Journal of the
Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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

FOR THE YEAR

1911

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II.—*A Simple Method of Obtaining Instantaneous Photomicrographs.*

By J. Edwin Barnard.

(*Read November* 16, 1910.)

In view of the considerable development, or what perhaps might more properly be described as the re-introduction of dark-ground illumination methods, it is desirable that some simple method should be available for photographing living or moving microscopic objects.

Various arrangements have already been described for effecting this, but they are of necessity somewhat elaborate and costly. The method that I have recently employed is to use an ordinary reflex camera in conjunction with a vertical photomicrographic camera. It may be that this is a perfectly well-known arrangement, but, if so, I can only say I have not hitherto seen any description of it.

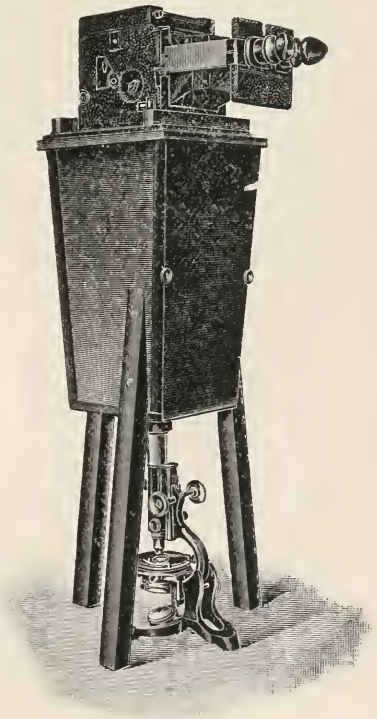


Fig. 1.

The type of vertical camera most suitable is that usually known as the Van Heurck model, as made by Messrs. Watson, for this camera is much more stable and stiffly supported, not relying for its stability on a single rod as do most other vertical types. The lens, and if possible the whole front, is removed from the reflex camera, and it is then placed face downwards on the top of the vertical photomicrographic camera. The focusing screen is vertical and faces towards the observer. It is then quite easy to observe the image on the ground-glass screen of the reflex camera through the focusing hood, and at the same time to control with ease the necessary adjustments of the Microscope. Exposure would, of course, be

effected by releasing the focal plane shutter in the reflex camera, and its duration could be varied to suit the rapidity of movement of the object, as in ordinary camera manipulation. In practice it will rarely be found that high speeds are necessary.

The only practical objection that I am able at present to see to this method is that there is considerable liability of vibration on the release of the shutter. In a camera such as I am showing this evening (fig. 1), made by Messrs. Newman and Guardia, this perhaps does not constitute such an objection, as they claim, and I think with justice, that the exposure is effected so rapidly after the release of the mirror that there is no time for the transmission of a vibration to the apparatus itself. A much less expensive type of camera would probably answer the purpose.

I put this apparatus forward and make the suggestion in the hope that it may be of service to some of those who wish for a readily available means of obtaining a record of the appearance of living micro-organisms under dark-ground or similar methods of illumination.

III.—*On the Use of a Metallic Electric Arc in Photomicrography.*

By J. Edwin Barnard.

(*Read November* 16, 1910.)

Some time ago I described to this Society a method of using a mercury vapour arc for visual microscopic work. I explained that it had such advantages that it was probably substantially ahead, as a source of light, of any other illuminant then available—an opinion that subsequent experience has more than confirmed. As the light is derived from the luminous arc itself, and not from either of the luminous electrodes, it follows that its spectrum is a bright-line one, and that it is possible, by a suitable arrangement of prisms, or by suitable colour screens, to obtain illumination in the Microscope that is truly monochromatic. While for visual work the amount of light so obtained is amply sufficient for use with the highest powers, when it comes to photomicrography the exposures are in many cases prolonged, and sometimes unduly so. I have therefore been experimenting for some time to see whether a metallic arc with solid metal electrodes might be made available for the purpose mentioned.

I must at once admit that up till quite recently the results obtained have not been favourable, as it is extremely difficult to get an electric arc with metallic electrodes to burn with any degree of steadiness; and, further, there is always the difficulty that with most metals the electrodes themselves either quickly melt, or the arc changes its position, owing to bending or displacement of the metals. Again, if, for instance, we take an arc formed between iron electrodes, in which the metal itself has not a low melting-point, and which may, by suitable arrangements, be made to run steadily, we are confronted with the difficulty that its spectrum consists of a great number of lines of moderate intensity which are distributed pretty evenly throughout the spectrum, so that, owing to the closeness of the lines one to another, there is no advantage over a source of light with a continuous spectrum, such as an ordinary carbon arc.

Of all metals giving a suitable spectrum, other than mercury, none so thoroughly fulfil the necessary conditions as cadmium; but unfortunately cadmium has a particularly low melting-point, rather lower even than that of lead, so that to use it in a pure state is simply impossible. A recent paper by Dr. T. Martin Lowry, on "A New Method of Producing a Cadmium Arc," has suggested that

by combining silver and cadmium in suitable proportions, electrodes are produced that have a very high melting-point, and that under ordinary conditions will produce a very good arc. The proportion of silver to cadmium may conveniently be 60 p.c. cadmium to 40 p.c. silver, and such an alloy has a melting-point above 700° C.

On examining the spectrum given, it is found that the principal lines are situated in the blue, green, and red portions of the spectrum, so that it is possible to obtain a monichromatic source of light at will in either of these regions, and of almost unlimited intensity—the intensity, in fact, being only dependent on the size of the electrodes, and the number of amperes used. If an attempt is made to run an arc with pure-metal electrodes of almost any sort, it will be appreciated how very difficult it is to so adjust the arc that anything approaching a constant source of light may be obtained. With the cadmium-silver arc the conditions are very much better, but to obtain the best result the electrodes should be rotated in opposite directions during the time that the arc is burning. This method is, of course, one perfectly well known, and requires no further explanation here. It is not one that entails any considerable complication in apparatus, in fact, it is quite practicable for the short exposures required in photo-micrography, to have a hand-driven type of mechanism, which is both inexpensive and sufficiently efficient.

It may be urged that owing to the fact that the electrodes suggested are an alloy, that the spectrum of silver will be equally evident with that of cadmium, and this is, of course, the case; but fortunately the spectrum of silver is such that it does not interfere to any extent with the cadmium spectrum, the principal cadmium lines, in fact, being so brilliant that the others are almost negligible. The red cadmium line, with a wave-length of 6438^{-10} m., is a particularly brilliant one not far from the region of the orange, so that it has considerable visual luminosity. The green line wave-length, 5085^{-10} m., is in the most brilliant portion of the spectrum, and running the cadmium silver arc with 10 amperes, a fully exposed plate may be obtained in a few seconds, even with the highest powers, using, of course, a suitably sensitized plate. The blue line wave-length, 4799^{-10} m., has very high luminosity for the blue part of the spectrum, so that it may be used for work with diatoms, or where the greatest visual resolution is required. It might be interesting to note that the bright lines in the cadmium spectrum are extremely narrow ones. It follows that the light transmitted, whether screened off, or obtained by spectroscopic methods, is of one wave-length.

In the case where this arrangement is used in conjunction with a monochromatic light apparatus, in which the light is split up by the aid of prisms, the slit may be opened very wide indeed so that the light transmitted becomes a very broad band, quite

sufficient to fill the field with moderate or high-power microscopic objectives.

It may be urged that the method, although, perhaps, not without scientific interest, is impracticable owing to the cost of the cadmium silver electrodes, and it must be admitted that this is not altogether a negligible factor. Cadmium is now, however, not a rare metal, and can be bought cheaply, whilst the value of silver is well known to you all. I may say, moreover, that I have recently obtained some of this alloy from Messrs. Johnson Matthey, the Metallurgists, of Hatton Garden, and that the cost of a single electrode works out at five shillings. This is sufficient for a fairly long run, so that after all the expense would not, in most cases, be an insuperable objection where some special result is aimed at.

IV.—*Aerator Suitable for Laboratory Aquaria.*

By J. F. Gemmill, M.A. D.Sc. M.D.

(*Read November* 16, 1910.)

This instrument has some advantages over the one I described in a former number of the Journal.* It adapts itself readily to such variations of pressure as occur from hour to hour in the water supply of towns, and accordingly it is somewhat easier of adjustment and needs less supervision than the other. At the same time, its construction is simpler, and it provides an uninterrupted supply of air. As in the former instrument, the air is washed free of impurities, and is under sufficient pressure to enable it to be distributed to different aquaria and to be forced through such nozzles (e.g. suitable pieces of partly decayed wood †) as will give out streams of very fine air-bubbles; also, should leakage occur anywhere there is no danger that the aquaria may be flooded with tap-water. The working of the instrument will be understood from the sketch, etc., appended (fig. 2).

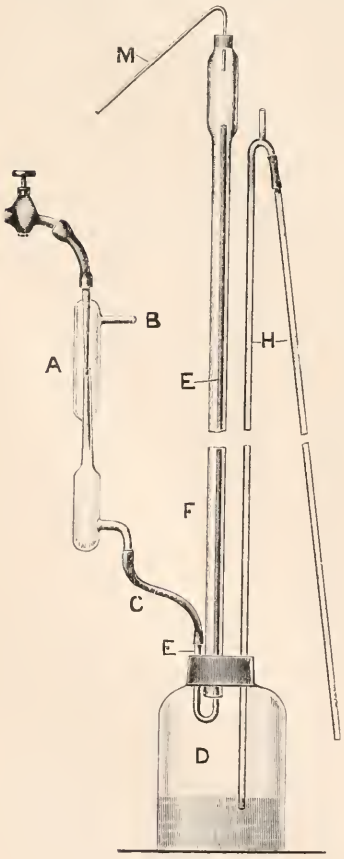


Fig. 2.

A. An ordinary *small* aspirator of glass or metal attached to a water tap, the water supply being under considerable pressure.

B. Opening in the aspirator for the entrance of air.

C. Rubber tubing attached to outflow of aspirator, and connected with the tube E.

* See this Journal, 1910, pp. 9–13.

† Loc. cit.

D. Bottle, of e.g. 600 c.cm. capacity, with neck about 2 in. wide, and a tight cork pierced with the necessary holes.

E. Bent tube, of about $\frac{3}{8}$ in. internal diameter, one end connected with C, the other passing up within the wider tube F to 8 in. from the top, and opening there.

F. Wider tube, 6 or 7 ft. high, and of about $\frac{9}{10}$ in. internal diameter, passing through the cork, and connected at the upper end with M, the air-tube supplying the aquaria.

H. A bent tube of about $\frac{1}{2}$ in. internal measurement, and about 10 in. shorter than F, with an opening at the top of the bend. One limb of the tube pierces the cork and reaches nearly to the bottom of the bottle, while the other is led to a waste sink.

M. Air-tube for supply of aquaria.

When the tap is turned on, water mixed with air emerges at the top of the bent tube E within the wider tube. The water is free to fall down the wide tube into the bottle, while the air remains higher up. Pressure rises inside the bottle and the tubes coming from it, and the water used escapes by H, and thus runs to waste. This gives a supply of air along M under as much pressure as the height of H allows. If more air is supplied than is used for aeration, it gradually displaces the water in D as far down as the lower end of H, and then the surplus escapes.

The opening at the top of the bend on H ensures against syphon action taking place, and thus destroying the internal pressure. Should the water pressure at the tap slacken and give a diminished supply of air, the water level in the bottle and in the tube F rises till it adjusts itself to the lessened internal pressure. Should inflow at tap cease altogether, any water which may be in the tubes above the level of B escapes by this opening, and accordingly it is as well to have attached thereto a piece of rubber tubing leading to the waste sink.

The attachment between tap and aspirator needs to be secure. The nozzle of the tap should be of suitable shape, and pressure tubing, firmly tied on and strengthened by having string or a strip of strong tape wound round it, should be employed.

V.—*Adaptation of Ordinary Paraffin Baths for Vacuum Embedding.*

By J. F. Gemmill, M.A. D.Sc. M.D.

(*Read November* 16, 1910.)

The advantages of being able to embed certain objects in a vacuum, or under diminished atmospheric pressure, are well known. Baths made for the purpose are, however, costly, and many workers who possess a good ordinary paraffin bath may welcome a means of adapting it when desired to embedding *in vacuo*.

The following arrangement works satisfactorily in the case of a large open embedding bath which was made for me eight or nine years ago by the Cambridge Scientific Instrument Co., according to a model slightly modified from that given under No. 291 of their catalogue (fig. 3). A similar arrangement can be adapted to closed baths.

A. An ordinary small aspirator connected with C, a bell-jar, by means of strong rubber tubing, in the course of which a gauge or indicator (B in the sketch) may, if desired, be interposed. The bell-jar should be small, e.g. 2–3 in. across the mouth.

D. A flat ring of good rubber, about $\frac{1}{8}$ in. in thickness, $\frac{1}{2}$ in. broad, and of a diameter suited to the size of the bell-jar.

The jar I use was got by cutting off the bottom of a small bottle of fairly strong glass, grinding the cut end flat, and at the same time very slightly smoothing the edges.

Bell-jar and rubber ring were made just of the right size to fit over any one of the small embedding pots on the top of the bath. The ring serves as an air-tight joint or washer between the bell-jar and the bath. When the jar is fitted in position and the water turned on, the air pressure within the jar can readily be reduced to as low as $\frac{1}{2}$ in. of mercury. But unless when air has to be extracted from some cavity in the specimen being embedded, I prefer to work with a much more imperfect vacuum, especially in the case of delicate tissues.

One must remember that only a strongly made open bath could stand having a vacuum chamber fitted on any part of it. Practically all open baths have, however, places for holding embedding tubes. These tubes can be fitted with a suitable stopper and exhausted in the same way as the bell-jar, without risk of breakage of any kind unless they are very thin.

In the case of closed embedding baths, all one has to do is to

supply a suitable base for the bell-jar, and to put the jar so fitted into the inside of the bath, leading a tube to it from the aspirator in whatever way is most convenient. For example, a small piece of suitable piping can be soldered through one side and left as a permanent fixture, to which tubing may be attached, leading on the one hand to the aspirator, and on the other with the bell-jar inside. Or, as most baths have an opening in the roof for letting down a thermometer, this opening may be utilized for the passage of the tube. The base may be of strong copper, or, perhaps, better of plate glass, the thickness being greater the larger the bell-jar used.

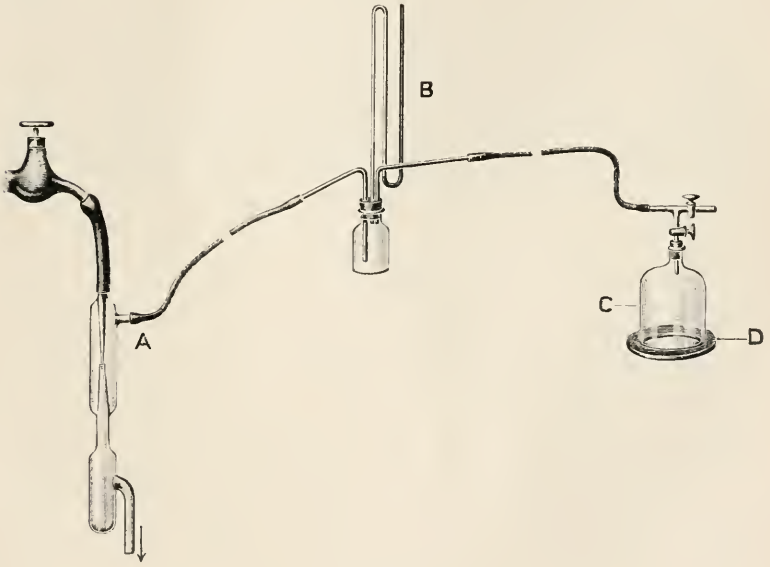


Fig. 3.

The dishes containing melted paraffin and the objects to be embedded are placed under the bell-jar. The latter is then fitted on to the base with the help of the rubber ring, and exhaustion is effected as before. Or again, as in the case of the open bath, the process may be carried on by using tubes with suitable stoppers.

It is well to have the top of the bell-jar fitted with stopcocks, as shown in the sketch. The lower of the stopcocks enables one to shut off the vacuum chamber at once when the required degree of diminished pressure has been attained. The upper of the stopcocks is useful when the process is at an end, as when opened it allows free entrance of air into the bell-jar without the least risk that any water may be sucked in from the tubing connected with the aspirator.

I find it useful for other purposes to have at hand in the laboratory a means of producing a vacuum, and it is simple to arrange that the tubing from the aspirator may be fitted whenever desired to another bell-jar with the requisite rubber washer and base, apart altogether from the bath. One can get very rapid and very perfect removal in vacuo of the absolute alcohol by the clearing agent, e.g. xylol or cedar oil. One can also extract absolute alcohol from these substances so that they can be used over again even for the final stages of clearing.

Then on the bath, paraffin already used, and now no longer free enough from traces of the clearing agent to allow it to be used again for the final embedding, may be rendered fairly pure if kept melted for a time under the aspirator. Even though the actual embedding of objects in paraffin is allowed to proceed in the ordinary way, it is still of very great advantage at the end of the process to submit the dish of melted paraffin, containing the object, for a short time to the action of a vacuum, as in this way the mass, when cooled, will be of uniform consistence and free from crystallization.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(3) Illuminating and other Apparatus.

Sliding Nose-piece for use in Stereo-photomicrography.†—H. C. Banfield describes a useful piece of apparatus for moving the objective

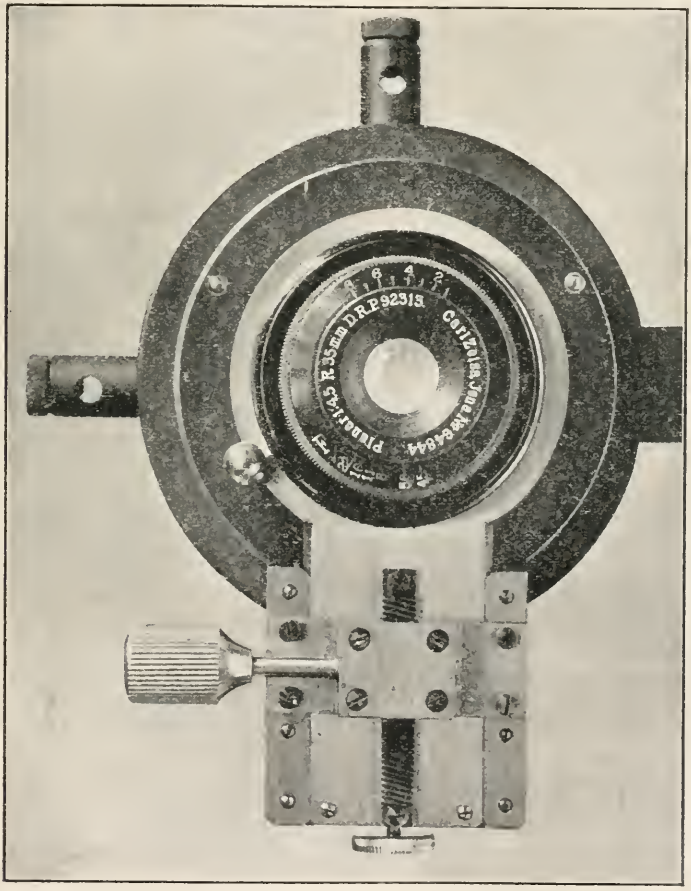


Fig. 4.

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

† Journ. Quekett Micr. Club, xi. (1910) pp. 121-2 (1 fig.).

for low-power photomicrography. The device consists of a sliding plate screwed to carry the objective, and laterally displaceable by means of a small rack-and-pinion (fig. 4). For several reasons this method is more convenient than moving the object, as the illumination is unaltered and the shadows fall on their right place. The apparatus can be used only on Microscopes with a large body-tube, but a half-plate camera and a Microscope fitted with the Zeiss sliding objective changers are all that is necessary for high-power work, as the lateral screw of these changers moves the objective adequately and efficiently.

Arc Lamps for Projection.*—H. P. Gage has, with the help of the General Electric Company at Schenectady, made an exhaustive series of investigations on the above subject. These investigations were suggested by, and supplementary to, certain preliminary investigations at Cornell University. They dealt with direct and alternating currents as applied to the three ordinary types of projection lamps, viz. with inclined carbons, with electrodes at right angles, with converging electrodes. Full descriptions, with diagrams, are given of the experiments and results. The author concludes that a direct current obtained from a mercury-arc rectifier gives almost as much light as a direct current from a generator. In every case direct current gives much more light for equal current values than does alternating current. He is of opinion that evidently the power drawn from the line depends upon the power consumed at the arc and the efficiency of the "ballast" or transforming device. Of the devices tested the rectifier was the most efficient, and the least efficient was a resister used with alternating current.

Improvement in the Illumination of Objects observed with the Binocular Microscope.†—C. Cépède, in the course of his botanical and zoological researches with the binocular Microscope, has found rather serious inconvenience arise from the formation of a shadow zone in the part of the object turned towards the observer. This shadow is a hindrance, by its depth, to the minute morphological and anatomical study of all this part of the object. The author has overcome the difficulty by illuminating the part in question by the help of a concave mirror, which may be applied in three ways.

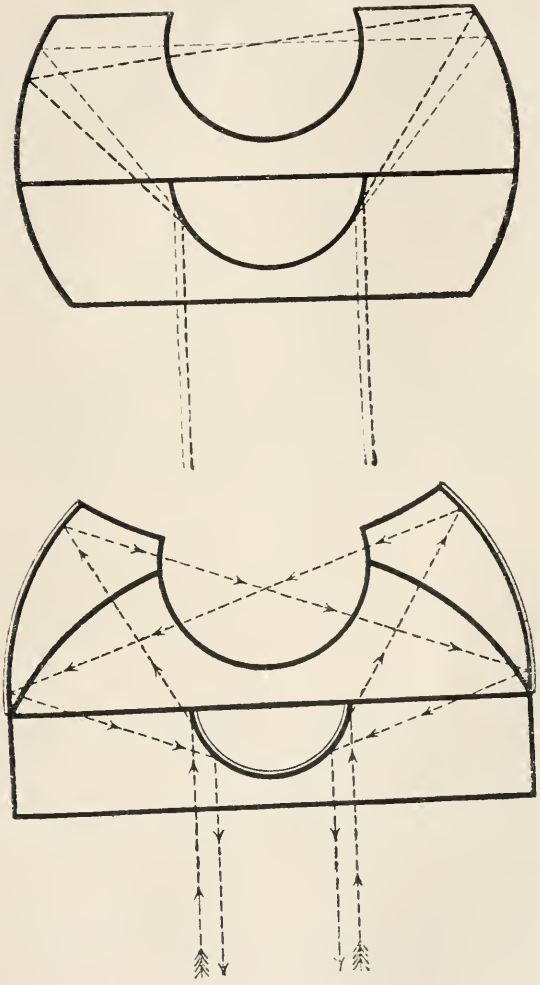
First Arrangement.—In this case, midway between the holes admitting the spring-clips, the stage is pierced by a similar hole for the admission of a cylindrical screw-piece, resembling those bearing the clips. To this screw-piece is attached a brass or nickel rod, bent at right angles, and carrying a mirror-holder at its further extremity. The mirror is fixed by help of screws, so that it has movement in two directions. The whole arrangement thus has a triple articulation, and can be directed as desired.

Second and Third Arrangements.—In these the screw which fixes the arm of the Microscope to the stage is used for screwing the mirror-holder, which may be fastened either to the upper part of the arm (second arrangement) or to its lower part (third arrangement). The mirror-carrier itself is substantially the same as in the first arrangement.

* Electrical World, Oct. 13, 1910 ; and as a separate pamphlet, 5 pp. (9 figs.).

† Comptes Rendus, cli. (1910) pp. 948–9.

Jentsch's Ultra-condenser.*—This apparatus has been designed by F. Jentsch for investigations concerned with molecular movement in gases. It permits the passage of rays from all azimuths of the plane perpendicular to the Microscope-axis, and, in addition to these, many



Figs. 5, 6.

other rays above and below this plane find their way to one and the same point. This peculiarity distinguishes the apparatus from Zsigmondy's ultramicroscope, which only admits a beam of rays from

* Verh. Deutsch. Phys. Gesell., xii. pp. 992–4 (3 figs.).

one side. The author attains his purpose by the arrangements shown in figs. 5, 6, 7. Thus, in fig. 5, by means of the two reflecting spherical surfaces, each ray undergoes four reflexions, two before, and two after, reaching the particles contained in the upper spherical cavity. It will be noticed that the rays quit the condenser on the same side of the apparatus as they enter it. The pattern in fig. 5 is built up of two constituent pieces of glass; that in fig. 6 is composed of three constituents. The substance under examination in the upper cavity may be a gas, a vapour, or a fluid. For many fluid examinations, especially when only a small quantity of a strongly absorbing substance is available, the form shown in fig. 7 is better adapted. In this form

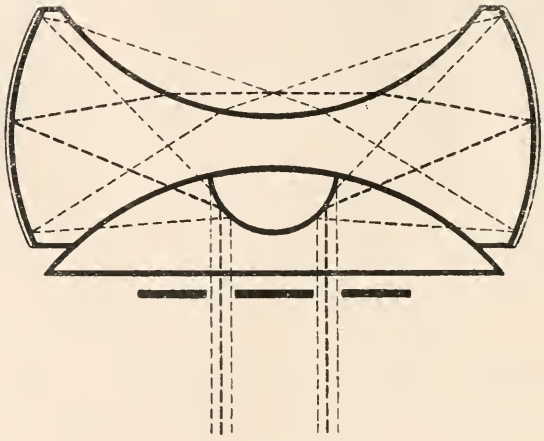


Fig. 7.

the hollow space is so arranged that boundary surface breaks the rays and takes part in forming the ray-combination. In addition to great brilliance, these designs, at any rate Nos. 5 and 6, offer the great advantage of freedom from colour-error, as their action depends exclusively on reflexion. Even with No. 7 colour-error need not arise if the aqueous solution be so chosen as to preserve the principle of "homogeneous dispersion."

If tobacco smoke be blown into this condenser, a very great number of bright particles is seen in active molecular movement. If an electric spark be introduced, the tiny particles of metal torn off from the electrodes can be seen whizzing about.

Jentsch's Concentric Condenser.*—F. Jentsch, after some general remarks about mirror-condensers in general, discusses in detail the principles of one based on the properties of two concentric circles. These will be understood from fig. 8, where AP_1P_2B is a ray originating at A and arriving at B after a convex reflexion at P_1, and a concave

* Verh. Deutsch. Phys. Gesell., xii. pp. 975–91 (8 figs.).

reflexion at P_2. O is the common centre of the circles, $a = o\,A$, and $b = o\,B$; the inner and outer radii being r_1 R_1 respectively. By properties of a triangle, it follows that

$$a \sin \alpha = r \sin \phi = R \sin \gamma = b \sin \beta ;$$

whence

$$b = a \frac{\sin \alpha}{\sin \beta}.$$

If the origin be removed to infinity, then for a ray of incidence-height h,

$$f = \frac{h}{\sin \beta},$$

where f is the focal distance of the zone in question. The condition for aplanatism is

$$\frac{\sin \alpha}{\sin \beta} = \text{a constant} ;$$

or, if A be at infinity,

$$\frac{h}{\sin \beta} = \text{a constant}.$$

Moreover, it can be shown that a system of two concentric reflecting circles is free from coma. Owing to the fact that one mirror reflects convexly and the other concavely, the catacaustics will have opposite

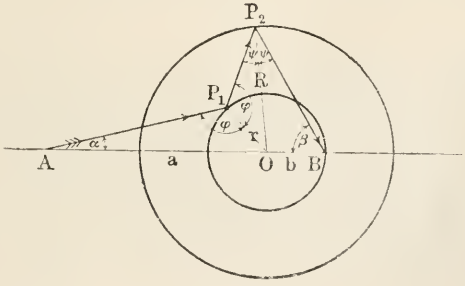


Fig. 8.

sense, and will tend to neutralize one another. With medium aperture the zone-aberration-values will change but slightly, and the system will have its greatest advantage under such a condition. There will, again, be many pairs of rays whose aplanatism will be perfect, and by suitable choice of radii this property can be made to apply to any desired range of aperture. The author also discusses the conditions under which the brightness will be a maximum, and shows that theoretical values can almost be attained in practice.

