refractive Index.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) pp. 161-3 (1 fig.).

Taylor, G. H.—**Cleaning Marine Muds.**
[Detailed directions.] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 147-9.

Taylor, T.—**Butter and Fats.** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) pp. 163-4 (1 fig.).
Cf. also p. 174—exhibits at New Orleans Exposition showing the results of experiments on butter, fats, and fibres of various kinds treated with reagents.

Technical Notes, various.—

Siliceous Cement, for protecting corks from the fumes of acid, &c.—Mix equal parts colloid silica and thick gum-water, with sufficient gilders' whiting to make it of the consistency of treacle.—Labelling slides.

Carbolic Acid Preservative, for animal and vegetable tissues.—Carbolic acid, 1 drachm; alcohol, 2 drachms; distilled water, 12 oz.: dissolve the carbolic acid with the alcohol, then add it to the water and boil for ten minutes.

Acetate of Aluminium.—To 1 part acetate add 4 parts distilled water. This is very good for preserving vegetable colours, as in desmids and other algæ.

Glycerin and Acetic Acid is useful for mounting minute insects, &c.; glycerin, 1 oz.; acetic acid, ½ oz.

Dammar Cement.—Dissolve gum dammar in benzole, and add one-third gold-size; it dries very quickly, and is preferably used as a first coat for fixing the cover-glass when glycerin is used for mounting.

Gum, for attaching labels, covering papers, and objects mounted dry. Dissolve 2 oz. of gum arabic in 2 oz. of water, and add 2 drachms of soaked gelatin, 30 drops of glycerin, and a lump of camphor.

The Microscope, V. (1885) pp. 179 and 182.

Tichborne.—**Experiments to illustrate the application of the Microscope to practical Mineralogical questions.** [*Supra*, p. 922.]

Ann. and Mag. Nat. Hist., XVI. (1885) p. 145.

Tyas, W. H.—**Small Freezing Microtome.**

[Golding-Bird's, Vol. IV. (1884) p. 523, with the addition of a clamp which can be fixed to a table and a woollen cover to slip over during the freezing process.]

Trans. and Ann. Rep. Manchester Micr. Soc., 1884–5, p. 33.

Van Brunt, C.—**Prof. H. L. Smith's new Mounting Medium.**

Journ. N. York Micr. Soc., I. (1885) pp. 158–9.

Vorce, C. M.—**The Microscopical Discrimination of Blood.**

[Details the practical requisites for accurate measurements of blood-corpuscles, and the examination of blood-stains, and gives the processes followed and the results obtained in an investigation of a murder case.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 127–9.

„ „ **The Working Session.** A word to the working microscopists.

The Microscope, V. (1885) pp. 152–3.

Ward, E.—**Dry Mounting.**

[Prefers metal cells and brown cement. For black ground, matt black, which dries dull, is unsurpassed. Object should if possible be cut to the size of the cell and kept in position by the cell-wall without gum. Directions for gumming small objects. Sealing up, *post*.]

Trans. and Ann. Rep. Manchester Micr. Soc., 1884–5, pp. 33–6.

Watson and Son's Slides of British Fresh-water Algæ.

[Twenty-four slides illustrating the most important genera for the use of students.]

Grevillea, XIV. (1885) p. 22.

[Whitman, C. O.]—**Microtome Knives.** [*Post*.]

Amer. Natural., XIX. (1885) pp. 830–2 (1 fig.).

Williams, G. H.—**The Microscope in Geology.** [*Supra*, p. 921.]

Science, V. (1885) pp. 190–1.

Wright, R. R.—**Suggestions as to the Preparation and Use of Series of Sections in Zootomical Instruction.** [*Post*.]

Amer. Natural., XIX. (1885) pp. 919–20.

Ziegler, E.—**Technik der histologischen Untersuchung pathologisch-anatomischer Präparate.** (Technique of the histological investigation of pathological-anatomical preparations.) Appendix to the 'Lehrbuch der allg. u. spec. patholog. Anatomie u. Pathogenese.' 36 pp., 8vo, Jena, 1885.

coil, so as to contain a much larger percentage of ozone than any natural atmospheric air, was passed continuously through a 1 per cent. solution of white of egg placed in a glass flask, the inlet and outlet tubes of which were carefully plugged with cotton-wool previously to commencing the experiment. It was found that a stream of air, containing an amount of ozone equal in weight to the albumen in solution, passed through 100 c.c. of the liquid for thirty hours, failed in producing the slightest trace of oxidation, and that the ozonized air passed through the liquid quite unaltered. During the course of the experiment and for six days following, the development of micro-organisms ceased, but at the end of that time, and notwithstanding the cotton-wool plugs, the liquid became slightly turbid from the presence of organisms. As dilute hydrogen peroxide is without action upon albumen, the conclusion seems inevitable that albumen is practically indestructible by any atmospheric agency without previous splitting up by micro-organisms, and further, that whilst micro-organisms cannot develope and are probably killed in an ozonized atmosphere, their spores are not easily destroyed by its agency. These results confirm the surmise of the late Dr. Angus Smith, that putrefaction is a necessary preliminary to oxidation in all cases of *natural* river purification.

MICROSCOPY.

a. Instruments, Accessories, &c.*

D'Arsonval's Water Microscope.—Our justification for noticing this instrument (fig. 229) is that it has been suggested by a leading member of the Société de Biologie of Paris, M. D'Arsonval, who presided at a meeting of the Société in May last. The suggestion is, moreover, evidently a serious one, as the Société devoted two pages of their Proceedings † to a description of it.

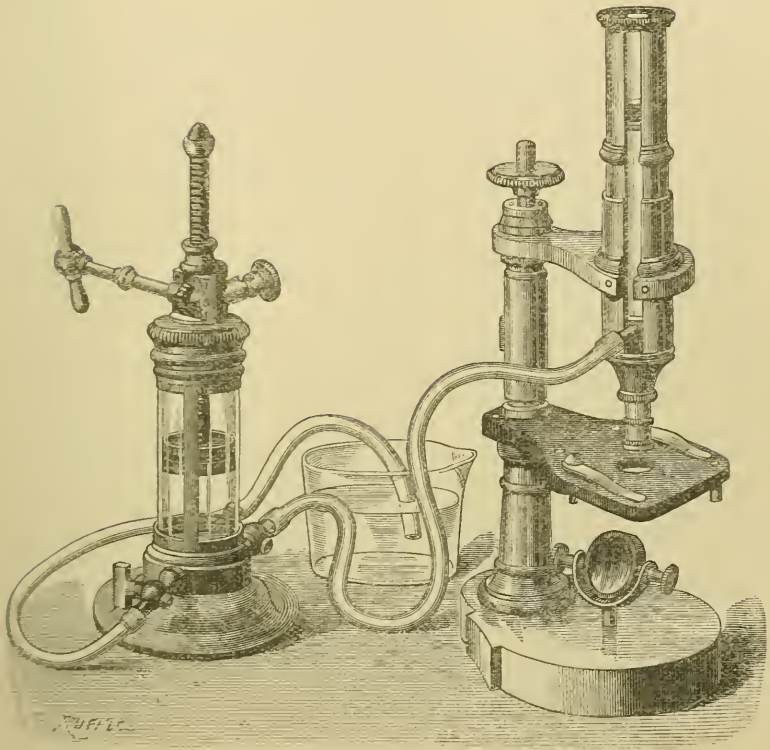
The principle of the instrument depends upon the fact that if an object is viewed through a parallel plate of glass it will appear the nearer as the plate is thicker. The interposition between the objective and the eye-piece of a greater or less quantity of water will act in the same way, and thus (in theory) a very sensitive method of focusing is obtained, the focus varying according to the thickness of the stratum of water.

The construction of the instrument is as follows:—A glass cylinder (fig. 230), open at the top and closed at the bottom by a plane glass disc, is inserted into the body-tube, which is split to allow the contents of the cylinder to be observed without removing it. An orifice at the lower end communicates by an indiarubber tube with a

* 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.

† See this Journal, ii. (1879) p. 767.

FIG. 229.



syringe (the Lacaze-Duthiers vertical injecting syringe is the most convenient for this purpose). By working the syringe water can be forced into the tube or withdrawn from it, and, as before stated, the focus of the Microscope is varied. A cover (fig. 231) can be used to exclude the light from entering the body-tube through the slit.

FIG. 230.

FIG. 231.

We will assume that by this means the variation in the focus can be made with much more sensitiveness than with the best mechanical means, though the latter has now reached a great pitch of perfection. Is this (assumed) increased sensitiveness obtained at the sacrifice of other indispensable qualities? There can be no doubt that it is. The arrangement is of course of no use except with high powers—for low powers the existing focusing arrangements leave nothing to be desired as a practical

question. With high powers, however, the interposed water would seriously interfere with the corrections. The objectives are constructed to work with air, and if the rays have to pass through water there is a considerable disturbance of their action both as regards aplanatism and achromatism. The same result follows from capillarity, by the action of which the upper surface of the water is distinctly curved.

We are obliged therefore to come to the conclusion that M. D'Arsonval's idea, though a not uninteresting contribution to the history of suggestions on the construction of the Microscope, cannot be realized in practice.

Another advantage claimed by the inventor was the power of using thick cover-glasses; also coloured solutions for monochromatic light for photography.

In this connection it may be interesting to note an idea which occurred to Hooke,* in regard to the use of water between the lenses. "I provided me a Tube of Brass . . . ; into the smaller end of this I fixt with Wax a good plano convex Object Glass, with the convex side towards the Object, and into the bigger end I fixt also with wax a pretty large plano Convex Glass, with the convex side towards my eye, then by means of the small hole by the side, I fill'd the intermediate space between these two Glasses with very clear water, and with a Screw stopped it in; then putting on a Cell for the Eye, I could perceive an Object more bright than I could when the intermediate space was only fill'd with Air, but this, for other inconveniences, I made but little use of."

Direct Vision Microscopes.†—Mr. T. E. Amyot, observing that many of the old faults and deficiencies of these instruments remain uncorrected and unsupplied, describes the alterations which he has made in one, which have rendered it "perfectly available for many purposes for which it was previously inapplicable, and in fact," as far as his own requirements go, "a very useful instead of a nearly useless instrument."

The faults of all the instruments of this class with which he is acquainted are the following:—

1. The object examined is rendered indistinct by the amount of side light which falls upon it in its exposed position.

2. The stage arrangements are so imperfect that it is impossible to examine any but the central portion of the slide, or at best such a portion as has been previously arranged for examination.

To correct the first fault nothing more is required than 1/3 in. of metal tube blackened internally, the size of, and projecting beyond, the stage aperture; this too would easily carry a polarizing prism or a spot-lens if desired.

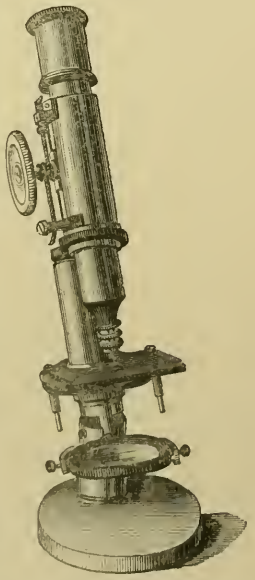
To remedy the second fault (the instrument operated on being Dr. Beale's Class Microscope) the bell-shaped end is removed and in its place is fixed a brass cylinder, with a gap in front for the use of

* Hooke, R., 'Micrographia,' 1667, preface.

† Sci.-Gossip, 1885, pp. 201–2 (1 fig.).

reflected light when required, as in the original arrangement. It is 3/4 in. long and 2 in. wide, and to it is attached by a strong bar a stout brass disc or stage, with a central aperture of 3/4 in. diameter, the interval between it and the cylinder being 1/4 in. A thinner brass disc of rather smaller circumference and similar central aperture, but having its edge bordered by a projecting rim both above and below, is kept in close apposition to the first by a coil of wire-spring soldered to it and to the base of the internal circumference of the brass cylinder. It is between these two discs that the slide is lightly but firmly held, it being easy to move it without jerk or unevenness in any direction. The shallower projecting rim, which is deficient in front, should be about the depth of the thickness of an ordinary slide, and is intended to prevent the possible pressure of cemented objects between the discs when searching far from their centre. The deficiency of the rim in front secures the cover-glasses from injury. The other rim should be much deeper, its use being to keep the disc central, and working within the cylinder when drawn down. Its border is arched, and the points between the arches are bent outwards; the centre one forming a convenient catch for the thumb of the left hand when depressing the disc to introduce the object, and the others steadying the movement in the inside of the cylinder. There is also a small pin attached to this rim, which works in a tube fixed to the cylinder, securing perfect steadiness.

Fig. 232.



Microscope with Catgut Focusing Adjustment. — In 1881 * Herr J. Ulmer suggested the use of a silk thread for obtaining a simple adjustment of the focus of a Microscope, working very easily and without "loss of time." The principle was apparently adopted several years earlier in the form shown in fig. 232.

A piece of catgut is attached by its two ends to the top and bottom of the fixed sheath in which the body-tube moves, and is wound once round a spindle with milled head, which is screwed to the body-tube and passes through a slot in the sheath. On rotating the milled head the catgut winds on the spindle, thus carrying the body-tube up or down as desired. The spindle travelling in the slot prevents any rotation of the body-tube. For the purpose of tightening the catgut the upper end is passed through a hollow screw working in a fixed socket. The axle of the spindle is milled to prevent the catgut slipping.

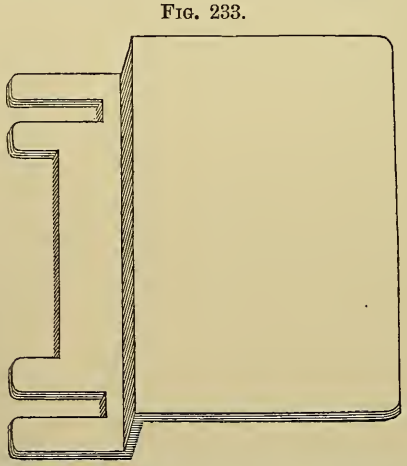
* See this Journal, ii. (1882) p. 406.

Inostranzeff's Double Microscope.*—M. Inostranzeff "proposes to use the tint and lustre of non-transparent minerals as a means of comparison, by adapting a double Microscope, so that the objectives receive separately the rays proceeding from the minerals studied. The rays are inflected by prisms, so that they reach a single eye-piece, and form two halves of the field of view divided by a fine line. With identical minerals a uniform image is obtained, but the slightest change of shade in any one object causes the line of division and two distinct parts to appear."

Microscopes with Accessory Stages.—The cutting of series of sections now so much in use necessitates, as mentioned *ante* p. 153, a considerable increase in the size of the slides on which they are to be mounted, some of those in use at Cambridge being 6 in. × 2 in. with cover-glasses 5 in. × 1½ in., and containing it may be 500 sections.

This of course renders it desirable that the stage of the Microscope should be much wider than ordinarily made, so as to support the slides when the sections at either end are examined. For broad as well as long sections such as brain, the arrangements devised by Schieck and Giacomini and shown *ante*, p. 515, are very suitable. The extensible

Fig. 233.



arms of Schieck's form will not however accommodate the narrow slides used for series of sections, and the supports of Giacomini's are more especially intended for broad and not for long and narrow slides. The increase in the size of the fixed stage is moreover undesirable, what is wanted being some simple and readily adapted addition to a stage which will allow it to be again restored to its normal size when required.

This want may be supplied by an adaptation of the device used many years since by Andrew Pritchard and Powell, and applied in more modern times for the attachment of the hand-rests used with German dissecting Microscopes.

* Illus. Sci. Monthly, iv. (1885) p. 27.

It consists of a brass angle-plate with slots, which slide on suitably arranged milled-head screws beneath the stage. When the plate is in position the screws are tightened, and it is firmly clamped to the stage, forming a continuation on either or both sides at the same level.

Riddell's Binocular Compound Microscope.—Prof. J. L. Riddell, of New Orleans, Louisiana, was the original inventor of the Binocular Compound Microscope with one objective. A description of his form of prisms was published in 1854,* but the instrument itself has not been figured complete, either here or abroad. Prof. Riddell's own instrument is the property of the United States Government, but by the courtesy of the Surgeon-General of the United States Army (acting through Dr. John S. Billings, Curator of the Army Medical Museum, Washington) it was placed in the hands of Mr. J. Grunow, of New York (brother of the original constructor), by whom a duplicate was made and sent to this country, and is reproduced in fig. 234. The arrangement of the binocular prisms is shown in section in fig. 235, as drawn in the original paper.

The pencil of rays emerging from the objective *l* is divided in two, each half passing respectively into the right and left prisms. The path of the rays is *a*, *b*, *c*, *d* (the object is at *o*). In the prisms figured Prof. Riddell remarked that the equal angles at the long face are 45°, consequently the rays suffer a slight chromatic dispersion at *c*, but he found no attendant practical disadvantage, unless eye-pieces of unusually high power were used. By making the equal angles of the prisms 85° or 86°, so that the immergence and emergence would be at right angles to the glass planes, the dispersion would be avoided; but then another difficulty would arise by the transmission of direct rays (without reflection from the binocular prisms) from the object, which would destroy the binocular image.

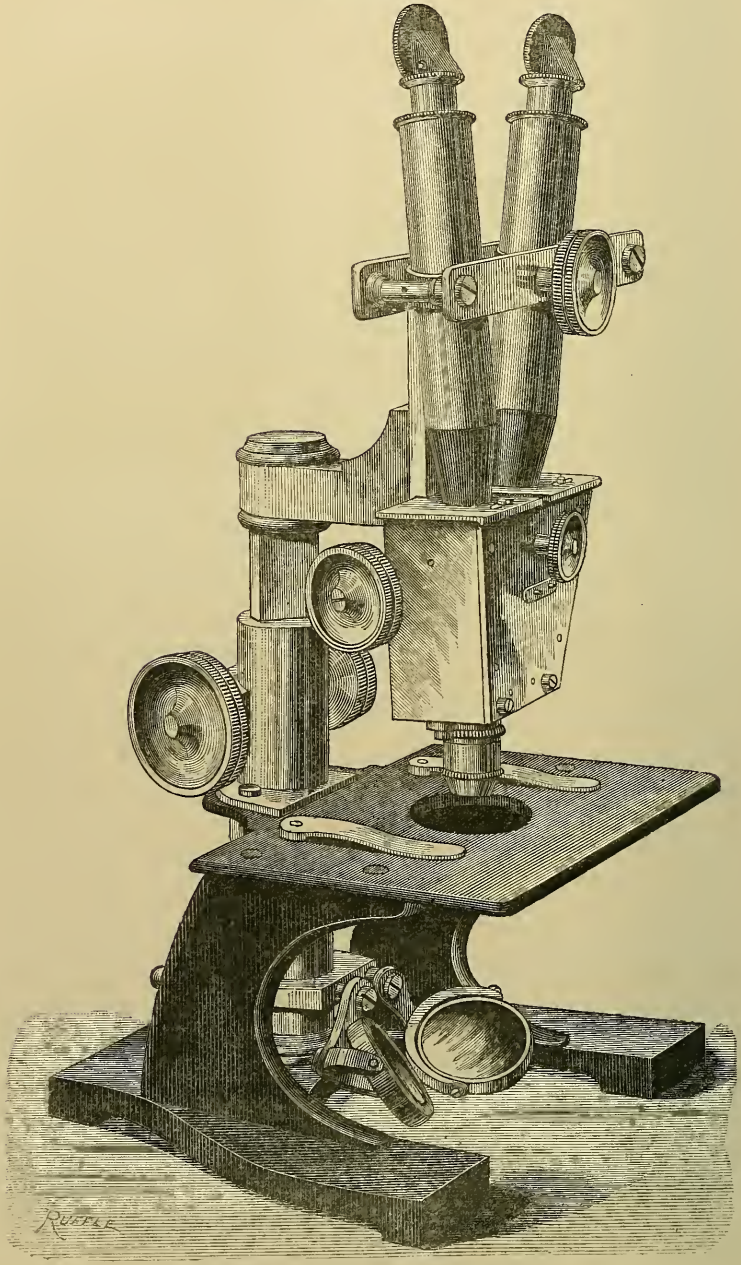
To facilitate the perfect coalescence of the images in the field of view for every width of eyes, Prof. Riddell provided (1) a means of regulating the inclination of the prisms by mounting them in hinged frames, so that while their lower terminal edges remain always in parallel contact the inclination of the internal reflecting faces can be varied by the action of a milled head in front of the prism box; (2) the lower ends of the binocular tubes are connected by travelling sockets, moving on one and the same axis on which are cut corresponding right- and left-handed screws, so that the width of the tubes may correspond with that of the prisms; and (3) the upper ends of the tubes are connected by racks, one acting above and the other below the same pinion, so that right- and left-handed movements are communicated by turning the pinion.

Prof. Riddell found that in many cases it was advantageous to employ two small concave mirrors rather than one large one, so as to equalize the illumination in both fields.

To obviate the inconvenience of using the instrument always in the vertical position, small rectangular equilateral prisms are so mounted in brass caps as to be slipped at pleasure over the eye-pieces.

* Quart. Journ. Micr. Sci., ii. (1854) pp. 18–24 (4 figs.).

FIG. 234.



RIDDELL'S BINOCULAR MICROSCOPE.

These prisms are adjustable so that the image may be viewed at any inclination between the vertical and the horizontal. The combination of the binocular prisms with the eye-piece prisms inverts the image in both planes, so that the movement upon the stage is seen through the instrument to be natural or erect—"a condition essential to the convenient manipulation or dissection of a microscopic object."

Fig. 235.

In the original description Professor Riddell states that the instrument, with its firm stand, broad stage [6 by 4 in.], and erect images, is pre-eminently adapted for use in prosecuting minute dissections, or the unravelling of minute structures of any kind. Opaque objects may be illuminated by the bull's-eye condenser, and transparent objects by one or two concave mirrors, aided perhaps by two diaphragms or screens. At night two candles may be used conveniently with one mirror. To illuminate for the higher powers a single achromatic condenser suffices.

Megaloscopy.*—Under this heading M. Boisseau du Rocher writes as follows:—

"I will first indicate the optical principle that has guided me in the construction of a series of instruments for the inspection of cavities, notably the stomach, bladder, and rectum (*μέγας*, large, *εἰκών*, image, *σκοπεῖν*, to see).

The problem was to pass through a tube 7 mm. in diameter and 50 cm. long, the image of a very near object of the dimensions of 20 cm. To accomplish this I reduced the image of the object to microscopical dimensions by means of a suitably placed objective. This image, visible in the lower part of the instrument, is then examined with a telescope, which I call a megaloscopic telescope. It will be understood that with lenses of suitable focal length the reduced image of the object can be magnified, and consequently observed with the normal dimensions of the object.

The application of the principle is as follows:—The instrument is in the form of a tube or probe, terminated at its extreme end by a lantern in which is fixed an incandescent lamp. Above it is the optical arrangement which reduces to microscopical dimensions the image of the mucous membrane to be observed. This is composed of a right-angle prism; above are two plano-convex lenses with their convex surfaces facing each other, which have given the best results, whether in regard to the diminution of the image and of the field of view, or to distortion which is thus absent. At the other end of the

* Comptes Rendus, ci. (1885) pp. 329-30.

tube is the megaloscopic telescope consisting of an objective and an eye-piece of suitable power.

The advantages of this arrangement are first, that the adjustment for the eye of each observer is made externally by the eye-piece, and therefore all internal mechanism is suppressed. This allows, moreover, a second eye-piece of much greater power to be substituted for the first eye-piece; the mucous membrane and its lesions are then observed as with a magnifier. Second, adjustment for focus, properly so called, is nil. This proposition which is not theoretically exact, is so, however, practically. The reduced image formed in space, being displaced by a very small quantity only in proportion to the greater or less distance of the object, the focal adjustment may be neglected; the eye of the observer itself makes *unconsciously* its proper adjustment for focus, and the different parts of the mucous membrane situated at different planes are thus seen in their entirety with the same clearness—a point of first importance.

For the bladder and the rectum the tubes are straight. For the stomach there is a double tube; one with an elbow has a prism 7 cm. long, placed between the reduced image and the telescope; the other is straight and passes into the former, and its movements of elevation, depression, or rotation are governed by exterior mechanism.

A further improvement, which is in contemplation, is the photographic reproduction of the megaloscopic image.

Finally, this instrument shows that the result obtained is and will always be the same, however long may be the tube at the extremity of which the reduced image is formed, or whatever may be the distance of this image from the telescope and the eye of the observer."

The apparatus of M. du Rocher appears to be identical with that described * by Herr J. Leiter, but there is no acknowledgment of his priority in the matter.

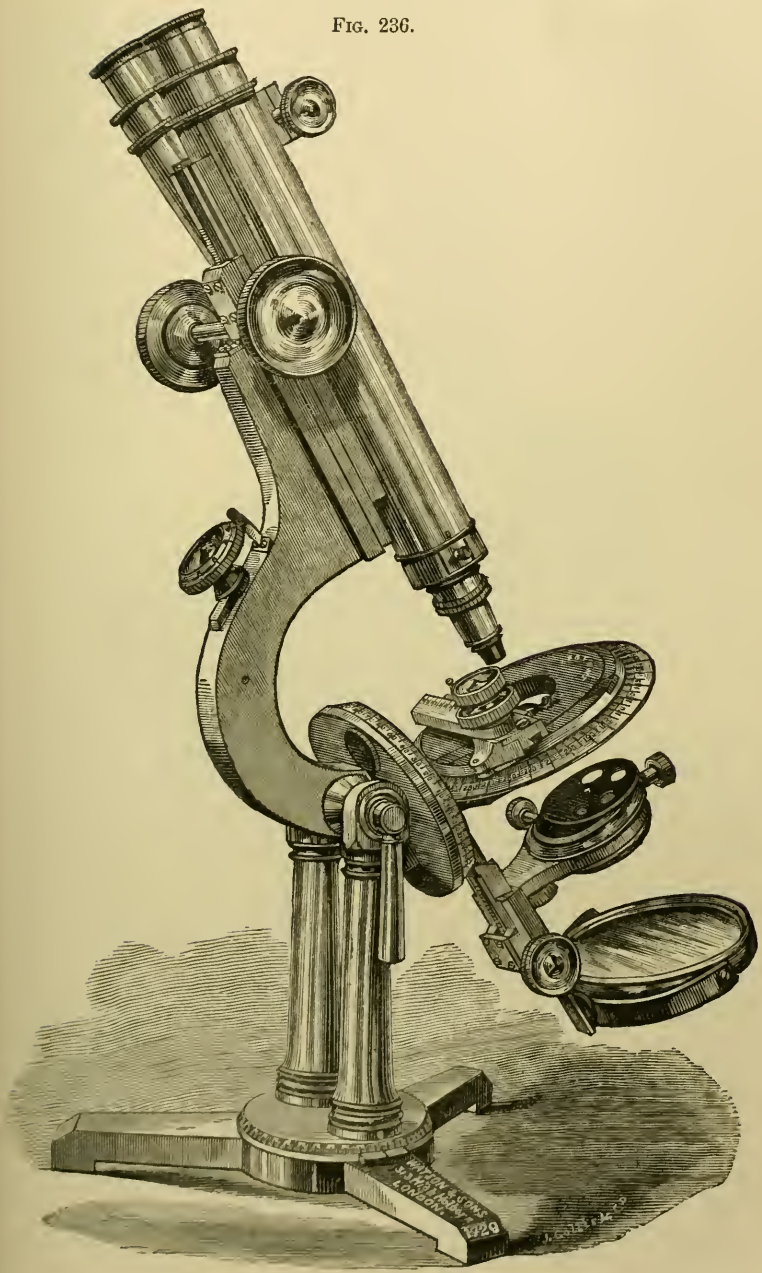
Watson's Swinging Substage Microscope.—Messrs. W. Watson and Sons have modified their large stand † which now has the form shown in fig. 236. It has a rotating base plate, mirror arranged to swing either above or below the stage (with graduated circle), and patent concentric rotating stage.

The fine adjustment is upon the Zentmayer principle, in which the coarse adjustment slide is carried by the fine adjustment slide, and the whole moved together by a lever acted on by a micrometer screw. The peculiarity of Messrs. Watson's construction is in the application of adjustable slide bearings to the original form of arrangement. For this purpose they have made the fine adjustment slide much broader than usual, thus increasing its stability; the prism bars also not only slide in grooves on the main surfaces of contact of the bearings, as in Bulloch's and other forms, but the bearings are carried round the outer prismatic edges of the whole length of the main slides, and adjustable screws are applied by which the friction on these edges can be regulated.

* See this Journal, iii. (1883) p. 421.

† For the original form see Engl. Mech., xxxii. (1881) pp. 487-8 (1 fig.).

Fig. 236.

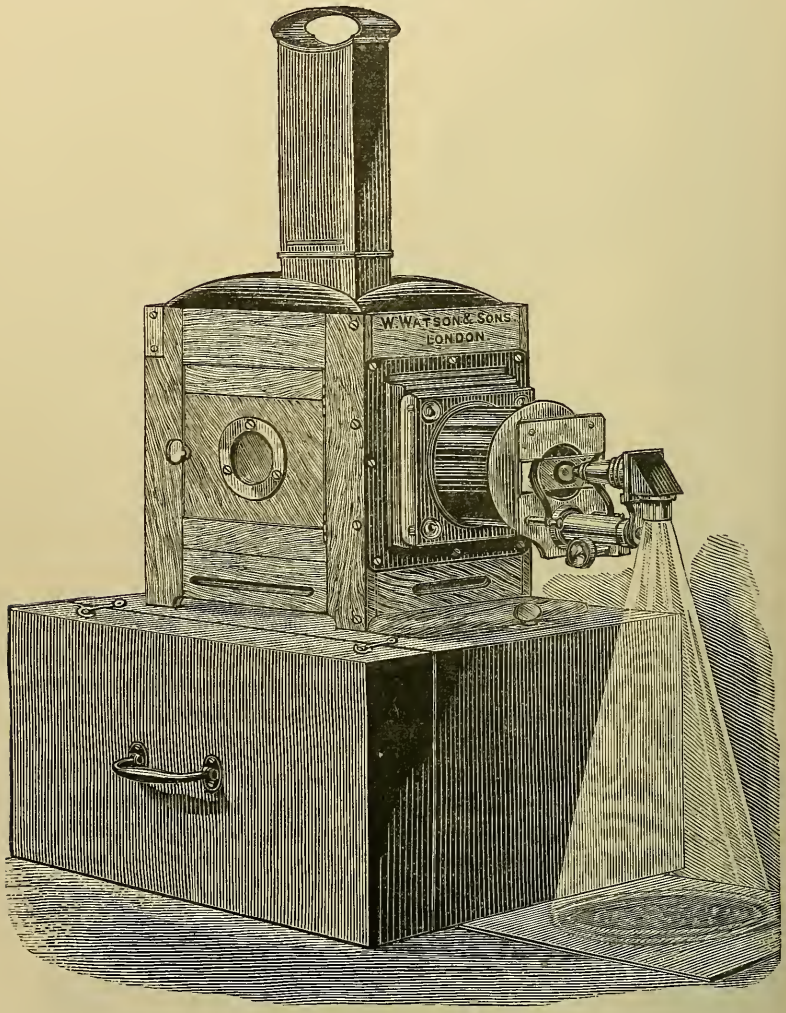


Watson's Swinging Substage Microscope.

3 z 2

Watson's Camera or Lantern Microscope.—This (fig. 237), also designed by Messrs. W. Watson and Sons, is a very convenient arrangement either for drawing microscopic objects, or for exhibiting

Fig. 237.



them to a class, as a number of students can examine the object at the same time, and have its special features pointed out to them.

It consists of a four-wick paraffin lamp in a lantern body, with compound condensing lenses 4 in. in diameter. In front of the latter

is a tube of length corresponding to the focus of the condenser, and to this is screwed a frame consisting of a stage for the objects, and a fitting with Society screw to take the ordinary objectives. There is a rack and pinion for focusing. The image from the objective is received by a right-angled prism and is thrown through an amplifying lens on a sheet of paper placed below to receive it. As has been before pointed out, a microscopic object can thus be more easily and correctly traced or drawn, than by any other method. The instrument can be used as an ordinary magic lantern by removing the Microscope attachment and substituting an achromatic front lens.

Leckenby's Microscope Pencil-case.*—Mr. A. B. Leckenby has devised a combination of a pencil-case and a Microscope for the use of school children in the study of botany. "It consists of a thin tube of brass to hold the pencils, at the end of which is a lens mounted in such a way that when drawn out of the tube it is a simple Microscope well adapted for studying seeds and parts of plants, insects, &c. In addition to the Microscope pencil-case Mr. Leckenby has prepared sets of fifty slides of seeds neatly mounted on stiff paper to accompany it. The case and sets of seeds will be a source of pleasure and instruction to children, and also to persons more advanced in life, for this little Microscope can reveal a world of beauty."

Adjusting the Eye-pieces of Binoculars to eyes of unequal focal length.†— Colonel Malcolm thus describes an arrangement for binocular field-glasses which might we think be well applied to the Microscope, having regard to the number of observers whose eyes differ in focal length.

"One tube is left untouched; the eye-piece of the other is so arranged that it can be moved through a small range in and out, with reference to the eye-piece of the untouched tube, by turning round a milled ring. An index arrangement is provided.

The unaltered tube is used with one eye and brought to the most perfect focus possible in the ordinary way; then the other tube is used with the other eye, and by means of the adjustment its definition is made as perfect as may be, the ordinary adjustment not being interfered with. The two eyes are then used together; and the process of adjustment had better be gone over again, as certainly the two eyes do help each other.

The final position of the index mark is noted; and that holds good for all ranges, as far as I have tried.

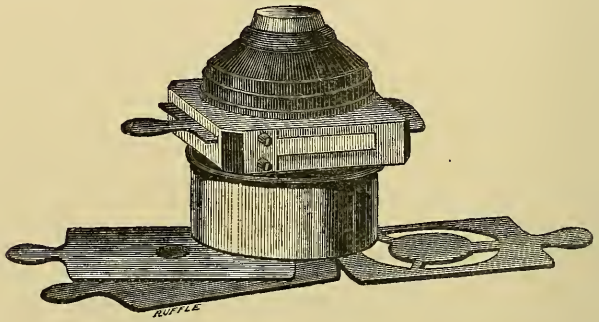
Having noted this, you may lend your glasses to your friend, who may alter them to his sight, and yet have them in perfect order for yourself by bringing the index to your own mark."

Abbe Condenser.—This condenser, the use of which is extending very largely both on the Continent and in America, is made in a great variety of forms, nearly all concurring, however, in a very considerable curtailment of the original dimensions which rendered it

* Amer. Mon. Micr. Journ., vi. (1885) p. 200.
† Proc. Phys. Soc. Lond., vii. (1885) pp. 80-1.

very heavy and unsuitable for use with Microscopes to which it was not specially adapted. The latest modification of form is that of Mr. J. Grunow, shown in fig. 238.*

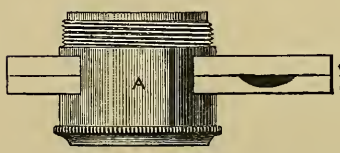
Fig. 238.



Device for Testing Refractive Index.†—A new device for testing the refractive index of immersion media, and indicating how near an approach to homogeneity with crown glass can be made, was described at the recent meeting of the American Society of Microscopists by Prof. H. L. Smith, who claims for this simple device superiority, both as to ease of manipulation and accuracy of indication, over the well-known wedge and bottle furnished by Herr Zeiss. In testing any medium for immersion purposes, but little more than a drop of the liquid is required, and the slightest variations of refractive index are indicated by a considerable latitude of motion, when, in the ordinary use of the wedge, these variations would be inappreciable.

The instrument is used upon the Microscope, and a reference to fig. 239 will make its application plain. A is an adapter about 3/4 in. in length, with the Society screw outside and inside. This is attached to the Microscope, and carries a 1 in. objective. *a* and *b* are two slips of crown glass, as near the refractive index of the cover-glass as possible, 2 in. long and 1/2 in. wide, each about 1/40 in. in thickness. In one of these, *b*, near the end, a concave is ground to a depth of about one-third or more of the thickness of the glass, and polished.

Fig. 239.



To test whether a medium has the same refractive index as the glass, and also the dispersion, a drop of it is put into the concave, and the two slips of glass are placed together and inserted into an opening

* See Amer. Mon. Micr. Journ., vi. (1885) p. 183 (1 fig.).
† Ibid., pp. 181–2 (1 fig.).

cut in the adapter-tube, as shown in the figure. A thin stratum of the medium will flow between the two slips. The whole being now in the position shown in the figure, the 1 in. objective is screwed on below, and the Microscope is focused on some well-defined object on the stage. Looking through the two slips in this way, the focus will be found not to differ appreciably from what it would be if the glass plates were removed. When the object is clearly defined the plates are pushed in, bringing the concave, filled with the liquid, directly over the back of the objective; if the medium be optically homogeneous with the glass slips, there will be neither spherical nor chromatic aberrations produced, and the definition and focus remain unchanged. As none of the immersion media now known are strictly homogeneous in this sense, but may, nevertheless, have the same mean refractive index as the crown glass, clear vision with these will be obtained with the general focus unchanged, but an excess of colour will fringe the outlines of the object.

If the focus has been obtained by means of the rack and pinion, the fine adjustment always remaining the same, one can readily ascertain the refractive indices of various media proposed for use with immersion objectives in this way. Let a mark be made on the rack-bar or sliding tube, as the case may be, when the focus is obtained with the plates in the position shown in the figure; this mark will indicate, for example, a refractive index of 1·52. Filling the concave now with cinnamon oil, and focusing again (using the same object, objective, and eye-piece), we get another position for a mark indicating a refractive index of 1·6. Using water, we get still another, 1·33, and with glycerin 1·41, the extremes will be about 1/2 in. apart, as measured on the bar or tube, and, by interpolating, we can thus get pretty nearly the refractive index of any fluid medium. Prof. Smith has found the so-called homogeneous media sold in the shops to differ very greatly, fully 1/4 in. out of the way in many cases. A specimen of cedar oil from Zeiss caused a change of focus only about 1/20 in., which was less than was required by any other samples tried.

When one has a fine objective, and with a given immersion medium has obtained certain positions of the screw collar for the best work on certain tests, the exact refractive index of the medium can be ascertained, and afterwards always secured. A non-adjustable immersion objective, an 1/8 by Spencer, which performed most admirably, both with oblique and direct light with the medium furnished by the maker, showed but indifferently well with another medium, which, on being tested with the little apparatus above described, required an alteration of focus necessary to obtain distinct vision, or rather the most distinct vision, of fully 1/4 in. On diluting the second medium to bring it to the same index as that sent out by the maker, the performance was entirely satisfactory. It will be understood that there should be a diaphragm in the adapter of such size as will prevent any light passing through when the concave is put over the objective with the immersion fluid to be tested in it, except what actually passes through the fluid.