Fig. 9 shows how the principle of the concentric condenser can be actually realized for an aperture range of 0·97 to 1·35.

It will be noticed that in Jentsch's design the two curved surfaces are worked out of one and the same piece of glass, while in Ignatowsky's and in Siedentopf's patterns two pieces are required, thus introducing centring errors which are here absent. Jentsch's upper glass is a square

plane-parallel piece; it has only the significance of an intermediate piece, and serves to approximate the upper surface of the condenser to the object-carrier. This peculiarity also makes it less sensitive to injury in the use of high temperatures which might affect the cement. Both mirrors are silvered so that only those rays emerge which are required for dark-ground illumination; thus the concave mirror functions also somewhat as a diaphragm stop.

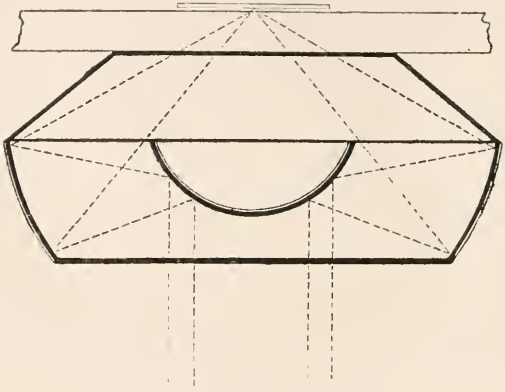


Fig. 9.

Simple Method of Making Drawings for Projection Purposes.* M. Ponzo pours filtered gelatin over glass plates; old cleaned-up photographic plates do very well. When dry, these plates may be drawn on with ink, Indian ink, anilin colours, with brush or pencil. Mistakes may be remedied by scratching off the gelatin and refilling the erased spaces with fresh gelatin.

Electric Heating Apparatus for Microscopical Observations.†—Figs. 10, 11, 12 show that the main idea in F. Jentsch's heating apparatus is a rectangular or circular brass box. This contains the heating apparatus, well isolated externally by means of asbestos: the box is fastened by two screws on to a slate slab 6 or 7 mm. thick, and is placed directly on the object-stage. The heating chamber is, in figs. 10 and 11, a small hollow metal box of good heat-conductivity in order to warm up the preparation uniformly, and is especially capable of resisting loss of heat by the observation-hole. In pattern No. 1 (fig. 10) the stove has a certain slowness, so that heating up, and cooling down, require some minutes (perhaps one minute for 250° C.). If the observation-hole is covered with a cover-glass a preparation may be kept for a whole day at a constant temperature. This effect is essentially due to a special spirally shaped coiling of the heating resistance wire, which gives within wide limits a temperature gradient proportional to the time. The highest temperature attainable depends

* Zeitschr. Biol. Technik u. Methodik, ii. (1910) p. 46.
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 259–64 (5 figs.).

only on the melting-point of the material used. With the above-mentioned stoves 900° C. could be reached; with platinum stoves,

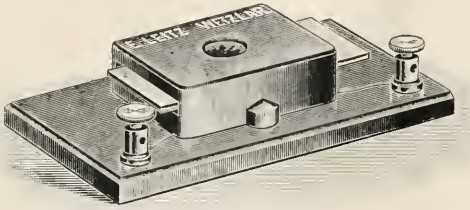


Fig. 10.

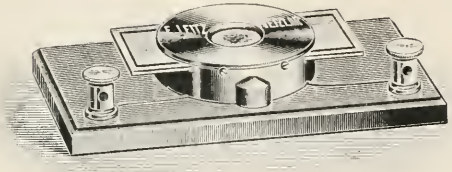


Fig. 11.

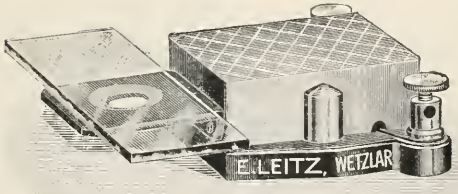


Fig. 12.

1500° C. With pattern No. 1 (fig. 8) the objective can be lowered to a working distance of 5 mm., which with Leitz' objectives would furnish a magnification of 258 diameters.

Pattern No. 2 (fig. 9) is for higher magnifications, the object-slide being brought up closer to the objective. A dry system will give 2000 diameters.

Fig. 13.

Pattern No. 3 (fig. 10) is arranged for the convenience of the illuminating system, the object-slide being placed on a laterally projecting slab. With this pattern, however, the constancy of the temperature is evidently liable to be affected by air-currents. On the other hand, changes in the object can be more readily noted.

Nos. 1 and 2 are suitable for mineralogical and petrographical sections, and No. 3 for microchemical reactions and interference figures in convergent polarized light. Another pattern is made intended for biological studies.

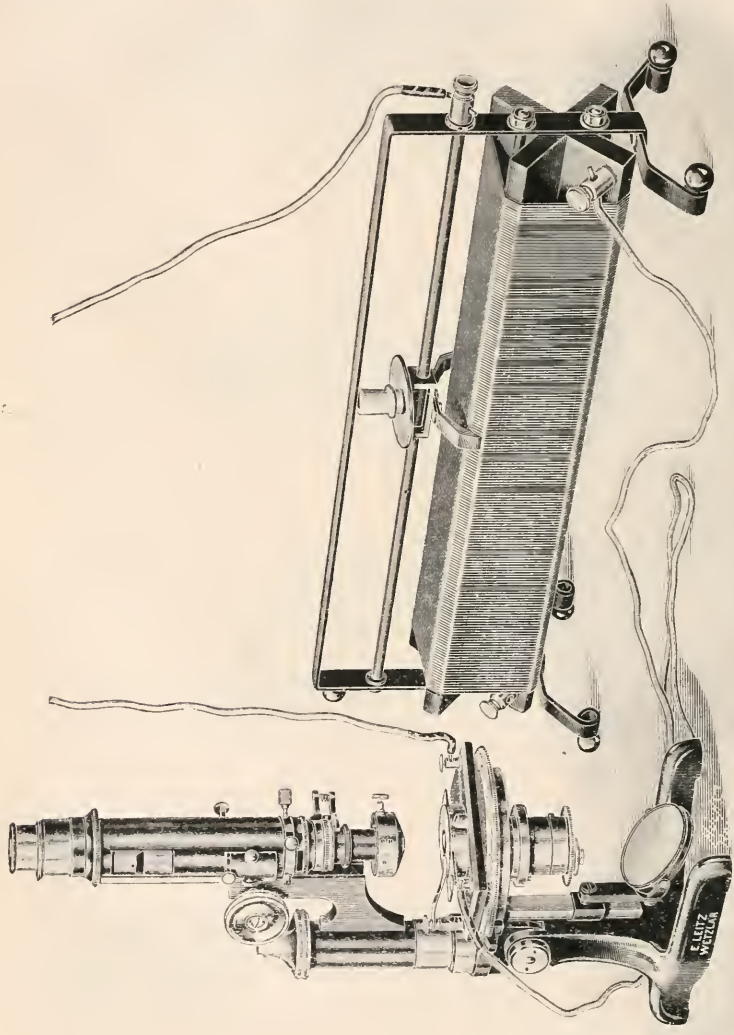


Fig. 14.

For small magnifications, and therefore for considerable objective distances, the objective does not require special protection. But for all cases of high temperature the objective needs a small protecting cap

(fig. 13). This cap easily fits on to the objective, and surrounds it with an isolating mantle of air.

For the determination of temperatures at which fluid crystallization and allotropic changes occur, the author considers his apparatus would be eminently suitable.

Fig. 14 shows the general arrangement with resistance coil.

(4) Photomicrography.

Simple Object-holder for Photomicrography: Tables of Magnifications.*—R. Müller describes this apparatus, which he has designed and found very useful. He uses it with the Zeiss horizontal-vertical camera, but slight alterations would adapt it to other Microscopes. The apparatus consists of a board 50 × 50 cm., secured by two lateral boards to the object-stage; it may be arranged for horizontal or vertical adjustment. In the horizontal position, the surface of the object-holder lies accurately at the height of the Microscope stage, the Microscope itself being perpendicular and firmly clamped on the foot-plate. In the vertical position, a hole is cut out of the board for the object-stage of the horizontally-inclined Microscope. Two adjustable laths with clamps serve for holding the objects to be photographed, e.g. culture-dishes, negatives, water-chambers, etc. A special shelf is used for photographing paper pictures. The whole arrangement is ingenious, and the author gives numerous pictorial illustrations of its application, as well as a very complete tabular list of the necessary numerical adjustments.

Wratten and Wainwright's Photomicrography.†—This handy little book is written in a clear and lucid style, and is intended to be a trustworthy guide to the beginner. Its style is expository, not scientific. Its object is not to discuss possible methods, but to explain the easiest, and, while some of the statements made need qualification, it has been thought best to do so rather than to perplex the beginner by diffuseness. The work is not intended to replace the regular text-books of the subject, but to supplement them. Some beautiful examples of photomicrography are given in the plates.

New Photographic Apparatus of the Paris School of Mines.‡ J. Boyer describes this apparatus, which was devised by H. Ragot, of the Geological Laboratory of the Sorbonne, for the reproduction of opaque and of transparent objects. It is also intended for photographing microscopic objects (fig. 15), but instead of moving the Microscope by means of a rack-and-pinion, focusing is effected by moving the object. The entire apparatus is attached to a rigid beam, and may be used in a horizontal or a vertical position. The object-holder rests on a carriage which is movable upon a second and larger carriage. The large carriage is moved rapidly by turning one of the wheels and long rods shown in the photograph, and the smaller carriage is moved slowly, with respect to the

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 265–71 (11 figs.).
† Wratten and Wainwright, Ltd., Croydon, 16 pp. (6 pls. and several figs.).
‡ Scientific American, ciii. (1910) p. 104 (2 figs.).

large one, by turning the other wheel and rod. A Zeiss planar lens of short focus is used for moderate enlargements, and a Microscope objective for enlargements on a greater scale. As the pitch of the screw threads which are cut on the long rods is only one-fifth inch, the focusing can be accomplished as easily and accurately as with a rack-and-pinion. The object is illuminated by a Nernst lamp of 120 candle-power, provided with condensing lenses. The part of the object which it is desired to photograph is brought into the field by means of a total reflection prism and a Microscope eye-piece attached to the camera, as the great length of the apparatus makes it impossible to move the object by hand while observing its image on the ground-glass screen. In addition to these

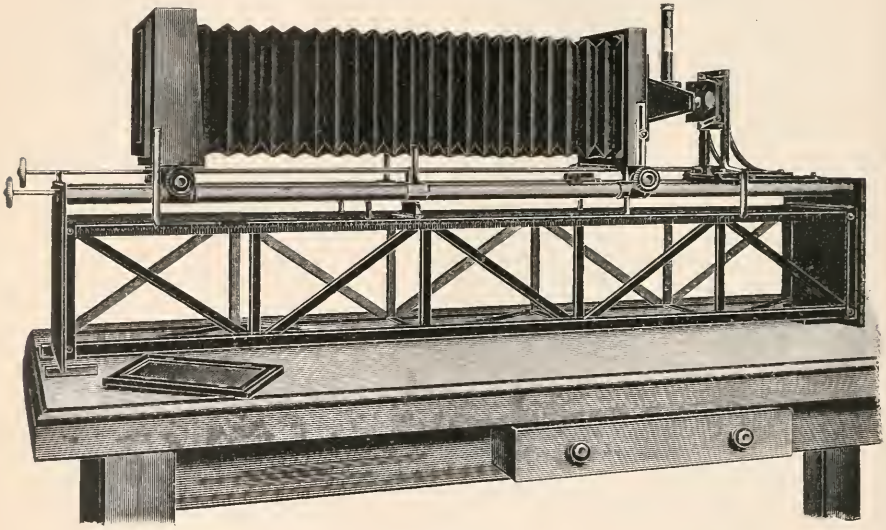


Fig. 15.

two forms of apparatus, the photographic laboratory of the School of Mines contains an excellent equipment, including two dark-rooms provided with all necessary apparatus, and a third and larger dark-room containing an enlarging camera and a paper-holder for the production of enlarged positives, 30 by 40 cm. (12 by 16 in.) in size. The camera and the paper-holder are mounted on a single frame, which is supported by springs on four light masonry columns. In consequence of this arrangement the tremors produced by the passage of railway trains and trolley-cars affect the negative, the lens, and the paper simultaneously and to the same degree, and therefore do not diminish the sharpness of the reproduction. Another enlarging camera, sliding on rails, and provided with a lens of 12 in. focus, is used for the reproduction of drawings, measuring 12 by 16 in. The same apparatus, with the addition of two arc-lamps and a series of screens, is employed for instructing the future engineer in the methods of photo-engraving.

FIG. 1.

FIG. 2

FIG. 3.

FIG. 4.

[*To face p.* 105.]

Eder, J. M.—**Jahrbuch für Photographie und Reproduktionstechnik.**
[The "Separat-abdruk" from the above summarizes with its usual completeness the most important progress made during the year.]
Halle: Wilhelm Knapp.

Linder, P.—**Mikro-photographische Aufnahmen von lebenden Objekten in der Ruhe und in der Bewegung.** Muschau, 1910, p. 787.

(5) Microscopical Optics and Manipulation.

Interference Phenomena in Polarized Light.* — These three volumes, by the late Hans Hauswaldt, together form the most complete black-and-white photographic record of polarization phenomena that has ever been produced, and which it is very unlikely will ever be surpassed. The work has been done with characteristic German thoroughness. Neither brains, time, nor money have been spared. This statement will be understood when it is remembered that the various crystal sections used were prepared by Steeg and Reuter, the apparatus employed was made by Carl Zeiss, and the description of the same was written by Siedentopf, of ultra-microscope fame.

The first volume consists of some thirty-three full-sized autotypes showing the stauroscopic figures produced by plates of various thicknesses, and cut at different obliquities to the axis, in white and sodium light, of such typical uniaxial crystals as calcspar, nitrate of soda, apatite, zircon, quartz (including amethyst), and such biaxial crystals as arragonite, mica, gypsum, topaz, and sugar.

The illustration given shows one of these plates. Fig. 1, pl. III., is the figure given by a plate of apatite, cut normal to the axis of the crystal, in sodium light and between crossed nicols; whilst fig. 2, pl. III., shows the same plate combined with a quarter-wave mica, to show the test for negative crystals. Figs. 3 and 4, pl. III., show similarly the figures given by a plate of zircon—a positive crystal.

The second volume, containing eighty plates, is a very interesting one. It gives, in the first place, the different figures obtained in convergent sodium light—the N.A.'s employed being 0·636, 1·168, and 1·70—in such crystals as calcspar, topaz, gypsum, etc. These figures are followed by others showing the effect of using practically monochromatic lights of different wave-lengths in calcspar and brookite. The mica combinations of Rensch and Norrenberg, the spectrum analysis of the colours produced by double refraction, and the figures produced by various shapes of glass, stressed in different ways, are finally dealt with.

The third volume, of seventy-two plates, deals largely with the phenomena produced by circularly polarized light, twin crystals, etc.

Enough has been said to indicate the complete nature of the work done by Hauswaldt. This, as will be seen, is not so remarkable for the originality of the problem, attacked as it is for the thoroughness with which work so often attempted by others has been done. Indeed, until colour-photography becomes practical for this class of work, it would be labour in vain for anyone to attempt to rival the work of Hauswaldt.

* Interferenz-Erscheinungen an doppeltbrechenden Krystallplatten im konvergenten polarisirten Licht. By Dr. Hans Hauswaldt. Magdeburg, 1902 (33 pls.); Op. cit., 1904 (66 pls.); Op. cit., 1907 (80 pls.).

No first class text-book dealing with the subject is, in our opinion, likely to be published during the next half-century which does not draw upon these rich store-houses of illustrations.

(6) Miscellaneous.

Sensibility of the Eye to Variations of Wave-length in the Yellow Region of the Spectrum.*—From observations on his own vision, Rayleigh concludes that the distinction in colour of the two D lines can be perceived if favourably presented to the eye.

Quekett Microscopical Club.—The 470th Ordinary Meeting was held on January 24, the President, Professor E. A. Minchin, M.A. F.Z.S., in the Chair. From particulars supplied by Mr. F. J. Keeley, of Philadelphia, who possesses a mount labelled "*Navicula amicii*, Florence, Italy—from Professor Amici to C. A. Spencer," Mr. Nelson considers the much-disputed Amician test to be certainly identical with what he terms the "English *rhomboides*." † Mr. C. F. Rousselet, F.R.M.S., described and exhibited three new species of Rotifer. These are *Anuræopsis navicula* sp.n., from central Ceylon, a very small species, lorica 92 μ; *Brachionus satanicus* sp. n., from Devil's Lake, North Dakota, U.S.A.; and *B. havaniensis* sp. n., from Illinois River, near Havana. Mr. R. T. Lewis, F.R.M.S., read a note "On the Larva of *Mantispa*." The differences between mature specimens of the Mantidæ family and those of sub-family Mantispides are not very obvious to the casual observer. Perhaps the most noticeable difference is in the life-history of the larvæ of the two groups. In *Mantis*, on emerging the young insects closely resemble the adult form, except as to size, colour, and absence of wings. In *Mantispa* the emerging larvæ bear not the slightest resemblance to the perfect insect. They are only about 1 mm. in length; have two simple eyes; are armed with apparent mandibles; have 3-jointed antennæ and 7-jointed palpi; the six legs are of equal size, and are terminated by a hollow trumpet-shaped appendage instead of the usual claws. On leaving the egg the larva bores its way into the ovisac of a spider and feeds upon the eggs or young until the second ecdysis. In the subsequent stage it becomes a helpless, fleshy grub, and spins a cocoon. Emerging from this it begins to resemble the perfect insect, but has only rudimentary wings, and not until two more moults does it become a mature Neuropterous *Mantispa*. Mr. H. Gunnery, of Acomb, York, exhibited a number of preparations for the Microscope, mostly botanical sections, and a series of lantern slides, mostly photomicrographs of various stages of nuclear division in *Lilium*. The Microscopes used were kindly lent by Messrs. C. Baker.

Abney, Sir W. de W.—**Colour-blindness and the Trichromatic Theory of Colour Vision. Parts i. and ii.**

[Part i. treats of the relation of complete, and Part ii. of incomplete, colour-blindness to the trichromatic theory of colour vision.]

Proc. Roy. Soc., Series A, lxxxiii.–lxxxiv. (1910) pp. 462–74 and 449–64.

Blakesley, T. H.—**A Means of Measuring the Apparent Diameter of the Pupil of the Eye in very feeble Light.** *Phil. Mag.*, Dec. 1910.

* Proc. Roy. Soc., Series A (1910) pp. 464–8.

† See Journ. Quekett Micr. Club, ser. 2, xi. (1910) p. 95.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Human and Bovine Tubercle Bacilli.† — W. R. Park and C. Krumwiede, who have been investigating the relative importance of the bovine and human types of tubercle bacilli in the different forms of human tuberculosis, state that all cultures were isolated by means of the guinea-pig, and finding that egg-media were eminently successful, used them in the following two combinations: (1) Dorset's medium, the whole egg mixed with 10 p.c. water; (2) Lubenau's medium, 10 eggs mixed with 200 c.cm. of glycerin-bouillon. It was found that the human virus grew better from the start on the glycerin-egg medium, while the bovine variety was inhibited. They arrive at the following general conclusions: (1) All cultures growing luxuriantly on glycerin-egg from the start are of the human type. (2) All cultures growing sparsely (or even not at all) on glycerin-egg in the first few generations are of the bovine type.

Method of Isolating and Growing the Lepra Bacillus of Man.‡ F. W. Twort started from the idea that, as there may be a close relationship between tubercle and leprosy, the leprosy bacillus might be cultivated on media to which tubercle bacilli had been added. Accordingly, pure cultivations of tubercle were obtained, and the bacilli were ground up with glycerin and saline, and having been steamed for half an hour were added to the yolk and white of new laid eggs in the following proportions: Eggs 75 parts, 8 p.c. sodium chloride 25 parts, tubercle bacilli 1 p.c., glycerin 5 p.c. or less. The medium was placed in test tubes, heated to 60° C. for 1 hour: on the following morning incubated at 38° C. for 6 hours, and again heated in a water bath at 60° C. for 1 hour, and set in slopes at 85° C.

The ericolinized nasal discharge of a leper § was inoculated into this medium, the tubes being capped with rubber, and incubated at 38° C. After 24 hours the medium absorbed a quantity of the ericolin, so that the material was lifted off with a platinum loop and rubbed over fresh tubes. The bacilli grew and were subcultured in pure growth. The bacilli were fairly long-headed rods, and quite acid-fast. The growth at first was extremely slow, and only evident to the naked eye after about six weeks as a colourless film along the needle track.

Artificial Cultivation of Animal Tissues.‖—M. T. Burrows and A. Carrel give, in a series of communications, an account of their experiments, which show that portions of various animal tissues can be removed from their natural environment and cultivated in an artificial medium

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

† Centralbl. Bakt., 1te Abt. Ref., xlvii. (1910) pp. 673–80.

‡ Proc. Roy. Soc., lxxxiii. (1910) pp. 156–8.

§ For the Ericolin method see this Journal, 1909, p. 526.

‖ C.R. Soc. Biol. Paris, lxix. (1910) pp. 291–4, 298–301, 328–34, 365–8.

at 39° C. This medium is composed of plasma derived from the animal or the parent of the animal, from which the culture material is to be obtained, but no particulars of its preparation are given.

In the first communication, Burrows describes his experiments with chick embryos. The myosomes, neural tube, heart and epithelium were dissected upon the warm stage of a binocular Microscope at a temperature of 39° C. The tissues were then kept in plasma in a sealed chamber at this temperature. Mesenchymatous cells began to grow and multiply after an interval of 2 to 12 hours. Long nerve-fibres developed in 3 or 4 hours. The heart continued to beat for 8 hours, and from portions of exposed surface of heart-muscle grew mesenchymatous cells and muscular cells which contracted at the same rhythm as that of the adjoining heart. From the central nervous system cultivations were also made, which grew more slowly.

Further communications deal with the cultivation of adult tissues. The authors have been successful in obtaining growth with artificial cultures of conjunctiva, cartilage, bone-marrow, peritoneum, vascular endothelium, kidney, thyroid, suprarenal, ovary, and lymphatic glands. The abundance and rapidity of growth vary according to the nature of the tissue, the age of the animal, and a number of other factors. The material was obtained from dogs and cats. In cultivations of thyroid from a kitten a few hours old, growth was observed within 12 hours. Cartilage, conjunctiva, and peritoneum grew more slowly. The beginnings of growth were marked by the appearance of fine granulations at the periphery and upon the upper surface. Each organ produced two types of cell—the connective-tissue cell and the differentiated cell. Detailed accounts are given of the cultivation of renal tissue, spleen, and bone-marrow. With the thyroid gland, the authors have succeeded in producing secondary and tertiary subcultures.

Further, from sarcoma in the chick and in man, cultures have been obtained. These grew even more rapidly than normal tissues in artificial culture. By means of continuous observations, the process of multiplication of sarcoma cells in vitro has been observed.

J. Jolly,* criticising the above research, considers that the authors have only demonstrated the survival of animal tissues, a phenomenon already established by previous researches. He is doubtful as to whether any true cultures have been obtained, and even regards some of the phenomena described as in reality necrobiotic changes.

Modified Method of Isolating Typhoid and Paratyphoid Bacilli.† O. Mayer has made extensive use of a modification of the Lentz-Tietz method. Six loopfuls of the fæces to be investigated were spread on a malachite green agar plate, and then the same glass spreader was rubbed over three large plates of lactose-litmus-agar or fuchsin-agar. The malachite green plate was incubated for 24 hours at 37°, the other plates for 48 hours at 30° C. After this incubation, the growth upon the malachite green plate was washed off with a small quantity of saline. This emulsion was allowed to stand for five minutes, and then one loopful was

* C.R. Soc. Biol. Paris, lxix. (1910), pp. 470–3.
† Centralbl. Bakt., 1te Abt. Orig., lvi. (1910) pp, 552–75.

plated upon lactose-litmus-agar or upon fuchsin-agar. The author found that these organisms were often recovered from the malachite green plate by this means, when a negative result was obtained from the plates directly inoculated. He emphasized two points: firstly, that the emulsion on the malachite green plate should not be shaken, as this permits less motile and less easily detached organisms to be taken up; and, secondly, that the malachite green (Höchst 120) should be fresh or kept in an ice chest.

The author concludes that this method is a necessary adjunct to the method of simple plating, and gives a better chance of finding the organisms when they are scarce. The greater the bulk of fæces plated, the more valuable the results obtained.

New Method for Differentiation of Bacteria.*—L. S. Dudgeon, D. N. Panton, and H. A. F. Wilson have made a series of observations upon the influence of bacterial extracts upon phagocytosis. These extracts were prepared by freezing and thawing alternately thick bacterial pastes, so that the organisms became disintegrated. By dividing phagocytosis experiments into stages and, in the first place, incubating extract and leucocytes, extract and bacteria, or extract and serum, and then adding the third component and again incubating, it was shown that the specific action of the extract was upon the serum; but it was also found that this action was not directly related to absorption of complement. The diagnostic value rests upon the observation that an extract will remove from a serum with which it has been incubated almost all the homologous opsonin. Thus if serum after incubation with typhoid extract be added to leucocytes and typhoid bacilli and incubated, no phagocytosis will occur: while, on the other hand, phagocytosis of another organism, such as *Bacillus achard*, i not much diminished.

Rapid Method of Identifying Bacillus coli.†—F. Domergue and R. Legendres give an account of their method for determining the presence of this organism in samples of water or shellfish. Tubes of nutrient broth are prepared, and, after sterilization, there are added to each tube fifteen drops of a solution containing 0·5 p.c. of neutral red and 5 p.c. of phenol. The tube is then inoculated with material, and placed within a large thick glass tube containing a few cubic centimetres of water and tablets of caustic soda and pyrogallic acid. The outer tube is now hermetically sealed, and in a few moments oxygen and carbon-dioxide are completely absorbed. After incubation at 42° C. for 24 or 48 hours the culture is examined, and the presence of *Bacillus coli* is indicated by the canary-yellow colour of the medium, green fluorescence, and the production on the surface of gas-bubbles. The high incubation temperature and the anaerobiosis are important agencies for the selection of *B. coli*.

(2) Preparing Objects.

Examining the Salivary Glands of Ticks.‡—M. Elmassian dissected out the salivary glands in saline water by Christophers' method and then

* Proc. Roy. Soc., lxxxiii. B (1910) pp. 33-7.
† Comptes Rendus, cli. (1910) pp. 1401-3.
‡ Arch. Zool. Expér. et Gén., xlv. (1910) pp. 379-419 (2 pls.).

fixed them. The most satisfactory fixative was Orth's liquid, to which a little acetic acid was added. Paraffin sections were stained with Heidenhain's iron-hæmatoxylin, Delafield's hæmatoxylin (3 p.c. in H_2O) for 24 hours and then differentiated with absolute alcohol. The methods of Benda and of Mann were also used, as well as the well-known toluidin-blue and orange G : the action of the latter is uncertain.