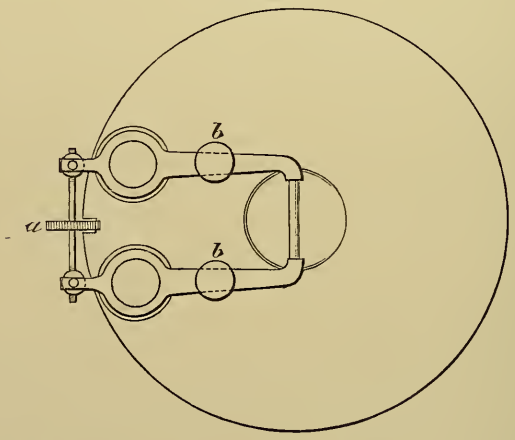
Table of Colour-corrections.*—Mr. J. W. Queen gives the following table of the colour-corrections of objectives :—

	Within Focus.	Without Focus.
Under-correction	Brick red	Greenish blue
Slightly under—but a large number of the finest lenses have this colour ..	Claret	Light green
Nearly colourless—shows the secondary spectrum	Lilac	Paler green
Over-correction	Blue	Yellow

Joly's Meldometer.†—The apparatus which Mr. J. Joly calls by this name ($\mu\epsilon\lambda\delta\omega$, to melt) consists of an adjunct to the mineralogical Microscope, whereby the melting-points of minerals may be compared or approximately determined, and their behaviour watched at high temperatures, either alone or in the presence of reagents (figs. 240–1).

As now used, it consists of a narrow ribbon of platinum (2 mm. wide) arranged to traverse the field of the Microscope. The ribbon, clamped in two brass clamps so as to be readily renewable, passes bridgewise over a little scooped-out hollow in a disc of ebony (4 cm.

Fig. 240.



diam.). The clamps also take wires from a battery (3 Grove's cells), and an adjustable resistance being placed in circuit, the strip can be thus raised in temperature up to the melting-point of platinum.

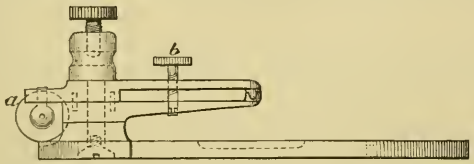
The disc being placed on the stage of the Microscope, the platinum strip is brought into the field of a 1 in. objective, protected by a glass slip from the radiant heat. The observer is sheltered from the intense light at high temperatures by a wedge of tinted glass, which further can be used in photometrically estimating the temperature by using

* Queen's Micr. Bull., ii. (1885) p. 38. † Nature, xxxiii. (1885) pp. 15–16.

it to obtain extinction of the field. Once for all approximate estimations of the temperature of the field might be made in terms of the resistance of the platinum strip, the variation of such resistance with rise of temperature being known. Such observations being made on a suitably protected strip might be compared with the wedge readings, the latter being then used for ready determination.

The mineral to be experimented on is placed in small fragments near the centre of the platinum ribbon, and closely watched while the current is increased, till the melting-point of the substance is apparent. Up to the present Mr. Joly has only used it comparatively, laying fragments of different fusibilities near the specimen. In this way he

Fig. 241.



has melted beryl, orthoclase, and quartz. Mr. Joly has been using the apparatus for nearly a month, and in its earliest days it led him right in the diagnosis of a microscopical mineral, iolite, not before found in Irish granite. The unlooked-for characters of the mineral, coupled with the extreme minuteness of the crystals, led him previously astray, until the meldometer fixed its fusibility as far above the suspected bodies.

A form of the apparatus has been adapted, at Professor Fitzgerald's suggestion, to fit into the lantern for projection on the screen. In this form the heated conductor passes both below and above the specimen, which is regarded from a horizontal direction.

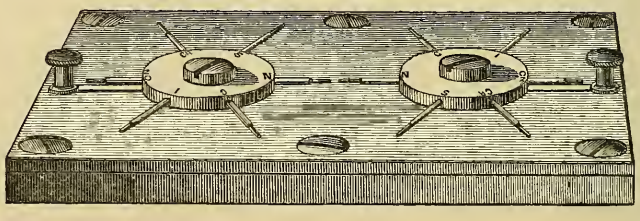
Mr. Joly writes us:—"The figs. represent the improved form of the meldometer; in which the clamps of the stage can be used to hold it firm against the drag of the wires connecting it with the battery. The platinum strip is held by two forceps bound to the hearth of the meldometer by the binding screws, taking the leads but free to turn round the shafts of these screws, so that, on rotating the little adjusting screw shown at *a*, the forceps are brought nearer or further apart. The object of this is to take up the sag of the platinum strip, which becomes very considerable at high temperature. The forceps are opened when inserting the platinum by turning the little screws *b b*. In the figure the jaws of these forceps are shown so shaped as to tend to impress a trough or channel form on the strip, which is advantageous both for the purpose of keeping the specimen from falling off and also as further insuring its being at the temperature of the strip."

Stokes-Watson Electric Spark Apparatus.—Messrs. Watson have modified this apparatus as shown in fig. 242, substituting for the single electrode of the original form * a second disc of six electrodes.

* See this Journal, iv. (1884) p. 964.

By this arrangement any given metal can be used, not merely in conjunction with platinum only, as before, but also with any other metal.

Fig. 242.



A simpler and cheaper form is also supplied, in which the discs are replaced by two supports, each carrying a single arm for the electrodes.

Optical Arrangements for Photo-micrography, and Remarks on Magnification.*—Mr. R. Hitchcock discusses the relative merits of the two methods of obtaining amplification in photographing microscopic objects: viz. by regulating the distance of the sensitive plate, or by the interposition of an eye-piece, or a supplementary lens, usually an achromatic concave, between the objective and the sensitive plate. The following are his conclusions:—

"Summing up this matter, we are personally inclined to favour the use of large plates, 8 by 10 in. for example, using the lens with an amplifier instead of an eye-piece, for the reason that large pictures highly magnified can thus be obtained of exquisite definition. These will bear further enlarging with the solar camera. There remains, however, the consideration of expense, and the inconvenience of using such a large apparatus under ordinary circumstances. It is, unquestionably, more convenient in most cases, to use smaller plates and to work with an eye-piece. Still better, to use an amplifier in place of the ocular, for then it is possible to attach the amplifier to the camera in such a position that when the object is focused with the eye-piece it is also in focus on the ground glass of the camera when the latter is attached. With such an arrangement, a quarter-plate camera can be used with perfect satisfaction, giving negatives equal to any that can be made.

The same cannot be said when the ocular is used, although there is no doubt thoroughly satisfactory results can be obtained with the ocular on small plates."

Actinic and Visual Foci in Photo-micrography with High Powers.†—It is very commonly said that whilst the difference between the visual and the actinic focus is considerable when making photo-micrographs with low powers, it is not appreciable when using high

* Amer. Mon. Micr. Journ., vi. (1885) pp. 168–70.

† Ibid., pp. 193–5. (Paper read before the American Society of Microscopists.)

powers. Dr. J. D. Cox's experience does not accord with this statement, and he makes the following remarks on the subject:—

"If the statement had been that a sharp picture may be taken when the object is exactly in focus with a high power I should not take exception to it, and I incline to think that this is what has been meant. But a sharp picture may be either a positive or a negative of the visual image seen in the Microscope, and in my own work so many examples have turned out to be positives when I expected them to be negatives, that I have been led to make an investigation of the subject, in which the evidence tends strongly to show that with our best high-power lenses the image fixed upon the sensitive plate is a positive instead of being a negative, and consequently the paper prints from this are negatives and not positives.

It would be very easy to overlook this difference in a large class of photo-micrographs, because, in an alternation of dark and light lines, or dark and light spaces, it often matters little which of a pair is light or dark; the picture may be equally clear and satisfactory either way. In the case of a large majority of the microscopic objects photographed, either the positive or negative image would be good enough for the purpose intended; so good that a close examination of the point I am now suggesting would hardly occur to one. This, in fact, was my own experience until, in efforts to get a good picture of the broken edge of fragments of the finer diatoms, my attention was arrested by the fact that the appearances seen by the eye were often reversed in the print from the supposed negative which I had taken. As, in dealing with minute areolæ, this often amounted to showing a projection where I had seen an apparent depression, and *vice versâ*, it became in effect a failure to photograph what I had seen, and challenged my best efforts to overcome the difficulty. If the illumination of such transparent objects as diatoms were always by a perfectly central beam of parallel rays of light, there would be no practical difference whether they showed light upon a dark ground or the reverse. But we rarely get such exactly central illumination, even after our best efforts to do so. For example, plate No. 23 of my broken shell series was thus taken with light intended to be strictly central, a diaphragm being behind the achromatic condenser, which had a small circular hole in it, limiting the illuminating rays to the small central portion of the condenser. Yet in one position the central areolæ of the *Coscinodiscus* which it represents, appear as deep cups, whilst, if it be turned round so as to change places of top and bottom, they appear as projecting bosses.

No. 51 of the same series was the first in which I distinctly marked in my note-book the fact that the dots in that diatom, *Mastogloia angulata*, appeared dark in the instrument, but light in the photograph print. The difference of effect was least important in shells which have an even, smooth film of comparatively little thickness, and the greatest in those in which the diatom seems to have strongly marked bars separating the lines of areolæ, as in *Pleurosigma balticum*.

In a number of cases in which the plates were originally taken

with a sharp focus upon the view of the shell which I desired, I have taken transparencies from them by contact, and using these last as negatives from which to print the paper prints, I have found that these last are, according to my notes, what the former should have been if there were no difference between the visual and the actinic focus. A few of these have been prepared for exhibition to the Society. The prints taken from the second plates are marked 'positives' of the originals, and are in fact the true representation of the object as I saw it when taking the original photograph. They are—

No. 66. *Navicula serians* Kütz., taken with a Spencer 1/16 in. balsam angle 125°, with No. 118 as the positive from it.

No. 60. *Pleurosigma formosum* W. Sm., taken with a Spencer 1/10 in. balsam angle 108°, with No. 122 as the positive from it.

No. 83. *Pleurosigma formosum* W. Sm., taken with a Wales 1/15 in. balsam angle 82°, with No. 119 as the positive from it.

No. 110. *Pleurosigma balticum* W. Sm., taken with a Zeiss 1/18 in. balsam angle 116°, with No. 113 as the positive from it.

The objectives are all of the first class, and it is safe to assume that what holds true with them will be found true with any of our best glasses. In taking the original photographs, I used a plain plate of glass instead of the usual ground-glass screen in the camera, and focused by the aid of a Dorlot focusing glass.

The examples to which I have referred would seem to warrant the conclusion that in using high-power objectives, the difference between the visual and the actinic focus is the equivalent of that between a positive and negative image of the object, when the details have passed a certain limit in fineness. But some experiments, made for the purpose of finding how far the tube of the Microscope must be moved to secure the proper actinic focus upon the sensitive plate, have had such unsatisfactory results as make me unwilling to venture any positive conclusion, but content myself with stating the facts above given, until further investigations which I am making shall be completed.

In the course of the experiments referred to, I noticed that the image taken on the plate was apparently of a lower plane in the object, than the visual one which I was seeking to get. This was shown in the diatoms with a convex surface, by the sharper image, in the print or plate, of areolæ nearer the margin of the object than those upon which I had focused. It showed also that the difference seemed to be the same in kind as in the use of low-power objectives, with which it is necessary to raise (withdraw) the tube after getting a sharp visual image of the object. Acting upon this, I tried in several instances the gradual raising of the tube, taking pictures at slightly varying departures from the visual focus, until the image was quite spoiled and blurred to the eye. I made some series of as many as five or six plates thus progressively varying, but without satisfactorily establishing any point (different from the visual focus) at which the objective should be placed to secure in the photographic image the true characters of the visual one. I was surprised to find at what a distance from the visual focus a sharp image could be

taken, but it was not the image for which I was in search. Examples of this sort are among the prints which I will exhibit to the Society.

I design to add to my experiments on the subject, the examination of the effect of changing the focus of the focusing glass to correspond with the difference between the visual image of a diatom, showing little dots or areolæ and that which shows dark ones. Everybody has noticed that a slight change of focus with a high power produces this change of appearance, and if the focusing glass were adjusted for the image which is complementary to the one desired, and then the focusing done in the usual way, the result might be that which is sought. It has at least seemed worth the experiment, but a press of other work has prevented my making a satisfactory test of it before the time of our meeting."

Images in the Binocular Microscope.*—Mr. E. M. Nelson writes, "Binoculars give less critical pictures than monoculars, for the very good reason that half an objective will not perform so well as a whole one. All prisms are defective; therefore the image in the left tube is worse than that in the right. The image in the binocular, therefore, consists of an indifferent picture in the right-hand tube, and a worse one in the left. Observers put up with this for the sake of the stereoscopic effect, which is gained at the cost of a critical image. . . .

Opticians know very well that the eye will accommodate itself, and combine almost anything; therefore little or no pains are taken to send out binoculars in perfect adjustment. I will mention a fault which is frequently seen in binoculars exhibited at the Societies.

1. The axis of the left-hand tube does not make the proper inclination with the other; this causes the field of the left-hand tube not to coincide laterally with that of the right hand (fig. 243).

2. If the axes of the eye-pieces are not in the same plane, the field of one tube will be either above or below the other (fig. 244).

Fig. 245 shows what is often found, viz. Nos. 1 and 2 combined.

3. The focus of each tube should be carefully adjusted, either by the tube or by the eye-piece. I have my own done by collars round the eye-pieces; but the tube-length method is preferred by some, and is just as efficient.

4. The eye-pieces should be matched in power.

5. The position of the prism in its carrier should be correctly adjusted. One would think that a very trifling movement in the prism would make a very great difference in the position of the image of the field, but such is not the case. The plane of the base of the prism should be at right angles to the axis of the objective; if, however, this is tilted through an angle of 20°, one will be surprised at the small difference it makes. Any twist in the prism would make a very serious fault; in other words, the planes of the reflecting surfaces of the prism must be at right angles to the plane of the axes of the tubes. See fig. 246, which shows that when the prism is out of adjustment an object will not occupy the same position in each

* Engl. Mech., xlii. (1885) p. 202 (6 figs.).

field. (In making this test it is as well to use the same eye-piece on each tube.)

6. When the carrier of the prism is pushed home, the edge of the prism should exactly bisect the back of the objective. Fig. 247 shows the picture in the left-hand tube when the prism is not pushed in far enough. When the prism is pushed in too far the dark patch would be seen on the opposite side of the right-hand tube.

7. The diaphragms in the eye-pieces should be of the same size (fig. 248).

Fig. 243.

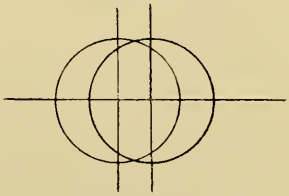


Fig. 244.

Fig. 245.

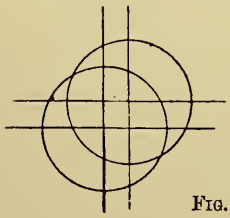


Fig. 246.

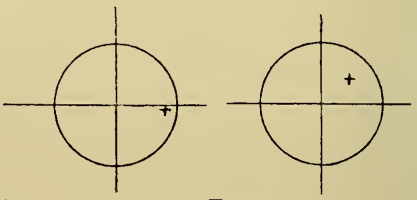


Fig. 247.

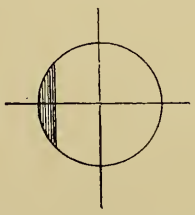


Fig. 248.

The best way to find out if the fields are exactly superimposed is to blink or wink rapidly with each eye alternately." (Mr. Nelson's remarks apply to the Wenham Binocular only.)

Position of Objects with the Binocular.—Mr. E. M. Nelson, considering that the binocular Microscope does not give images so good as the monocular, has endeavoured to find out the cause and to remedy it if possible.*

He obtained a Wenham prism of good quality and had it properly

* Journ. Quek. Micr. Club, ii. (1885) pp. 198-200.

fitted; then, finding that the left tube was rather longer than the right, he had the eye-pieces differently focused to suit, having them so marked as to be able to tell the one from the other. Having done this he found that matters were improved, but that there was still something more which required a remedy. To test it he took one of the fine bristles from the maxillary palpi of a blow-fly, but he found that no kind of illumination would make it appear sharp if it were placed on the stage in a vertical position, but if it were placed horizontally across the prism, it was perfectly shown.

Another experiment was in regard to the stereoscopic effects obtained when the object was in different positions, and the object selected for this purpose was the central pseudo-trachea of the proboscis of the blow-fly. On examining this he found that when it was placed in a vertical position, there was no difference between the stereoscopic effect with and without the prism, except as regarded the marginal portions of the field where the eyes were to a certain extent deceived, but when the object was placed horizontally a strongly stereoscopic effect was produced. On the central membrane of the trachea there were a number of small spines which formed excellent test-objects, and if these were placed vertically they appeared foggy, and nothing could be clearly made out about them; but when seen in the horizontal position their appearance was so changed that it was hardly possible to recognize them as the same objects. In his specimen there was a slight dip or depression in one part of the membrane, which could not be perceived under any illumination with the monocular, but under the binocular in a horizontal position it was perfectly well seen, though the same instrument failed entirely to show it when the major axis of the lips was in a vertical position. He also tried diatoms, and found the difference in the stereoscopic effects surprisingly marked, especially in the case of *Heliopelta*.

In a later communication * Mr. Nelson deals more fully with the case of the proboscis of the blow-fly as follows:—

"I wish that every possessor of a binocular would try the following experiment.

Place the proboscis of the blow-fly, squeezed flat in balsam, in a vertical position, and examine it binocularly with, say, a 2/3 in. objective, and let the attention be concentrated solely on the two main vertical cut suctorial pipes. Now let the observer carefully examine those with a view to determine the amount of stereoscopic effect the binocular gives to them. Let me warn him against letting his eye cheat him by giving those suctorial pipes a stereoscopic effect which they do not possess, derived by contrast with other parts of the field. He must, to make this experiment correctly, resolutely shut his eyes to everything else in the field except those suctorial pipes. I feel sure that no candid observer correctly performing this experiment will be able to detect any more stereoscopic effect on that object than if it were examined monocularly. Of course, there will be stereoscopic effect to a certain degree, as there will be also in the

* Eng. Mech., xlii. (1885) pp. 202-3.

monocular, for it must be admitted that the monocular gives a decided idea of solidity. For myself, I cannot see any difference in the stereoscopic effect between the binocular and monocular on that object when it is placed in the position I have pointed out, although I have repeatedly gone over the experiment with great care, and with a perfectly unbiassed mind.

Now turn the object round, so that the cut suctorial pipes lie in a horizontal or east and west position; the stereoscopic effect is so marked that you might easily fancy you could crawl along the pipes. When the object is in a vertical position, I would call the attention of the observer to the loss of definition of all fine details which lie in a vertical position. I allude to the minute hairs on the delicate membrane which is stretched across the two cut suctorial pipes. When the object is turned round, notice how sharp they become.

To sum up, every exhibitor should be careful to *place his object so as to secure the largest amount of stereoscopic effect.* It is, of course, immaterial which way some objects are placed, such as a *Coscinodiscus;* but *Isthmia*, *Pleurosigma*, *Navicula*, &c., should be placed with their major axes east and west, as well as objects such as scales on butterflies' wings, and many others."

Mr. Nelson further expressed "the hope that some one might be "able to find out the cause of the difference, and to suggest a remedy."

It may be that we underrate the difficulty which Mr. Nelson feels on this matter, but we should have thought it almost unnecessary to point out that the maximum of stereoscopic effect is obtained, *ex necessitate rei*, only when the object lies in a "horizontal" position. In that position there is necessarily the maximum of displacement of the images observed by the two eyes; in the "vertical" position this displacement is at its minimum, and the stereoscopic effect is in great part lost.*

Another and quite different point to be noted in explanation of Mr. Nelson's difficulty is the reduction of aperture that takes place *in one direction* with the Binocular, which we have already pointed out in this Journal.† This necessitates for the resolution of the markings on diatoms, for instance, that the *particular markings to be resolved* should be placed "east and west," but not necessarily the major axis of the object, as directed by Mr. Nelson, a direction which we fear will mislead some microscopists.

Whilst pointing out that the explanation of Mr. Nelson's problem is one that has been long recognized by microscopists, and presents no such difficulty from a theoretical point of view as supposed, we quite agree with him that it is but rarely that any practical effect is given to the matter by exhibitors.

Microscopes at the Inventions Exhibition.—The following Jury awards have been made in respect of the Microscopes and Microscopic Apparatus exhibited at the International Inventions Exhibition.

To Messrs. R. & J. Beck a Gold Medal for "Microscopic and other

* See further on this subject, this Journal, i. (1881) p. 203, and iv. (1884) p. 20.

† See this Journal, iii. (1880) p. 874.

optical apparatus." To Messrs. Ross & Co. a Gold Medal for "Progress and excellence of work in the manufacture of lenses since the early days of photography, also microscopic and other optical apparatus." To Mr. H. Crouch a Silver Medal for "Improvements in microscopic apparatus." And to Mr. C. Baker a Bronze Medal for "Students' microscopic apparatus."*

Photo-micrograph of Tongue of Blow-fly.—The Photographic Society of Great Britain awarded a medal to Mr. Mansell J. Swift for a photo-micrograph of this object shown at their recent exhibition. There were 805 exhibits, and 20 medals were awarded.†

Pen-and-Ink Drawings of Microscopic Objects.‡—A very valuable addition has recently been made to the science collections now displayed in the western galleries at the South Kensington Museum of Science and Art. Mr. Rochefort Connor, of the Inland Revenue Department, has prepared a number of exquisitely finished pen-and-ink drawings of objects viewed with the Microscope, often by the aid of very high powers.

The collection, which covers two large screens in the rooms devoted to biology and geology, includes drawings of insects and other minute forms of animals and of various anatomical preparations from them, of curiosities of pond-life and of the skeletons of many organisms both recent and fossil. Amongst these last Mr. Connor's highly finished representation of some of the more complicated forms of the Diatomaceæ, such as *Heliopelta* and *Coscinodiscus*, are especially worthy of admiration, though some of his drawings of Foraminifera, Pryozoa, and sponge-spicules are scarcely inferior to these in delicacy of execution. These drawings represent, we understand, the leisure hours of a busy lifetime, and their author is now engaged in a series of microscopic drawings illustrating the characters of food products and their adulterants. A few of these are now exhibited as samples, and the series, when complete, cannot fail to be of great use to public analysts and others.

Supposed increase of the Aperture of an Objective by using highly refractive Media.—A very important misapprehension appears to have arisen on this subject amongst some of our colonial brethren, it being supposed that by using a mounting medium of high refractive index an objective of small aperture can be made equal in effect to one of large aperture. This is recorded in the Journal of the Royal Society of New South Wales,§ from which we make the following extracts.

"Dr. Morris exhibited a new mounting medium, having a refractive angle of 2·6, the highest known, and comparing favourably with the celebrated one of Prof. Smith, of Geneva, New York. Sulphur is melted on the slide, and the cover to which the diatoms are attached is dropped upon and pressed down upon the sulphur; the refractive index of sulphur is 2. Also selenium and sulphur ground and mixed

* Supplement to the 'London Gazette' of 11th August, 1885, No. 25,500.
† Cf. Journ. and Trans. Phot. Soc., x. (1885) p. 13.
‡ Nature, xxxii. (1885) p. 633.
§ Journ. and Proc. Roy. Soc. N. S. Wales, xviii. (1884) pp. 178–9.

together, and the slide prepared as above—refractive index about 2·3. Also selenium by itself—refractive index 2·6.

With all the above media *A. pellucida* was splendidly resolved. These experiments by Dr. Morris were undertaken with a view of enabling objectives of the older constructions and of less angular aperture to resolve the highest test diatoms as easily as the new wide-angled homogeneous lenses."

"Mr. Hirst exhibited *A. pellucida* resolved by Zeiss's 1/8 water-immersion objective, in a manner scarcely to be surpassed by the new oil-immersion objectives. The diatom was mounted in sulphur—this proving Dr. Morris's theory that a highly refractive mounting medium enables low-angled objectives to compete in resolution with the new oil-immersions."

We do not quite understand how such a notion could have arisen, unless it was from misapplying a little the principle which requires the use of a mounting medium of at least equal refractive index to the aperture of the objective, in order to fully utilize such aperture. It need hardly be pointed out here that if an objective has an aperture of say 0·75 only, nothing that can be done with the mounting medium can possibly increase the aperture or resolving power of the objective. The advantages of highly refracting media are limited (as shown by Mr. Stephenson in his original paper *) to intensifying the images. An appropriate medium will enable the full effect of a given aperture to be utilized, but cannot increase it or make an objective of low aperture "resolve the highest test diatoms as easily as a wide-angled homogeneous lens." We propose to return to this subject when we can find space for a few diagrams, which will, we hope, prevent such an idea as that above quoted being again put forward.

American Society of Microscopists.—[Conclusion of Report of Cleveland Meeting. Also a serio-comic account of the working of the Session and Soirée, from the 'Plain Dealer,' containing such comments as the following: "Having looked at the wriggling worms [in printers' paste] that made the mass literally alive, they could understand why it is that newspaper paste so seldom sticks. The insects literally walk off with the pasted clipping on their backs."]

Amer. Mon. Micr. Journ., VI. (1885) pp. 195–9.

See also *Queen's Micr. Bull.*, II. (1885) pp. 33, 34–5.

BANKS, C. W.—**[Electricity under the Microscope.]**

[Exhibition of "Stokes's Spark Apparatus," and "Moore's Geissler tube." "Mr. Banks also showed the peculiar effects produced by the passage of the electric spark through various substances—such as oil, filings of metals, films of soot, finely powdered plumbago, &c. These displays were in nearly every case vivid and beautiful. The oil imparted an intensely green colour to the spark; while the course of the latter through the filings of metals produced entirely different, though not less striking effects. A peculiar appearance was produced by the passage of the calorific spark through a mixture of small globules of mercury and gold-filings. The current was thereby interrupted in such a manner that instead of continuous streams of light, these were broken up into dots and dashes, very strikingly resembling a luminous Morse alphabet. The entire exhibition was attractive by reason of its novelty as well as its beauty."]

Proc. San Francisco Micr. Soc., 1885, Sept. 23rd.

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* See this Journal, ii. (1882) p. 163.

Behrens, W.—**Winkel's Mikrometerocular mit vertical beweglichem Mikrometer.** —(Winkel's Micrometer-eyepiece, with vertically movable Micrometer.)

[Abstract of article in Zeitschr. f. Wiss. Mikr., II. (1885) p. 41. With comments. *Post.*]

Zeitschr. f. Instrumentenk., V. (1885) p. 326.

Bert, P.—**First Year of Scientific Knowledge.** Transl. by Mdme. P. Bert.

[Sec. 131, Lens, pp. 168-9, 176 (2 figs.). Sec. 132, Compound Magnifying-glasses and Microscopes, pp. 169–70, 176 (1 fig.). "Great magnifying power may be obtained by a Microscope. Things appear 100 times, 200, and even 1000 times larger than they really are." "Had we time, how many astonishing and marvellous things might I not show with its help! Thousands of living beings in a drop of stagnant water, *millions of tiny red bodies in a drop of blood*, and I cannot tell what besides."]

344 pp. (figs.), 8vo, London and Paris, 1885.

Blacking Brass Diaphragms, &c.

[Dissolve 1/4 oz. sulphate of copper and half its weight of hyposulphite of soda in a little more than a pint of water. Well clean the diaphragm; place it in the solution and heat it. More hyposulphite will give a darker tint; more sulphate, a lighter steel-grey colour.]

Amer. Mon. Micr. Journ., VI. (1885) p. 178, from *Brit. Journ. Phot.*

Burrill, T. J.—**Photo-micrography work with high powers.**

[Title only of paper read at Ann Arbor meeting of the Amer. Assoc. Adv. Sci., 1885.]

Amer. Journ. Sci., XXX. (1885) p. 327.

Carpenter, W. B.—**The President's Address to the Quekett Microscopical Club, 24th June, 1885.**

[Remarks on Mr. Buffham's paper on the conjugation of *Rhabdonema*, *ante*, p. 842. Expression of regret at the tone of Prof. E. R. Lankester's criticism of Mr. B. T. Lowne's views of the eyes of insects. Recommending the study of the question whether the Bacteria have permanent specific forms and distinctive potencies, or are capable of being modified by culture or natural influences so as to change their potency. Nitrification.]

Journ. Quek. Micr. Club, II. (1885) pp. 180–8.

Chadwick, W. I.—**The Magic Lantern Manual.**

[The Microscope, pp. 131–5.]

2nd edition, 154 pp. and 107 figs., 8vo, London, n.d. (Preface 1885).

Cox, J. D.—**The Actinic and Visual Focus in Photo-micrography with High Powers.** [*Supra*, p. 1070.] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 193–5.

Czapski, S.—**[Abbe's Optical Thories.]**

[Brief general summary in a review of Dippel's 'Grundzüge der Allgemeinen Mikroskopie.'] (*In part.*)

Zeitschr. f. Instrumentenk., V. (1885) pp. 367–9.

Ellis, A. J.—See Helmholtz, H. L. F.

Fleischl, E. v.—**C. Reichert's neuer beweglicher Objecttisch.** (C. Reichert's new movable stage.) [*Post.*]

Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 289–95 (2 figs.).

Friederich, K.—**Instrument zur Messen und Theilen von Linien.** (Instrument for measuring and dividing lines.)

German Patent Kl. No. 31,878, June 4th, 1884, and No. 32,805, March 10th, 1885.

G., E. P.—**Binocular Microscope.**—See Nelson, E. M.

Gray's (S.) Water Microscopes.

[Description (by "the ghost of Stephen Gray") of his water, fluid reflecting, and isinglass Microscopes—from Phil. Trans., XIII. (1696–7).]

Engl. Mech., XLII. (1885) pp. 99–100 (2 figs.).

Grunow's (J.) Abbe Illuminator. [*Supra*, p. 1065.]

Amer. Mon. Micr. Journ., VI. (1885) p. 183 (1 fig.).

Helmholtz, H. L. F.—**On the Sensations of Tone** as a physiological basis for the theory of music. 2nd Engl. ed. transl. from the 4th German ed. by A. J. Ellis, with additional notes and appendix.

[Contains a description of the "Vibration Microscope." *Post.*]

xix. and 567 pp. (70 figs.), 8vo, London, 1885.

HEURCK, H. VAN.—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition. *In part.*)
Journ. de Microgr., IX. (1885) pp. 364–75 (6 figs.).

HIRST, G. D.—[**Dr. Morris's theory as to highly refractive mounting media.**]
[*Supra*, p. 1078.]
Journ. and Proc. Royal Soc. N. S. Wales, XVII. (1884) p. 179.

[HITCHCOCK, R.]—**Postal Club Boxes.**
[Contents of Box F.] *Amer. Mon. Micr. Journ.*, VI. (1885) pp. 199–200.

HOGG, J.—**The Microscope**; its history, construction, and application.
[New title-page only.]
11th ed., xx. and 770 pp., 8 pls. and 356 figs., 8vo, London, 1885.

HYDE, H. C.—**The Electric Light in Microscopy.**
[Exhibition of lamps of 1 and 3 candle power. He "agreed with the conclusions arrived at by other observers, that while the light itself is eminently adapted to microscopical purposes, its general adoption will have to be deferred until marked improvements are made at the battery end. He doubted whether any of the fluid batteries could be modified so as to answer the purpose, and was disposed to think that in some form of storage battery the necessary qualities would ultimately be found. To that end he was experimenting."]
Proc. San Francisco Micr. Soc.., 1885, *August 26th.*

INOSTRANZEFF.—[**Double Microscope for non-transparent Minerals.**]
[*Supra*, p. 1058.] *Illus. Sci. Monthly*, IV. (1885) p. 27.

Jadanza, N.—**Zur Theorie der Fernrohre. Ueber die zusammengesetzten dioptrischen Systeme.** (Theory of the Telescope. On compound dioptric systems.)
Centr.-Ztg. f. Optik u. Mech., VI. (1885) pp. 193–5, 205–8 (2 figs.).
Transl. from *Atti R. Accad. Sci. Tor.*, XIX. (1883).

[JAUBERT, L.]—**Les Instruments de l'Observatoire Populaire.** (The Instruments of the 'Popular Observatory.')
[Microscopes *post.*] *Les Sciences*, I. (1883) pp. 53–7 (4 figs.).
Cf. also pp. 9 and 11, 31, 46, 62–3, 78, 109.

JOLY, J.—**The Meldometer.**
[*Supra*, p. 1068.] *Nature*, XXXIII. (1885) pp. 15–6.

LANKESTER, E.—**Half Hours with the Microscope.** A popular guide to the use of the Microscope as a means of amusement and instruction.
[New title-page only.]
16th ed., xx. and 130 pp. (30 figs. and 9 pls.), 8vo, London, n.d.

Leckenby's (A. B.) Microscope Pencil-case. [*Supra*, p. 1065.]
Amer. Mon. Micr. Journ., VI. (1885) p. 200.

LEWIS, R. T.—**New Gauge for Wires or Plates.**
[Trotter's Patent.] *Journ. Quek. Micr. Club*, II. (1885) pp. 203–4.

MÖLLER, J.—**Reichert's Condenser.** [Vol. IV. p. 437.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 339–40 (1 fig.).

MORRIS, W.—[**New Fluid for homogeneous objectives.**]
[Oil of resin, used pure or thinned with oil of cedar.]
Journ. and Proc. Royal Soc. N. S. Wales, XVIII. (1884) p. 177.
„ „ **New Mounting Medium.** [*Supra*, p. 1077.] *Ibid.*, pp. 178–9.

NELSON, E. M.—**Microscopical.**
[1. Reply to F. D'Agen (*ante*, p. 888) as to the effect of bubbles at the back of an objective. 2. As to the resolution of *A. pellucida* (96,000 striæ per inch in Smith's medium 2·4) with a Powell dry 1/12 in. of N.A. 0·94. "Of course it had to be coaxed by using sunlight, heliostat, and a suitable condenser." 3. "With regard to the Abbe theory (theoretical limit of resolving power of objectives as tabulated on cover of R.M.S. Journal), I find it in practice absolutely correct. I also believe the law on which it depends is as certainly proved as is the law of gravitation." 4. Correcting three slips in F. Grant's communication.]
Engl. Mech., XLII. (1885) p. 100 (2 figs.).
„ „ **Podura Scale.**
[Criticism of a suggestion for placing a diaphragm above the condenser instead of, as is preferable, below.] *Engl. Mech.*, XLII. (1885) p. 202.

NELSON, E. M.—Microscopical Binoculars.
[*Supra*, pp. 1073–5. Reply to query by E. P. G., p. 171.]
Engl. Mech., XLII. (1885) pp. 202–3 (6 figs.).

" " **Diaphragms.**
[Diaphragms close to the object or in contact with the lower side of the slip have no effect.]
Ibid., XLII. (1885) p. 239.

" " **Pygidium of the Flea as a test-object.** [*Post.*]
Journ. Quek. Micr. Club, II. (1885) p. 197.

" " **Position of Objects with the Binocular.** [*Supra*, p. 1074.]
Ibid., pp. 198–200.

OLDFIELD, W.—**The Construction of Object-glasses.**
[Criticism of Orderic Vital's comments on his articles.)
Engl. Mech., XLII. (1885) p. 205.

PELLETAN, J.—**Les Objectifs à immersion homogène de MM. Bézu, Hausser et Cie.** (The homogeneous immersion objectives of MM. Bézu, Hausser & Co.)
[Commendation of their Microscopes and objectives.]
Journ. de Microgr., IX. (1885) pp. 313–6 (1 fig.).

"PROCELLA."—**Microscopical.**
[1. Correcting some errors in F. Grant's communication, *ante*, p. 889. 2. Strongly recommending B Kellner eye-pieces.]
Engl. Mech., XLII. (1885) p. 100.

QUEEN, J. W.—**Table of Colour-corrections.** [*Supra*, p. 1068.]
Queen's Micr. Bulletin, II. (1885) p. 38.

REGNARD, P.—**Sur un dispositif permettant de suivre par la vue les phénomènes que presentent des animaux soumis à une pression de 600 atm.** (On an apparatus allowing the phenomena to be followed which are presented by animals subjected to a pressure of 600 atmospheres. [*Ante*, p. 876.]
Comptes Rendus, C. (1885) pp. 1243–4 (1 fig.).
Nature, XXXII. (1885) pp. 399–400 (2 figs.), from *La Nature*.
Journ. Soc. Scientifiques, I. (1885) pp. 358–9. (*Soc. de Biol.*, 25th July.)

Robin (C.) Death of. *Nature*, XXXII. (1885) p. 578.

ROYSTON-PIGOTT, G. [W.]—**Microscopical Advances—Ancient and Modern. I.**
Engl. Mech., XLII. (1885) pp. 231–2.

SMITH, H. L.—**The influence of Science Studies.**
[Presidential Address to the Cleveland Meeting of the American Society of Microscopists.

"Happily we, in the study of microscopy, are untrammelled by metaphysical thoughts. We microscopists do not trouble ourselves with cause and effect, but leave the leaven in the lump, feeling assured that it will in time leaven the whole. The old word has passed away. The age of the hero has passed away. The people have arrived. Science has arrived, and theology, law, and all are on trial. Those who devote their lives to scientific research develope a love for truth."

"Professor Smith said that he could remember when physicians were shy of the Microscope. To-day, while there are a few old practitioners who shrug their shoulders distrustfully when the younger physicians use the Microscope, even the older ones are unconsciously affected in their practice by advancement in microscopical investigations. The President spoke of biology, which owed its existence to microscopy, and which has worked a revolution in medicine. Anything that can claim to aid us in coping with contagious diseases, with blights upon our crops and diseases in our flocks, is of intense interest to the public, and it is with these that biology deals. It is in its infancy yet, but it is destined to become more and more important. The speaker said that it had been shown that a two-hundred millionth part of a drop contains enough bacteria to be deadly infectious. He said that when it is shown that ventilation and sewage have been greatly benefited by microscopic investigations, it may be considered fortunate that some men have microbes on the brain, as has been said in jest. He said that biology may yet prove that the infinitesimal organisms with which it deals are not alone concerned with

disease, but with health as well, and that they, acting in the pores of the human system as workers, carry off the sewage of the system, and thus overcome the effects of violations of nature's laws, and thus work to the end of aiding man in working out in himself the theory of the survival of the fittest. He said that microscopy has a great work to do in geology, and thus in affecting the commerce of the world."]

Amer. Mon. Micr. Journ., VI. (1885) pp. 166–7.

SMITH, H. L.—**Device for Testing Refractive Index.** [*Supra*, p. 1066.]

Ibid., pp. 181–2 (1 fig.).

Cf. *Queen's Micr. Bull.*, II. (1885) p. 40.

SORBY, H. C.—See Wedding, H.

W., E. D.—**Measurement of Power and Aperture of Microscopic Objectives.**

[1. Describes the following method:—Remove the eye-piece; adjust the length of the tube by means of the draw-tube to exactly 10 in. from the back lens of the objective (this may conveniently be done by dropping a straw cut to 10 in. in length into the tube, allowing the lower end of it to rest on the back lens). Place a stage-micrometer divided into hundredths and thousandths of an inch on the stage. Hold a finely ground slip of glass on the top of the draw-tube. Focus until the divisions of the stage-micrometer are clearly visible on the ground-glass slip, when they can be marked on the slip with a pencil. The extent to which the divisions of the micrometer are magnified on the glass slip indicates the power of the objective.

2. Also gives a method for ascertaining the angular aperture of an objective:—Place the Microscope with its tube in a vertical position on a table having a dark-coloured cover. Take out the eye-piece. Rack down the tube until the front of the objective is level with or below the under side of the stage. All substage fittings must be removed. Take two pieces of white card and place them on the table right and left of the Microscope. Look down the tube, and move the pieces of card until you can just see the extreme edge of each piece of card mirrored on each side of the field of the objective on the extreme edge of the circle of the field. Now measure the distance apart of the two pieces of card (their inside edges) and the distance from the table of the front lens of the objective. Draw the first-mentioned distance on a sheet of paper as a horizontal line, and set up the latter distance from the middle of this line, and perpendicular to it. Draw two lines from the ends of the horizontal distance to the top of the perpendicular one—when the angle formed by these two lines will be the angular aperture of the objective, or a close approximation to it.]