Methods of Studying Rotifera.*—G. Hirschfelder gives an account of the technique employed in a study of this class. The examination of living specimens was facilitated by the use of a 1 : 50,000 neutral red solution. The animal, in a drop of this fluid, was placed on a slide, and a coverslip with wax feet laid over it. Sufficient pressure was applied to the slip to immobilise the animal without destroying it.

In order to obtain satisfactory dead specimens, it is necessary, in the first place, so to narcotise the animal that it dies fully expanded. The object is put in a vessel containing 1·5 c cm. of water, and to this are added two or three drops of a cocaine solution. Rousselet's mixture—cocaine hydrochloride, 2 p.c., 3 parts; alcohol, 90 p.c., 1 part; water, 6 parts—is a very suitable solution. Care should be taken not to shake the specimen. After about a quarter of an hour, the creature comes to rest, and a drop of 1 p.c. osmic acid is added. Ten minutes later the specimen is transferred to distilled water; it is left in distilled water about five hours, and then transferred to 2 p.c. formalin. The whole specimen may be mounted without further treatment between two slips separated by wax feet, the margins being sealed with paraffin.

For sections, the narcotised animal may be treated with a mixture of picric and chromic acids, followed by warm water and rising alcohols. Ehrlich's hæmatoxylin followed by orange G form the best staining system. Picric and acetic acids may also be used as fixing fluid.

Method of Studying Phagocytosis of Erythrocytes by Endothelial Cells.†—W. O. Meek obtained endothelial cells from ascitic fluid from cases of hepatic cirrhosis. The fluid was passed straight from the siphoning tube in the sterile normal saline containing 0·85 p.c. of sodium citrate. The cells obtained by centrifugalizing were washed in normal saline, the mass of cells being gently broken up between each washing with a platinum wire. A suitable emulsion in saline was then prepared. The cells were used as soon as possible after removal from the body.

The erythrocytes employed consisted of 1·0 p.c. suspensions in normal saline of washed red cells from a normal man and various patients. The sera were obtained from normal persons and from a number of hospital patients.

Serum, erythrocytes, and endothelial cells were mixed in small lengths of glass tubing sealed at one end. The open end was plugged with sealing-wax, and the tubes incubated in a vertical position at 37° C. for 30 minutes. The erythrocytes and cells then fall to the bottom of the column, and a film is made containing a minimum of fluid. The Microscope was used to ascertain whether agglutination of red cells had occurred.

* Zeitschr. wiss. Zool., xcvi. (1910) pp. 211–17.
† Lancet, 1910, ii. p. 1267.

Simple Shaker.*—K. Poppe describes a new type of shaker, worked by a water turbine (fig. 16). The rockers *a b*, *a b*, which work round the axes *a*, *a'*, support a carriage, the base of which is hinged to a connecting rod attached excentrically to the revolving wheel. On the platform *c* can be placed a tray (not illustrated) for carrying test-tubes horizontally. The upper stage, for carrying flasks, is attached by means

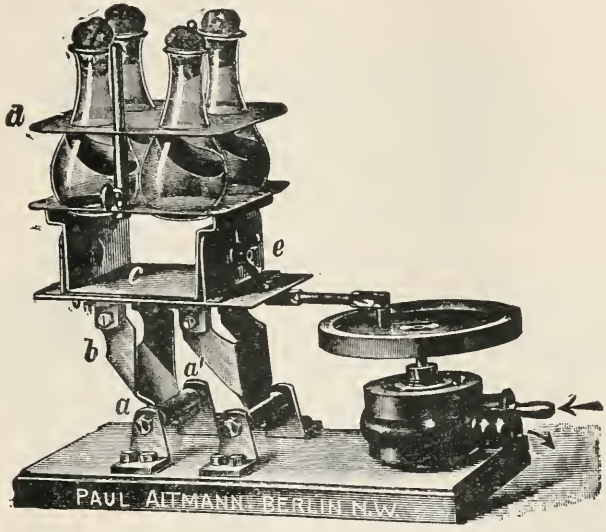


Fig. 16.

of wing screws. The flasks are kept in position by means of a movable plate *d*. The whole apparatus is small enough to go into a medium-sized incubator.

Fixation and Embedding of Embryological Material.†—H. Schridde, from a long experience, finds that Orth's mixture of Müller's fluid and formalin (9 : 1) is the best fixative for the purpose. The fluid should be warm. Small objects should remain at a temperature of 36° in the mixture for 4 to 6 hours. Large specimens require from 12 to 24 hours. On removal the preparations are placed in running water for from 3 to 12 hours, and then transferred to 50 p.c. alcohol. When required for embedding they are passed through upgraded alcohols to absolute alcohol, after which they are transferred to cedar-wood oil, wherein they remain until they are quite clear. After this the preparations are immersed in xylol or toluol for 20 to 30 minutes, according to size. This procedure is followed by paraffin m.p. 42°–44°: small objects 15 to 30 minutes, the larger one, 30 to 60 minutes. After this they are transferred to paraffin m.p. 54°–56°, in which they remain for ¾ to 1 hour. For large objects an intermediate

* Centralbl. Bakt., 1te Abt., Orig., lv. (1910) pp. 527–8.
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 360–5.

stage with paraffin m.p. 48°–50° is advisable. The objects are embedded in a metal frame placed on a warm glass plate, and when the surface of the paraffin is set the plate is at once placed in cold water.

Poso, P.—**Uber Fixierung und Einbettung von Placenta und Uterus des Menschen.** *Zeitschr. wiss Mikrosk.*, xxvii. (1910) pp. 353–9.

(3) Cutting, including Embedding and Microtomes.

Apparatus for Rolling Wax Plates.*—O. Berner describes an apparatus (fig. 17) by means of which wax plates of any required thickness can be rolled for reconstruction work. It consists of an iron plate, a heater, a steel roller, and a special heater for the roller. The iron plate, of which the dimensions are 60 × 40 cm., is supported upon

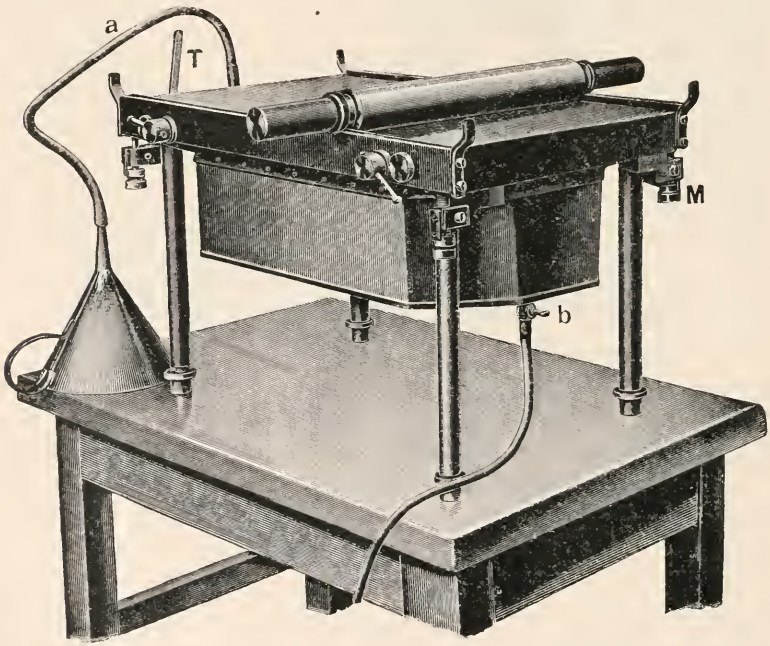


Fig. 17.

four metal feet, provided with screws for adjusting the level. This plate carries the wax. Along the long sides of the plate are guide-ridges, along which the rolling-pin travels. Screws, M, adjust the height of these guide-ridges, and so determine the thickness of the plate. Underneath the plate is a copper water-vessel, provided with a thermometer, T. This vessel is heated by a Bunsen burner; it is filled through the tube *a*, emptied through the tube *b*. The rolling-pin is a solid steel

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 44–7.

bar, grooved to fit the guide-flanges. It is raised to the required temperature by means of the heater shown in fig. 18. Before use, the plate is moistened with turpentine. The most convenient temperatures are about 52° C. for the plate, and 100° C. for the roller.

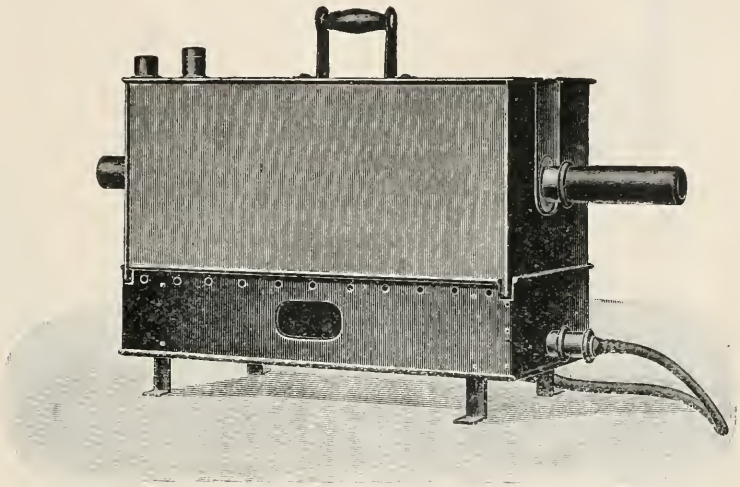


Fig. 18.

Manipulation of Paraffin Sections.*—J. T. Wilson hastens the setting of paraffin blocks by using a metal plate on the floor of the embedding chamber, and placing this on a freezing microtome.

For floating out paraffin sections placed on top of the water-bath he employs a mercury surface as an artificial horizon. On the top of the bath is placed a shallow glass tray filled to a depth of 6 or 7 mm. with mercury. On this surface the slides may be placed until the sections are completely flattened.

For celloidin-paraffin sections a much deeper tray or box is required; this is covered with an accurately fitting lid. When the slides are placed on the mercury surface a small pledget of cotton-wool soaked in ether is placed in one corner, and then the lid is put on.

For passing blocks of tissue through various fluids he uses short segments of wide glass tubing 18 to 30 mm. in diameter; one end is closed with mosquito netting, or some fine material, while the other is plugged with a perforated cork; the cork must be bulky enough to float the whole in the fluid.

Tetrander Microtome.†—P. Mayer describes this instrument, which owes its name to the number of persons who co-operated in the design.

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 232–4.
† Tom. cit., pp. 52–62.

In principle it is a sliding microtome, in which the object moves and the razor remains stationary. The razor is held firmly in a massive metal

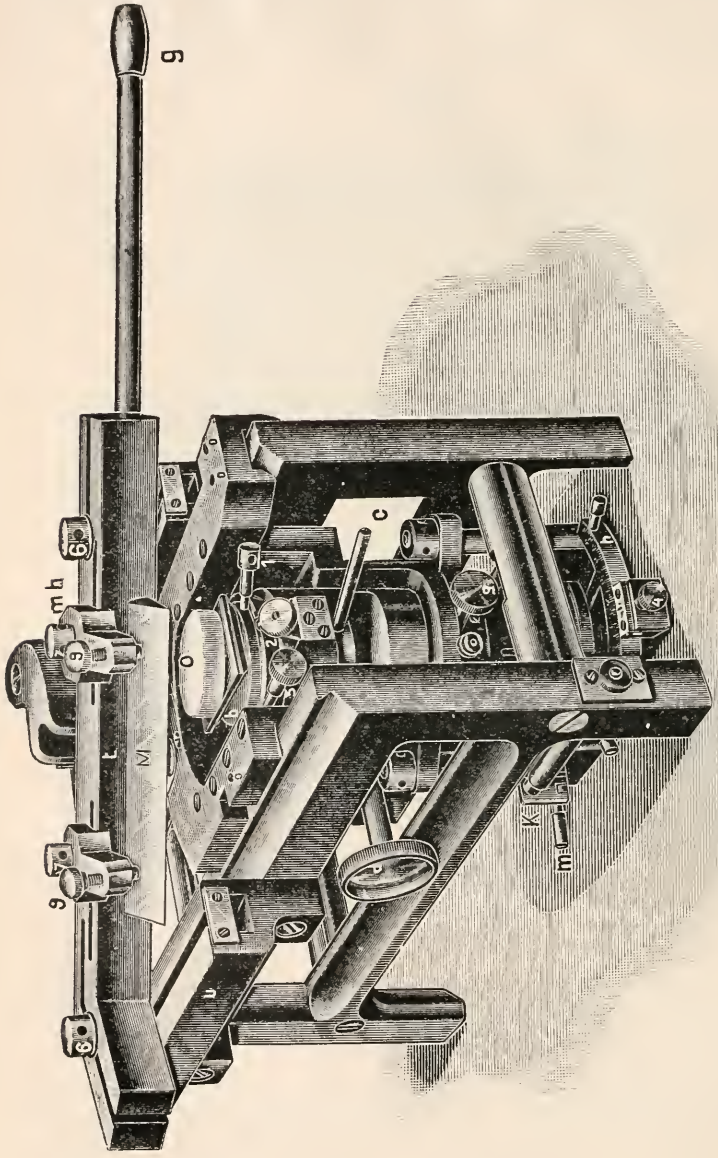


Fig. 19.

bar, upon which, as can be seen in the diagram, there are a number of screws for controlling the inclination and adjustments of the cutting

edge. Figs. 19 and 20 illustrate two models, which differ principally in the design of this mechanism for holding the razor. The movement to and fro of the microtome-stage is controlled by the lever *g*. The

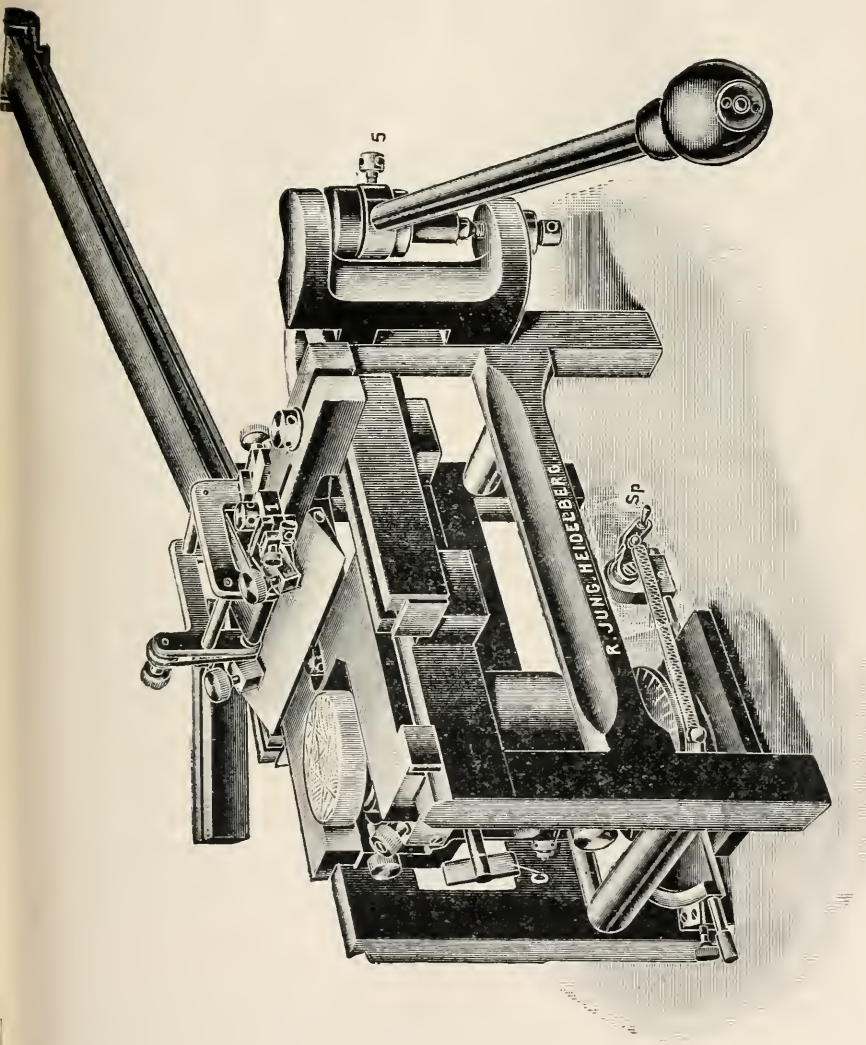


Fig. 20.

thickness of sections is determined by the adjustment of the lever *h*, which can be moved along the index shown in the lower part of fig. 19. The substage mechanism also allows of free movement of the stage up and down, so as to bring the block into the proper position for cutting.

New Method of making Celloidin Serial Sections.*—F. Maier cuts celloidin sections under 75 p.c. alcohol and transfers them to slides; there should be a margin of celloidin outside the tissue of from 0·25 to 0·5 cm. The sections are pressed firmly down on the slide with blotting paper. Over the series is poured a mixture of oil of cloves 1 part, and absolute alcohol 9 parts; this is allowed to remain until the celloidin is soft, i.e. from 15 to 30 seconds; the superfluous fluid is poured off, and then the slide is laid flat for a while in order to let the sections get fixed. Then a mixture of ether and alcohol is poured over the series in order to remove all traces of oil of cloves; this is removed by evaporation merely. After 15 to 30 seconds sulphide of carbon is poured over the series and allowed to act for 10 to 15 minutes. All traces of the carbon sulphide are removed by means of 96 p.c. alcohol changed more than once. After this, down-graded alcohols to water, in order that staining, etc., may be carried out in the usual way.

The object of this technique is to make sections of any thickness stick to the slide.

Utilizing Organized Structures as Directing Marks for Plastic Reconstruction.†—J. T. Wilson described over ten years ago‡ a system for obtaining directing marks in microscopical sections for the purposes of plastic reconstruction. In his new system he still builds up an embedding chamber on a base-plate, but has discarded the Naples bars, and has adopted an apparatus the dimensions of the component parts of which may be varied as desired.

The base of the embedding chamber is formed by a brass plate *a* (figs. 21 and 22), through which are bored two pairs of cylindrical holes *b*, each about 3 mm. in diameter. The ends of the embedding chamber are formed by rectangular brass plates *c*, set up upon the base-plate; they are held in position by projecting dowel pins *d*, which fit into the holes in the base-plate. The lower end of each end-plate is provided with two socket holes *e*. These fit over two pins *f*, which project 2 to 3 mm. up from the base-plate. The calibre of the pins is 1 mm. or less, and the distance between them must be exactly the same at either end, 2 to 3 mm.

In order to carry out the nerve-strand method of embedding, a filament is gently stretched around the two pairs of pins, and the filament must be taut but not strained. The loose ends should be crossed on the plate at one end and held there in position, while the corresponding end-plate is placed in position and its dowel pins firmly pressed home; the nerve-filament is thus securely clamped. The second end-plate is similarly treated. This done it will be found that the two parallel nerve-filaments are in contact with the surface of the base-plate. Two pieces of wire (common pins decapitated) are inserted between the surface of the base-plate and the nerve-strands, close to the end-plates. The embedding chamber is then completed by the addition of the special side-

* München. med. Wochenschr., lvii. (1910) pp. 637–8, through Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 385–7.

† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 227–32 (2 figs.).

‡ See this Journal, 1900, p. 735.

walls g; the sloping sides tend to minimize the pitting of the paraffin block.

An alternate method of utilizing organized structures so as to provide directing marks in paraffin blocks is as follows :—A glass plate is smeared evenly with a minimum of glycerin. A slab of bulk-stained tissue some 50 microns thick is deposited on the plate, some water is run under it,

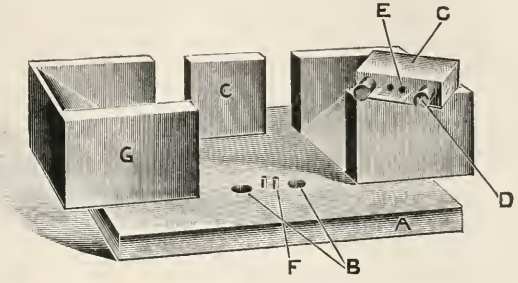


Fig. 21.

and the plate is gently heated; the water is drained off and the section allowed to dry on. When required for reconstructive purposes, embedding bars are set up on the plate, the paraffin section forming the floor. The object is then embedded in the usual way, so that eventually a block

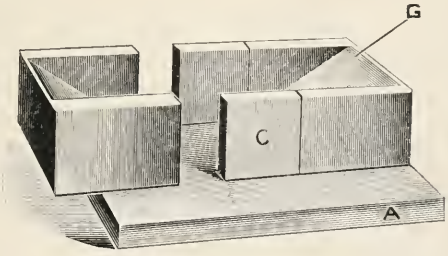


Fig. 22.

with one covered surface is obtained. This face is then grooved with a "Ritzer." No further treatment is required, and the block is cut in the usual way, taking precautions to ensure that the grooves made by the "Ritzer" shall be perpendicular to the cutting plane.

(4) Staining and Injecting.

Distinguishing Dead from Living Leucocytes.*—C. Achard finds that when leucocytes are treated with neutral red, the living are uncoloured or contain red-stained and intra-protoplasmic vacuoles or granulations; the nuclei of dead leucocytes stain red-brown, and there is no intra-protoplasmic coloration. Two solutions are used, one is normal saline with 6 per 1000 citrate of sodium, another is normal

* Brit. Med. Journ. (1910) ii. p. 1416.

saline with 1 per 1000 neutral red. Ten drops of each solution are mixed in a tube, and then 1 drop of blood, or 1–4 drops of the sediment of a centrifuged exudate. The tube is incubated at 37° for 20 minutes, and then the liquid is examined in a glass cell and the living and dead leucocytes separately enumerated.

New Method of Demonstrating Spirochæta pallida. * — J. T. Lenartowicz and K. Potrzobowski give the following procedure: Perfectly clean slides are exposed to the vapour of ½–2 p.c. osmic acid for 5 seconds; the vaporized side is then covered with a smear of the material to be examined; the smear is at once fixed for 10 to 20 seconds with osmic acid vapour, and when quite dry is stained for ¼ to 1 minute with the Ziehl-Neelsen carbol-fuchsin tubercle stain. This done, the preparation is washed with water, dried and examined under an oil-immersion. It is important to notice that the exposure to the osmic acid vapour should not exceed the time given above. In successful preparations the ground is stained red, and upon this *Spirochæta pallida* stands out as an unstained appearance; other bodies, such as *S. refringens*, red corpuscles and bacteria, stain well; hence, according to the authors, this procedure not only facilitates the search for *S. pallida*, but also serves for a differential diagnosis. The method is also useful for detecting flagella.

Use of Picramic Acid for Staining.†—A. Fröhlich, after alluding to the ill qualities of picric acid, recommends as substitute picramic acid, and gives the following procedure: (1) Stain in hæmalum, wash in tap water, or in faintly ammoniacal distilled water until blue. Transfer to saturated alcoholic solution of picramic acid for 3 to 5 minutes or longer. Wash quickly in absolute alcohol. Next immerse in saturated alcoholic solution of chromotrop 2 R or 6 B (Höchst) for ½ to 2 minutes until the sections begin to turn red. Lastly, a short wash in absolute alcohol, xylol-alcohol, xylol-balsam.

Combined Staining Methods for Tubercle bacilli.‡—S. Harano gives two methods for the better staining of tubercle bacilli: (1) Stain with warm carbol-fuchsin for 5 minutes; wash; 25 p.c. sulphuric acid for 10 to 30 seconds: 75 p.c. alcohol until all the colour has disappeared. Stain with methylen-blue solution for 2 minutes and wash. Then Gram's stain. In the second method the procedure is reversed.

Staining in bulk with Hæmatoxylin.§—C. Morel and Bassal fix in a mixture the following solutions: A. Bichromate of potassium 2, water 100. B. Formol 10, acetic acid 10, water 80, for 8 to 20 hours. The pieces are thoroughly washed in running water for 24 hours, and then immersed for 1 day in 95 p.c. alcohol. The pieces are then placed in a freshly made mixture of the two following solutions: I. Hæmatoxylin 1 grm., 95 p.c. alcohol 100 c.cm. II. Perchloride of iron 2 c.cm.; hydro-

* Centralbl. Bakt., lvi. (1910) pp. 186–91 (1 fig.).

† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 549–52.

‡ Berlin Klin. Wochenschr., xlvi. (1909) pp. 1694–5, through Zeitschr. wiss. Mikrosk., xxvii. (1910) p. 313.

§ Journ. Anat. et Physiol., xlv. (1909) pp. 632–3.

chloric acid 1 c.cm. ; 4 p.c. aqueous solution of copper acetate 1 c.cm. ; water 95 c.cm. After an immersion of from 24 to 48 hours the pieces are removed to a mixture of equal parts of alcohol and distilled, and, if necessary, afterwards to running water. Dehydration in absolute alcohol (24 hours) ; aceton 24 hours ; paraffin 6 to 8 hours. Sections are stuck on with 0·1 p.c. gelatin with a few drops of formalin added.

Staining the Internal Network in Nerve-cells.*— R. Collin and M. Lucien fixed the material in the following mixture : 20 p.c. formalin 30 ; 1 p.c. solution of arsenious acid 30 ; 96 p.c. alcohol 30. After 6 to 8 hours the pieces are transferred to ½ p.c. silver nitrate solution for 13 hours to a few days. After a wash in distilled water they are immersed in the following mixture : hydroquinone 20, anhydrous sulphate of sodium 5, formalin 50, distilled water 1000. The pieces are next washed, hardened, and embedded preferably in celloidin. The sections are then gold-stained by means of the following solutions, mixed immediately before use. A. Hyposulphite of sodium 30, ammonium sulphocyanate 30, distilled water 1000. B. Gold chloride 1, distilled water 100. In this the sections remain until they assume a grey hue. Though the following steps are not indispensable, they bring out the network better. After washing in distilled water the sections are treated with the following mixture : potassium permanganate 0·5, sulphuric acid 1, distilled water 1000. Then wash thoroughly in 1 p.c. oxalic acid and afterwards in distilled water. Stain in carmalum, wash, dehydrate, and clear up.

New Methods of Demonstrating Plasmodes.†—S. Bálint fixed the material in 2 p.c. formalin and then cut sections, which were preserved, while awaiting further treatment, in 4 p.c. formalin. The sections are stained with an iodine solution made by dissolving the iodine in 2 p.c. formalin and then adding 25 p.c. sulphuric acid. While the sections are staining, a few drops of 4 p.c. formalin, saturated with iodine, are added : staining is completed in from 2 to 3 hours. The preparation may be mounted in glycerin or balsam, but unfortunately the finer details do not last longer than six months. Another method which gives good results consists in staining sections, which have been fixed in formalin and preserved in alcohol, or subsequently further fixed with aqueous or alcoholic sublimate, with the following solution : anilin oil 3 c.cm., acid-fuchsin 20 grm., H_2O 200 c.cm. After treatment with the staining solution for 10 to 20 minutes, they are washed out with a saturated alcoholic solution of picric acid, which has been diluted with 100 c.cm. distilled water to every 50 c.cm. Then follow 96 p.c. alcohol, benzol-alcohol, benzol (in each of which a little picric acid is dissolved), benzol-balsam.

Staining Celloidin Sections of Nervous Tissue by the Iron-hæmatoxylin Method.‡—Marie Loyez fixes the material in 10 p.c. formalin for eight days or longer ; the pieces are carried through in the

* C.R. Assoc. Anatomistes, 1909, pp. 238–44 (7 figs.), through Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 294–5.

† Zeitschr. wiss. Mikrosk, xxxii. (1910) pp. 243–5.

‡ C.R. Soc. Biol. Paris, lxix. (1910) pp. 311–13.

usual way, and the celloidin sections are treated as follows. They are first mordanted with 4 p.c. iron-alum for 24 hours, and then rapidly washed. Next they are stained with Weigert's hæmatoxylin (hæmatoxylin 1 grm., alcohol 10 c.cm., water 90 c.cm., saturated solution of lithium carbonate 2 c.cm.), for 24 hours: the staining at 37° in an incubator is advisable, but not indispensable. After a wash in water the sections are differentiated in two stages; first with 4 p.c. iron-alum until the grey substance begins to clear up, and then, after a careful washing, in Weigert's solution (borax 2 p.c., ferricyanide of potassium 2·5 p.c.). They are next washed in ammonia water, and after this washed again in water for a long time: finally they are passed through ascending alcohols to xylol and balsam.

J. Nageotte* remarks that staining the celloidin sections with hæmatein, and decolorizing with the ferricyanide solution, gives results equally good.

Staining the Medullary Sheath in Brain-sections.†—E. Pötter cuts sections of brain which have been fixed in 10 p.c. formalin, with the Reichert large microtome. The sections, about 15 mm. thick, are then placed in Weigert's fluorchrom-copper mordanting fluid for 14 days at room temperature. They are then dehydrated in upgraded alcohols (70°, 80°, 96°, 100°, 2 days each). Next ether-alcohol (āā) for 2 days, as a preparatory for thin celloidin (2 days); this is followed by celloidin of syrupy consistence. To render the thick celloidin more suitable for sectioning it is advised to add 4 drops of cedar-wood oil to every 20 c.cm. The celloidin is then allowed to inspissate, and when sufficiently thickened the material is cut into blocks and preserved in 70 p.c. alcohol. The sections are made with an immersion-microtome, and preserved, if necessary, in 70 p.c. alcohol; when required for staining they are placed between two sheets of acid-free tissue paper. They are then immersed in Weigert's iron stain without the hydrochloric acid for 2½ to 3 hours. On removal they are treated with Lustgarten's fluid, which makes the cortex assume a dark-brown hue, the medullary sheaths being black. After this the sections are further differentiated with borax 2, ferricyanide of potash 2, H_2O 100, until they assume a yellowish tinge. This is followed by washing for several days in frequently changed water. Then dehydration in upgraded alcohols, carbol-xylol, balsam.

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

Method of Preserving Plague Material.‡—C. Broquet finds that if the viscera of animals affected with or dead of plague be preserved in 20 p.c. glycerin the virus will retain its activity for 8 or 9 days, while the addition of 2 p.c. carbonate of lime gives still more satisfactory results.

Bentley-Taylor Method of Mounting Mosquitos.§—This method is extremely simple and rapid. Twelve specimens can be mounted in

* C.R. Soc. Biol. Paris, pp. 517–19.
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 238–42 (1 fig.).
‡ Ann. Inst. Pasteur, xxiv. (1910) pp. 888–94.
§ Proc. Roy. Soc. Med., iv. (1910) med. sect., pp. 41–2.

about 24 minutes, and few or none are ever spoiled in the process, which is as follows :—1. Prepare a solution of 1 p.c. celloidin in absolute alcohol. 2. A solution of celloidin (5 p.c.) in absolute alcohol of the consistence known as "thick" in ordinary histological work. It is essential that no ether be employed in the solution, as it makes the scales transparent. 3. Catch the mosquito. 4. Chloroform it. 5. When dead or narcotized, place a drop of solution No. 1—thin celloidin—on a cover-glass. 6. Place the insect back downwards on the cover-glass. In the majority of cases wings and legs spread themselves out in the orthodox exhibition position. If they do not do so the solution remains fluid sufficiently long in Bombay at a temperature of 85° F. to 90° F. for from 3 to 5 minutes to permit them to be adjusted with a needle. 7. When the thin solution has become "tacky," to use the language of the motorist—i.e., in about 8 or 10 minutes from the commencement of operations—place a drop of the thick solution, No. 2, over the insect. 8. Invert the cover-glass over a hollowed slide, to which it may be fixed by a ring of balsam. The specimen is now complete, and in this condition both ventral and dorsal surfaces can be examined under the Microscope.

If it be thought desirable to employ a white background, instead of manœuvre 8 proceed thus :—8*a*. Suspend some oxide of zinc in ordinary mounting Canada balsam. Shake or stir well immediately before using ; fill the cell or hollow of the slide with this emulsion ; invert the cover-glass with the mosquito, and press rather firmly into the emulsion. 9. Clean off any of the emulsion that spreads beyond the edge of the cover. Specimens prepared by this latter method will, of course, display only one surface.

Celloidin in Microscopical Technique.*—L. Neumayer has found that celluloid in plate form may be found useful as slides or coverslips. The best material is practically as transparent as glass, and can be obtained in any size and thickness. In this connexion it may be recalled that mica and gelatin have also been used instead of glass. The inflammability of celluloid must be taken into consideration ; in other respects it seems that celluloid is a convenient substitute for vitreous plates.

Microscopical Examination of Foods and Drugs.—This work, by H. G. Greenish,† is a practical introduction to the method adopted in the microscopical examination of foods and drugs in the entire, crushed and powdered states. It has deservedly reached a second edition.‡ Its principal features remain unaltered, though certain revisions and additions have been made. Among these may be mentioned the chapter on fibres, saffron, liquorice, calumba, etc. A chapter has been added on the more commonly occurring adulterants of powdered foods and drugs. A new section consists of a general scheme of examination which will be found specially useful in the investigation of an unknown powder.

Drop-bottle for Preventing the Action of Air on Copper-oxide-ammonia Solution.§—G. Herzog describes a drop-bottle which he has

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 234–8.
† London : J. and A. Churchill, 1910, xvii. and 386 pp. (209 illus.).
‡ See this Journal, 1903, p. 561.
§ Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 272–4 (1 fig.).

devised for keeping copper-oxide-ammonia solution from the action of air. This reagent, so important in testing the fibres of hemp and flax, rapidly deteriorates, and under ordinary conditions is not permanent for long. The bottle is made of brown glass, and, as will be seen in the illustration (fig. 23), the neck is closed by a caoutchouc plug, in which are two holes for the passage of glass tubes; one of these dips into the ammoniated copper solution, the other just ends below the stopper, its outer extremity being fitted with a teat having a small perforation. The

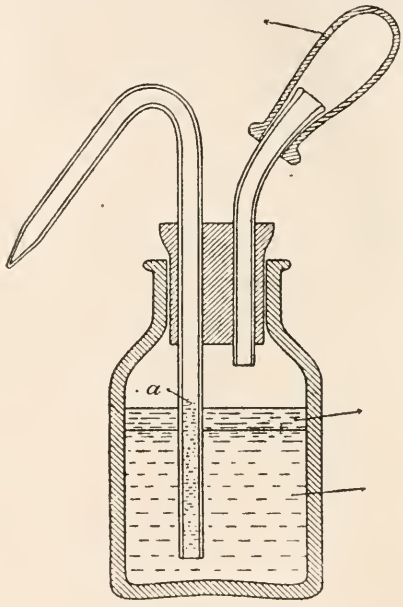


Fig. 23.

copper solution is covered with a layer of paraffin oil. The same device is used for several purposes in laboratories, but has not been exploited for this special purpose before.

Simple Arrangement for Determining the Sinking-velocity of Plankton Organisms.*—F. Krause was led to contrive his apparatus by desire of pursuing the following investigations: "What influence has body-form and body-magnitude of plankton-organisms on their sinking-velocity? How is the velocity of the same individual affected by the viscosity of the medium? How are such results affected by various temperatures in the same water?" His apparatus consists of two parts—a receptacle for the organism, and an observation instrument. The receptacle is formed out of a rectangular metal plate 65 mm. long, 35 mm. broad, and 2·5 mm. thick, whose middle part is cut away so as to leave a rectangular notch 45 mm. long and 6 mm.

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 347–9 (2 figs.).

broad. There is an arrangement for closing the front of the notch by a large cover-glass, and the back is closed by a milk-glass scale, e.g. a fragment of an old thermometer-scale. The notch thus forms a trough of suitable shape, and its metal surroundings, being pivoted by two screws on a suitable frame, materially assist in procuring a perpendicular position, to which a circular level contributes. This frame is prolonged into a tripod foot, and can be raised or lowered. The observation part of the apparatus is one of Zeiss' Braus-Drühner preparation Microscopes, and this is directed on to one of the divisions of the glass scale. When the organism has reached this division a stop-watch is released, and the time of reaching the next division recorded. The author hopes at some future time to publish an account of his researches.

Metallography, etc.

Polymorphism of Zinc.*—C. Benedicks has determined the electrical resistance of samples of pure and commercial zinc, at small temperature intervals, between 16° C. and the melting-point. The existence of a transformation-point at about 340° C., discovered by Le Chatelier, was confirmed, and a similar point was found at about 170° C. The author concludes that zinc is trimorphous, the α form being stable up to 170° C., β in the range 170° to 330° C., γ from 330° to 419·4 C°. Abnormal results were given by the impure samples.

Aluminium-calcium Alloys.†—From the results of determinations of electro-chemical potential and electrical conductivity of a series of aluminium-calcium alloys, J. M. Breckenridge deduces the existence of the compound Al_3Ca.

Alloys of Lithium.‡—G. Masing and G. Tammann have studied the binary systems of which the components are lithium and one of the metals sodium, potassium, tin, cadmium, and magnesium. By using very thin thermocouple wires and protecting tubes, it is possible to apply the methods of thermal analysis to a few grams of material, and thus to work out equilibrium diagrams of systems of metals which can be obtained in a pure state only in small amounts. The original should be consulted for the detailed results of the investigation.

Gold-magnesium Alloys.§—G. G. Urasow and R. Vogel explain differences in the equilibrium diagrams obtained by them when working independently. The existence of Au_2Mg_5 is confirmed, but it is stable only in the range 796°–716° C., breaking up into $AuMg_2$ and $AuMg_3$ at the lower temperature.

Silver-cadmium Alloys.‖—G. Bruni and E. Quercigh have determined the equilibrium diagram by means of cooling curves of 30 alloys. The compounds AgCd and $AgCd_4$ occur; these form solid solutions with silver, or cadmium, or each other, according to the composition of the alloy.

* Metallurgie, vii. (1910) pp. 531–7 (5 figs.).
† Met. and Chem. Eng., viii. (1910) p. 349.
‡ Zeitschr. Anorg. Chem., lxvii. (1910) pp. 183–99 (5 figs.).
§ Tom. cit., pp. 442–7 (4 figs.). ‖ Tom. cit., pp. 198–206 (3 figs.).

Silver-copper Alloys.*—N. Kurnakow, N. Puschin, and N. Senkowsky have determined the electrical conductivity at 25°, 50°, and 100° C. of 16 silver-copper alloys before and after annealing. Hardness measurements, by the Brinell method, confirm the results of the electrical determinations, which indicate that the limits of solid solubility are 4 atomic p.c. silver in copper, and 9 atomic p.c. copper in silver.

Silver-sodium Alloys.†—E. Quercigh, by means of a thermal study of twenty alloys melted in an atmosphere of nitrogen, has found that silver and sodium are miscible in all proportions in the liquid state, that no compound is formed, and that the single eutectic lies close to the sodium end of the equilibrium diagram. The solid solution of sodium in silver has the concentration limits 0 to 13 atomic p.c. sodium.

Ternary Alloys of Magnesium, Zinc, and Cadmium.‡—G. Bruni, C. Sandonnini, and E. Quercigh have investigated by thermal methods the binary systems zinc-cadmium, zinc-$MgZn_2$, and cadmium-$MgZn_2$. The compound $MgZn_2$ is the only one occurring in the magnesium-zinc system, and behaves like a simple metal in ternary alloys. Having cleared up the doubtful points in the binary systems, the authors proceeded to study the ternary system, cadmium-zinc-$MgZn_2$, as a portion of the complete ternary system. Cooling curves were taken of 109 alloys lying in fifteen vertical sections of the usual triangular diagram; these sections were parallel to the zinc-magnesium side of the triangle. The ternary system examined has three binary eutectic lines meeting in a ternary eutectic point at 250° C. and 73 atomic p.c. cadmium, 25 zinc, 2 magnesium.

Alloys of Copper, Antimony, and Bismuth.§—N. Parravano and E. Viviani, first investigating the binary systems, find that antimony and bismuth appear to form a continuous series of solid solutions. Antimony does not retain copper in solid solution, and copper does not retain more than a minute quantity of antimony in solid solution. The compound Cu_3Sb melts without decomposition; the ternary system is therefore regarded as two systems, Cu-Cu_3Sb-Bi and Cu_3Sb-Sb-Bi. The compound Cu_3Sb and bismuth are only partly miscible in the liquid state, and they do not form compounds or solid solutions. The general form of the equilibrium diagram of the ternary system Cu_3Sb-Sb-Bi is discussed.

Heat-treatment of Bronze.‖—E. Heyn and O. Bauer have investigated the unsatisfactory behaviour of some bronze bushes containing 93 p.c. copper and 7 p.c. tin, which were shown by hardness measurements to be softer than good specimens having the same composition. Microscopical examination revealed that the hard samples contained two constituents, the soft samples only one. Heat-treatment experiments showed that the soft condition and its corresponding structure were produced by

* Zeitschr. Anorg. Chem., lxviii. (1910) pp. 123–40 (4 figs.).
† Tom. cit., pp. 301–6 (2 figs.).
‡ Tom. cit., pp. 73–90 (8 figs.).
§ Atti R. Accad. Lincei, xix. 1 (1910) pp. 835–40; xix. 2 (1910) pp. 69–75, through Journ. Chem. Soc., xcviii. (1910) pp. 779, 852.
‖ Mitt. Kgl. Materialprüfungsamt, xxviii. (1910) pp. 344–8, through Journ. Soc. Chem. Ind., xxix. (1910) p. 1110.

slow cooling between 1030° and 855° C., while the hard condition and duplex structure resulted from rapid cooling through this interval.

Metallic Silicides.*—L. Baraduc-Muller, in the course of an extended investigation of the action of silicon carbide on metallic oxides at high temperatures, and of the properties of the metallic silicides produced, has studied the metallography of these bodies. Two etching reagents were used: (1) commercial hydrofluoric acid, to which was added twice its volume of alcohol, and an amount of water depending on the rapidity of action required; addition of water increases the activity of the reagent; (2) a preparation of aqua regia and ferric chloride. The method of taking cooling curves is described, and some account of the microstructure of alloys of silicon with numerous metals is given.

Impurities in Copper.†—F. Johnson summarizes the available information as to the effect of arsenic, lead, nickel, bismuth, cobalt, antimony, tellurium, iron, tin, silver, sulphur, and oxygen occurring as impurities in copper.

Solubility of Oxygen in Molten Silver.‡—F. G. Donnan and T. W. A. Shaw find that the concentration of oxygen in molten silver is proportional to the square root of the oxygen-pressure over a wide range of pressures. From this it is inferred that the oxygen is either physically dissolved as atomic oxygen, or more probably exists in the form of dissolved silver monoxide.

Crystallography of the Iron-carbon System.§—A. Kroll has sought to establish the relation existing between the crystallography and the equilibrium diagram of the iron-carbon system. The main experimental method employed consisted in heating polished sections in an atmosphere of hydrogen or nitrogen; the different structures resulting are identified as the effects of the more or less sudden crystalline rearrangements taking place at the thermal critical points. A crystallographical explanation of the formation of troostite and of the precipitation of graphite is attempted. Ordinary cementite appears to be hexagonal, but the carbide entering into solution in γ-iron is regular; troostite is this solution-carbide saturated with γ-iron.

Iron-carbon Alloys.‖—H. Lütke has investigated the effect of manganese on the concentration at the eutectic temperature (1130° C. in the iron-carbon system) of the saturated solid solution of cementite in γ-iron. Two series of alloys, containing respectively about 5 p.c. and 10 p.c. of manganese, the carbon ranging from 1·5 to 4 p.c. in each series, were examined thermally and microscopically. While in both series the cooling curves indicated the first appearance of eutectic at 2·0 to 2·3 p.c. carbon, the microscopical examination showed that 1·8 p.c. was the concentration of the saturated mixed crystals. Manganese, therefore, appears to have little influence on the carbon-concentration of the saturated solid solution.

* Rev. Métallurgie, vii. (1910) pp. 657–834 (44 figs.).
† Met. and Chem. Eng., viii. (1910) pp. 570–5 (9 figs.).
‡ Journ. Soc. Chem. Ind., xxix. (1910) pp. 987–9 (1 fig.).
§ Journ. Iron and Steel Inst., lxxxi. (1910) pp. 304–402 (33 figs.).
‖ Metallurgie, vii. (1910) pp. 268–73 (7 figs.).

Transformation-point Curve γ- to β- or α-Iron.*—P. Goerens and H. Meyer give a summary of previous investigations dealing with the positions of the critical points A_3 and A_2 in iron-carbon alloys, and describe their own work on six alloys containing 0·16 to 0·78 p.c. carbon, with about 0·23 p.c. manganese and 0·15 p.c. phosphorus. Thin disks were heated to 950°–1000° C., cooled to a given temperature, at which they were held for 15 minutes, then quenched in water and microscopically examined. With each series a number of quenchings at temperatures ascending by steps of 10° C. were performed. For each alloy the mean of the two quenching temperatures which gave, respectively, martensite + a little ferrite, and pure martensite, was taken as the transformation point. The transformation temperature falls from 905° C. in the 0·16 p.c. carbon-steel to 855° C. in that containing 0·54 p.c. In the alloys with higher carbon, the point was not so definitely ascertained.

Influence of Silicon on the Maximum Solubility of Carbide of Iron in γ-Iron.†—C. Schols has taken cooling curves of thirty-one melts classified in four series, containing respectively about 1·2, 1·5, 1·9, and 2·5 p.c. carbon, the silicon-content varying between 0 and 10 p.c. With all carbon-concentrations the addition of silicon lowers the temperature of commencing solidification, leaves the temperature of final solidification constant at about 1120° C., and raises the temperature of pearlite formation. Pearlite is no longer formed when silicon-content exceeds a certain percentage, this limit being 5·6 p.c. for alloys containing 1·2 p.c. carbon, and 4·5 p.c. for alloys containing 1·5 p.c. carbon. The eutectic halt (1120° C.) appears at lower carbon concentrations as silicon-content rises, indicating the diminished solubility of carbon in γ-iron with increase of silicon-content. Pieces of selected alloys were heated to 1140°C., slowly cooled to 1120° C, and quenched after 10 minutes at 1120° C. The microscopical examination of these specimens, together with the cooling curves, enabled the author to ascertain the silicon-content necessary for the formation of eutectic in alloys containing less than 2·2 p.c. carbon, the saturation point of the solid solution of carbide of iron in γ-iron when no silicon is present. Eutectic occurred in the 1·2 p.c. carbon alloy when more than 5·6 p.c. silicon was present. Sodium picrate, which coloured the eutectic brown in the quenched samples, was used for etching, also nitric acid in amyl-alcohol.

Iron Sulphide-iron System.‡—K. Friedrich has re-determined the freezing-point diagram, using more pure materials than those employed by Treitschke and Tammann, and finds some differences. The critical points of iron are somewhat lowered by addition of sulphide of iron, but are not caused to coincide.

Iron-nickel System.§ — Discrepancies in the results obtained in previous investigations of this system have led R. Ruer and E. Schüz to determine the temperatures of solidification of a number of alloys prepared from pure materials. The temperatures of magnetic transformation

* Metallurgie, vii. (1910) pp. 307–12 (18 figs.).
† Tom. cit., pp. 644–6 (15 figs.). ‡ Tom. cit., pp. 257–61 (9 figs.).
§ Tom. cit. pp. 415–20 (7 figs.).

on heating and cooling were determined by measuring the permeability at different temperatures. The smooth and continuous freezing-point curve shows a minimum at 70 p.c. nickel, at which concentration the magnetic transformation temperature curve shows a maximum. These facts point to the existence of $FeNi_2$, but measurements of electrical conductivity have afforded no indication of the existence of this compound. Alloys containing less than 29 p.c. nickel are irreversible, those with more nickel are reversible.

Iron-nickel-copper Alloys.*—C. F. Burgess and J. Aston summarize the results of their previous investigations on the mechanical properties of the binary alloys of electrolytic iron with nickel and with copper, and describe a similar investigation of a series of ternary alloys. Monel metal is an alloy of nickel and copper obtained directly from the ore; the nickel content is about three times the copper content. The ternary alloys were prepared by melting electrolytic iron with Monel metal, the successive members of the series containing proportions of Monel metal increasing by steps of 2 p.c. to 20 p.c. The curves showing the relation of mechanical properties to proportion of alloy added are very similar to the corresponding curves for the iron-nickel alloys. Copper does not in general appear to have a deleterious effect, and when nickel + copper does not exceed 10 p.c., the copper appears to be beneficial.

G. A. Roush † gives the results of determinations of hardness by means of the scleroscope, of binary and ternary alloys of iron with nickel and copper, other properties of which have been determined by Burgess and Aston.

G. H. Clamer ‡ and J. A. Matthews § give particulars of the properties of some copper-nickel steels.

Arnold, J. O.—**A Fourth Recalescence in Steel.**
[Attempts to explain an evolution of heat occurring between Ar_3 and Ar_1 in a steel containing about 0·2 p.c. carbon.]
British Association, Sheffield, September 1910.

Chappell, C., & F. Hodson—**Influence of Heat-treatment on the Corrosion, Solubility, and Solution Pressures of Steel.** *Loc. cit.*

Ducelliez, F.—**Alloys of Cobalt and Silver.**
Bull. Soc. Chim., vii. (1910) pp. 506–7.

Mazzotto, D.—**Heat of Solidification of Alloys of Lead and Tin.**
Nuovo Cim., xix. (1910) pp. 215–32.

Vigouroux, E.—**Alloys of Nickel and Silver.**
Bull. Soc. Chim., vii. (1910) pp. 621–2.

Pannain, E.—**Variations in the Physical Properties of Metallic Alloys subjected to Mechanical and Thermal Action. I. Specific Gravity.**
Gaz. Chim. Ital., xl. 1 (1910) pp. 431–3.

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* Met. and Chem. Eng., viii. (1910) pp. 452-6 (6 figs.).
† Tom. cit., pp. 468–70, 522–3 (7 figs.).
‡ Tom. cit., p. 527. § Tom. cit., pp. 527–8.

X.—*Adams's "Variable" and the Evolution of the Modern Microscope.*

By Edward M. Nelson.

(*Read March* 15, 1911.)

This Microscope * (fig. 27), designed in 1770 by an anonymous "noble person," and made by George Adams, is by far the most important

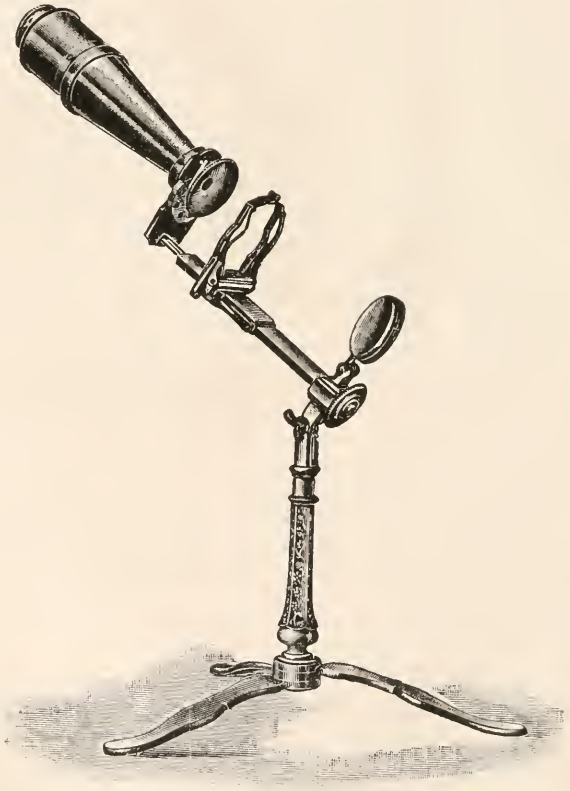

Fig. 25.—Watkins, 1755.

* Micrographia Illust. Adams, 4th ed., 1771, pl. ii., 60 Fleet Street.

of all the ancient Microscopes, because in it we find embodied the main principles of the Microscope as constructed at the present time. It may briefly be described as a stand with a hinged joint at the top, to which is attached a bar carrying the body, the stage, and the illuminating apparatus, i.e. the mirror. If, therefore, the Microscope body is inclined, the stage and the mirror are inclined with it, precisely as in the Microscopes of to-day.

The first Microscope to have a limb carrying the body, stage, and mirror attached by a joint to a stand in this manner, is that of F. Watkins * (1755), fig. 25, but there the idea was carried out in such an impossible manner that even when it was merely

Fig. 26.—Cuff, 1765.

touched it could not help shaking like an aspen, for the pivot was at the tail end of the limb; but, be that as it may, it probably gave the idea to the noble inventor of the "Variable," who in a thoroughly practical manner corrected the faults of the Watkins Microscope. Previous to Watkins's Microscope, there were tube or drum Microscopes, and those on the telescope plan, where the object at which the Microscope was pointed was disconnected from the body. Hertel's Microscope, the first to possess a mirror (1715), was built on this telescope plan. Bonami's Microscope (1691), the first to have the object and illuminating apparatus connected to the body, was a type by itself; for the whole apparatus was fixed to a base-

* Journ. R.M.S. 1908, p. 137.

board, similar to a photomicrographic or projection Microscope of the present day.

The second is a portable Microscope by John Cuff,* fig. 26, which differs both from the Watkins and the Variable, because the limb is hinged to the foot and not to the top of a pillar. The mirror, stage, and body arm all fold up on joints, so it is a very shaky affair, nevertheless, it is an important model, as it is the second known example of a Microscope which has the body, stage, and mirror attached to a hinged limb.† Its date can be fixed approximately because it is signed Cuff, and Adams, who took

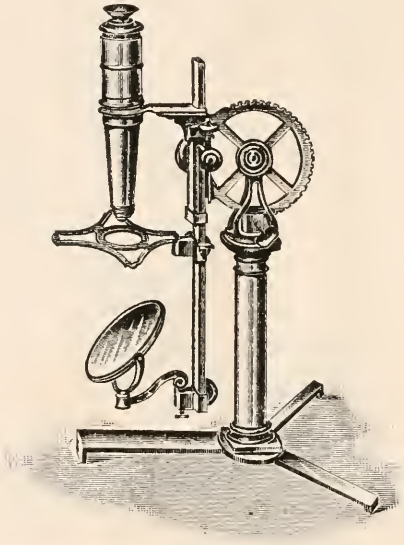

Fig. 27.—The Variable, 1770.

over Cuff's business in 1770, made this same model under his own name; also it was said to be an improved form of Ellis's Aquatic Microscope, which was made in 1755, so it may be dated "circa 1765" without much error. It was one of Cuff's latest Microscopes, probably inspired by the Watkins model of 1755. With all these loose joints it was a type that, like the Watkins, could never last. After Adams had appropriated this Cuff model, Benjamin Martin was not long in following suit, for the large instrument, which formerly belonged to His Majesty George III.,

* Journ. R.M.S. 1898, p. 675, fig. 117.

† Microscopes of this form, without the folding joints, are still made in France, and are sold here as youths' microscopes, for 14*s.* 6*d.*

which is now in our collection, is made precisely upon that plan, and is the earliest Microscope of this type in our collection, as its date is 1775.

We are therefore justified in calling the Variable, fig. 27, although the third in seniority, the most important of the three.