Engl. Mech., XLII. (1885) pp. 100–1.

WARD, R. H.—**Choice of Objectives and Oculars.**

["It is probably quite safe to say that objectives anywhere from 1/8 in. to 1/12 in., if not lower, can now be obtained, which will show as well as has ever been done anything that has yet been seen by the Microscope. The question as to the choice of moderate or extreme apertures for objectives is still open, and somewhat evenly disputed." "In the combining of oculars with objectives it is still undecided whether it is preferable to secure a sufficient variety of powers by means of a large number of objectives, or by the high and low eye-piecing of a few."]

Journ. N. York Micr. Soc., I. (1885) p. 164, from article "Microscopy," in 'Appleton's Annual Cyclopedia' for 1884.

" " **The Binocular.** (*Concluded.*)

[Wenham's, Nachet's, and Abbe's, and general remarks.]

Queen's Micr. Bull., II. (1885) p. 38, from *The Microscope in Botany* (Behrens).

WEDDING, H.—**The properties of malleable Iron deduced from its microscopic structure.**

[Includes a letter from Dr. H. C. Sorby, on a "Direct illuminative" contrived by him. *Post.*]

Colliery Guardian, 1885, June 5, p. 908.

WRIGHT, L.—**The Optical Lantern.**
[Reply to "Rector," *ante*, p. 891. Waste heat cannot be utilized. As to Newton's new improved 6 in. and 4½ in. objectives for the oil-lantern.]
Engl. Mech., XLII. (1885) pp. 121–2.

WYTHE, J. H.—**The Microscopist**; a Compendium of Microscopic Science; including the use of the Microscope; mounting and preserving microscopic objects; the Microscope in Chemistry, Biology, Histology, Botany, Geology, Pathology, &c.
4th ed., pp. i.–xii. 17–434, 240 figs. and 27 pls., 8vo, Philadelphia, 1883.

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

Preserving Eggs of Cephalopoda and preparing Blastoderms.*—Mr. W. E. Hoyle finds that when the young Cephalopods have reached a stage at which the rudiments of the arms are clearly visible it is moderately easy, after a little practice, to extricate them by making an incision into the egg-membrane with a fine scalpel; but previously to this period they so nearly occupy the whole interior of the egg that it is almost impossible to obtain them uninjured. A quantity of such eggs he preserved whole by a method suggested by Dr. Jatta. The strings of eggs are placed whole in a weak solution of chromic acid (about 0·25 per cent.) for a few hours, and then in distilled water for twenty-four hours, after which they are preserved in alcohol. The embryos can then be extracted much more readily than when fresh.

A number of blastoderms in process of segmentation were preserved according to a method proposed by Ussow. The egg, without removal of the membranes, is placed in a 2 per cent. solution of chromic acid for two minutes, and then in distilled water to which a little acetic acid (one drop to a watch-glassful) has been added, for two minutes longer. If an incision be now made into the egg-membrane the yolk flows away and the blastoderm remains; if any yolk still clings to it, it may be removed by pouring away the water and adding more. The blastoderms thus prepared show, when appropriately stained, fine karyokinetic figures.

Treatment of the Eggs of the Spider.†—The eggs of the grass spider (*Agalena noevia*) are deposited in cocoons attached to the under side of loosened bark and other sheltered places. During the entire winter cocoons may be found with eggs in early stages of development. The species thrives well in captivity, so that there is no difficulty in obtaining eggs freshly laid.

For studying the egg in a living condition the long-used method of immersion in oil is, Mr. W. A. Locy thinks, excellent. The oil should be perfectly clear and odourless. The external features can be studied to better advantage by mounting the eggs in alcohol after they have been freed from the chorion and stained. Another valuable method for surface study consists in clearing the already stained egg in clove oil. The thickness of the blastoderm is most easily determined in this way.

The best method of hardening preparatory to sectioning is that

* Nature, xxxii. (1885) p. 506 (Report to British Association).
† Amer. Natural., xix. (1885) pp. 102–22.

of heating in water to about 80° C., and then after cooling slowly, treating with the usual grades of alcohol. Good results are obtained with Perenyi's fluid, which renders the yolk less brittle. Osmic acid does not penetrate the chorion, and chromic acid or acid alcohol are not easily soaked out on account of the thickness of the chorion.

Borax-carmine is, on the whole, the best staining fluid. It is difficult to make the dye penetrate the chorion, and, after hatching, the cuticula forms a similar obstacle. This difficulty may be overcome by prolonged immersion in the staining fluid. In some cases seventy-two hours were required to obtain a sufficient depth of colour. In order to avoid maceration, which would result from so long continued immersion in a weak alcoholic dye, the staining process may be interrupted at the end of every twenty-four hours by transferring to 70 per cent. alcohol for an hour or more.

After most methods of hardening the yolk becomes very brittle, and the sections crumble. This difficulty may be overcome by collodionizing the cut surface before making each section, in the manner described by Dr. Mark.*

Balkwill's Foraminifera Slides.—Various "triumphs of mounting" have been issued from time to time, including the well-known arrangements of the scales of butterflies, but Mr. F. P. Balkwill must be considered to have carried off the palm by his slides of Foraminifera which he commenced to issue now some years ago. On a

Fig. 249. Fig. 250.

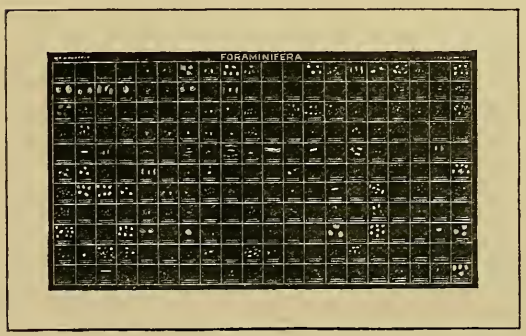


plate only $2\frac{1}{4}$ in. by $1\frac{1}{4}$ in. no less than 220 different collections of species of Foraminifera are arranged and named. Fig. 249 shows the slide in natural size, with the 220 divisions. It has not been possible to reproduce the photographed names, but fig. 250 enlarged 4 times shows how they are placed.

Preparing Leaves to show Starch-grains.†—A very interesting experiment, showing the influence of light upon the formation of

* Amer. Natural., xix. (1885) p. 628. See this Journal, *ante*, p. 737.
† Cf. Amer. Mon. Micr. Journ., vi. (1885) p. 178.

starch in leaves, can be readily performed according to a method recently described by Prof. J. Sachs. To show the starch-grains a leaf must be bleached and made transparent in this way: The fresh leaf is placed in boiling water for ten minutes, after which the chlorophyll is extracted by placing it in alcohol. The colour is thus removed without rupturing the cells, which retain the starch. The latter is then made visible by treatment with iodine. The cellular tissues become stained dark blue or lighter, according to the quantity of starch present. Comparative experiments may be made by exposing half of a leaf to sunshine while the other half is protected. A leaf collected in the evening contains much more starch than in the morning.

Studying Pollen-grains.*—For the study of the development of the pollen-grains of *Campanula Americana*,† Prof. C. R. Barnes used alcohol-fixed buds, which had been twenty-four hours in equal parts of 95 per cent. alcohol and glycerin, commencing with those 2 mm. in length. The sections of the entire bud were stained with an aqueous solution of methyl-blue. The plant is an admirable one for the use of students in this respect.

For the study of the pollen-grains themselves fresh material is requisite. The best results were obtained by staining with Grenacher's borax-carmine. The grains are placed in a drop of 2 per cent. acetic acid, and after a few minutes a drop of borax-carmine added. This is allowed to remain an hour, the slide being protected from evaporation meanwhile. The stain is then washed out with acidulated alcohol (70 per cent. alcohol 100 cc., HCl. 5 cc.), and a drop of dilute glycerin placed on the specimens. The demonstration of the nuclei is extremely difficult.

The grains were germinated in a hanging drop of 3-12 per cent. sugar solution in the usual moist chamber. After three hours they were examined, the cover-glass with the drop being lifted off and allowed to fall on (1) a drop of acetic-iodine-green,‡ or (2) a drop of picro-carmine. After a few minutes dilute glycerin is run under the cover. Both yield excellent results. The nuclei in the tubes are thus more deeply stained than the cytoplasm.

Longitudinal sections of the stigmas serve for the study of the entrance of the pollen-tubes. The author used alcoholic material, without any staining, mounted in glycerin.

The pollen-tubes in the conducting tissue may be studied either in longitudinal sections of the style, or by laying open the style, and drawing a needle through the canal, thus dragging out the conducting tissue. In the latter case care must be taken to tangle the strands as little as possible, and methyl-blue should be used as a stain, otherwise the transparency of the pollen-tubes renders them very difficult to follow. The very greatly elongated cells of the conducting tissue are almost exactly the diameter of the pollen-tubes, and are liable to

* Bot. Gazette, x. (1885) pp. 353–4. † See this Journal. *supra*, p. 1028.

‡ A drop of 1 per cent. acetic acid, to which a small drop of iodine-green is added. (Strasburger, 'Neue Untersuchungen,' p. 6.)

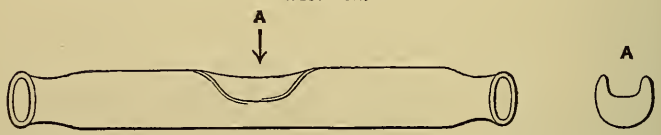
mislead, were it not for the abundant cellulose plugs which occur only in the tubes.

In the study of the ovules material fixed in strong alcohol, in a saturated aqueous solution of picric acid and in chrom-acetic acid,* was used. The contraction of the contents of the embryo-sac is unavoidable. Prof. Barnes thinks the alcoholic material is quite equal to the others and less troublesome. He found it necessary to depend on getting chance sections of the ovules by cutting the whole ovary longitudinally and laying the sections in glycerin. Previous to the cutting, the material is placed in alcohol glycerin for twenty-four hours or more. After being mounted in glycerin the sections become clearer and clearer. He also tried cutting sections in various known directions, by imbedding the ovules in coloured pith to render them more easily seen. The results, on the whole, are not better than by depending on chance sections, and they are much more troublesome.

Imbedding in Paraffin.†—Dr. E. Selenka has devised a method for fixing minute objects in a definite position in paraffin.

In a thin-walled glass tube (fig. 251) a central depression of limited extent is formed by heating this portion, closing one end of the tube with the finger, and sucking at the other end. One open end of the tube is then connected with a T-piece, one arm of which is in communication with a vessel of warm water, the other with a

Fig. 251.



vessel of cold water; the other end of the glass tube permits the water to flow out into another vessel. The paraffin is poured in a melted condition into the depression A on the glass tube, which is previously warmed by passing hot water through it, and the object to be imbedded is arranged under a lens; cold water is then admitted, and the object is fixed in the desired position.

Andrews and Nachtrieb's Water-bath.‡—The following is a description of a water-bath planned by Mr. E. A. Andrews and Mr. H. F. Nachtrieb, which has been in use for some time in the biological laboratory of the Johns Hopkins University.

The bath proper consists of a closed copper cylinder 28 in. in diameter and 8 in. deep. To the borders of holes cut in the top are soldered four round, flat-bottomed basins, 8 in. in diameter and 4 in. deep, with a distance of 2 in. between the nearest points of any two basins; and nearer the edge of the top, at the angles between the

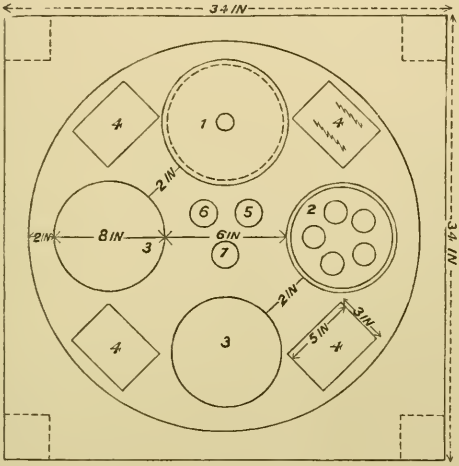
* Chromic acid 0·7, acetic acid 0·3, distilled water 99. Strasburger, loc. cit., p. 328.

† Zool. Anzeig., viii. (1885) pp. 419–20 (2 figs.).

‡ Amer. Natural., xix. (1885) pp. 917–9 (3 figs.).

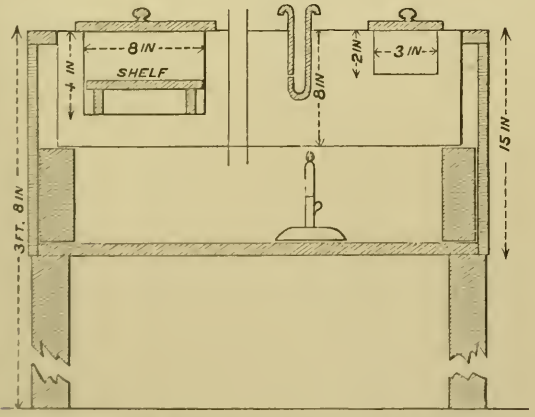
round basins, are four rectangular basins each 5 in. long, $3\frac{1}{2}$ in. wide and 2 in. deep. In each of the large basins is placed, on movable

FIG. 252.



Surface view of the bath in the table. 1, basin with lid on; 2, shelf with holes for dishes in basin; 3, open basins; 4, rectangular basins for slides; 5, tube for gas-pipe; 6, hole for regulator; 7, hole for thermometer.

FIG. 253.

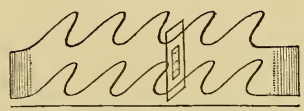


Diagrammatic section to show the depth of the bath and its basins, and its relation to the table. The legs of the table, of course, extend from the top of the box, not from the lower shelf of the table, as indicated above, and they are at the corners of the table.

supports, a shelf for the paraffin cups. This shelf is made from the circular piece of copper which was cut out of the top for the insertion

of the basin. For each basin there is also a copper lid with a button handle in the centre and a hole, 1/2 in. in diameter, near this for a thermometer. When the bath is once regulated this thermometer can of course be dispensed with and the hole in the lid can be plugged up with a cork. By this arrangement the paraffin dishes are always kept dry and at a uniform temperature all over. The four rectangular basins are used for warming the slides. In each of them is a movable rack made of two tin slips, each about 1/2 in. wide, and folded as shown in fig. 254. Each of these basins also has a copper lid with a button handle in the middle.

Fig. 254.



Supports for slides in rectangular basins.

Near the centre of the bath a tube 1 in. in diameter passes from the top down to and through the bottom. This tube is the passage way for the glass tube that connects the burner under the bath with the gas-jet above the centre of the bath, and it should be soldered to the upper side as well as to the under side of the bottom of the bath. Near this tube are two others, each 1 in. in diameter, that project about $1\frac{1}{2}$ in. above the upper surface of the bath, but are soldered with their lower ends flush with the under side of the top of the bath. One of these tubes is for the automatic regulator, and the other is for the thermometer. Through them the water is put in or taken out of the bath. The thermometer and regulator are each in a test-tube with holes blown in the sides, about $1\frac{1}{2}$ in. from the bottom, and with a good flange on the upper edge by which it is supported on the copper tube. A bit of cotton in the bottom of the test-tube protects the mercury bulb of the regulator or thermometer from any jars against the hard test-tube. The holes in the sides of the test-tube allow the water of the bath to come in direct contact with the mercury bulbs and at the same time they are up high enough to keep the mercury from running into the bath should either of the mercury bulbs break while in the tube. The copper bath is supported in a square box-table, the top of the bath being flush with that of the table.

This table is essentially a box on four legs, with a hole in the top slightly more than 28 in. in diameter, and with a door at one end. The bath is supported on four props that rest on the lower shelf of the table, and around the inside of the table is a lining of common tin to protect against possible accident. By this means a steady flame is obtained and the loss of heat is reduced to a minimum; and by grouping the regulator, thermometer and gas-pipe near the centre of the bath, hindrances are practically done away with. There is also connected with the gas-jet a small home-made glass Bunsen burner that is attached to the glass gas-tube a little above the bath. It is very convenient for warming dip-tubes, lifters, &c. In so large a bath as this two flames are required, but both are burned very low. The one burner is connected directly with the gas-jet and the other by way of the regulator. After the bath has, so to speak, been once set it runs on uniformly and requires no attention. It is regulated

by putting a thermometer through the hole in one of the lids into the dry chamber and shutting off the regulator burner when the chamber is warm enough. The temperature, as indicated by the thermometer that dips into the water, is always a few degrees higher than that of the dry chambers. When the thermometer in the water indicates a temperature of 60° C., the basins are warm enough to keep the hardest grade of paraffin melted. The whole stands at a convenient working height, about 3 ft. 8 in.

Barrett's New Microtome.—Mr. James W. Barrett exhibited at the last meeting of the Society a microtome which he had devised (with the assistance of Messrs Swift & Son) for the purpose of preparing large sections of tissues imbedded in celloidin, gum, paraffin, or similar material, cutting under spirit, or (if necessary) under water.

The machine is adapted to allow of the preparation of sections up to 12·5 cm. diameter, or even more, but Mr. Barrett has used it chiefly to prepare sections of the whole eye, in which the parts are maintained *in situ*. Fairly serviceable machines for these purposes have hitherto been made by (amongst others) Katsch,* but the object of the present construction has been to obviate the results of faults in those previously devised. The chief improvements are (1) general solidity and large size, (2) accurate raising mechanism which gives a definite minimum movement corresponding to a rise of ·01 mm., and (3) the support given to the knife at *both* ends.

In using the instrument the imbedding mass is fixed to a plate or tube carried inside the bath by the raising mechanism. If celloidin is to be used, the mass is fixed to the cork-covered plate by simply moistening both the cork and a *flat* surface of celloidin with ether, and then firmly pressing the two surfaces together in the air until the ether has evaporated. The mass then becomes most firmly adherent to the plate. The plate is then placed in the bath, which is filled with spirit, and sections may be at once cut.

If paraffin or gum be used, the plate is replaced by an adjustable metal tube which holds the imbedding mass. The size of the plate or tube can be made to vary almost indefinitely, so that if the manufacturer is informed beforehand, the machine can be adapted for the preparation of sections of very great size.

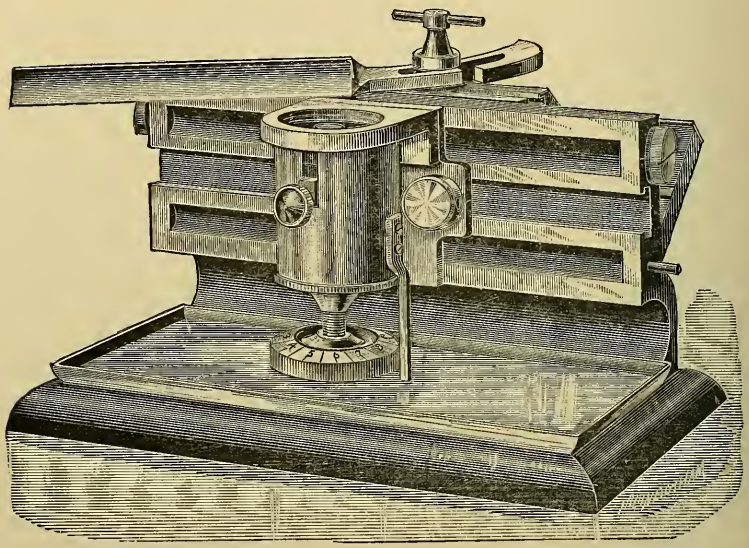
Bausch and Lomb Optical Co's. Laboratory and Student's Microtome. — This company have issued a modification of the Schanze microtome, under the name of the "Laboratory Microtome."