It has always been an interesting problem to discover the

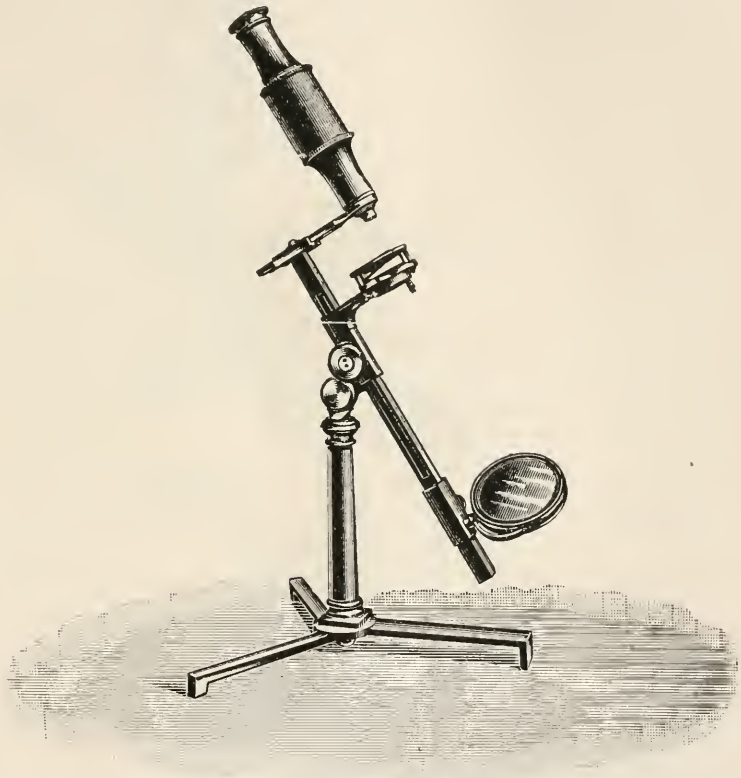

FIG. 28.—Adams, 1785.

identity of this anonymous "noble person," and now I think I am able to give you his name; not, of course, with the evidence of an affidavit, but with a very high degree of probability.

First, the fact that he was a noble person narrows down the list from which we have to select a name. At that date there was one man who, if he was not the anonymous author of this important instrument, fits the circumstances of the case in all particulars. He was not a peer, but the son of the brother of a

duke, and on that account may very well have been given by Adams the courtesy title of a "noble person."

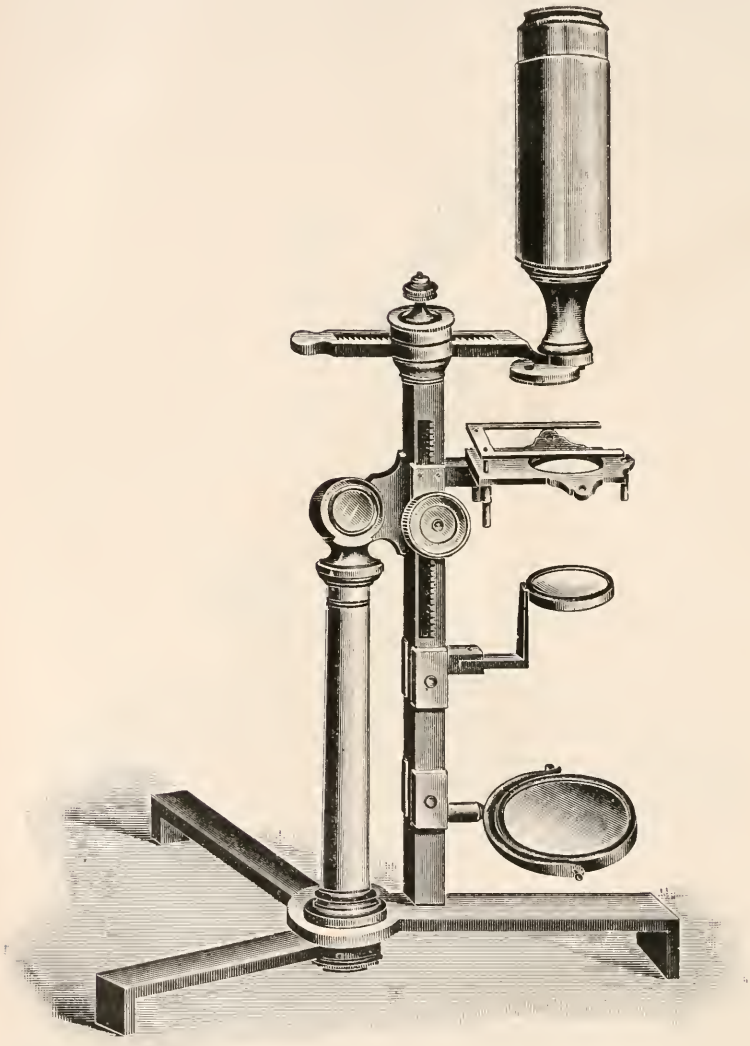

Fig. 29.—Jones's Most Improved, 1797.

His name was Henry Cavendish (1731–1810), son of Lord Charles Cavendish, brother of the third Duke of Devonshire, His mother was Lady Anne Grey, a daughter of the Duke of Kent.

After Newton he was the greatest English scientist of that time. He was exceedingly clever, exceedingly shy, very wealthy, and had a house full of scientific apparatus.

Now obviously there was just a shade of plagiarism about the design; it therefore suited Henry Cavendish to remain anonymous, and it suited George Adams to throw the responsibility of its production upon the broad shoulders of a "noble person." The whole story fits the historical facts of the case.

So we see that we owe the present form of our Microscope first

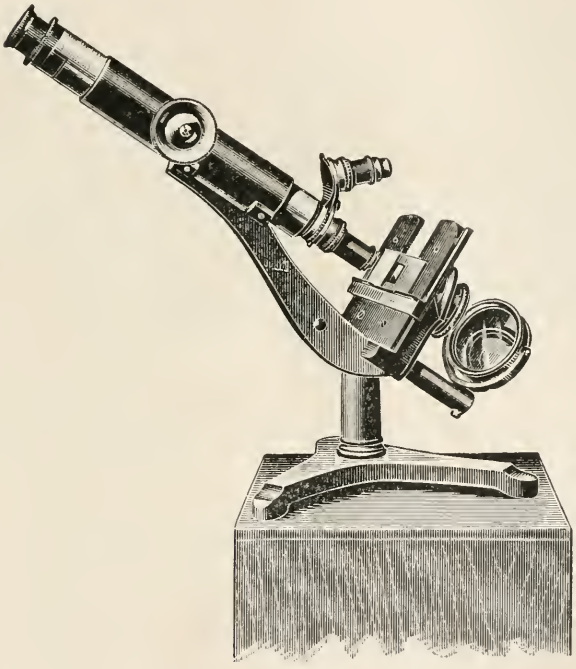

Fig. 30.—Powell, 1840.

to François Watkins * (mother probably French), and secondly to Henry Cavendish, who, by attaching the joint to the centre of gravity of the limb, made it a practical type, which has lasted to the present time.

The figures 25 to 30 show the several steps in the evolution of the modern Microscope in their chronological order.

Fig. 30 shows the highest type of this class of Microscope, for in design it is far in advance of its many imitations. The author, who has constantly used this instrument for rough work during a

* Author of L'Exercice du Microscope. London: Charing Cross, 1754.

period of thirty-five years, has described it in this Journal, 1899, p. 209, where the measurements of its various parts will be found; but the Varley foot and the conical joint are described in the Journal, 1900, p. 291.

Since the reading of this paper, Mr. Parsons has found a notice (date 1854) of the firm of opticians, Watkins and Hill, at Charing Cross.

Erratum.—A correction is needed in my note on Watkins Microscope (this Journal, 1908, p. 141, line 26). *For* ". . . an objective which was a combination," *read* ". . . . a dividing objective." A dividing objective must obviously be a "combination," but the reverse is not necessarily true. The word "combination" in technical optics has a special meaning, and is only used to denote an objective whose lenses, or groups of achromatic lenses, are separated from one another. For example, an object-glass consisting of two or more achromatic doublets is a "combination," but a single achromatic doublet would be called a "doublet." Similarly the historically famous triple inch by Tulley would be called a "triple," and not a "combination."

The first Microscope to possess a "combination" was that of Grindl, described in Zahn's Oculus Artificialis, 1685.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Winkel's Stand No. 1.†—This stand (fig. 31) has been specially designed for photomicrographic work and visual observations demanding the greatest precision.

It has rack-and-pinion, coarse- and new form of fine-adjustment, one division of the drum of which represents a vertical movement of 0·002 mm., centring rotating mechanical stage, the lateral mechanism of which can be removed; the rotation can also be clamped by means of a milled head on the left-hand side of the instrument; iris-diaphragm mounted beneath the stage; substage illuminator No. 1, body-tube 6 cm. in diameter, thus permitting the use of the low-power micro-luminars without cutting down the field, after removing the draw-tube, which is of the usual standard gauge graduated to millimetres.

The whole is mounted on a heavy horseshoe foot with hinged upright-hand clamp; the instrument can thus be set at any convenient inclination from vertical to horizontal; the fitting carrying the plane and concave mirror can be removed when the instrument is required for use in the latter position.

Winkel's Travelling Microscope.‡—This instrument (fig. 32) which is of medium size, can, by hinging stage and foot, be fitted into a case $11\frac{1}{2} \times 8 \times 3\frac{1}{2}$ in., thus rendering it much more portable than our laboratory models of similar size.

It has rack-and-pinion, coarse- and micrometer screw fine-adjustment, square stage fitted with iris-diaphragm, substage illuminating apparatus, with screw focusing adjustment, graduated draw-tube, double nose-piece, and joint for inclination.

The method of packing will be obvious from the illustration. Before rotating the stage to pack the instrument, the mirror, which slides in a groove, must be lowered, and on again setting up the instrument care must be taken to see that the stage is brought right over to the stop

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

† R. Winkel, Gottingen Catalogue, 1911, pp. 22-3 (1 fig.).

‡ Tom. cit., p. 45 (1 fig.).

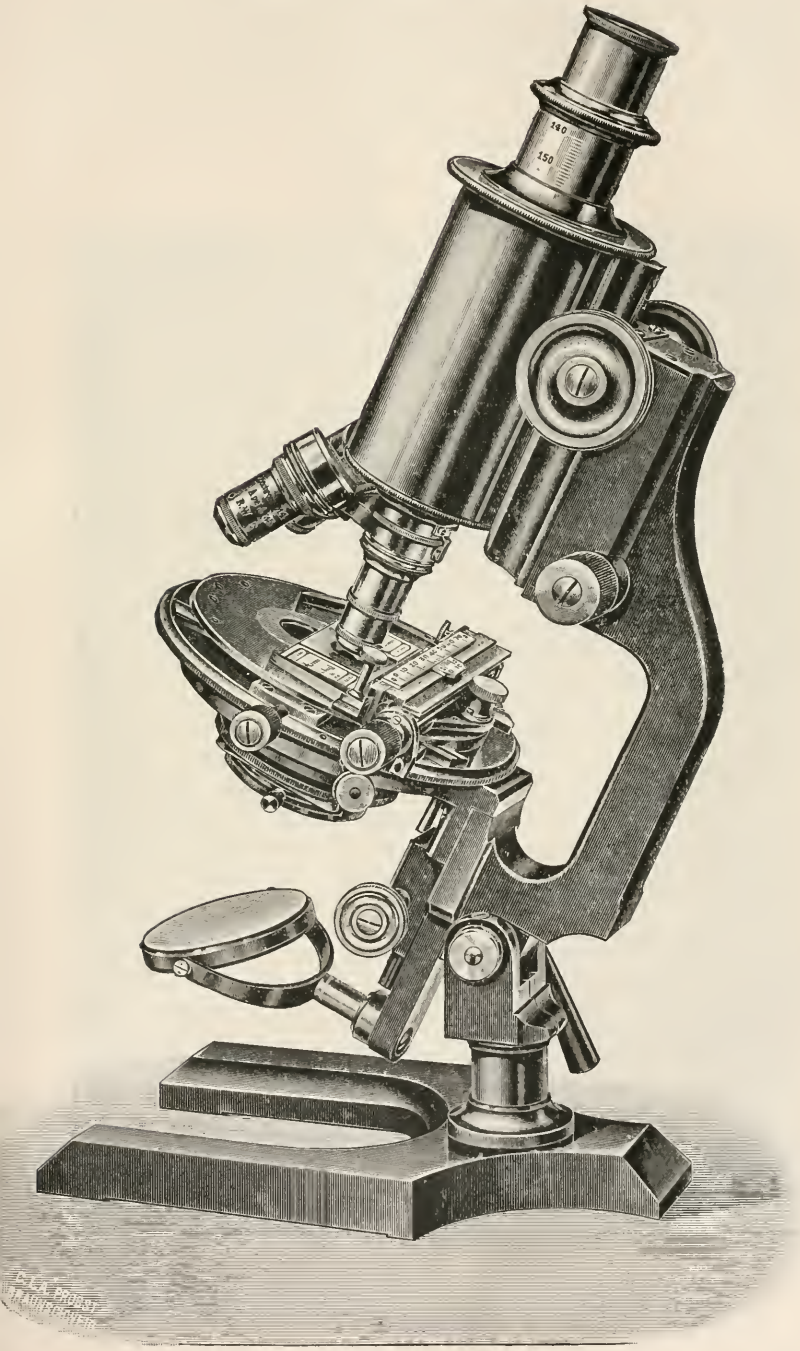

FIG. 31.

provided, thus assuming a truly horizontal position before clamping, otherwise the optic axis will not be perpendicular to it.

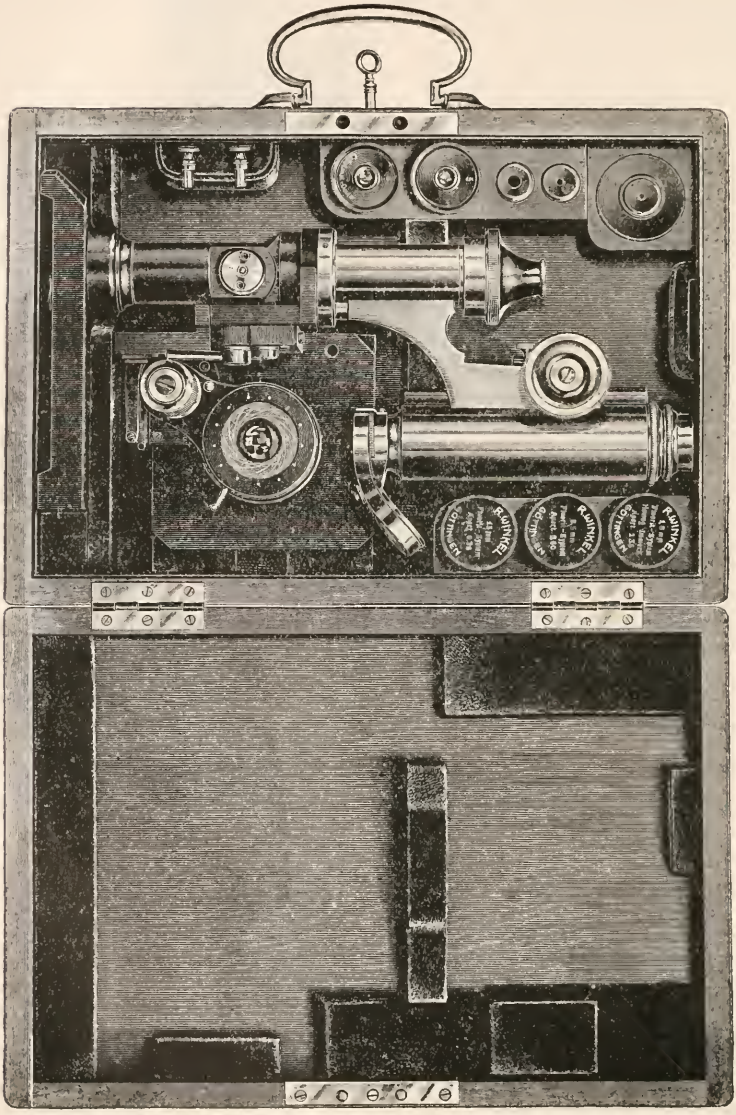

Fig. 32.

Winkel's Dissecting Microscope.*—This instrument (fig. 33) gives greater working surface than most dissecting Microscopes. As will be seen from the illustration, it has rack-and-pinion focusing adjustment and also a rack-and-pinion movement for adjusting the optical system in a horizontal plane, which, together with a rotary movement in the

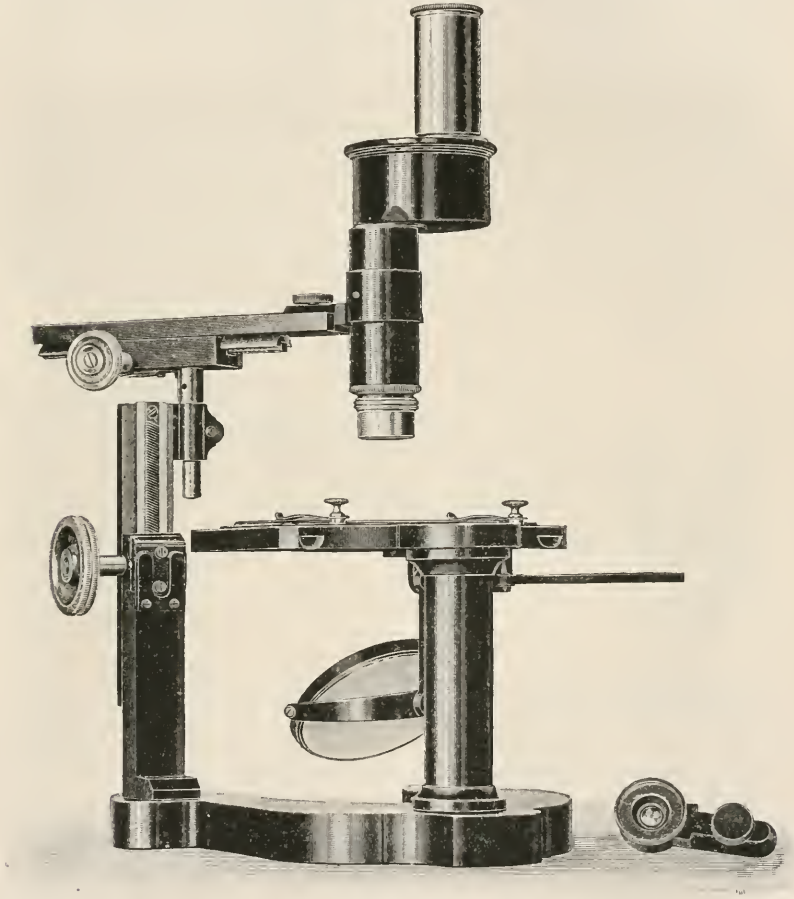

FIG. 33.

same plane, permits of its use over any desired portion of the stage. The arm carrying the optical system is slotted to receive either the Porro erector, which can be used with ordinary objectives and eye-pieces, or a ring to carry single lenses, both of which are provided, together with silvered and opal reflectors for illuminating transparent objects, and a plate with black and white surfaces—shown in the illustration swung aside—as a contrast background for opaque objects.

* R. Winkel, Gottingen Catalogue, 1911, p. 50.

(2) Eye-pieces and Objectives.

Edinger's Pointer-Double-Ocular.*—In spite of the advantages of the pointer-ocular, L. Edinger has long felt that an eye-piece which would allow of simultaneous observation by two persons, and which would at the same time preserve the principle of the pointer, was a great desideratum. The applicability of such an auxiliary to teaching purposes needs no demonstration. The apparatus shown in fig. 34 has been made by the Leitz firm to the designs of C. Metz, and is found to answer its purpose completely. The name Pointer-double-ocular (Zeigerdoppelocular) has been given to it. Between the collective-lens and the eye-lens of an ordinary ocular and exactly over the ocular diaphragm a double prism, i. ii., is inserted. Prism i. is an isosceles prism of angles 35°, 35°, 110°. Prism ii. is right-angled, with angles 35°, 55° and 90°. The prisms are placed so that their larger sides (i.e. those opposite 110° and 90°) are in juxtaposition, and in such a manner that they are separated by an exceedingly thin layer of air. At this air-space, inclined at 35° to the optic axis, a partial reflexion of the light-beam takes place.

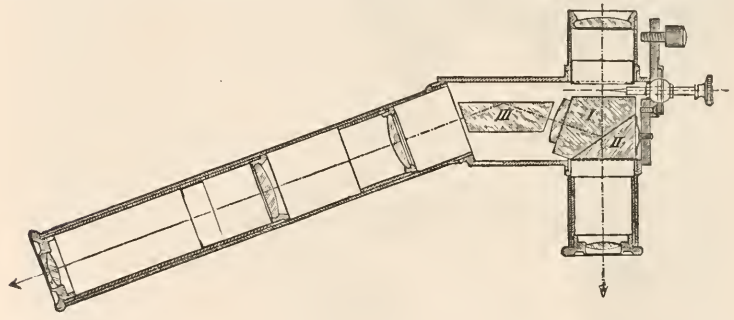

Fig. 34.

About two-thirds of the beam passes on and about one-third is reflected. The image formed in the main optic axis is therefore somewhat brighter than that formed by reflexion. The images formed are of equal value, because in both the full aperture of the objective is utilized. The axis of the reflected image forms with the axis of the Microscope an angle of 70°. Lateral observation would be quite possible if an eye-lens, the same as for the vertical observation, were applied at a suitable distance. But this would bring the lateral observer too near to the tube and to the first observer. Therefore a lens combination is applied somewhat similar to a terrestrial ocular. The tube of this telescope has a downwards inclination which imparts some difficulty to its use until the observer's head has found the right position. But the Leitz firm also deliver the apparatus with an upwards-inclined tube, and for this purpose prism iii. is introduced. This, however, has the effect of weakening the light, and the author prefers the first method. Adjustment is made at the vertical eye-lens, and this is simultaneously effected through the bent tube at the second eye-lens. If the second observer's eyes are not normal

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 336–8 (1 fig.).

he must correct them by spectacles. The two images are then identical and the pointer appears in each. The slight difference in brightness is not found to be a detriment. The author has, after a year's experience, found the instrument a very valuable help in his demonstrations.

BOEGEHOLD, H.—**Eine neue Konstruktion von Korrektionslinsen.** [Chiefly relates to telescopes.]
Zeit. f. Instrumentenkunde, xxx. (1910) pp. 302-7 (1 fig.).

(3) Illuminating and other Apparatus.

New Method for Microscopical Metallography.*—E. Sommerfeldt describes J. Königsberger's apparatus and method. If natural light be allowed to fall by means of a vertical illuminator on an isotropic surface the reflected light does not exhibit polarization. But if the reflexion occurs at an anisotropic surface a separation of the light takes place into two components vibrating perpendicularly to each other, and these components are of unequal intensity, so that a partial polarization follows. Two arrangements serve for realizing this polarizing effect on well-polished surfaces. The simpler arrangement—not serviceable, however, for quantitative measurements—consists of a Klein quartz plate, in combination with a nicol prism (polarizer), placed in front of the vertical illuminator; the analyser (inner nicol) remaining in the usual place. The Klein plate gives violet effects with isotropic substances; but with anisotropic substances it furnishes a coloured field which changes during rotation (red and blue; with strong anisotropy, bright yellow or green). The second arrangement involves the use of a Savart's double plate, which, observed with a telescope adjusted for infinity, must reveal between crossed nicols two deep black quite sharp bands, surrounded by coloured bands. If unpolarized light is reflected (i.e. if the preparation is isotropic) no bands appear. The more complete the polarization of the reflected light the clearer appear the bands, and therefore the deeper the anisotropy of the preparation. By means of a contrast plate, prepared out of two smoke-quartz plates cut perpendicularly to the axis, the bands become intensified. The preparation must be very accurately set perpendicular to the incident light rays, and this is effected by the adjusting apparatus J seen in fig. 35.

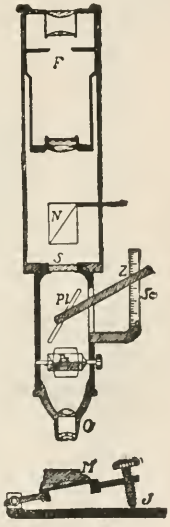

FIG. 35.

Application of Mercury Light to Microscopical Works.†—A. Köhler describes a Hageh Microscope lamp which the Zeiss firm have made for him and which he has found very useful in his microscopical work. The light source is furnished by one of Messrs. Schott's Hageh lamps, in which the mercury column has a special length of 20 cm. A special

* Metallurgie, vi. (1909) pp. 605-7 (1 pl. and 1 fig.). See also Zentralbl. f. Min., Geol. u. Paläont., 1908, p. 565; 1909, p. 245; and Zeitschr. wiss. Mikrosk., xxvii. (1910) p. 445 (1 fig.).

† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 329-35 (1 fig.).

resistance coil is supplied for use with currents of 65 to 220 volts A current strength of about 3·5 amperes is necessary. As seen in fig. 36, the tube is placed in an inclined position in a ⌊⌋-shaped holder and secured with springs. The lower end of the lamp where the mercury accumulates is connected with the negative pole of the circuit. The lamp is shielded from the observer by an iron shade, so as to shut off the superfluous light; the shade has an opening opposite the middle of the lamp for transmitting the light, which then impinges upon the flask filled with a solution and acting as an engraver's globe. The holder of this flask (see figure) also acts as a handle for lifting the whole apparatus. The effect of the entire arrangement is to throw an image of the illuminating mercury column on the iris diaphragm of the Microscope, and hence on to the plane of the object. The fluid in the flask not only

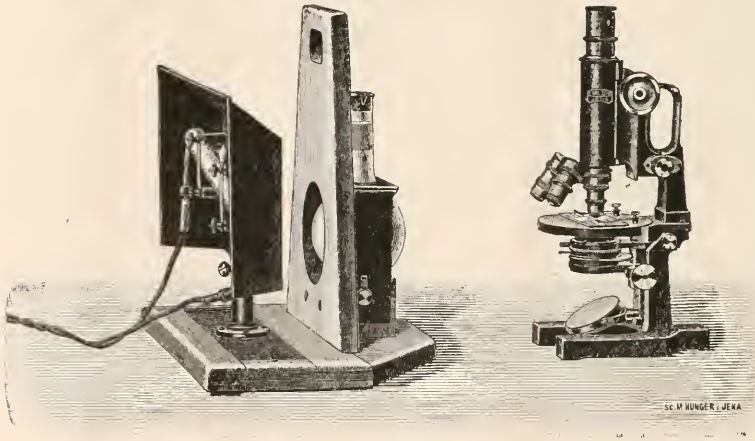

Fig. 36.

provides light for the lenses but also acts as a light filter. For clear green light of wave-length 546 $\mu\mu$ (this is the brightest line of the mercury vapour lamp) the filter should have the following composition:—distilled water, 300 c.cm.; picric acid, 0·4 grm.; copper sulphate, 3·5 grm.; didymium nitrate, 15·0 grm. If this didymium nitrate be omitted no light is transmitted beyond the line $\lambda = 546$ $\mu\mu$; the yellow lines $\lambda = 576$ $\mu\mu$ and 579 $\mu\mu$ also disappear. These two yellow lines are, however, obtained with great brightness with the following solution:—distilled water, 300 c.cm.; potassium bichromate, 15 grm.; copper sulphate, 3·5 grm.; sulphuric acid, 1 c.cm. The blue and violet lines $\lambda = 436$ $\mu\mu$, 407 $\mu\mu$ and 405 $\mu\mu$ are obtained with:—distilled water, 225 c.cm.; copper sulphate, 1 grm.; ammonium hydrate, 75 c.cm. With subjective observation only the line 436 $\mu\mu$ is effective, as it is much more intensive than the two violet lines; the light in this case is, therefore, practically monochromatic. Flasks can be filled with the respective solutions and secured with well paraffined corks; they are then always available for obtaining light of their corresponding colours. For the

finest subjective observation the green light is usually the most useful. Its wave-length almost exactly corresponds with that for which the eye has the greatest adaptability, so that the finest details are seen in the clearest way. So great is the brightness that it suffices for the strongest magnifications. The yellow and the blue light filters will be more useful for studying changes in resolving power.

The lamp is very simple in management, and can be used for photomicrography.

New Microscope Lamp.—This lamp (fig. 37) was exhibited and described at the December Meeting.* By the kindness of the designer,

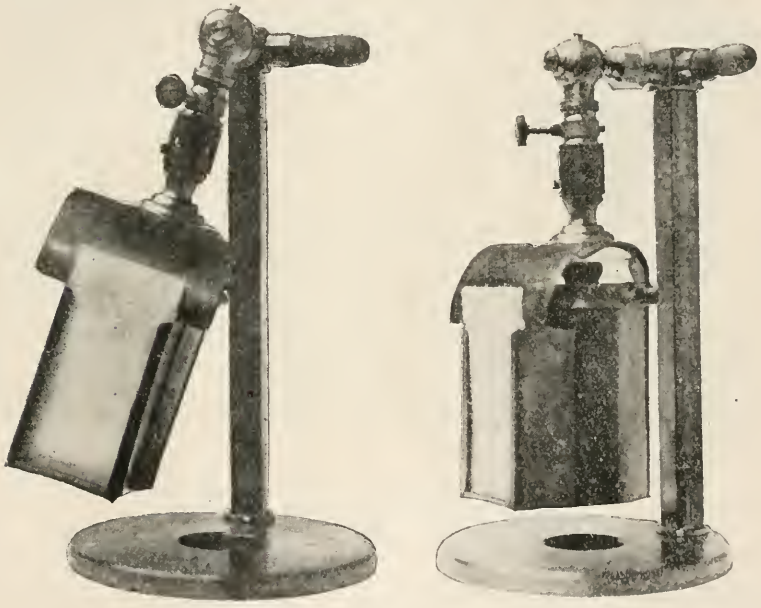

FIG. 37.

C. E. Heath, we are able to add some important particulars and give an illustration. Although not designed for critical work, he suggests that the lamp might be used for that purpose if a ground glass slip were inserted in the lamp, the surface of the ground glass being utilized as the source of light and focused upon the object by the sub-stage condenser. As it is difficult to focus the ground glass, a slip having lines ruled on the ground surface is used for focusing, and when the lines are sharply focused, a slip of ground glass without lines is substituted for it, care being taken that it faces the same way round as the ruled slip, so that the ground surfaces will be in the same plane, and therefore exactly in focus. The ground glass is kept from shifting by the pressure of the curved metal sheet seen in both figures.

* See this Journal, 1911, pp. 128–9.

Microspectroscope.*—This microspectroscope (fig. 38), made by Adam Hilger, can be substituted for the eye-piece in any form of Microscope. It has an adjustable slit, comparison prism, and clip for test-tube to hold comparison liquid, condensing lens, collimating lens, and compound prism. A photographic scale and screen adjustment for setting the same to the fiducial reading, and mirror for illuminating the scale from any source of light, are also supplied.

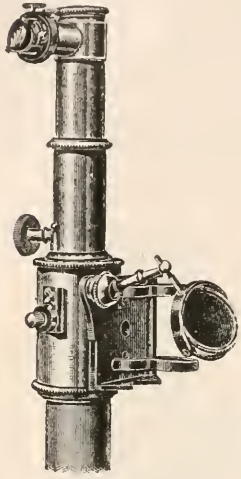

Fig. 38.

Plug Micrometer.†—H. Hipple describes a plug micrometer (fig. 39), having a hardened bushing, H, with three holes to receive the balls K. The bushing H is inserted in the barrel B. The holes in the barrel are bored rather small, so that at most only one-third of the diameter of the ball can project. The barrel B is graduated longitudinally, and threaded inside to receive the pin S. This pin is provided at one end with the cone C, and is fixed in the sleeve M, which is graduated. By turning the sleeve M, the pin will screw forward or backward, its cone C forcing the balls K outward or letting them come inward. In measuring a hole the pin S is screwed out so far that the balls do not project through the barrel B, therefore resting on the smallest diameter of the cone C. Then the instrument is inserted in the hole that is to be measured, and the pin S is screwed in so far that the ballstouch the side of the holes.

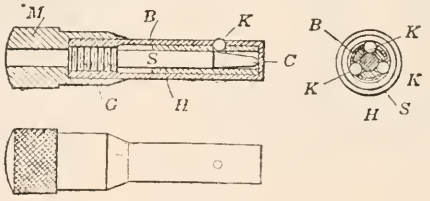

Fig. 39.

The diameter is then quickly read on the scale. The accuracy of the instrument is dependent on (1) the thread, (2) the cone, and (3) the balls. The smallest instrument is made for a hole from 6–7 mm. (0·25 in.) in diameter. It is therefore necessary to have a number of instruments in order to measure holes of greatly varying diameters.

Gaidukov, N.—**Dunkelfeld-beleuchtung und Ultra-mikroskopie in der Biologie und in der Medizin.**
Jena: Gustav Fischer (1910) 83 pp. (5 pls. and 13 figs.).

Löwe, F.—**Ein tragbares Interferometer für Flüssigkeiten und Gase.**
Zeit. f. Instrumentenkunde, xxx. (1910) pp. 321–9 (7 figs.).

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* Adam Hilger, Ltd., Catalogue, 1911, Section J, p. 3, fig. 4.
† American Machinist, through Eng. Mechanic, xcii. (1911) p. 581.

(4) Photomicrography.

Photographing Fossils by Reflected Light.*—L. D. Burling describes a method of photographing fossils by reflected light. The scheme seems to yield excellent results, and may be generally valuable in photographic reproduction. The back of an ordinary enlarging and reducing camera was pivoted so that it would revolve about a vertical line passing through the centre of the ground glass plate, and the rack upon which the specimens are mounted was made to revolve about a vertical line passing through the centre of the specimen. Suitable scales were so attached to both the specimen rack and the back of the camera, that each might be clamped at any desired angle. In practice the specimen is placed in position, the lens is removed, and the relative position of the light and the angular position of the specimen are manipulated to secure the most favourable illumination. (Experience has shown that variations in the intensity of light are necessary to bring

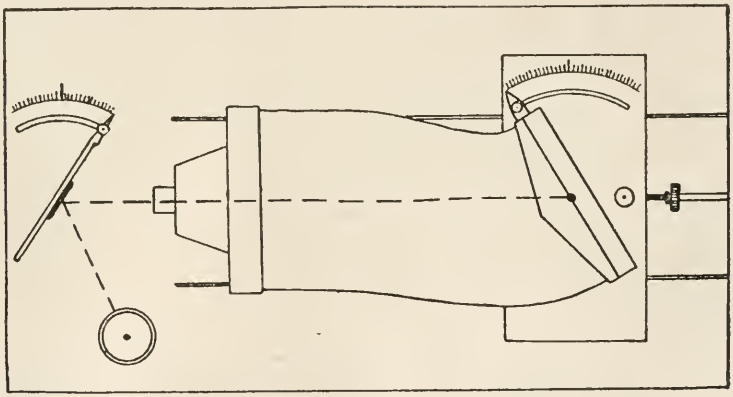

Fig. 40.

out the particular features of different specimens, and that the degree of illumination required can best be determined by direct observation through the camera rather than upon the ground glass.)

In order to eliminate distortion, the back of the camera is then revolved through an angle corresponding to that indicated by the scale on the specimen rack, the lens is replaced, and the specimen is focused and photographed. The best results have been obtained with lenses having a focal length of at least 6 or 7 inches, or long enough to eliminate any errors arising in the adjustment of the camera.

Fig. 40 is a plan of the camera showing its arrangement. The light used is a screened arc lamp, suspended by a pulley from the ceiling ; the camera stand is movable, and the specimen rack and the back of the camera are each free to move through an arc of 60°. The box-like projection into which the bellows may be compressed has been cut away, to increase the angle through which the back of the camera may be revolved.

* Amer. Journ. Sci., xxxi. (1911) pp. 99-100 (1 fig.).

(6) Miscellaneous.

Microscopic Structure of Uric Acid Calculi.*—S. G. Shattock divides uric acid calculi into two classes, the cancellous and the compact, according as there are or are not lacunæ to be found in the sections. In the course of his remarks, the author compares the crystals forming calculi with uric acid sediments in urine, and discusses the nature of the nucleus of uric acid calculi. He finds that the nucleus is almost invariably of the same chemical composition as the rest of the stone, but that its structure varies, consisting of loosely arranged crystals resembling "crystalline rubble" in the cancellous variety, while in the compact one it is a dense mass of crystals arranged in radiating columns, and often starting from a small collection of cuboidal crystals. He points ont that the essential condition for the formation of crystals must be supersaturation of the urine with uric acid. The paper is copiously illustrated.

Coloured Plates of Microscopical Preparations.†—Y. Sobotta describes a two-colour autotype process, by means of which the majority of histological preparations may be faithfully reproduced at a comparatively small cost. In preparing a plate of a section stained with hæmatoxylin and eosin, the stains may be represented by violet and red. A drawing is made first of all of the hæmatoxylin stained portion alone. This is executed in black with Chinese ink. By means of the autotype process, prints of this are prepared in black, in violet, and in a pale shadowy ground colour. Upon this last print, a drawing is made of the eosin-staining portion alone. This is also done in black. From this are prepared a plate in black and a plate in red. Then a combined print of the violet and the red plate will give a tint two-colour reproduction of the preparation.

Microchemical Demonstration of Guanin.‡—A. de Giacomo describes a method, by which the presence of guanin may be demonstrated in microscopical sections of birds' kidneys. This process depends upon Burian's reaction. The reagents employed must be carefully prepared at the time of use. The section, fixed in alcohol and adherent to a coverslip, is washed in distilled water and dried. Two drops of a solution of diazobenzolsulphonic acid are added. After half a minute, a further quantity of the reagent is added, and then a small quantity of a sodium hydrate solution. The reagents may also be used in the reverse order. Yellowish-red points appear. The section may be mounted on a slide in the excess of sodium hydrate, or in glycerin. In a section so treated, an orange-red colour shows the presence of guanin in many of the cells of the tubular epithelium and in the connective tissue. The guanin-free portions have a pale yellow colour. Particulars of the stock solutions required and the methods of preparation are given.

Histological Changes in Infantile Paralysis.§—In the spinal cord of an old standing case of infantile paralysis, V. Jonnesco has found a

* Proc. Roy. Soc. Med., Pathol. Section iv. (1911) pp. 110-46 (26 figs.).
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 209-13.
‡ Tom. cit., pp. 257-9.
§ C.R. Soc. Biol. Paris, lxx. (1911) pp. 109-10.

remarkable formation. The case was of the monoplegic type. In the cells of the cervical ganglia, on the side corresponding to the affected limb, there appeared rosette bodies staining deeply with iron-hæmatoxylin. They are stained blue by the methods of Giemsa and Mallory. A low magnification shows six or eight axially-disposed filaments surrounded by a hyaline zone. High magnification shows that these filaments consist of a large number of small spherical granules linked together. The formation is placed in the ganglion cell, usually at some distance from the nucleus. The author considers various possible explanations, and regards as most probable the hypothesis that this is a crystalloid formation in the ganglion cell, which only becomes visible on account of the chromatolysis of the chromatophil substance of Nissl.

Quekett Microscopical Club.—At the 471st Ordinary Meeting, held on February 28, 1910, which was also the 45th Annual General Meeting, the President, Professor E. A. Minchin, M.A., F.Z.S., delivered an address on "Some Problems of Evolution in the Simplest Forms of Life." The principal points dealt with were popular classifications of living things, scientific methods to the same end, and the need in the latter case to draw distinctions and institute comparisons undreamt of by the ordinary person. The Microscope, relatively a thing of yesterday, is not yet adequate for our needs, but is growing and daily becoming more efficient. Different types of metabolism were observed in the Protista. In some cases a Protist organism can be at one time a plant, at another an animal. In Protista there are two well-marked types. One, more primitive and in which chromatin occurs only in scattered granules, "chromidia." The second, higher and leading on to the ordinary plants and animals, and in which the greater part of the chromatin is aggregated into a nucleus, and which, further, has a distinct protoplasmic zone—the cytoplasm. The first is the bacterial type, the second the cellular type. The existence in all forms of higher life of sex and sex-phenomena was then briefly dealt with. Sex-phenomena are also observed in the cellular type of Protista. In the visible world of living things it is found universally that organisms are divisible more or less easily into groups which are termed "species." Some species are sharply marked off from others, some are less so, but no one now considers a species as a fixed and immutable entity. The fact, however, remains that the tendency of living things to separate themselves into species more or less distinct, is one of the most constant and universal peculiarities of the organic world. In so far as the Protista are concerned it was thought that syngamy was the bond which unites the individuals comprising a species and separates them from those of another, though closely allied, species. Without syngamy a species would tend to break up into distinct races or strains, either under the influence of environment or by innate variations. Syngamy tends to reduce the individual differences to a common level, by mixing together the characters of divergent strains. It therefore follows that there are no true species amongst organisms of the bacterial grade, if it be true that syngamy does not occur amongst them, and the so-called species of bacteria are to be regarded as mere strains capable of modification in any direction by environmental influences. From these considerations it was thought to be evident that

the passage from the bacterial to the cellular grade was perhaps the most important advance in the evolution of living beings, as the cellular type was the starting point for the evolution, not only of the Protozoa, but through them of the whole visible everyday world of animals and plants, in all of which the cell is the unit of structure. Further, with the cellular type were initiated, in the President's opinion, two of the most universal and characteristic peculiarities of living beings, namely, the phenomena of sex and the tendency to form species.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Selective Action of Dieudonné's Medium.†—E. Glaser and Y. Hachla have carried out an investigation upon Dieudonné's alkaline blood-agar medium, devised for the isolation of cholera vibrios, with a view to ascertaining whether the growth of certain organisms other than cholera was permitted. They found that *Bacillus fæcalis alkaligenes*, an organism often present in normal fæces, grew on this medium as luxuriantly as *Vibrio choleræ*, and suggested that a ready means is thus afforded for the separation of *B. typhosus* and *B. fæcalis alkaligenes*. *B. fluorescens* and *B. fluorescens non liquefaciens* both grow well upon this medium at 22° C, but show little growth at 37° C. *Proteus vulgaris* grows well at both room temperature and blood heat, but *Proteus piscicidas versicolor*, while showing good growth at room temperature, is restrained at a temperature of 37° C.

New Method for Studying Movements of Bacteria.‡—M. Liachowetzky gives the following account of his method : Melted agar is poured into a small Petri dish, which must be perfectly horizontal. Upon the surface of the solidified agar is laid a sterile Swedish filter-paper, marked with three intersecting millimetre scales. The paper is moistened by the condensation-water of the medium. Should this prove insufficient, a small quantity of saline may be added. By means of a special platinum needle, the paper and agar are inoculated, from a culture of the organism to be investigated, at the point of intersection of the millimetre scales. Small pieces of sterile silk, from 2–5 mm. in length, are placed in various positions upon the scales. The plate is then placed in the incubator, the horizontal position being exactly maintained. After a suitable time, according to the nature of the investigation, and of the organism that is being studied, these silk threads are transferred to broth tubes, which are then incubated for one to three days. If the organisms, starting from the point of intersection, travel far enough to reach one of these threads, they will infect it, so that subsequent cultivation from this thread will yield a growth of the organism. Thus, if the broth tubes, inoculated with the nearer threads, give a growth, while

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

† Centralbl. Bakt., 1te Abt., Orig., lvii. (1911) pp. 371–84.

‡ Tom. cit., pp. 180–91.

cultivations from those more remote remain sterile, an accurate expression for the powers of locomotion of the organism may be obtained.

The author gives tables showing marked differences between the figures obtained in observations of non-motile and motile organisms. He shows that, by his method, the influence of abnormal chemical and physical conditions upon the motility of organisms may be demonstrated. As contrasted with procedures which depend upon continuous observations and eye-pieces bearing scales, he claims that his plan is suited for observations extending over several hours, and further, that by it, error consequent upon variations in the energy of individual organisms are obviated. In conclusion, it is stated that, by this means, pure cultures of organisms, differing in their powers of movement, may readily be obtained.

Methods of Investigating Oriental Sore.* — C. Nicolle and L. Manceaux give an account of their researches upon some cases of this condition occurring at Gafsa. The experiments were carried out at the Pasteur Institute at Tunis. *Leishmania tropica*, the causal organism, was isolated by puncture of some of these sores in the non-ulcerated stage, by means of a syringe needle or a capillary glass pipette. The material was inoculated into Novy-MacNeal tubes of the classical formula. At other times a simplified formula was used. These cultures were put into an incubator at 19°–23°, improvised from two biscuit boxes. After seven days, they were transported across the desert to the laboratory.

In order to obtain a pure culture it was necessary to paint the surface of the lesion with several applications of tincture of iodine. The organism grows at 20°–22°, rather more rapidly than the parasite of Kala-Azar. On the fourth day, flagellate forms appear, which begin at once to divide. There is luxuriant growth on the eighth to the tenth day. Soon the rosettes appear, and form masses just visible to the naked eye. Then the infusoria tend more and more to agglutination and immobilization, and the culture is dead at the end of two months. It was found possible, however, to keep the organisms alive by repeated subculturing. Cultivations were made on other media, but no important results were obtained. The microscopical appearances of this parasite differ in no way from that of Kala-Azar.

Rearing Sterile Flies.†—Eng. Wollman, in a contribution to the knowledge of the part played by microbes in the alimentary canal, gives the technique he adopted in rearing flies under sterile conditions. The eggs of *Calliphora vomitoria* sterilized in from 1–4 per 1000 sublimate, were placed on damped tufts of glass-wool, and then spread out by means of brushes. The glass-wool was then rolled up cylinder-wise, and the ends turned in. The whole was then tied up and placed in a tube, wherein it was exposed to alternate currents of sublimate and sterile water. The glass-wool was next placed in a Petri's capsule, the ligature was removed, and the mass unrolled. This done, the eggs were transferred one by one to tubes containing sterilized meat. Three kinds of controls were used. The cultivation tubes were tested from time to time, and those that were contaminated at once rejected.

* Ann. Inst. Pasteur, xxiv. (1910) pp. 673-80.
† Op. cit. xxv. (1911) pp. 79-88 (2 figs.).

Bacillus of Acne.*—H. F. Hartwell and E. C. Streeter find that *Bacillus acnes* is essentially an anaerobe. Under anaerobic conditions it grows well in all common media, but best on glycerin, agar. Slants inoculated by smearing pus on the surface show fair-sized colonies in from three to five days ; the colonies are raised, greyish white, opaque. The bacillus is Gram-positive, and often has an irregular or beaded appearance ; it is moderately wide ; its length is variable, especially in cultures, where it frequently shows branching forms. It does not form spores.

(2) Preparing Objects.

Demonstrating the Structure of the Yeast-cell.†— H. Wager states that the best fixatives are Gram's iodine solution, Flemming's weak chromic acid solution, and Perenyi's fluid. The best stain is Heidenhain's iron-hæmatoxylin. The structure of the yeast-cell is best determined by means of sections, and the method is perfectly simple. A quantity of yeast is put into a tube about half an inch in diameter ; it is then fixed and stained, and allowed to settle at the bottom of the tube ; the supernatant liquid is decanted, and is replaced by up-graded alcohols and finally by turpentine or xylol. After a short time the xylol or turpentine is poured off ; soft paraffin wax is added, keeping it melted at as low a temperature as possible until the yeast is impregnated with it. Then wax of a higher temperature is added, and finally the tube is cooled as quickly as possible. It is then broken gently, and the paraffin block with the contained yeast-cells removed. The block is then cut up, and the sections mounted in balsam for microscopical examination. In this way three sections of a single cell may be obtained.

Investigating Nature of Supposed Algal Coals.‡—E. C. Jeffrey worked with material softened by various treatments. In the case of cannel, or cannelard coal, the material was immersed in 70 p.c. alcohol saturated with caustic alkali, and incubated at 60°–70° C. The alkali was then removed by frequent treatment with hot alcohol, after which it was generally found expedient to treat for two or three weeks with strongest hydrofluoric acid. After washing out the acid, the material was embedded in the usual way in celloidin. Sections of about 5 micra thick were made. In the more resistant cannels, especially bogheads and oilshales, it was necessary to treat with aqua regia, and in some cases to replace the hydrochloric by hydrofluoric acid. It was sometimes advantageous to return the material to alkaline alcohol after treatment with acids ; in such cases all the acid must be removed before the pieces are placed in alkaline alcohol, as otherwise they suffer disastrous swelling. After the sections are cut they are dehydrated in a mixture of alcohol and chloroform, in order to avoid softening the celloidin matrix ; after clearing in benzol or xylol they are mounted in balsam. In a few instances it was found advantageous to mount in glycerin jelly. In dealing with serial sections, the best procedure is to lay the sections on a slide as they come off the knife, and then dehydrate and clear them in their order.

* Publications Massachusetts Gen. Hosp., iii. (1910) pp. 200–4 (4 figs.).
† Journ. Inst. Brewing, xvii. (1911) pp. 2–22 (3 figs.).
‡ Proc. Amer. Acad. Arts. and Sci., xlvi. (1910) pp. 273–90 (5 pls.).

(3) Cutting, including Embedding and Microtomes.

Injection Preparations of Petromyzon.*—B. Mozejko gives an account of his methods. The living fish is divided in two by a cut through the region of the abdomen. Most of the blood escapes through the cut ends of the large vessels, and gentle pressure is used to expel as much blood as possible. Cannulæ with slightly enlarged extremities are introduced into the aorta, and into one of the great veins. A broad ligature is then placed near the cut surface, in order to keep the cannulæ in position. The ligature must not be employed in such a way as to damage the tissues. By an injection into the aorta, so that the material is forced through to the veins, a single-coloured injection of the vascular system is effected. A two-colour preparation may be obtained by first injecting the veins. When the material so injected has solidified, the arteries may be injected. By means of another modification, a three-colour injection, distinguishing arteries, veins, and sinuses, may be obtained. After injection is complete, the preparations are placed, without removing the ligatures, into a fixing fluid which contains formalin. After fixation the ligatures are removed, and the preparations preserved. Portions may be embedded in celloidin, and serial sections cut. In previous communications, † particulars as to the materials suitable for injection have been given.

The author has combined these injections with the clearing methods recommended by Lundvall, by means of which semi-transparent preparations are obtained. In the application of this latter process to *Petromyzon fluviatilis*, it is necessary to bleach the highly-resistant pigment by means of prolonged application of free chlorine. This precludes the use of carmine or ultramarine in the injection material. Faint colours such as chrome-yellow are the most suitable.

Demonstrating Presence of Starch in a Leaf.‡—O. H. Latter exposes the leaf to sunlight for some hours, then boils in water for a few moments, and afterwards dissolves out the chlorophyll with methylated spirit. The alcohol is removed by means of water, and then the leaf is treated with iodine solution. The leaf is next immersed in benzol, which dissolves out the iodine from all parts except the blue starch-iodine compound. Hence the blue colour shows up plainly, being no longer masked by the yellow-browns of the cellulose and protoplasm.

Method of obtaining Sections of Urinary Calculi.§—S. G. Shattock, in his communication on the microscopic structure of uric acid calculi, gives the following account of the technique adopted.

The method consists in rubbing away half of the calculus on a file or on glass-paper, the final part of the grinding being carried out on a wet hone. In some calculi the nucleus is so differentiated as to readily allow of identification. This is, however, not always the case ; one has to guard against the fallacy of mistaking the section of a zone around the proper nucleus for the nucleus itself, since both will present an

* Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 248–56.

† See this Journal, 1910, p. 257 ; Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 353-77, and 382; 1910, pp. 542–7. ‡ Knowledge, xxxiv. (1911) p. 59.

§ Proc. Roy. Soc. Med., Pathol. Section, iv. (1911. pp. 111–12.

equally circular figure. This difficulty is usually surmountable by examining the wet surface of the grinding at intervals with a hand lens. When doubt still exists the only sure method is to grind the calculus in two planes, at right angles to each other, so as to obtain a sector consisting of a fourth of the whole; the centre can then be determined by its exposure in both planes.

After the process is completed, the ground surface is carefully washed and cleared of débris by allowing water to drop from a height through a cone of filter paper; the half of the calculus so prepared is excluded from dust and allowed to dry. It is, in the next place, cemented to a slide with solid Canada balsam, a fragment of which is heated on the slide over a spirit lamp until it melts; and in order to diminish the brittleness of the balsam, a small quantity of the ordinary mounting solution in xylol is first placed on the slide, the materials being mixed after heating by rocking the latter to and fro. The half of the calculus is now placed on the slide, the central portion of which is already covered with the melted balsam. A copious effervescence takes place from the under side of the calculus, owing to the expansion of the air in its interstices. The slide must now be turned over, so that the ground surface can be viewed, the calculus being moved about and gently pressed until no trace of air remains between the specimen and the glass. As soon as the balsam has set, the material is ground away from the convex side until the chief bulk has been removed. The last and most delicate part of the process is the grinding of the section to such a degree of thinness as to allow the light to pass through it. This is done, first on fine glass-paper, but completed on the hone with water. When the requisite thinness is reached, the surface is washed by allowing water to drop on to it through a cone of filter paper; lastly, when the section is dry, a xylol solution of balsam is placed on it and the cover-glass applied.

Caffyn, C. H.—**A Rock-grinding Machine for Amateurs.**
[Describes how to adapt a sewing-machine for making petrological sections and the method of preparation of a rock section.]
Knowledge, xxxiv. (1911) pp. 10–11 (3 figs.); pp. 74–5.

(4) Staining and Injecting.

Staining Blood-films.* — J. Sabrazès uses an aqueous solution of medicinal methylen-blue in dilutions of from 1 : 300 to 1 : 1000, customarily 1 : 500. Only the supernatant fluid is employed, and this is removed by means of a capillary pipette. The film must be well dried and fixed with osmic acid paper. The films may be counterstained with eosin. The eosin solution is made by mixing 5 c.cm. of a saturated solution of eosin (française pure) in 95 p.c. alcohol with 10 c.cm. of 95 p.c. alcohol.

Demonstrating the Presence of Mitochondria in Cartilage-cells.† J. Renaut removes cartilage from the long bones of fœtal sheep as soon

* C.R. Soc. Biol. Paris, lxx. (1911) pp. 247–8.
† Comptes Rendus, clii. (1911) pp. 536–8 (2 figs.).

as possible after the ewe's death. The slice is placed in saline (0·8 p.c.) on a slide; at a short distance therefrom is made a mixture of artificial serum and of saturated aqueous solution of methyl-violet 5 B. The mixture is then run on to the cartilage. As soon as the slice of cartilage becomes violet, a cover-glass is imposed and ringed round with paraffin. In this way a preparation is obtained wherein the mitochondria are stained deep violet. When a cell is non-vacuolated the mitochondria are massed around the nucleus; if vacuolated they are scattered and isolated.

New and Quick Method for Staining Spirochætes in Smear Preparations.*—A. A. W. Ghoreyeb uses the following solutions: (1) 1 p.c. osmic acid; (2) Liq. plumbi subacetatis diluted one hundred times with distilled water; must be freshly prepared; (3) 10 p.c. aqueous solution of sodium sulphide. The smear is stained as follows: (1) cover with osmic acid solution for 30 seconds; (2) wash in water; (3) cover with lead subacetate for 10 seconds; (4) wash in water; (5) cover with sodium sulphide solution for 10 seconds; (6) wash in water. This process is gone through three times. Following this, the osmic acid solution is applied for thirty seconds, and then the specimen is washed in water, dried, and mounted in balsam. After the application of each solution the washing with water must be thorough. The illustrations are both good and instructive.