A second form, which they call the "Student's," is shown in fig. 255. It retains the main features of the first form, but is limited in its adjustments. The base, curved arm, upright and V-shaped beds for the object-holder and knife, are made of one casting, thus insuring rigidity. The vertical bed has a grooved slot its full length. An adjustable carriage to which the object-holder is attached, slides along the groove and can be fastened at any point. The knife-slide rests on five points upon Prof. Thoma's plan. It has a spring

* See this Journal, ii. (1882) p. 126.

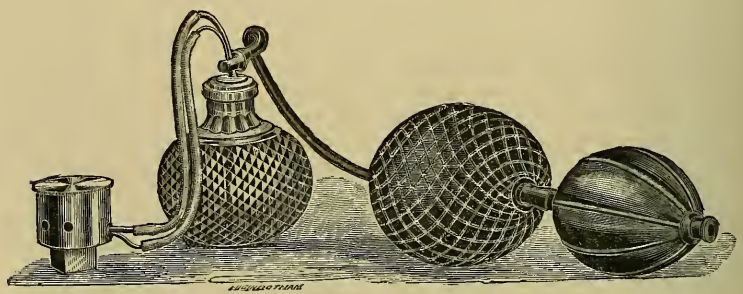
which bears against a projecting flange on the upper end of the V-bed, so that no matter how hard the material may be, the knife moves steadily through it without deviating from its plane or re-

Fig. 255.



quiring any extra pressure. The upper surface has a grooved slot to which is fitted a sliding thumb-screw so that the knife may be fastened at any point. The object-holder has a clamp for holding hard specimens, and a cup which is quickly attached for imbedding soft ones.

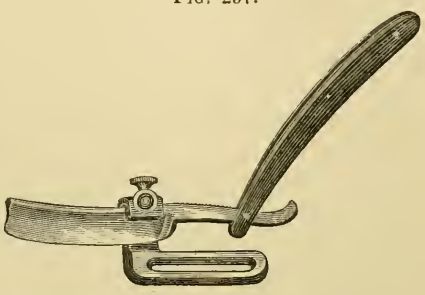
Fig. 256.



For ether freezing a nickel-plated cylinder with atomizer (fig. 256) is fastened in the clamp.

An attachment (fig. 257) is also supplied for holding other knives than those specially made for the microtome. It is provided with a slot so that it may be adjusted upon the block, and with set-screws so that the angle of the cutting edge of the knife may be varied. The knife is fixed by the thumb-screw. It will hold a razor as well as a large knife with handle.

Fig. 257.



Seiler's Microtome Attachment.—At the suggestion of Dr. C. Seiler the Bausch and Lomb Optical Co. have devised a special attachment which may be fastened to either of the preceding microtomes. It consists of a circular V-shaped way which is firmly fixed on the vertical bed. A circular block is fitted to it in a manner similar to that used in the straight movement, and is provided with a grooved slot for the attachment and adjustment of the knife. When the block is made to traverse in the circle the knife moves through the specimen in a circular as well as transverse direction, thus bringing each point of the cutting edge in a continually varying position in contact with the specimen. Dr. Seiler is able to cut large and thin sections in a very satisfactory manner.

Cambridge Rocking Microtome.*—Dr. C. O. Whitman considers that the chief objection to this microtome is, that it is adapted to only one mode of section-cutting, namely, that of producing ribbons of sections imbedded in paraffin. It could not be used for cutting collodion sections, nor can it be conveniently employed in the Duval-Mason method, where the block of paraffin is collodionized before making each section. The position of the object is such that it cannot be conveniently watched during the process of cutting; and this appears to him to form another serious objection to the instrument.

Suggestions as to the Preparation and Use of Series of Sections in Zootomical Instruction.†— Prof. R. Ramsay Wright writes on this subject as follows:—It is convenient to have in the laboratory prepared series of certain types, so that the student may supplement the information he has acquired from dissection by the study of these. Thus entire series of *Limax* and *Cyclas* and partial series of the earthworm and leech are almost indispensible for an accurate knowledge of the anatomy of these forms.

Slides 2 × 3 in. (i. e. double the ordinary width instead of double the ordinary length) are most convenient for small stages, and fit into many forms of slide-cabinets. Mica covers may be cut for these, and have the advantage of cheapness.

* Amer. Natural., xix. (1885) pp. 1022–5. † Ibid., pp. 919–20.

Czokor's alum-cochineal * is an exceedingly convenient stain for such purposes, as it penetrates an object of considerable size readily, and differentiates admirably. Thus a *Limax* may be left in the fluid twenty-four hours, afterwards washed in water and the excess of colouring matter removed by 70 per cent. alcohol before it is transferred to stronger alcohol. Sections of tissues stain in the fluid in from two to three minutes to two to three hours, according to the method of hardening that has been adopted. The fluid is prepared as follows:—Rub up 7 grm. of cochineal with an equal quantity of burnt alum in a mortar, add 700 c.c. of water, and boil down to 400 c.c. Add a trace of carbolic acid, and filter.

Bismarck brown in concentrated solution in water or 70 per cent. alcohol also stains well *in toto;* there is no danger of over-staining, as the excess of colour is removed by alcohol. It is particularly to be recommended where cartilaginous parts are to be studied, or where the sections are to be photographed.

Schällibaum's collodion and clove-oil mixture (one volume of the former to three of the latter) is excellent for sticking the sections to the slide. Although it is possible by this method to stain the sections on the slide in either watery or alcoholic media, much time is saved, and on the whole more satisfactory results obtained by staining the objects previously *in toto*. The collodion medium stains slightly in anilin colours, if staining on the slide be resorted to.

The study of a slide containing a large number of sections may, in certain cases, be much facilitated by having a photograph of the slide enlarged two or three times by means of an ordinary view-lens. Such an enlargement is frequently sufficient to indicate where an organ appears or disappears in a series, and thus to save time in the study of the individual sections.

Series of Sections. Thickness of Sections.†—Dr. R. v. Lendenfeld considers that there should always be continuous series of sections cut and mounted, one after the other. For certain things, however, and particularly for a preliminary investigation, this is not necessary to such an extent as in others, and it will save time, trouble, and material, if in such a case every second section is cut thick and thrown away, and every other cut to the required fineness and mounted.

As to the thickness of sections—a point on which a great deal depends—the mutual position of whole organs or groups of cells can generally be ascertained much better by means of thick sections and low powers, than by means of very fine sections. For histological details, however, a section is rarely too fine.

For an investigation into the structure of a rare and valuable specimen, a continuous series of sections may be recommended, which are alternately as thin as they can be made, and of medium thickness, say 0·005–0·02 mm.

Fol's Injection-table.‡—Dr. H. Fol describes the table (fig. 258) for injecting devised by him. (The fig. is a cliché of the original,

* See this Journal, ii. (1882) p. 426.

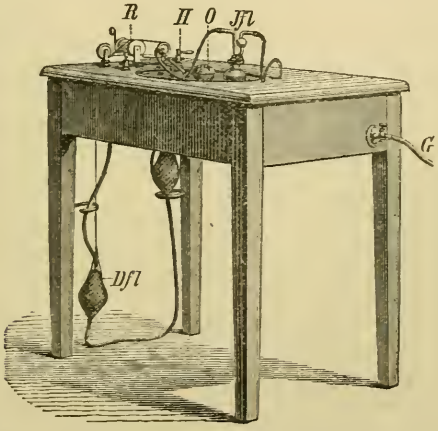
† Proc. Linn. Soc. N.S. Wales, x. (1885) p. 32.

‡ Fol's Lehrbuch d. Vergl. Mikr. Anat., 1884, p. 25 (1 fig.).

and shows more of the table than of the apparatus which it supports.)

The two indiarubber balls *Dfl* underneath the table are raised or lowered by means of a pulley arrangement R. The tap H allows the apparatus to be brought into connection with one or other of the

Fig. 258.



balls, the upper one then communicating with the air. The object O and the vessel with the injecting fluid *Jfl* are both placed in a metal pan sunk in the table and filled with water, and can be kept warm by a gas-jet (tap at G). The table is free, and everything is close at hand for almost instantaneously altering either heat or pressure.

The original explanation is a little meagre as to the action of the apparatus.

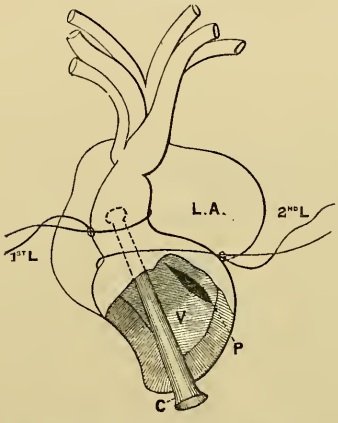
Simple Method of Injecting the Arteries and Veins in small Animals.*—The principle involved in Prof. H. F. Osborn's method is that by the use of two injecting fluids, of different densities, one passing through the capillaries, the other arrested at the capillaries, the whole vascular system may be injected from the aortic arch.

The application of the principle is as follows:—(1) The animal is immersed in tepid water and the heart is uncovered. (2) The apex of the single ventricle, in the case of an amphibian, or of the left ventricle in the case of higher animals, is then laid widely open and the blood allowed to flow freely from the auriculo-ventricular aperture (see P in fig. 259). (3) A cannula is then inserted a short distance into the arterial bulb and the first ligature is fastened around the nozzle. The second ligature is then made ready around the base of the ventricle, thus surrounding the auriculo-ventricular apertures. (4) An ordinary gelatin injecting mass, stained deep red or purple, is in the meantime prepared. When the body is thoroughly warmed, this mass is slowly injected. As the second ligature is still loose, a

* Amer. Natural., xix. (1885) pp. 920-1.

quantity of blood, gradually followed by the gelatin, issues from the auriculo-ventricular opening. (5) When the gelatin begins to run pretty clear, the second ligature is fastened and the syringe containing gelatin is replaced by another containing a red plaster of Paris injecting mass. The latter drives the gelatin contained in the arteries before it as far as the capillaries, thus completely filling the venous system. When the gelatin is thoroughly cooled the animal is ready for dissection.

Fig. 259.



Illustrating method of preparing the frog's heart. V, ventricle; L A, left auricle; P, auriculo-ventricular opening; 1st L and 2nd L, first and second ligatures; C, cannula.

This method can be applied with considerable ease to all the smaller animals, such as frogs, lizards, and pigeons, in preparation for class-work or investigation. Its advantages are numerous. Among its disadvantages may be mentioned the fact that alcohol cannot well be used as a preservative, because it dehydrates the gelatin, causing it to shrink and break up the veins. This difficulty is entirely obviated, however, by the use of Wickersheimer's fluid, in which the injection remains perfect for an indefinite time.

New Methods of Preparing Carmine Staining Fluids.*—Sig. G. Arcangeli states that the unsatisfactory results and the instability of the ordinary carmine stains, induced him to try other methods, and he has obtained excellent results by the following modifications.

1. Boil together 100 grms. distilled water, 4 grms. boric acid, and 50 centigrms. carmine for about 10 minutes. Filter when tepid. The fluid gives a beautiful cochineal-red stain, much resembling that of eosin. The nuclei of vegetable tissues attain their maximum of coloration in about twenty-four hours. The cutaneous epithelium and muscular fibres of *Rana esculenta* stain well. It is necessary to be aware that the sections should not be washed more than twice or thrice in water, and should be then transferred to alcohol, which seems to set the stain.

2. Another carmine stain, which gave the best results, was obtained by boiling for about ten minutes 100 c.c. of a saturated solution of alum, 2 grms. of boric acid, and 25 centigms. of carmine. The fluid so obtained is of a fine violet-red colour, and stains the nuclei of animal and vegetable tissues in about twenty-four hours, and according as the sections are placed in an alcoholic or aqueous solution of the stain, so is the greater or less rapidity of its action. When used in an alcoholic solution the staining is rapid, and the whole of the cell

* Atti Soc. Toscana Sci. Nat., Proc. Verb., iv. (1885) pp. 233–7.

participates in the process. When in combination with water only, the action is slower, and the nucleus alone affected.

3. A third stain was made by substituting salicylic for boric acid. 100 grms. of a saturated solution of alum, 25 centigrms. carmine, and 25 centigrms. salicylic acid, are boiled together for ten minutes. The fluid thus obtained has a redder hue, and its stain a more vivid red than that of the preceding fluid. Vegetable and animal tissues stain in about twenty-four hours.

4. Satisfactory results were obtained by boiling 25 centigrms. carmine with 50 c.c. saturated solution of picric acid for ten minutes, and filtering when cold. The fluid thus obtained much resembles in its action and appearance picrocarmine.

Staining Salivary Glands.*—Dr. N. Kultschizky points out that the secreting cells of the serous salivary glands of the hedgehog (corresponding to the parotid of other mammals) stain badly by the rapid process; slow staining for twenty-four hours or so is better. He specially recommends Prof. Kutschin's method, which consists in immersing thin sections of the organs, previously hardened in chromic acid salts or alcohol, in a 4 per cent. solution of chloral hydrate slightly tinged with picrocarmine. The plasma is differentiated into an outer granular nucleated zone deeply stained with carmine or logwood, and an inner zone, finely granular and less coloured. The epithelial cells lining the small ducts show three zones after staining with logwood or carmine.

2. The mucous glands (corresponding to sublingual of most mammals; the orbital of dogs) contain, in the fresh condition, cloudy cells, which clear up with alcohol or chrome salts. The nuclei and plasma stain equally well with carmine and logwood; the epithelial cells of finer ducts stain well with logwood.

3. The mixed glands (corresponding to submaxillary of man, mouse, and guinea-pig) contain two kinds of cells. (*a*) Muconoid, distinguished from ordinary mucous cells and from serous cells by the fact that their protoplasm is stained deeply with carmine; logwood only stains their nuclei. (*b*) Serous cells, which stain slightly with carmine, strongly with logwood.

Staining with Hæmatoxylin.†—Mr. W. A. Haswell, in an account of his experience of histological methods in connection with class-work, says he finds objects which have been hardened by any of the usual methods, after having been at least a fortnight in alcohol, are best stained *en bloc* by an aqueous solution of crystallized hæmatoxylin, followed by bichromate of potash as recommended by Heidenhain.‡ For most organs and tissues, pieces 1/2 in. square are most successfully and uniformly stained through by means of a 1/2 per cent. solution of hæmatoxylin, allowed to act for ten to twenty-four hours; the staining agent is followed by a 1 per cent. solution of bichromate of potash, which should be allowed to act for two or three hours. It

* Zeitschr. f. Wiss. Zool., xli. (1884) pp. 99–106 (1 pl.).
† Proc. Linn. Soc. N. S. Wales, x. (1885) pp. 276–7.
‡ Pflüger's Arch. Gesammt. Physiol., xxiv. (1881) p. 468.

is quite impossible, of course, to lay down any precise rule as to the time required for staining satisfactorily portions of any given organ; though twenty-four hours' immersion in a 1/2 per cent. solution of hæmatoxylin will, in the majority of cases, give satisfactory results, in some instances the object will be rendered too black, and in others will be found not to be stained throughout. The tissues which require the most prolonged staining, when hardened by one method, may become much more rapidly coloured when treated in another way. It will, therefore, be found necessary, in order to insure good specimens of all the organs, to take several pieces of each, prepared in different ways, and subject them all to the same process of staining; or else, taking several pieces of each specimen, to subject each of them to the action of the staining fluid for a different interval. The results obtained by this method excel, in Mr. Haswell's opinion, in the definiteness of the cell-outlines, and the distinctness of the differentiation of the tissues, any that can be obtained by any of the ordinary processes of staining capable of being carried out in a class.

Imbedding in Paraffin.*—Specimens of animals or of organs stained as above described *en bloc*, and afterwards treated with bichromate of potash, require, after soaking for a few minutes in distilled water, to be treated with strong alcohol for several days—absolute alcohol being used for at least the last two days—in order completely to remove the water with which they have become saturated. As in staining so also in the imbedding, both time and material are saved by preparing a large number of specimens —say twenty or more—at one time. The alcohol is then replaced by chloroform. If the objects are delicate and complicated, this will be very conveniently and thoroughly effected by using some such contrivance as the chloroform-box which Mr. Haswell employs. This is an oblong brass box, divided internally into two compartments by a vertical partition, which does not reach the bottom, but leaves an opening of 3/4 in. Chloroform, with a slight admixture of sulphuric ether, is poured into the box until it rises a little above the lower border of the vertical partition. Absolute alcohol is gently poured by means of a pipette on the surface of the chloroform in one of the compartments; the objects are placed in this, and, as they become saturated with the chloroform, they sink down until they drift through below the partition into the other compartment, which contains only the mixture of chloroform and ether. From this they can be taken out without disturbing the equilibrium of the alcohol and chloroform. Ordinary objects may simply be transferred from absolute alcohol to chloroform, and kept in the latter for twenty-four hours, or until saturated. Saturation with paraffin is then effected by the well-known method of Giesbrecht. Mr. Haswell uses a special water-bath, with trough divided into a number of compartments. To ensure a good result, equal parts, by volume, of chloroform and paraffin (of low melting-point) should be used, and the objects should be left in the bath at the temperature of the melting-point of the soft paraffin for about twenty-four hours.

* Proc. Linn. Soc. N. S. Wales, x. (1885) pp. 277–8.

Eau de Javelle for Clearing.*—Prof. E. Strasburger calls attention to Eau de Javelle† as a medium for rendering vegetation-points clear.

Eau de Javelle (hypochlorite of potash) is decidedly superior to Eau de Labarraque (hypochlorite of soda). It is made by mixing 20 parts of the officinal (25 per cent.) calcium chloride with 100 parts water: after standing some time, a solution of 15 parts potash in 100 water is added, and after standing some days longer it is filtered. Should the solution be found to contain too much lime, add a few drops of potash and filter off precipitate.

Fixing Objects to the Cover-glass.‡—Mr. C. Van Brunt gives one of many methods of fixing objects to the cover-glass which has been used very successfully in glycerin mounts—the albumen method. Mix filtered or strained albumen and glycerin in equal parts, and with a needle apply a thin film of the mixture to the surface of the cover-glass. On this film place the object. If now the albumen is coagulated by a gentle heat it will hold the object so fast that it can be mounted in glycerin, and will always keep its place. The albumen is transparent, except when too much is used.

Smith's Mounting Media of High Refractive Index.§—At the Meeting of the American Society of Microscopists at Cleveland, Prof. H. L. Smith described his process of mounting in media of high refractive index, and gave the formulæ for preparing the same. The white medium, which has a refractive index of about 1·7, is very easily prepared, and is pronounced by Prof. Smith and those who have used it, as unchangeable, provided moisture is kept out. The following is the formula as given for this:—

A stiff glycerin-jelly is first made, about the consistency of honey, by dissolving clear gelatin (Cox's) in pure glycerin, by aid of heat, and in two fluid drams of this, 40 gr. of pure stannous chloride are dissolved. The solution is easily affected by a little heat. When this solution is made it will probably be somewhat milky, but by boiling it in a test-tube it will become beautifully clear and about the colour of balsam. This boiling must be done in a test-tube not over one-fourth full, as the bubbles are, towards the last, very large and thrown violently up and liable to eject the fluid from the tube; but with care the whole may in a short time be made not only clear, but when cold about as stiff as thick balsam, and, if in a small vial, it is not readily poured out. This medium should be used in making mounts precisely as balsam is when the mounts are to be finished by heating. The bubbles escape very rapidly and easily, but towards the end of the boiling, as the medium becomes viscid, they are inclined to persist, but by carefully heating, using a small flame, they will disappear, and indeed, as they are mostly steam, they will frequently disappear

* Bot. Centralbl., xxiv. (1885) p. 157.
† See this Journal, *ante*, p. 893.
‡ Journ. N. York Micr. Soc., i. (1885) pp. 158-9.
§ Amer. Mon. Micr. Journ., vi. (1885) pp. 161-3 (1 fig.).

wholly in cooling, when a balsam mount under the same circumstances would be full of bubbles.

If the boiling has been sufficiently prolonged, the cover will be found, on cooling, to be pretty firmly attached, and will allow the excess of material to be cleaned off without danger to the mount—indeed this excess should be hard, requiring a knife or a sharp edge to remove it. It is advisable to put on only so much as is necessary to fill in under the cover, and have no cleaning to do afterwards; or put on a minute drop, and if that should not be enough feed in a little more from the end of the small glass rod used for dipping. The best thing to clean off the excess is hydrochloric acid, a bit of tissue paper rolled up and moistened with this, not too wet, serves the purpose admirably, but water may also be used, and is nearly as good.

As the medium is deliquescent it is necessary to use a protecting ring. For this purpose, after the slide is well cleaned around the cover-glass, and warmed to dry it, apply a good coat of zinc white cement * or shellac coloured to suit the fancy. If the sealing is perfect there will be no change by time. It is recommended, however, to use a wax ring. These rings punched out of sheet wax, of such size as to cover the edge of the thin glass, are put on the mount when it is finished, and, by cautious application of a small flame, just melted but not so as to run. If any bubbles form under the ring they may be removed by touching with a hot needle or pin-point before the wax cools. A mount made in this way will stand indefinitely and can at any time receive a supplemental coloured ring of shellac or other varnish for a finish.

Amphipleura pellucida is very beautifully shown in this medium, and the various Pleurosigmas, indeed all diatoms except the very coarse ones, which appear almost black in the medium. A very little experimenting will enable one to use the medium successfully.

The use of the gelatin is only to give such a hold upon the cover as will permit the necessary pressure in cleaning. Many mounts were made in the earlier experiments with this medium, without the gelatin, but in all these cases the cover was less firmly attached to the slide. If the protecting ring keeps out moisture from immersion media, or the atmosphere, the mounts will remain unchanged. As the medium dissolves gelatin, albumen, &c., arranged diatoms must be fastened to the cover by heating the latter, supported on a bit of thin sheet iron or platinum, nearly to a melting or softening point. A larger proportion of the stannous chloride can be dissolved than that mentioned above, even as much as 60 gr., but then on heating to harden the mass, crystals will appear; the crystals never give any trouble when 40 gr. are used.

In a subsequent note † Prof. Smith says, the refractive index may be raised considerably by making a saturated solution ‡ in the glycerin jelly—about 60 gr. to the fluid dram—and mixing this with the

* See the next note. † Amer. Mon. Micr. Journ., vi. (1885) p. 182.

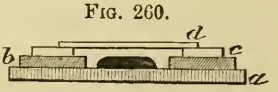
‡ By a saturated solution the author means one which, when *thoroughly cooled*, will show signs of crystallization.

normal solution of 40 gr. The refractive index in this case becomes nearly 2.

The second medium is realgar, the transparent sulphide of arsenic dissolved in bromide of arsenic by aid of heat. Both of these substances should be pure and the mount should be boiled as long as bubbles are readily given off with considerable heat, and when cold the cover should be more firmly attached than with balsam. These mounts are of a deep lemon-yellow colour, and the compound has a refractive index of 2·4.

Excellent and even better mounts, as to permanence, may be made by using realgar only by sublimation. A bit of the realgar is put on a plate of mica about 1 in. square, and thick as a penny. This is melted by strong heat of a spirit-lamp. On this mica plate is placed another, with a hole 5/8 in. in diameter, and above this a thin glass plate with a hole slightly less than the glass cover on which the diatoms are mounted. In fig. 260 *a* and *b* are the two mica plates, c the glass plate, and *d* the cover, with the diatoms facing the realgar. The whole is now supported on a metal ring. A strong heat will volatilize the realgar without change, and often a clear deposit is made all over the diatoms and under side of the cover, and the latter can now be mounted in balsam; but if bubbles are formed in the operation, as probably will be the case, the heat must be continued till these disappear and, as the deposit will now be thickest at the centre just over the realgar, the mount may be finished by putting the cover, realgar side down, on a clean slide and on the top of it to prevent breaking, a piece of thick glass, and then, grasping tightly with forceps to give pressure, heating strongly over a spirit-lamp. The realgar will soften (it must not be melted else bubbles will form which cannot be removed) and spread out, more or less, between the cover and slide making a nice clear mount. The colour of the heated realgar is very much deeper than when cold. Instead of the solid realgar a drop of the solution in bromide of arsenic may be used; but in this case it must be boiled to expel the most of the bromide, before the cover is placed above it; the solid compound now melts at a much lower temperature than the realgar alone. These mounts will not change, but those made from the solution directly will, if the ingredients are not entirely pure, containing no excess of either sulphur or arsenic. As bromide of arsenic will dissolve both sulphur and arsenic there is always danger, if the realgar is not pure, that there will be an excess of one of these, and if so the mount will either crystallize or granulate.

Fig. 260.



Prof. Smith also writes * that he is now testing still another medium of somewhat higher index than the stannous chloride, a full account of which will appear in due time.

Smith's New Cement.†—Prof. H. L. Smith has communicated the results of some recent experiments he has made with a new cement,

* Amer. Mon. Micr. Journ., vi. (1885) p. 182. † Ibid.

especially adapted for protecting mounts in his new stannous chloride mounting medium.* It is made by diluting a somewhat thick shellac cement with benzole, and adding sufficient litharge to give a consistency about the same as that of white zinc cement. It dries very quickly, forms a much harder ring than does the white zinc cement, and is not unpleasant in appearance, as it becomes quite brown or dark on exposure. A thin coat should first be applied, and when this is well dried it should be followed by another. So far as tried this seems to promise better than any other for preservation of the stannous chloride mounts. The white zinc often fails, and while the wax rings appear to answer admirably, the cement is more readily applied, and if the future use of it confirms the present promise it will be more acceptable.

Dry Mounting.—The ordinary method of fastening on the cover-glass is, in Mr. J. L. W. Miles's opinion,† the cause of a serious defect in most dry mounts, viz. imprisoned moisture on the under side of the cover. With very low powers it is not always noticeable, but with 1 in., 1/2 in., or 4/10 in. objectives definition is seriously impaired. It is usual to put the slide on the turntable and apply brown or other cement freely to the rim of the cell, to which the cover-glass adheres when placed thereon. The cement drying from the outside, the imprisoned portion upon which the cover rests hardens by evaporation within the cell, hence the result mentioned. This difficulty can be minimized, and in many cases, with care, entirely overcome by proceeding as follows:—Select a cover-glass much less in diameter than the cell is, measured across its outer edges; place and hold in position with a wire clip, and unite the edge of the glass to the rim of the cell by means of "tacky" gum, which should not run under, or but slightly, inasmuch as the cover-glass will not overlap the cell rim, but will barely rest upon its inner edge. There is yet another precaution to be taken, namely, file out a small portion of the cell, which will form an orifice or opening after the cover is put on. This is a capital plan when you are in doubt about the dryness of your object, as the minute opening can be plugged or bridged over by cement at any convenient time afterwards. Having got so far, all difficulties would appear to be overcome, but this is not so. It is necessary to carefully finish the slide with varnish or cement of a damp-resisting nature. Use brown cement in the first place, and finish with white zinc, which clings tenaciously to clean glass, and makes a secure and neat finish.

Mr. T. W. Lofthouse,‡ in regard to moisture getting into cardboard cells, considered that if the cell was not entirely coated with cement the moisture would be able to escape at the sides, and tested this by mounting two slides with a drop of water on the under surface of the cover before cementing it down. On warming the slide the cell was soon completely filled with moisture. After being held over

* See the preceding note.
† Trans. and Ann. Rep. Manchester Micr. Soc., 1884–5, pp. 26–9.
‡ Ibid., pp. 32–3.

the lamp for a short time, the slides were put on a warm kitchen mantel-piece for two or three hours, and on examining them a week afterwards they were found to be quite free from moisture.

Mr. E. Ward thinks * that if the moisture could get out of a paper cell it could also get in, unless it is sealed up at precisely the right moment with protective cement, and the difficulty is as to *when* is the right moment. He prefers to use a metal cell, to be careful to have dry objects, and having got rid of the moisture from the gum, &c., to seal up the cell. In this way he has mounted thousands, few of which have shown even a trace of moisture or fungi.

His plan is this. Having mounted an object in the cell and allowed it to become thoroughly dry, spin a ring of brown cement upon the cell and let it dry till it can be indented with the finger-nail without sticking. Then warm a cover-glass, and place it on the cell. Choosing then a *strong* glass slip, make it hot in the centre by means of a spirit-lamp, and press it down on the top of the cover-glass; the warmth melts the cement, and the cover is fixed firmly without evaporation inside the cells.

The slide should now be put away for a day or two for the cement to harden, and then, if another layer is applied, we may be sure of a dry mount.

White Zinc Cement.†—Dr. F. L. James briefly recapitulates the objections which have been made to this cement, and his answers thereto.

It is objected (1) that it does not attach itself firmly and evenly to glass at all points; (2) that it is brittle when dry, and easily cracks and scales off; (3) that it is peculiarly liable to "run in" under the cover-glass; and (4) that it is unreliable.

To these he replies:—(1) That if the cement works well at one time it certainly will do so at any and every other time, if the same conditions exist. A cement that attaches itself to glass at one point will do so at all points, if the surface is equally ready to receive it; but if one part of the surface is clean and dry, and another is dirty or moist, or both, no cement can be expected to act upon it with uniformity. (2) A cement made as hereafter described will neither scale nor crack, as a proof of which he can exhibit mounts made with it twelve or thirteen years ago, and which have been carried many thousands of miles with no especial precautions against breakage, and which are yet perfect. (3) As to the liability of the cement to run when used with balsam mounts, the fact is admitted; but it will do so only when the proper precautions against such an accident have been neglected. (4) "It is the very height of folly and absurdity to charge an inanimate substance with caprice and unreliability. If it acts well at one time and fails to do so at another, the fault lies not with the substance, but with its manipulator."

White zinc cement made as follows, has, Dr. James considers, no superior for general microscopical purposes:—Dissolve gum damar in pure benzol sufficient to make a solution of the consistency of

* Trans. and Ann. Rep. Manchester Micr. Soc., 1884-5, pp. 33-6.

† St. Louis National Druggist, vii. (1885) p. 181.

a thin syrup, and filter through absorbent cotton. Into a small porcelain capsule put a small quantity of chemically pure zinc oxide, free from moisture (a precaution which is very important and which is best secured by heating the oxide in a muffle for a short time prior to making use of it), and having previously wet it with a small quantity of benzol, add sufficient of the damar solution to make a paste the consistency of cream, or of thick paint. Rub with the muller or pestle until perfectly smooth, and then pour into a stock bottle. Repeat the operation until a sufficient amount of the cement is obtained. The material should now be allowed to stand until the zinc has separated and sunk to the bottom, and when this has occurred, enough of the damar solution should be added to make the fluid about equal the bulk of the precipitated zinc. Shake up again until the zinc is thoroughly mixed with the damar solution, and filter through a thin layer of absorbent cotton, to get rid of the grosser particles of zinc which escaped the action of the muller. The operation is finished by the addition of a small amount of some drying oil, to give the cement a proper toughness. Some persons use boiled or clarified linseed-oil for this purpose, but it is apt to make the cement "stringy," and hence good nut or poppy-oil is preferable. The amount added should not be over 12 or 15 minims to the ounce of cement. If too much of the damar solution has been added, it is easily got rid of by decantation, after allowing the zinc to separate by standing a few days in a quiet place. If the cement becomes thick after using a while, cut it with pure benzol—not benzin under any circumstances, nor impure benzol.

Dr. James also writes:—"Since writing and printing the foregoing, I have had occasion to make up quite a large amount of the cement, and have improved the processes somewhat. The principal point in which I have made a change is in doing away with the filtering process, as it is troublesome, slow, and wasteful. I now obtain better results by decantation. After mixing the cement as directed, I give it a vigorous shaking and set the vessel containing it in a quiet place. In the course of a few hours the grosser particles will have sunk to the bottom, and the cement, thus freed from them, may be decanted into other bottles. By repeating this process two or three times, a cement of the most exquisite fineness and finish may be obtained."

Leakage of Cells.*—On the cause of the leakage of cells, Dr. F. L. James writes as follows:—

"Many microscopists are in the habit of making their cells only when they are needed, allowing the rings to dry just so much that the cover-glass will not stick when applied. Some do this from thoughtlessness, or rather from never having experimented or investigated the relative merits of a fresh and thoroughly dried and seasoned cell. Others claim actual advantages for this procedure. They say that when the cover-glass is applied while the cell rings are yet plastic, a more accurate coaptation, or fit, is obtained. It is also claimed that a more homogeneous mass is made with the cement which is subsequently applied to seal the cell.

* St. Louis National Druggist, vii. (1885) p. 181.

These advantages, if indeed they be such, in all except dry mounts, are more than counterbalanced by a radical defect, which all such hastily prepared mounts must have, whether the cement be zinc white or Brunswick black, or the mounting medium be glycerin or balsam. And in this defect lies the secret of most of the failures and disappointments which produce the bitter complaints against this or that cement or mounting medium in the technical journals.

All the cements described in the preceding chapters, with the exception of gold size, consist of some solid material or materials dissolved or held in suspension in a medium more or less volatile, the evaporation of which again leaves a solid mass. The exception, gold size, hardens partly, though very slightly, by evaporation, its solidification depending principally upon oxidation. In the process of hardening or setting, the bulk or mass of the cement is very materially altered, a decrease in volume occurring which is proportionate to the amount of volatile matter lost in drying. *The cement shrinks.*

Now, when a cell is properly finished it must be entirely filled with the mounting medium. If it is not so filled we are bound to have air-bubbles, the *bête noir* of microscopists, which are not only unsightly, but will, in process of time, ruin the mount. If the cell walls were not entirely dry when the cell was closed it is plain that the process of shrinkage had not yet been completed, and that it is yet to occur to a greater or less extent. What is the inevitable result? The fluid within the cell is practically incompressible, yet pressure is brought upon it. It has no space within its container into which it can retreat, and consequently it must force its way out of it. This it does slowly and gradually. It may be some time before it is noticed, but it is bound to come. The cement gives way at its weakest point, and the fluid exudes—'creeps' out. It is discovered, washed off, and a fresh ring of cement applied. This puts off the evil day a while, but in a few months the process has to be repeated. Meanwhile the pressure is continuously exerted, and minute quantities of the mounting medium gradually infiltrate the walls at fresh points; the cement disintegrates, scales and splits off."

It should therefore be an axiom "never to use a cell until the cement walls are thoroughly dry and hard."

Coloured Crayons for Marking Preparations—Finder.*—Prof. E. Strasburger recommends Faber's coloured crayons for writing on glass or porcelain for marking preparations provisionally. The yellow crayons are most suitable for this object.

In order to find given places in a specimen, circles should be made with some sharp instrument on both sides of the aperture in the stage of the Microscope, similar circles being drawn with the crayon in corresponding positions on the slide.

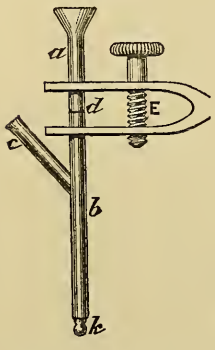
Filtering Minute Quantities.†—The ordinary method of filtering by means of paper funnels is not practicable for quantities less than

* Bot. Centralbl., xxiv. (1885) pp. 156–7.

† Haushofer, K., 'Mikroskopische Reactionen,' vii. and 162 pp., 137 figs., 8vo, Braunschweig, 1885.

300 cmm. If it is desired to obtain a sediment without loss Beudant's method should be adopted. In this, two watch-glasses, one placed at a higher level than the other, are made use of. The upper one contains the fluid to be filtered, and the two are connected by means of a moistened strip of filter-paper. This automatic action may be further increased if it be desirable to wash the filtrate. This is effected by a third watch-glass, filled with distilled water, and placed above that which contains the substance to be washed.

Fig. 261.



For filtering very small quantities Dr. K. Haushofer recommends two glass tubes, *a*, *b*, fig. 261, placed in vertical apposition, and connected by a screw-clamp E which allows the upper tube to be approximated to or removed from the lower one. From the lower tube another, *c*, projects upwards at an angle. Between the two tubes at *d*, a sheet of moistened filter-paper is inserted, and the tubes are then closely adjusted by means of the screw. The bottom of the tube *b* is closed by a stopper *k*. The fluid is then poured in, and suction made at the side tube. The filtrate is always perfectly clear, and the residue is collected in a small space.

Examining Blood in Typhoid Fever.*—Mr. T. S. Ralph states the results of his experiments on blood with phloroglucen, phosphoric acid, ozonic ether, and hydrocyanic acid.

With normal blood, phloroglucen causes the corpuscles to separate into a larger greyish solid portion and a smaller fluid residuum, presenting one or more spots of a reddish hue. A similar but less decided effect is produced by the action of phosphoric acid. Ozonic ether causes an active effervescence, followed on its cessation by the appearance of numerous large cells varying in size from 1/2000 to 1/1000 of an inch. Each of these cells contains a small vesicle or gas-bubble of a reddish or orange hue. By the action of hydrocyanic acid on dry films of blood, the presence of minute reddish or orange-coloured spots may be detected. These increase in size, vary in number, may be arranged in circles, or may be replaced by larger ones.

Similar changes can be brought about in typhoid blood by the use of these reagents, but typhoid blood examined without the aid of chemical agents presents under ordinary circumstances orange and red vesicular forms imbedded in the plasma. These vary in size from 1/10,000 to 1/7000 of an inch in diameter, are mobile, and surrounded by a white halo-like appearance. The action of ozonic ether and other reagents appears to release orange-coloured vesicular forms in a more permanent condition and in larger numbers than in healthy blood. Hydrocyanic acid is stated to produce certain appearances

* Ralph, T. S., 'Microchemical Observations on the Blood in Health and in Typhoid Fever,' 12 pp. (1 pl.), 8vo, Sydney, 1885.

which present on the one hand crystalline resemblances, and on the other more nearly approach in their appearance and character the low and obscure forms of vegetable life.

The author also records the fact that, after chloroform, the blood plasma exhibits escaped vesicular forms, and perhaps more abundantly than in typhoid and other febrile conditions.

Measurement of Blood-corpuscles.*—Dr. M. D. Ewell has endeavoured to determine whether there is a constant average size of the human red blood-corpuscles, so as to render it possible by means of micrometric measurements to distinguish human blood from that of domestic animals.

He used two accurate standards, one consisting of lines ruled on speculum metal 1/2000 in. apart, by Prof. W. A. Rogers, a Bulloch cobweb eye-piece micrometer and a 1/10 in. Spencer hom. imm. 1·35 N. A., with a Bausch and Lomb achromatic amplifier giving an amplification of about 1500; also Prof. H. L. Smith's immersion fluid.

An examination of the tabular statement of results shows that the difference between the greatest and smallest averages of 25 corpuscles is 0·000028 or 1/35714 in., a magnitude that may be easily measured by any person having the requisite skill and apparatus.

The difference between the highest and lowest averages of 50 corpuscles is 0·000015, or 1/66666 in., which approaches more nearly the limit of micrometric measurement, though probably not beyond it.

The difference between the highest and lowest averages of 75 corpuscles is 0·000012, or 1/83333 in., which approximates the limit of micrometric measurement.

The difference between the highest and lowest averages of 100 corpuscles is 0·000009, or 1/111111 in., which is within the limits of personal and instrumental error, "according to the highest living authority upon this subject," who writes, in substance, that it is easy to measure 1/50,000 in., but to be sure of 1/100,000 in. is not possible.