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

New Mounting Medium for Botanical Preparations.†—S. Bálint has devised a medium for mounting botanical specimens which has a refractivity equal to that of glycerin, or with glycerin-gelatin. It does not crumple up sections of soft vegetable tissue, and finally becomes so hard that ringing is unnecessary. It is composed of gum arabic 40 grm., loaf-sugar 60 grm., distilled water ad lib., glycerin 10 c.cm., acetate of potash 10 grm., lacto-phenol 10 c.cm., glacial acetic acid 10 c.cm. The gum arabic must be finely powdered, and a solution made which will filter easily; the loaf-sugar must be melted to prevent its tendency to crystallization; a thin solution is then made which is mixed with the filtered gum-solution, the acetate of potash is then added, and the mixture is then thickened in a water-bath. When the required inspissation is attained, the glycerin, lacto-phenol and glacial acetic acid are added. After the ingredients are thoroughly mixed, the medium is distributed into flasks, and these are immersed up to the neck in warm water and kept warm in a water-bath for some hours and then allowed to cool gradually. This procedure is necessary in order to get rid of air-bubbles, and it should be repeated on the following day. Finally, to every 200 c.cm. of the medium 6 drops of lacto-phenol and 10 drops of acetic acid must be added. The medium must be preserved in stoppered bottles. One of the recommendations of this new mounting medium is

* Publications Massachusetts Gen. Hosp., iii. (1910) pp. 367–9 (3 figs.).
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 245–7.

that it facilitates microscopical examination of unstained preparations even when quite thick, and in this respect is superior to glycerin or glycerin-gelatin.

(6) Miscellaneous.

Immobilizing Flies for Microscopic Investigation.*—In his investigation of Diptera, particularly of the genus *Drosophila*, A. Delcourt has made use of some simple devices (fig. 41), by which the activities of the animals may be arrested. For rapid identification he uses a glass tube flattened towards the middle (1, 2). The alteration in the lumen is shown by the diagrams of cross-sections. A small fly, sucked into this tube, becomes immobilized in the narrow part, and may then be examined under the binocular microscope. When identified, it may be blown out into the appropriate receptacle. The second piece of apparatus, which

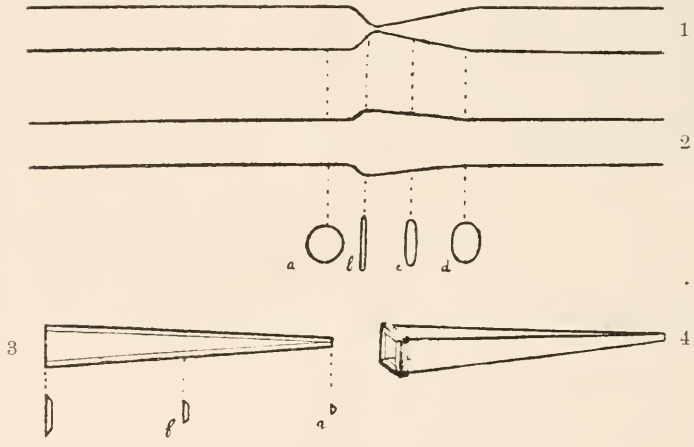

Fig. 41.

permits of a more detailed examination, consists of four glass plates (3), exactly alike, the apposition of which (4) forms a long, narrow, hollow pyramid. The fly is placed within this pyramid, at a level determined by its size, and while thus fixed may be examined from each side under a fairly high power. The plates are simply placed in juxtaposition, and secured by an elastic band. This is readily effected by the use of a metal matrix, which is withdrawn when the band is placed in position.

Anthrax Sterilization Process applied to Hides in Dry State.†—This process, devised by A. Seymour-Jones, is reported to be both very effective and innocuous to the hides. It consists in immersing the hides for 24 hours in a mixture of formic acid (1 p.c of 90 p.c. strength), and

* C.R. Soc. Biol. Paris, lxx. (1911) pp. 97–8.

† Pamphlet printed for the author by Bradbury, Agnew and Co., Ltd. (Dec. 1910) 31 pp.

1 part mercuric chloride to every 5000 parts of water. On removal the hides are drained, and then transferred to a pit containing a saturated solution of common salt for about one hour, after which they are drained. For goat- and sheep-skins the quantity of formic-acid is less.

Self-regulating Siphon.*—W. H. Tait describes a self-regulating siphon which is simple in construction and very efficient in use. The U-tube bent out of ordinary ¼-in. quill tubing, as shown in the illustration (fig. 42), is narrowed at the point A, and the small piece of glass rod C is drawn out so as to fit this constriction. The bulb B, sealed on to the top of this rod, floats on the surface of the water. The U-tube must be so fixed, that when the water is at the desired level the rod just fits into A, and so closes the exit. If the level of the water in the vessel D rises at all, the bulb is raised and the excess of water flows out through the siphon. A useful apparatus for laboratories when it is required to keep a continuous flow of water through a vessel in which the level must remain constant.

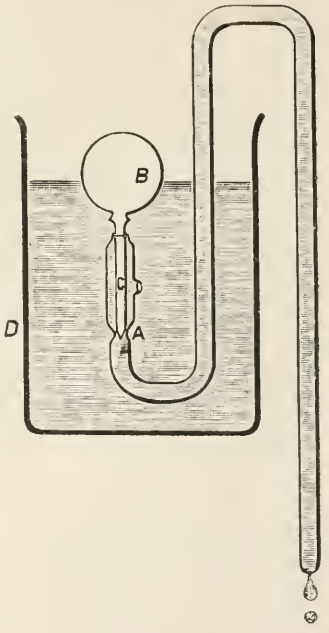

Fig. 42.

Filtering by Aid of the Centrifuge.†—R. Sabouraud and A. Vernes state that the difficulties of filtration are easily overcome by means of a centrifuge. They place porcelain bougie filters in the cups or buckets of a centrifuge ; presumably within some glass vessel, as the authors remark that the apparatus is easily sterilizable. The bougies will stand 6000 revolutions a minute without breaking, and filtration is effected in a few minutes. For filtering organic fluids, a collodion sac is easily made by coating the internal surface of the bougie with collodion.

Polishing Metallic Preparations for Microscopical Examination.‡ In the final polishing of delicate metallic specimens for microscopic examination, it has been found impossible entirely to obliterate the scratches without destroying crystalline structure. If, however, the following methods are adopted, there will be few, if any, objectionable marks visible under a power of less than 800 to 1000 diameters, and all the perfection of structure will be preserved. After polishing with

* Nature, lxxxvi. (1911) p. 45 (1 fig.).
† C.R. Soc. Biol. Paris, lxix. (1910) pp. 620-1.
‡ Communicated by John Mastin, F.R.M.S.

various grades of emery, etc., with selvyt or other method, friction should be given with the ball of the thumb, following which rice-starch, previously ground to a very fine powder, should be rubbed on with medical (but not medicated) wool—such as the pure wool sold by the chemist. Where this is not practicable, a piece of soft razor-strop leather, or a strip of selvyt glued on a piece of smooth hard wood, may be employed, using the starch plentifully. The starch must be used so plentifully that it does not get heated. The writer has used both processes for a long time past in metallography with the greatest success.

Metallography, etc.

Aluminium-silver Alloys.*—W. Broniewski has determined the electrical conductivity, the temperature-coefficient of electrical resistance, the thermo-electric properties, and the E.M.F. of solution, of a series of aluminium-silver alloys. The curves expressing the results indicate the existence of the compounds Al_2Ag_3 and $AlAg_3$. Confirmation was obtained by microscopical examination of the alloys.

Quenching of Bronzes.†—The softening effect of quenching cast-bronze from a suitable temperature appears to be due to the suppression of the decomposition of a solid solution. L. Grenet points out that if this explanation holds, subsequent re-heating of such softened material should cause an increase in hardness by bringing about the decomposition of the solid solution. Two tin-copper alloys, containing respectively 15 and 20 p.c. tin, were softened by quenching from 750° C., and, as anticipated, the hardness was restored by subsequent re-heating at temperatures 100° to 400° C.

Bearing Metals.‡—A. Hague discusses the qualities desirable in bearing metals, and classifies the alloys used for this purpose as : (1) rigid bronzes ; (2) plastic white metals ; (3) plastic bronzes. The plastic white metals consist of hard grains embedded in a plastic matrix. In the third class, plasticity is imparted to the bronzes by the addition of 15 to 30 p.c. of lead. The lead does not appear to alloy with the bronze, but to be held mechanically ; it exists in the bearing metal as veins of lead. The composition and properties of numerous anti-friction alloys are given, with much information on the best methods of employing them.

Behaviour of Copper towards Gases.§—A. Sieverts and W. Krumbhaar have investigated the solubility, in solid and in molten copper, of oxygen, nitrogen, carbon monoxide, carbon dioxide, hydrogen, and sulphur dioxide. The behaviour of hydrogen points to the existence of a solid solution of hydrogen in copper.

* Comptes Rendus, cl. (1910) pp. 1754–7 (4 figs.).
† Op. cit., cli. (1910) pp. 870–1.
‡ Engineering, lxxxix. (1910) pp. 826–9.
§ Zeitschr. Phys. Chem., lxxiv. (1910) pp. 277–307 (4 figs.).

Ternary Systems.*—E. Jänecke deals with the theory of ternary systems, in which the equilibrium diagram shows a ternary transition-point. The lead-cadmium-mercury system is considered as an example, and photomicrographs are given to illustrate the author's conclusions.

Cementation by Gases.†—A. Portevin opens a general review of this subject, by pointing out that in industrial cementation the part played by solid carbon is probably quite insignificant, the cementation being effected almost wholly by gaseous carbon compounds. The study of the laws governing cementation by gases should therefore precede the investigation of the much more complex mechanism of cementation by solid materials. Gaseous cementation agents may all be regarded as following one of the three types: (1) carbon monoxide; (2) cyanogen; (3) the hydrocarbons. Each one of these, in presence of iron at a high temperature, is capable of decomposing into carbon and another gas. The laws governing the phenomena are the same in each case, and the author proceeds to work out in some detail the theory of the system $CO - CO_2 - C$, as a representative case.

A full account is then given of the extensive experimental work on cementation by gases carried out by Giolitti and his pupils.‡

Cementation of Steel.§—F. Giolitti and F. Carnevali record the results of experiments on the cementation of two steels, containing respectively 0·18 p.c. and 0·94 p.c. carbon, at different temperatures, the cementation media being ethylene, methane, carbon-monoxide, and other gases.

F. Giolitti and G. Tavanti‖ describe a method of cementation by means of a mixture of carbon-monoxide and dioxide in equilibrium with carbon at the cementation temperature. By this method the sharp transition from a region of high-carbon content to a region of low-carbon content is avoided.

Cementation in a Vacuum.¶—F. Weyl summarizes previous work on cementation, and describes the experiments by which he has demonstrated the possibility of the cementation of iron by pure carbon. Small cubes of iron, prepared in an electric furnace, and containing 0·09 p.c. carbon, 0·3 p.c. manganese, were heated in a high vacuum at temperatures between 750° C. and 1050° C., in contact with one of the following varieties of carbon: sugar charcoal, Ceylon graphite, kish, and diamond powder. These materials had been previously carefully purified and heated for some time in a vacuum. Microscopical examination of the specimens showed that cementation had occurred when a sufficiently high temperature had been attained, but the smallness of the amount of

* Zeitschr. Phys. Chem., lxxiii. (1910) pp. 328–42 (24 figs.).
† Rev. Métallurgie, vii. (1910) pp. 859–85 (23 figs.).
‡ See this Journal, 1909, 1910, 1911.
§ Atti R. Accad. Sci. Torino, xlv. (1910) pp. 376–87, through Journ. Chem. Soc., xcviii. (1910) p. 616.
‖ Tom. cit., pp. 539–63, through Journ. Chem. Soc., xcviii. (1910) pp. 780–1.
¶ Metallurgie, vii. (1910) pp. 440–56 (39 figs.).

carbon absorbed by the iron indicates that industrial cementation proceeds chiefly through the agency of gases.

Influence of Segregation on the Strength of Mild Steel.*—F. Wüst and H. L. Felser have studied, in a very thorough manner, the segregation in basic Bessemer and open hearth steel containing about 0·07 p.c. carbon. Large and small ingots of each description of steel, weighing respectively 1000 kg. and 250 kg., were sectioned longitudinally, polished, and etched with copper-ammonium chloride; drillings for analysis were taken from sixty positions in each. Sulphur and phosphorus were found to segregate most; carbon, manganese, and copper to a lesser degree. While in the segregated regions the static tensile tests were little worse than those from the lower unsegregated parts, the impact bending tests gave much inferior results.

Gases in Commercial Steel and Iron.†—P. Goerens describes the method he has used for the extraction of occluded gas from steel. Fine drillings are heated in a vacuum at 900°–950° C. The results of numerous analyses of the gases extracted from basic Bessemer, open-hearth, and other steels, at different stages in their manufacture, are given.

Grain-size in Iron.‡—By heating pieces of steel wire containing 0·07 p.c. carbon at different temperatures for various lengths of time, A Joisten has confirmed Stead's statement that the greatest increase of grain-size in low-carbon steel takes place in the neighbourhood of 700° C. Curves are given showing the relation of dimensions of grain to length of time of heating at 400°, 500°, 600°, 700°, and 850° C.

Magnetic Properties of the Modifications of Iron.§—S. Hilpert questions the separate existence of β-iron, and also suggests that γ-iron may be magnetic at ordinary temperatures. The change in magnetic properties with temperature is continuous, and the thermal phenomena which are regarded as evidence of the existence of allotropic modifications of iron may be due to changes in specific heat accompanying loss of magnetic properties.

Iron-nickel Meteorite.‖—W. Guertler combats the view taken by Fraenkel and Tammann,¶ that the iron-nickel alloy of which meteorites are composed is metastable. The peculiar structure of meteorites is held to be due to the extremely slow cooling they have undergone.

Historical Note on Recalescence.**—W. F. Barrett gives an account of the discovery of the recalescence points in iron and steel. The observation by G. Gore, in 1868, of the momentary elongation of an iron wire during cooling from bright incandescence, led the author to investigate the subject, and in 1873 the afterglow or recalescence was discovered.

* Metallurgie, vii. (1910) pp. 363–84 (59 figs.).
† Tom. cit., pp. 384–95 (2 figs.).
‡ Tom. cit., pp. 456–8 (14 figs.)
§ Zeitschr. Electrochem., xvi. (1910) pp. 390–4, through Journ. Soc. Chem. Ind., xxix. (1910) p. 760.
‖ Zeitschr. Phys. Chem., lxxiv. (1910) pp. 428–42 (3 figs.).
¶ See this Journal, 1909, p. 785.
** Nature, lxxxv. (1910) pp. 235–6.

Theory of Hardening Carbon Steels.*—C. A. Edwards examines the available data relating to the hardening of carbon steels by quenching, in the light of the phase rule and the theory of alloys, and concludes that the hardening is due to the retention of the solid solution of carbide of iron in γ-iron. The theory that the hardening is the result of the retention of β-iron is held to be untenable. The suggestion is made that there is no constitutional difference between the so-called austenite and martensite, and that the apparent difference is due to the twinning of the γ solid solution crystals, caused by the mechanical pressure absorbed in suppressing the decomposition of this solution into α-iron and carbide of iron. The author's views met with both support and criticism in the discussion.

Hardening of Carbon and Low-tungsten Tool-steels.†—S. N. Brayshaw has submitted two varieties of steel to a lengthy series of experiments, the results of which are chiefly of workshop interest. Both steels contained about 1·15 p.c. carbon; one contained 0·5 p.c. tungsten, the other no tungsten. Heating and cooling curves, with different rates of change of temperature and different maximum temperatures, were taken; the effect of each variable is considered. The range of temperature within which the best results could be obtained in hardening, was determined. The effect upon physical properties of variations in temperature of the steel before quenching and of the quenching medium was investigated, as well as the effect of length of time of heating.

Slag in Steel.‡—Matweieff, continuing on the lines of his previous work,§ has investigated the metallographical characteristics of the phosphates of calcium, magnesium, manganese, and iron, and calcium ferrite. All these bodies may occur in basic Bessemer steel as intermixed slag. The compounds, either singly, or mixed with each other or with oxides, were enclosed in small hollow cylinders of steel closed with steel plugs; the cylinders were then heated to 1300° C. After cooling, transverse sections were cut and polished, so that both the envelope and the juxtaposed contained matter could be examined. Calcium phosphate did not melt, and had no action on the steel envelope. The other three phosphates were reduced by the iron, and some phosphide of iron was formed. As a result of this work, three new etching reagents are recommended: 1. A 2 p.c. solution of ammonium oxalate, which slowly attacks cementite in the cold, giving a red coloration after 30 minutes. 2. A boiling solution of neutral sodium picrate, which colours phosphide of iron after 30 minutes, leaving cementite, ferrite, the solid solution of phosphide of iron in iron, and pearlite, unaffected. 3. A 2 p.c. solution of ammonium carbonate; in specimens heated in this reagent for 20 minutes on a water-bath, the slags formed in dephosphorizing are disintegrated, while the metallic surface is

* Journ. Iron and Steel Inst., lxxxii. (1910) pp. 147–96 (17 figs.).
† Proc. Inst. Mech. Eng. (1910) 2, pp. 517–710 (62 figs.).
‡ Rev. Métallurgie, vii. (1910) pp. 848–58 (27 figs.).
§ See this Journal, 1910, p. 794.

unaffected. A scheme for the metallographical identification of the compounds occurring in slags found in iron and steel, is outlined, the appropriate reagents being given in tabular form.

Action of Mercury on Steel at High Pressures.*—In the course of an investigation of the thermal properties of mercury and water under high pressure, P. W. Bridgman found that hollow cylinders of hardened steel burst at very much lower than the natural bursting pressure when the fluid exerting the pressure was mercury. That this rupture was due to the amalgamation of the steel was evident from the appearance of the fracture. It was found that the fractured surface of steel broken under mercury was amalgamated. Any exposure to air before contact with mercury completely prevents amalgamation. The explanation advanced to explain the bursting of the pressure cylinders, involves the initial amalgamation of the steel permitted by its state of elastic strain. The rapidity with which the amalgamation spreads is greatly increased by the action of hydrostatic pressure.

Influence of Silicon on Cast Iron.†—A. Hague and T. Turner have studied seventeen alloys containing 2·3 to 2·9 p.c. total carbon, the silicon content increasing from 0·03 to 4·83 p.c. The molten alloy was cast in a mould giving a bar of circular section, and simultaneous observations were made of time, temperature, and change in length. Sections of the bars were examined microscopically, and mechanical tests were made. The pearlite arrest-point was gradually raised from 700° to 800° C. by the silicon additions, which also raised to a smaller extent the temperature of final solidification, from 1130° to 1160° C. The temperature of commencing solidification appears to be lowered by increasing silicon.

Manganese in Cast Iron.‡—H. I. Coe has measured the changes in length which occur in cast bars of iron-manganese-carbon alloys during cooling from the molten state. Simultaneously with these measurements, time-temperature cooling curves were taken. Hardness measurements were made on the cast bars, which were also microscopically examined. The forty-eight alloys studied are divided into two series, the first being prepared from pure white cast iron, the second from grey cast iron containing 2·45 p.c. silicon. Manganese increased from 0 to nearly 40 p.c. In the white iron series the temperature of commencing solidification was lowered by manganese, but the eutectic freezing point was not affected up to 20 p.c. manganese. An alloy containing 4 p.c. carbon, 26 to 28 p.c. manganese, 68 p.c. iron, appeared to be a pure eutectic, with its freezing point 15° C. below that of the eutectic of the pure iron-carbon system. The Ar1 temperature was lowered by about 20° C. for each 1 p.c. of manganese; this arrest gradually diminished in intensity, disappearing at about 10 p.c. manganese. In the grey iron

* Proc. Amer. Acad. Arts and Sciences, xlvi. (1911) pp. 325–41 (9 figs.).
† Journ. Iron and Steel Inst., lxxxii. (1910) pp. 72–104 (25 figs.).
‡ Tom. cit., pp. 105–46 (25 figs.).

series the results obtained were somewhat different. The manganese had no appreciable effect on the relative proportions of graphitic and combined carbon until 3 per cent. was present. With higher percentages the combined carbon increased at the expense of the graphitic; some graphitic carbon remained, however, with 17·5 p.c. manganese.

Fixing Objects to Stage.*—O. Wawrziniok describes a clamp for holding specimens. The clamp is screwed to the microscope stage, has a levelling arrangement for adjusting the level of the polished surface, and has been found useful for holding large objects such as ancient gun-barrels.

Photomicrographic Apparatus.†—F. Robin describes a number of modifications which he has introduced into the Le Chatelier apparatus. The objective is pointed downwards, and below it on the stage is placed the section with its polished face uppermost. The stage has movements vertically, and in two directions horizontally; its level may also be adjusted through large angles, and it is capable of carrying large and heavy pieces of metal. The apparatus rests on felt, which is more effective than rubber in deadening vibrations. The source of light is an arc, with carbons set at right angles; the positive carbon remains in the optical axis, and the crater does not alter its position. All examination is carried out upon the image projected on the ground glass screen of the camera. The focusing movements, as well as the other stage movements, are controlled by means of four horizontal rods, the free ends of which are below the focusing screen. Oblique illumination may be secured by moving the condenser and using a small mirror; transparent objects may be viewed by transmitted light. The author points out that examination by oblique light supplements most usefully the usual examination with vertical illumination; examples illustrated with photomicrographs are given. The application of microchemical analysis in metallography is discussed; methods and examples are given. A minute quantity of a solution, obtained by placing a drop of an acid or other reagent on a clean surface of the substance to be examined, is treated with reagents on a glass slip; the products of the reactions are observed microscopically.

Sulphurous Acid as an Etching Medium.‡—S. Hilpert and E. Colver-Glauert, in searching for an etching reagent having a purely chemical action on iron and steel, have found that sulphurous acid may be used with highly satisfactory results instead of the numerous diverse etching media proposed for developing the structure of hardened steel. The action of these reagents, many of which are complex mixtures of organic bodies, is little understood. A useful strength is a 3 to 4 p.c. solution in water of a saturated solution of sulphur dioxide in water, free from sulphuric acid. Etching is complete in from 7 seconds to 1 minute.

* Metallurgie, vii. (1910) pp. 312–13 (4 figs.).

† Rev. Métallurgie, vii. (1910) pp. 903–20 (23 figs.).

‡ Journ. Iron and Steel Inst., lxxxii. (1910) pp. 54–64 (9 figs.) See also Zeitschr. Anorg. Chem., lxviii. (1910) pp. 63–8.

An alcoholic solution may be used, but is slower in action. The action of the reagent appears to be essentially the formation of films of sulphide of iron, and as different constituents are acted upon with varying rapidity, they become coated with sulphide films of different thickness. Photomicrographs of steel, in which the authors claim to have developed the structure better with their new reagent than with any other, are given. Sulphurous acid is not suitable for steels composed of ferrite and pearlite, but is an excellent reagent for all other steels and pig irons.

Fatigue of Metals.*—J. H. Smith describes a method for determining a series of yield ranges by experiment on a single specimen. Numerous results obtained on different classes of steels, lead him to conclude that if a material be subjected to stress alternations of high periodicity and of fixed range, and compressive or tensile mean stress be gradually applied, a yielding condition will be found at a definite value of the applied mean stress.

Measurement of Hardness.†—G. Baume describes a dynamic method of applying the Brinell test. The apparatus consists of a weighted rod, suitably guided, holding at its lower end a hardened steel ball. The impression made by a known weight of rod and height of fall on a polished specimen is measured.

Viscous Flow in Metals.‡—E. N. da C. Andrade has devised a method of loading a wire in tension in such a manner that the stress remains constant however the wire may contract laterally on stretching. By loading wires of lead, a lead-tin alloy, and copper in this way, the author has demonstrated that, beyond the elastic limit, the extension after some time becomes proportional to the time, or the flow becomes viscous in character. The flow is purely viscous right up to breaking.

Electrical Conductivity of Molten Alloys.§—K. Bornemann and P. Müller have determined the electrical conductivity, at different temperatures, of numerous alloys belonging to the binary systems sodium-potassium, tin-lead, mercury-sodium, mercury-potassium, and others. It is shown that indications of the presence of compounds in molten alloys, and of the degree of dissociation of such compounds, may be obtained from concentration-conductivity curves. The temperature at which the separation of a homogeneous liquid alloy into two phases takes place is characterized by a change in direction of the conductivity-temperature curve, and may accordingly be determined by measurements of conductivity at different temperatures.

Temperature Co-efficients of Electrical Resistance.‖—A. A. Somerville gives curves showing the variation of resistance of nickel, tungsten, molybdenum, and an alloy named nichrome, in the range of temperature 0°–1060° C.

* Journ. Iron and Steel Inst., lxxxii. (1910) pp. 246–318 (37 figs.).

† Archives des Sciences Physiques et Naturelles (Geneva) xxx. (1910) pp. 418–20.

‡ Proc. Roy. Soc., Series A, lxxxiv. (1910) pp. 1–12 (7 figs.).

§ Metallurgie, vii. (1910) pp. 396–402 (5 figs.).

‖ Physical Review, xxx. (1910) pp. 532–4, through Science Abstracts, Sect. A, xiii. (1910) pp. 448–9.

Microscopical Examination of Blast-furnace Slag.* — H. Passow indicates the great value of microscopical examination of blast-furnace slag for determining its suitability for making Portland cement. Vitreous slag is required for this purpose, and while chemical analysis fails to distinguish between vitreous and non-vitreous slags, microscopical examination of crushed particles gives the required information.

DUCELLIEZ, F.—**Cobalt-silver Alloys.**
Procès-verbaux des séances de la Société des Sciences physiques et naturelles de Bordeaux, 1909–10, pp. 46–8.

,, ,, **Cobalt-zinc Alloys.** *Tom. cit.*, pp. 102–11 (1 fig.).

PEIRCE, B.O.—**The Resistivity of Hardened Cast-iron as a measure of its Temper and of its Fitness for use in Permanent Magnets.**
Proc. Amer. Acad. Arts and Sciences, xlvi. (1910) pp. 185–204 (10 figs.).

,, ,, **The Magnetic Permeabilities at low Excitations of two kinds of very pure soft Iron.** *Tom. cit.*, pp. 207–12.

VIGOUROUX, E.—**Nickel-silver System.**
Procès-verbaux des séances de la Société des Sciences physiques et naturelles de Bordeaux, 1909–10, pp. 44–5.

VIGOUROUX, E., & A. BOURBON—**Mutual Action of Nickel and Zinc.**
Tom. cit., pp. 95–102 (1 fig.).

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* Stahl und Eisen, xxx. (1910) pp. 989–93 (3 figs.).

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Beck's London Microscope: Handle Model.† — This instrument (fig. 43) was described at the April Meeting.‡ The illustration shows the special feature of the new model; it is so designed that the limb forms a strong handle, by which the instrument can be conveniently grasped without danger to the adjustments. In other respects the instrument possesses all the well-known characters of the original model.

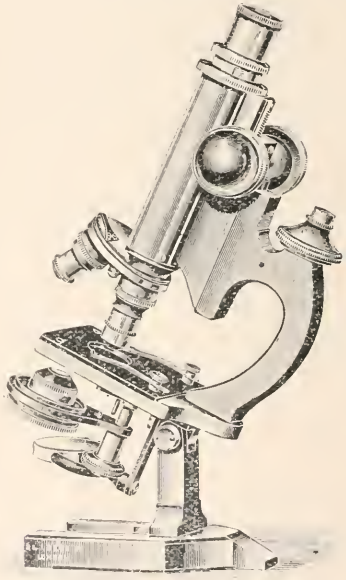

Fig. 43.

Winkel's Stand No. 1d.§—This instrument (fig. 44) is of medium size, and has similar focusing adjustments, stage and substage mechanism to Stand No. 1; but is smaller, owing to the body-tube being of the ordinary diameter. Owing to the lesser weight and slightly different position of the inclinable joint, a clamping lever is unnecessary.