The conclusion to be deduced from the above figures is obviously, Dr. Ewell says, "that, when a sufficient number of corpuscles are measured, there appears to be an average size which varies within very narrow limits, which may possibly be accounted for, or, at least, is consistent with personal and instrumental errors; for, though I have carried out the figures to the sixth decimal place, I have not the presumption to declare that the results can be relied upon further than the fifth place, and have carried out the figures to the sixth only to insure accuracy in the fifth so far as possible. Another conclusion is, that granting for the moment that it is possible to identify blood by measurement of the red corpuscles, of which I am by no means satisfied, it is reckless in the last degree, if not criminal, to express an opinion upon the measurement of less than 100 corpuscles. To express an opinion upon the measurement of only 10 corpuscles,

* The Microscope, v. (1885) pp. 183–6. Amer. Mon. Micr. Journ., vi. (1885) p. 150–1, from 'Chicago Legal News.'

as I am informed has been done within the last year or two, to take the most charitable view of the subject, betrays such culpable ignorance of a subject involving such momentous consequences as ought for ever to invalidate the testimony of one who should swear so recklessly. In a case involving the issue of life and death it would be better to measure several hundred corpuscles."

An examination of the unabridged table of measurements, from which the above summary is tabulated, discloses the further fact that by selecting the corpuscles it would be possible for a dishonest observer to make the average much larger or smaller than that above given without the possibility of detection; a fact the bearing of which upon the value of expert testimony upon this subject is so obvious as to need no comment.

Styles of Indian Corn for Examining Movement of Protoplasm.* —Prof. C. E. Bessey recommends the long styles of Indian corn for the study of the movement of the protoplasm. By taking a young style from an ear which has been kept in a warm place for an hour or so, clipping off a piece a couple of inches in length and carefully mounting it in water under a large cover-glass, there will be no difficulty in seeing a great deal of activity in the protoplasm. Care must of course be taken to have the style lie flat, remembering that it is not cylindrical in shape, but somewhat ribbon-shaped. The cells are much elongated, and the walls are so transparent that with careful focusing their contents may be seen, even in the interior parts of the style.

The protoplasm is sufficiently granular to be easily seen. It moves along the side of the cell in a strong steady stream, occasionally heaping up a great mass, which is eventually pushed onward by the current. As an easily obtained and instructive example of protoplasmic activity, Prof. Bessey knows of nothing which is superior to such a specimen.

Haushofer's Microscopical Reactions.†—Dr. K. Haushofer's work is intended as an introduction to the recognition of various elements and compounds by the aid of the Microscope, and deals with the application of the Microscope to petrographical research.

The author's method depends for its *raison d'être* on the constancy of crystalline forms and combinations of elements, crystallization being considered a constant property, just as colour, solubility, melting point, &c. The methods which, by the aid of the Microscope, aim at demonstrating the presence of different substances through these crystallizable compounds, for the most part possess the advantage, not only of being applicable to extremely small quantities, but of requiring very little apparatus and only very simple operations. Hence they are of great practical importance if we desire to analyse very minute quantities and do not possess other sufficiently sensitive tests. But for bodies which are demonstrable in very minute quan-

* Amer. Natural., xix. (1885) p. 888.

† Haushofer, K., 'Mikroskopische Reactionen,' vii. and 162 pp., 137 figs. 8vo, Braunschweig, 1885.

tities, such as iodine, iron, and manganese. microscopic tests depending on crystal formation will only be occasionally employed. The like holds good for substances which may be distinguished by spectroscopic appearances, as iridium, thallium, lithium, &c. This branch of petrology, though of comparatively recent date, has lately received greater attention, so that now quite a series of petrographic researches are known, and which may compare in exactitude with the most accurate analytical methods. The microscopic crystals which serve for proof of the existence of certain substances are formed either as precipitates after definite reactions or on evaporation of solutions. In practice the former method is usually found to be the more speedy in the end, for the slower the process the more perfect is the crystal. When, however, crystallization is defective from any cause, the crystals become skeletal, malformed, or jumbled together in masses. These aggregate malformed or skeletal forms are for many substances very characteristic, and certain combinations can only be obtained in such forms as, for example, copper nitrate, thorium nitrate, thallium chloride, &c. The formation of normal crystals is favoured by the employment of very dilute solutions. Very insoluble substances, such as barium sulphate, lead sulphate, silver chloride, are little suitable for the microscopic test applied directly.

The general method of examination when only small quantities are available, is to place a drop of the solution to be tested on a slide on the stage of the Microscope, and then add a drop of the precipitation-reagent. Cover-glasses are not needed unless any development of gas occurs, or when observations are made on fluorine and its compounds. In the latter case it is necessary to protect the objective by fixing a cover-glass in front of the face of the anterior lens. It is also necessary when hydrofluoric acid is given off during the reactions to cover the slides with a thin layer of Canada balsam, and to conduct preliminary operations in platinum vessels.

In the majority of the examinations carried out by these methods perfectly trustworthy results are obtained with 1–2 mgrm. of substance. Thus in a drop of gypsum solution which weighs only 10 mgrm. is contained merely ·03 mgrm. gypsum or ·01 mgrm. calcium oxide, and they can be recognized with certainty under the Microscope as sulphate or oxalate.

For the examination of the composite silicates the methods of Boricky and Behrens are recommended. Boricky's method is founded on the property of hydrofluosilicic acid to develope hydrofluoric acid on evaporation, and thereby to set free silicates even without the aid of heat. A minute fragment of the size of a pin's head is placed on a slide protected by a layer of Canada balsam and a drop of a 3–4 per cent. hydrofluosilicic acid is added. After acting from two to six hours, the decomposition is so far advanced that the crystallized double salts of fluorine permit the recognition of the basic constituents of silicates. This method, although simple, is not free from defects.

Behrens proceeds by completely decomposing the mineral to be tested with hydrofluoric acid, and by removing any fluorosilicons by

the aid of sulphuric acid. The powdered mineral, of which 1 mgrm. is sufficient, is heated to dryness with sulphuric acid in a platinum dish. The residue is treated with water, and a drop of the solution placed on a slide. Certain tests demonstrate the presence of basic constituents in solution. In the residue are found gypsum, the insoluble sulphates of barium and strontium; these are dissolved in strong sulphuric acid, and crystallize out on cooling.

The characteristics of microcrystals would be unsatisfactory and imperfect if their optical properties were left out of consideration. Therefore, with the study of crystal forms which aid the analysis of any substance, examination of crystals by polarized light must be associated. The optical characteristics of microcrystals gain in importance because, while their angular measurement does not attain the same distinctness as in the larger crystals, yet the optical anomalies of microcrystals are more rare than those of the large.

Dr. Haushofer's arrangement of the subject matter of his work is alphabetical. This, if not strictly scientific, at least saves all trouble of hunting for a given subject, and any compound can be found at once. The text is copiously illustrated by woodcuts of crystal forms of almost infinite variety.

In this connection it may be noted that Dr. J. L. W. Thudichum, in a discussion * on "Medico-legal and Chemical Microscopy," considers that in all cases chemical tests should be relied upon, crystalline form not being trustworthy evidence, for it frequently happens that these forms are determined by impurities present, so that often the substance in its pure form cannot be made to crystallize at all. Even when substances form definite crystals, these vary in appearance according to the mass of the substance used, the heat, and other circumstances. The microscopical detection of octahedral crystals is merely a confirmation of the presence of arsenic, but not diagnostic, since other substances produce similar crystals. Dr. Thudichum also considers that the micro-spectroscope has no advantage over the ordinary spectroscope, since both require the same amount of material to produce definite results. The Microscope is especially useful in the preliminary stages of an inquiry; thus, in dealing with 1500 ox brains, he had found it invaluable in preparing phrenosine from these.

Examining Diamonds and Cut Gems.†—In the microscopical examination of diamonds and cut gems the best results are obtained when they are submerged in glycerin or balsam. A temporary cell, large enough to contain the gem, is easily made by cutting or punching a hole in a cake of ordinary white wax, and it is firmly attached by heating the slide slightly. Small gems may thus be examined without removing them from their settings. The cell should be entirely filled with the mounting fluid and a cover-glass applied. Canada balsam gives better effects with most gems than glycerin does, but the difficulty of cleaning it off makes the latter preferable.

* Engl. Mech., xlii. (1885) pp. 219–20.

† St. Louis National Druggist, vii. (1885) p. 197. (Microscopy, by Dr. F. L. James.)

Many stones which do not show flaws when examined in the ordinary manner, will be found to contain cavities filled with fluid when examined as above.

ARCANGELI, G.—**Sopra alcune dissoluzioni carminiche destinate alla coloritura degli elementi istologici.** (On some carmine solutions for staining the histological elements.) [*Supra*, p. 1094.]
Atti Soc. Tosc. Sci. Nat.—Proc. Verb., IV. (1885) pp. 233–7.

BARNES, C. R.—**The Process of Fertilization in *Campanula Americana* L.** [Methods. *Supra*, p. 1085.] *Bot. Gazette*, X. (1885) pp. 353–4 (1 pl.).

BJELOUSSOW, A. K.—**Eine neue Methode von Injection anatomischer Präparate vermittelst kalter Masse.** (A new method of injecting anatomical preparations by cold masses.) [*Post.*]
Arch. f. Anat. u. Physiol., 1885, pp. 379–84.

BUCHNER, H.—**Ueber d. Verhalten d. Spaltpilzsporen zu den Anilinfarbstoffen.** (On the behaviour of the spores of Schizomycetes with anilin dyes.)
SB. Gesell. f. Morphol. u. Physiol., 1885.

CAMPBELL, D. H.—**On growing the spores of Botrychium ternatum.**
["The spores are devoid of chlorophyll, both before and after germination, which suggests that they should be grown in rich earth or humus. When prothallia of similar plants have been found they have been below the surface of the ground, and he devised a plan [not described] for sowing the spores under the soil yet so far as to be kept under constant observation."]
Bot. Gazette, X. (1885) p. 340.

COLE, A. C.—**Studies in Microscopical Science.** (Parts IX. and X., pp. 33–6, 37–40.)
Sect. I. (Botanical Histology). (IX.) Non-sexual organs of reproduction in Vascular Cryptogams. Type II. Cone of *Selaginella*. Plate IX. *S. inæqualifolia*. Lon. Sect. Fertile spitu × 13. (X.) Structure of Macrosporangia (Anthers) in *Taxus*. Plate X. Vert. Sect. of Ovule of *Taxus*.
Sect. II. (Animal Histology). Respiratory organs. Plate IX. Lung of Frog. Plate X. Lung of Duck. Tr. Sec. × 270.
Sect. III. (Pathological Histology). (IX.) Brown Induration of the Lung. Emphysema. Plate IX. Lung, Emphysema × 18. (X.) Pleurisy. Plate X. Pleurisy × 68.
Sect. IV. (Popular Studies). (IX.) The Tracheal System of Insects. (Methods, *post.*) Stem of *Bignonia*. Plate IX. Tr. Sec. × 75. (X.) Insectivorous and Carnivorous Plants. Plate X. Carnivorous Plants.

DETMERS, H. J.—**[Importance of reliable Microscopical Evidence.]** [*Post.*]
Amer. Mon. Micr. Journ., VI. (1885) p. 199.
Remarks at Cleveland Meeting of American Society of Microscopists.

DRAPER, E. T.—**Graphic Microscopy.** XXII. Transparent section of tooth of Ant-eater. XXIII. *Polysiphonia fastigiata.*
Sci.-Gossip, 1885, pp. 217–8 (1 pl.), p. 241 (1 pl.).

FEBIGER, C.—See James, F. L.

FŒTTINGER, A.—**Renseignements Techniques.** (Technical Information.)
[1. Chloral hydrate for the study and preservation of the lower animals. 2. Collodion for fixing on the glass objects to be preserved in alcohol. 3. Process for purifying and hardening the paraffin of commerce. *Post.*]
Arch. de Biol., VI. (1885) pp. 115–25.

GARRISON, F. L.—**The microscopic structure of Iron and Steel.** [*Post.*]
Journ. Franklin Inst., CXX. (1885) pp. 300–6 (5 pls.), from *Trans. Amer. Inst. of Mining Engineers.*

GIBBES, H.—**Practical Histology and Pathology.**
3rd ed., xii. and 196 pp., 8vo, London, 1885.

GIERKE, H.—**Färberei zu mikroskopischen Zwecken. Nebst Nachtrag.** (Staining for microscopical purposes. With Appendix.)
[Separate reprint of articles in Zeitschr. f. Wiss. Mikr. Cf. *ante*, p. 900.]
243 pp., 8vo, Braunschweig, 1885.

Goodale, G. L.—**Physiological Botany. I. Outlines of the Histology of Phænogamous Plants.**

[Vol. II. of Gray's Botanical Text-book, 6th ed. An important feature of this volume is the concise introduction in which the histological appliances and methods most frequently used are brought together for discussion.]

8vo, New York and Chicago, 1885.

Graber, V.—**[Preparing Eyes of Annelids.]**

[From Arch. f. Mikr. Anat. xvii. (1879) p. 250.—Decolor by soaking in glycerin with a little 35 per cent. caustic potash added—check by neutralizing with dilute hydrochloric acid—carefully wash before transferring to a hardening or mounting fluid—preserve in glycerin.]

Amer. Nat., XIX. (1885) p. 1137.

Hart, C. P.—**A new, cheap, and quickly constructed adjustable Microtome.**

[Title only of paper read at Ann Arbor Meeting of Amer. Assoc. Adv. Sci., 1885. Cf. *ante*, p. 861.]

Amer. Journ. Sci., XXX. (1885) p. 327.

Haswell, W. A.—**New Microtome.**

["Mr. Haswell described his new microtome based upon Mr. Caldwell's pattern, but with a new ribbon take-off of a very ingenious construction."]

Journ. and Proc. Roy. Soc. N. S. Wales, XVIII. (1885) p. 178.

„ „ **On some recent Histological Methods, and their adaptation to the teaching of practical Histology.** [*Supra*, p. 1095.]

Proc. Linn. Soc. N. S. Wales, X. (1885) pp. 276–8.

Haushofer, K.—**Mikroskopische Reactionen.** Eine Anleitung zur Erkennung verschiedener Elemente und Verbindungen unter dem Mikroskop als Supplement zu den Methoden der qualitativen Analyse. (Microscopical Reactions. A guide to the recognition of different elements and compounds under the Microscope, as a supplement to the methods of qualitative analysis.) [*Supra*, p. 1106.]

vii. and 162 pp. and 137 figs., 8vo, Braunschweig, 1885.

Henking, H.—**Neue Construction des Objecthalters an Schlittenmikrotomen.** (New construction of the object-holder of the slide microtome.)

[Abstract of article in Zeitschr. f. Wiss. Mikr. I. p. 491, with criticism. *Post.*]

Zeitschr. f. Instrumentenk., V. (1885) pp. 314–5 (1 fig.).

Horner, J.—**Work for the Microscope.** III. Instruments for dissection. IV. Solutions and Mounting Media. *Our Corner*, VI. (1885) pp. 75–9, 137–42.

James, F. L.—**Microscopical Technology.**—IX. Mounting Diatoms arranged in series. The Mechanical Finger. Preparing the Slide. [C. Febiger's method. *Post.*] X., XI. Mounting Diatoms in series. Selecting and placing the Diatoms. XII. Mounting Diatoms *in situ*. Fixing anilin colours.

St. Louis National Druggist, VII. (1885) pp. 196, 208, 219, 233–4, 234.

„ „ **Cement.**

["In pulverized gum arabic, with an equal bulk of powdered burnt alum, we have the material for a cement of great adhesiveness and brilliancy. The mixture should be kept dry, and wet up only when required for use, just enough being prepared for the work in hand."]

St. Louis National Druggist, VII. (1885) pp. 196–7.

„ „ **Examination of Diamonds and Cut Gems.** [*Post.*]

St. Louis National Druggist, VII. (1885) p. 197.

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

[IV. Practical Histology. Stains.]

Journ. of Microscopy, IV. (1885) pp. 231–45.

Lee, A. B.—**Cedernholzöl für Paraffineinbettung.** (Cedar-oil for paraffin imbedding.) [*Post.*] *Zool. Anzeig.*, VIII. (1885) p. 563–4.

Leone, T.—**Sui microorganismi delle acque potabili: loro vita nelle acque carboniche.** (On the micro-organisms of potable water: their life in carbonic acid water.)

[Contains methods. *Post.*]

Atti R. Accad. Lincei.—Rendic., I. (1885) pp. 726–32.

Locy, W. A.—**Treatment of the Eggs of the Spider.** [*Supra*, p. 1083.]
Amer. Natural., XIX. (1885) pp. 1021–2.

Mark, E. L.—**Repairing Balsam Preparations.** [*Post.*]
Amer. Natural., XIX. (1885) p. 1137.

Morris, W.—**New Mounting Medium.** [*Supra*, p. 1077.]
Journ. and Proc. Royal Soc. N. S. Wales, XVIII. (1884) pp. 178–9.

Naples Zoological Station, Third Catalogue of Marine Animals supplied by the.
[List of different objects, with prices.]
Issued with *MT. Zool. Stat. Neapel*, VI. (1885) Part 2.

Ognew, J.—**Zur Frage von der Morphologischen Bedeutung des fibrillären Bindgewebes.** (On the morphological significance of the fibrillar connective tissue.) [Methods *post.*] *Arch. f. Anat. u. Physiol.*, 1885, pp. 437–50 (1 pl.).

Queen & Co.'s (J. W.) Slide Case.
[Four trays holding 6 slides—falling front—3/4 in. thick—cover with flanged sides and front.]
Queen's Micr. Bull., II. (1885) p. 39 (1 fig.).

Ralph, T. S.—**Microchemical Observations on the Blood in Health and in Typhoid Fever.** [*Supra*, p. 1104.] 12 pp. and 1 pl., 8vo, Sydney, 1885.

Ryder, J. A.—**A Cheap Bell-glass for the Laboratory Table.**
["Taking a plain glass finger-bowl 4 or 5 in. wide and about 2 in. deep, a handle may be prepared by gluing a 1/4 in. cork to the bottom. Cut off the smaller end of the cork smoothly and cover it with marine glue. If the end of the cork is now heated over a spirit-lamp until the glue takes fire, and the cork is quickly pressed with its glue-covered end upon the centre of the bottom of the dish, you have a cork handle by which you can lift the dish."]
Amer. Natural., XIX. (1885) p. 920.

Smith, H. L.—**New Cement and new Mounting Medium.** [*Supra*, pp. 1097–9.]
Amer. Mon. Micr. Journ., VI. (1885) p. 182.

Sollas, W. J.—**On *Vetulina stalactites* (*O. S.*) and the Skeleton of the Anomocladina.**
[Contains a description of his method of examination.]
Proc. R. Irish Acad.—Science, IV. (1885) pp. 486–92 (2 pls.).

Strasburger, E.—**Zur Mikroskopischen Technik.** (Microscopical Technique.) [*Supra*, pp. 1097 and 1103.] *Bot. Centralbl.*, XXIV. (1885) pp. 156–7.

Stuhlmann, F.—**Ueber Nachbehandlung der Schnittserien mit Osmiumsäure.** (On treating series of sections with osmic acid.) [*Post.*]
Zool. Anzeig., VIII. (1885) pp. 643–4.

Trachsel-Crozet.—**[Le Microtome à triple pince.]** (The microtome with triple pincers.)
[Reply to A. Eternod, *ante*, p. 925.]
Journ. de Microgr., IX. (1885) pp. 317–8.

Van Brunt, C.—**Prof. H. L. Smith's new Mounting Medium.**
[Remarks on the composition and use of the medium. Cf. also *supra*, p. 1097. Also on fixing objects to the cover-glass. *Supra*, p. 1097.]
Journ. N. York Micr. Soc., I. (1885) pp. 158–9.

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

„ „ **The Cambridge Rocking Microtome.** [*Supra*, p. 1091.]
Amer. Natural., XIX. (1885) pp. 1022–5 (1 fig.).

„ „ **A means of differentiating Embryonic Tissues.** [*Post.*]
Ibid., pp. 1134–7.

„ „ **A new solvent of Chitin.** [*Post.*] *Ibid.*, pp. 1137–8.