The maker produces a similar instrument with centring rotating stage and stage diaphragm, but without rectangular movements.

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

† R. and J. Beck's Special Catalogue (1911) 4 pp. (2 figs.).

‡ See this Journal, p. 419.

§ R. Winkel, Gottingen Catalogue, 1911, pp. 26–7 (1 fig.); pp. 28–9 (1 fig.).

Winkel's Demonstration Microscope with Detachable Foot.*— This instrument is intended for use at lectures and demonstrations, when it is desired to pass specimens illustrating the various points dealt with from hand to hand. The sliding tube coarse-adjustment can

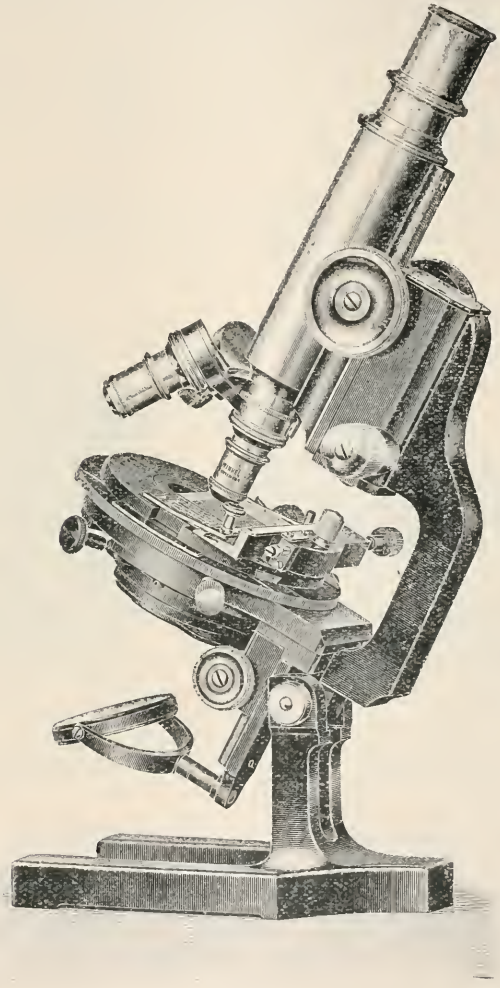

Fig. 44.

be clamped when desired. Fine-adjustment is effected by sliding the eye-piece in or out of the tube, which is sprung for holding it in the desired position.

Souza-Brandão, V. de—**O novo Microscopio da Commissão do Serviço Geologico.** *Comm. do Servico Geologico de Portugal*, v. (Lisbon, 1903) pp. 118–250 (2 pls.).

* R. Winkel, Gottingen Catalogue, 1911, p. 44 (3 figs.).

3. Illuminating and other Apparatus.

Efficiency of Metallic Filament Lamps.*—R. A. Houstoun has made some measurements on the radiant efficiency of carbon, osmium, tantalum and tungsten glow-lamps. By calculating the radiant efficiencies of the different filaments at their marked voltage and taking the mean he obtains the following results:—

	Radiant Efficiency.	Watts per Candle.
Carbon	2·9	3·5
Osmium	5·2	1·5
Tantalum	6·5	1·7
Tungsten	7·5	1·0

Reichert's New Breath Screen.†—This breath screen (fig. 45) is found to afford complete protection from the damage arising from the

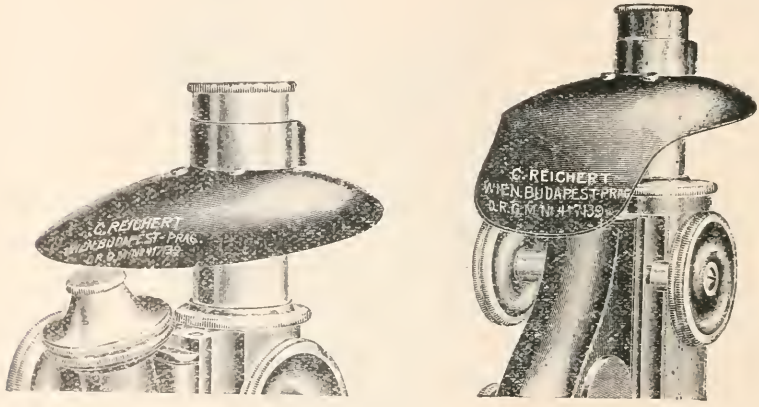

Fig. 45.

warm breath of the observer, especially during the cold seasons. It does not inconvenience the observer and is readily attached by means of a clamping screw.

Improved Micrometer.‡—The object of this improvement, which is described by M. Himoff, is to enable more accurate reading of the micrometer, so as to disclose at a glance how much above or below a given size a piece may be after the micrometer has been set to a given size.

The pin A slides on a guide, as shown in fig. 46. It is connected to the pointer B which indicates on the dial C, a spring normally holding the pointer at the low point. When the piece to be measured is placed in position the stem is screwed down, pressing the piece against the pin A until the pointer moves to zero. The reading is then taken, and when the next piece is to be measured to the same size it is placed between the pin A and the stem, and the pointer will move up or down according to

* Proc. Roy. Soc. Edinburgh, xxx. (1910) pp. 555-62.
† C. Reichert's Special Catalogue, 1910.
‡ American Machinist, through English Mechanic, xciii. (1911) p. 147 (1 fig.).

whether such piece is thicker or thinner than the standard. The scale indicates in thousandths or ten-thousandths, or whatever is desired. D is an adjusting screw and slot whereby the scale may be adjusted to compensate for the variation in the threads of the micrometer. In fig. 47 is shown the lever B connected by suitable gearing with the pin A and with the lever B′ and the pointer B. The operation will be the same, only the scale or dial in this case may be more conveniently made finer than in the other case, as for ten-thousandths or above. The button at B″ enables the lever B′ to be operated. In either case, if the piece to be inserted should be thicker than the standard the part B′ or B may be

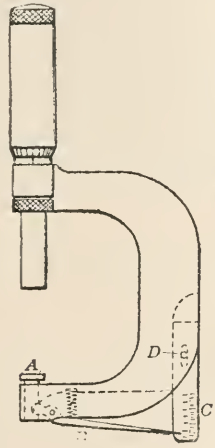

Fig. 46.

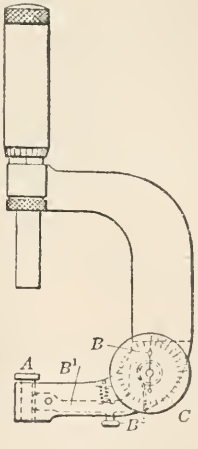

Fig. 47.

used to draw down the pin to let the piece in readily, and then when the pin is released it will move against the piece and indicate on the dial the amount the piece may be over or under the standard size.

(5) Microscopical Optics and Manipulation.

Transmission of Light through Transparent Inactive Crystal Plates, with special Reference to Observations in Convergent Polarized Light.*—F. E. Wright, in his treatment of this subject, divides his treatise into two parts, viz.: Part I., Theoretical; Part II., Observations and Measurements. In the first part he develops in terms of the electromagnetic theory of light the general mathematical treatment of the transmission of light waves through a transparent inactive crystal plate, special attention being given to the rotatory effects of the boundary surfaces of the crystal plate on the plane of polarization of a transmitted wave. Both theory and the observations of Part II. show that, as a general rule, a quiradial plane polarized light wave after trans-

* Amer. Journ. Sci., xxxi. (March, 1911) pp. 157–211 (18 figs.).

mission through a bare crystal plate is still plane polarized, but its plane of polarization has suffered a slight rotation depending on the direction of transmission, and if examined under crossed Nicols does not appear perfectly dark in consequence. In general it may be stated that from an incident plane polarized wave two refracted waves are formed which on emergence from the plate are each still plane polarized, but their planes of polarization are not precisely 90° apart.

Phenomena of Visual Inhibition which may accompany the re-association of the two Retinal Images dissociated by the Prisms of the Stereoscope. Conditions and determination of these Phenomena.*—M. A. Chauveau describes and discusses a series of experiments which tend to evaluate the function of each eye in stereoscopic vision. He arranges so that the two objects viewed differ in detail so as to produce a condition of asymmetry. When a person whose eyes are of unequal visual acuity views such objects through any ordinary stereoscopic apparatus, the effect seen is dependent on the object presented to the stronger, or dominating, eye. The phenomenon may be very strikingly illustrated by a suitable choice of asymmetrical objects. The necessary condition of asymmetry may also be produced by such means as breathing on one of the prisms.

HAVELOCK, T. H.—**Optical Dispersion: an Analysis of its Actual Dependence upon Physical Conditions.** *Proc. Roy. Soc.*, Series A, lxxxiv. p. 492–523.

(6) Miscellaneous.

Infinitely Small Chemical Magnitudes.†—P. A. Guye gives an excellent résumé of the modern views of molecular constitution. He discusses granules, molecules, atoms and electrons. He pays justice to the useful part played by the Microscope in this important field of research. With the ultramicroscope and arc-lamp illumination Siedentopf has easily distinguished objects of diameter $0{\cdot}01\,\mu$ and, with summer solar light, objects as small as $0{\cdot}003\,\mu$. As the molecules of certain albuminoids are ascertained by calculation to have a diameter of $6\,\mu\mu$, it follows that, under certain conditions, molecules can not only be seen, but their calculated magnitude be verified by experiment. While the molecules of gases seem at present to be beyond the reach of vision, yet Perrin by means of an enormous number of microscopic observations on emulsions has established that in an emulsion of uniform granules the distribution of such granules at various depths is subject to the same law as connects the density of the air with its pressure. In other words, Laplace's atmospheric equation

$$\frac{2}{3}\,w \log \frac{n_a}{n} = \phi\,(\Delta - \delta)\,g$$

is made applicable to certain solids. [w = mean granular energy ; n and n_a, the numbers of granules at depths h and h_a : ϕ, the volume of one granule : δ, its density ; Δ, the density of the medium ; and g the acceleration due to gravity.] One of the results of the observations

* Comptes Rendus, cliii. (1911) pp. 481–7 (2 figs.).
† Verh. der Schweiz. Natur. Gesell., i. (1910) pp. 168–200 (6 figs.).

is the calculation of w, which is found to have the same numerical value as for the mean kinetic energy of gaseous molecules. This leads up to the calculation of Avogadro's constant, or the number of gaseous molecules contained in a molecule-gram of any gas at 0° and under a pressure of one atmosphere. This constant is found to have a probable value of $70{\cdot}5 \times 10^{22}$.

Stereoscopic Illusion.*— F. G. Baily describes a stereoscopic observation which lends itself to quantitative expression and may possibly prove to be capable of practical application. It is well known that, if a finger be held vertically in front of the eyes and a distant object be looked at, two images of the finger will be seen, quite transparent if the two images do not overlap, and opaque only at overlapping parts. In place of the finger use a thin rod at a distance of some six or more feet, and focus on another vertical rod at a distance of 30 feet or more so that the second rod is seen between the two images of the first. The apparent position of the second rod will be found to be distinctly nearer than its real position. Thus, let A_1 A_2 (fig. 48) be the observer's eyes, B the first rod, and C the second. Then each eye

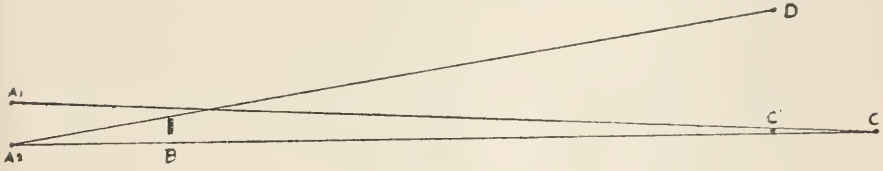

Fig. 48.

sees C without hindrance, and the observer sees a transparent image of B on each side. C then appears at C′. To observe this, B is preferably not strongly lighted, or the tendency to focus on B may be too great. C must be well away from its background, so as to stand alone with the background out of focus. The ground on which C stands must be hidden so as to prevent any other knowledge of its position. For if the actual situation on the ground is seen, the visible proof of its position will mentally outweigh the indication given by the stereoscopic effects. The apparent position of C may be determined by setting up a similar rod D near to the line A C sufficiently on one side to be visible to both eyes. D is then moved backwards and forwards until it is judged to be the same distance from the observer as C appears to be. The diagram has been drawn to correspond with the following actual figures, the vertical scale being exaggerated to twenty times the horizontal: A_1 A_2, $2\frac{5}{8}$ inches; B, 1 inch broad; A C, 100 feet; and C D, 1 foot. The author gives a full account of a number of out-of-door experiments tried by him. These experiments seemed to show that the displacement C C′ bears a definite relation to B C. The observation of the phe-

* Proc. Roy. Soc. Edinburgh, xxx. (1909-10) pp. 551-5 (2 figs).

reproduction, however, appears to be more or less personal, and probably depends to some extent upon the observer's power of stereoscopic perception.

Quekett Microscopical Club.—The 472nd Ordinary Meeting of the Club was held on March 28, 1911, the President, Professor E. A. Minchin, in the Chair. Mr. A. C. Banfield exhibited and described a new form of mercury-vapour lamp made by the Brush Electrical Company. The usual type of lamp takes the form of a luminous cylinder about 7 feet in length, giving a great total luminosity with a relatively low specific intensity. In the new form, the use of fused quartz for the manufacture of the tube enables the length to be reduced to about 4 inches, although the candle-power, about 3000, remains the same, and the gain in the specific intensity is so enormous as to render it eminently suitable for microscopic use. The peculiarities of the mercury spectrum were referred to, and the great advantages offered by this illuminant were pointed out. A paper on "Dark-ground Illumination," by Mr. E. M. Nelson, F.R.M.S., was read by the Honorary Secretary. The author referred to the increasing use of this method of illumination. The form of lamp recommended—paraffin, with ½-inch wick—was referred to, and the best means of obtaining dark-grounds described in detail. Owing to the lateness of the hour, a paper on "Some New Diatomic Structure Discovered with a New Zeiss Apochromat," communicated by Mr. A. A. C. Eliot Merlin, F.R.M.S., was taken as read.* Mr. James Murray, F.R.S.E., F.Z.S., made some introductory remarks to a paper on "Water-Bears, or Tardigrada," intended to supplement the one contributed in 1907. As the name Tardigrada is already appropriated by Vertebrates, the new official name of the group is order Arctiscoida, family Xenomorphidæ. Four new genera were described, and their relationships and those of the other genera discussed at some length, and the paper concluded with a synopsis of the ten genera known and the 120 at present admitted species. A bibliography is appended.

The 473rd Ordinary Meeting of the Club was held on April 25, 1911, the President in the Chair. Mr. A. C. Coles, M.D., D.Sc.Edin., etc., sent a note describing the use of Parolein as a mounting medium. It is absolutely neutral, and, so far as is known, is entirely without action on any dyes. Its refractive index is 1·471, as against 1·530 for balsam in xylol. The President exhibited and described preparations of two species of cysticercoid of rat-tapeworms from the body-cavity of the rat-flea, *Ceratophyllus fasciatus*. These were *Hymenolepis diminuta* and (probably) *H. murina*. He also showed dissections of the ventral nervous system of the flea, *Ceratophyllus fasciatus*, and the salivary glands and duct of the same organism. Mr. N. E. Brown contributed "Some Odd Notes upon Seeds," describing some of the more beautiful forms he had noticed. He recommended lighting the mounts with a spot-lens and concave mirror from below, and also with a stand-condenser from above, the combined lighting being very effective. The use of coloured gelatin, say red, placed below the spot-lens, and a piece of green placed over the stand-condenser, still further increased the beauty of

* Journ. Quekett Micr. Club, April 1911, p. 181.

these objects. Mr. D. J. Scourfield, F.Z.S., F.R.M.S., made some remarks on "The Use of the Centrifuge in Pond Life Work." He used a hand-driven form, running at about 7000 r.p.m., with very small tubes holding only about 1½ c.cm. He had observed quite a number of forms new to him, but could not yet say if they were really new: certainly some had never been named. He thought there was a considerable field for work on what had been termed the "centrifuged plankton."

Barus, C. & M.—**On an Adjustment for the Plane Grating similar to Rowland's Method for the Concave Grating.**

[The authors give full particulars of a simple apparatus contrived and successfully used by them.]

Amer. Journ. Sci., xxxi. (Feb. 1911) pp. 85-95 (6 figs.).

B. Technique.*

(2) Preparing Objects.

Studying the Compound Eyes of Water-mites.†—K. Bedau fixed the material (e.g. *Notonecta glauca*, *Hydrometra palustris*, etc.) in four kinds of fluid, but found that a mixture of 15 parts of 96 p.c. alcohol, 30 parts distilled water, 6 parts formalin, and 2 parts acetic acid gave the best results. Perforations were made in thorax and abdomen to allow the fixative to penetrate more easily. After from 6 to 12 hours, the insects were removed to 70 p.c. alcohol for 6 hours, and then transferred to "Seifenspiritus," in which they remained for 24 to 48 hours: soap spirit is preferable to Eau de Javelle or Eau de Labarraque for softening the chitin, and with the exception of fatty tissue has no deleterious action. The preparations were afterwards passed through upgraded alcohols, and afterwards, using cedar-wood oil as intermediary, embedded in paraffin. The sections were stained by Heidenhain's iron method or with hæmalum. For removing the pigment two fluids were used. One consisted of 3 parts of nitric and 3 parts of muriatic acids to 150 of distilled water: the other was composed of 2 parts 96 p.c. of alcohol and 1 part glycerin with some nitric acid.

(4) Staining and Injecting.

Studying the Cytology of Bacteria.‡—C. C. Dobell obtained his material from the intestinal contents of animals, mostly frogs, toads, and lizards. He found that the usual methods of fixation may under suitable conditions and with careful procedure be made to give excellent results. Films should never be allowed to dry before fixation. When the medium containing the bacteria is too watery, gelatin or albumen should be added until a film of suitable consistence is obtained; if the medium be too

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

† Zeitschr. wiss. Zool., xcvii. (1911) pp. 418-20.

‡ Quart. Journ. Micr. Sci., lvi. (1911) pp. 395-506 (4 pls.).

thick it should be diluted with isotonic salt solutions. After trying numerous fixatives and stains the author confined himself to two methods: (1) fixation with osmic acid or formalin, followed by one of the modifications of the Romanowski stains; (2) fixation with Schaudinn's sublimate alcohol, followed by Heidenhain's iron-alum hæmatoxylin. When using the former method the author proceeds as follows. A drop of the medium containing the bacteria is placed on a slide, and then by its side a drop of 1 p.c. osmic acid or of pure formalin. The two drops are mixed together and a film made. When dry the slide or slip is placed in absolute alcohol for 10 to 15 minutes. On removal, it is allowed to dry and then stained with Giemsa or Leishman. After staining, the film is differentiated in 30 p.c. alcohol, washed in distilled water, dried with cigarette paper and mounted in cedar-wood oil or in neutral Canada balsam. Chromatin structures are coloured a bright red, the cytoplasm being blue, lilac or pink, according to the degree of differentiation.

The author adds in a footnote that beautiful preparations of small Flagellates and other protista may be obtained by the foregoing method.

Rapid Staining with Giemsa's Azur-eosin Solution.*—G. Giemsa gives the following method of using his azur-eosin mixture. Equal quantities of the stock solution and methyl-alcohol are mixed. The slide is placed coverside up on a Petri dish and then covered with the solution; this is allowed to work for half-a-minute. Distilled water is then poured in until the slide is quite covered. The dish is then tilted to and fro in order to mix the water and solution. After 3 to 5 minutes or even longer the fluid is decanted off, the slide washed in running water, dried and examined in cedar-wood oil. The author states that he has not made sufficient trials to venture an opinion as to permanence.

New Method of Chromatin Staining.†—Mentz von Krogh describes the following easy method of staining chromatin; it is specially adapted for nervous tissue; the only preparations for which it is distinctly unsuitable are blood films. Paraffin sections are stained with Unna's polychrome methylen-blue for 5 minutes, and after a short wash in tap-water are mordanted from 1 to 15 minutes (according to the object dealt with) in 2 p.c. chromic acid. After another wash the sections are differentiated with 5 p.c. tannic acid solution until they assume a pale blue or a reddish-violet hue. They are then washed anew, rapidly dehydrated with absolute alcohol, then xylol and balsam. The chromatin of the cell-nucleus should be dark blue, the protoplasm and its prolongations pale blue. Nissl's bodies are blue, but not so dark as the nucleus; axis cylinders are violet; connective tissue is of a pale greenish hue. The stain is suitable for showing up Negri's corpuscles.

Saffron in Histological Technique.‡—P. Masson has found that saffron has a remarkable affinity for collagen, staining it a brilliant golden yellow. As some samples stain the cell-protoplasm to a certain extent, it is advisable to combine it with eosin and some nuclear stain,

* Muench. med. Wochenschr., 1910, p. 2476.
† Centralbl. Bakt., 1te Abt. Orig., lviii. (1911) pp. 95-6.
‡ C.R. Soc. Biol. Paris, lxx. (1911) pp. 573-4.

by which means a triple staining is effected. The technique is as follows: 1 grm. of saffron is boiled in 100 c.cm. of water for half an hour and the decoction filtered. In the course of a few days the solution becomes turbid, but retains its staining properties for 2 to 3 weeks. Pieces of tissue are best fixed in Bouin's fluid, but Zenker and sublimate give fair results. The sections are first stained with Mayer's hæmalum. Should the connective tissue be stained, the section must be decolorised in HCl-alcohol. After washing in tap-water the sections are blued in lithium carbonate 1 p.c.; they are then washed freely to remove all traces of the carbonate, and afterwards stained for 10 minutes in 5 p.c. water-soluble eosin, or for 2 hours or more in 1 p.c. eosin. After a wash in water the sections are treated with the saffron solution for from 5 to 10 minutes. They are then rapidly washed with water, dehydrated, cleared up and mounted in dammar or balsam. The nuclei are blue, protoplasm red to orange red, connective tissue, bone, and cartilage yellow.

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

Fading of Anilin-stained Microscopical Preparations and a New Medium.*—A. C. Coles, after remarking that the greatest cause of fading in balsam-mounted preparations is acidity, whether present at the time or developing subsequently from oxidation of the mounting medium, expresses the opinion that practically all substances of the nature of balsams, oleo-resins, or cedar-oil, will sooner or later oxidize and become acid, and therefore are liable to cause fading of aniline stains. The author was advised to try paraffinum liquidum, or a pure form thereof, viz., parolein, as it was absolutely neutral and remains so. His method of use is as follows:—

"A small drop of parolein is placed on a perfectly clean cover-glass, which has been held over the flame of a spirit lamp to drive off any moisture on the glass, and this is applied to the air-dried film, which is also held for a second considerably above the flame, just long enough to make the moisture fade off. If the amount of oil is just sufficient to reach the margin of the cover-glass, so much the better. If there be too much oil the preparation is placed under a piece of blotting paper, and the excess of oil removed as much as possible. The margin of the cover-glass is then rung round with Apathy's gum syrup made as follows: picked gum arabic, cane sugar, ordinary, not candied, distilled water, of each 50 grm. Dissolve over a water bath and add 0·05 grm. thymol. I test the reaction with litmus paper, and if acid I add a little sodii carbonas. If the cover-glass is round the cement can easily be applied on a turn-table; if square, which I prefer, one paints it round with a very small brush. The gum syrup sets quickly in a warm room in about 15 to 30 minutes. When dry I apply over it a coat of Bell's cement, which also dries quickly (the latter is not acted upon by the immersion oil), and I feel I have a preparation that will keep."

The writer points out that time alone will show whether the preparations will be permanent or not, and then remarks that while the mounting is a little more trouble, parolein is optically superior to cedar-oil or balsam.

* Lancet (1911) i. pp. 878–8.

Mounting Arthropoda in Amann's Chloralphenol.*—M. Langeron calls attention to chloralphenol, one of the media devised by J. Amann for mounting vegetable preparations.† The writer finds that this medium is very effective for preparing and mounting Arthropoda, as it not only softens the chitinous investment but at the same time clears up and dehydrates the specimen. The manipulation is extremely easy; the insects are killed by immersion in hot 70° alcohol; they are then treated with the chloralphenol, which may be renewed once, and when sufficiently dehydrated are removed to xylol balsam. The only preparations which failed were those of insects gorged with blood.

(6) Miscellaneous.

New Forceps.‡—M. Morosoff describes a forceps which he uses for picking up cover-glasses and slides. He has found them especially useful when dealing with highly infective material, such as plague, glanders, etc. The chief feature of the instrument is the grooved fangs.

Film Test for Crude Rubber.§—C. P. Fox, after examining 33 commercial brands of crude rubber belonging to ten distinct groups, failed to find any indication pointing towards a definite film peculiar to any particular brand of rubber. The experiments were undertaken in order to confirm or refute the observations of J. Torrey, who found that when 5 grm. of crude rubber were dissolved in 100 cc.m. of petroleum naphtha, a few drops allowed to evaporate on a white surface gave characteristic figures. If Torrey's view was correct then any crude rubber could be identified: unfortunately his observations are not confirmed.

Metallography, etc.

Nickel-sulphur System.‖—K. Bornemann has made a further thermal and microscopical study of this system in the range 0–30 p.c. sulphur, and finds that his earlier equilibrium diagram can be simplified by the replacement of two series of nickel-rich mixed crystals by one series. Errors in the earlier determinations appear to have been due to supercooling of the melts.

Tellurides of Sodium and of Silver.¶—G. Pellini and E. Quercigh have made a thermal study of the sodium-tellurium system and the silver-tellurium system. The compounds found are Na_2Te, Na_3Te_2, Na_2Te_3, AgTe, and Ag_2Te.

Tellurium Alloys.**—M. Kobayashi has determined the equilibrium diagrams of the tellurium-cadmium and tellurium-tin systems. One compound, having a high melting point, exists in each system. TeCd

* C.R. Soc. Biol. Paris, lxx. (1911) pp. 457–9.
† See this Journal, 1899, p. 442, sections (1) and (4).
‡ Centralbl. Bakt., 1te Abt. Orig., lvi. (1910) pp. 191–2 (3 figs.).
§ Ohio Naturalist, x. (1910) pp. 146–8.
‖ Metallurgie, vii. (1910) pp. 667–74 (6 figs.).
¶ Atti R. Accad. Lincei, xix. (1910) pp. 350–56, 415–21, through Journ Chem. Soc., xcviii. (1910) pp. 1062–3.
** Zeitschr. Anorg. Chem., lxix. (1910) pp. 1–9 (9 figs.).

melts at about 1041° C., but exists in the melts only in equilibrium with an excess of tellurium. TeSn melts at 780° C. Mixed crystals do not occur in either system.

Gold-tellurium System.*—M. Coste has made a microscopical examination of twenty gold-tellurium alloys, prepared in minute quantities by melting together weighed portions of the two pure metals in sealed vacuous glass or silica tubes. One compound, $AuTe_2$, which forms eutectics with each of the two metals, was found. The results were confirmed by measurements of E.M.F. of solution.

Alloys of the Noble Metals.†—W. Geibel has determined the electrical conductivity, temperature coefficient, and thermal E.M.F. against platinum, of several series of binary alloys of metals of the platinum group, gold, and silver. The tensile strength of wires was also determined. Complete results are given for the palladium-gold series.

Physico-chemical Studies of Lead.‡—E. Cohen and K. Inouye claim to have proved that the two apparently different kinds of lead crystals, which may be obtained by electrolysis of solutions of lead salts, are not allotropic modifications, but must be regarded as identical.

Zinc Amalgams.§—E. Cohen and P. J. H. van Ginneken have found in the 10 p.c. and other zinc amalgams transition points at 42·9° and 20° C. The equilibrium diagram of the zinc-mercury system, based on these and previous observations, is applied to the explanation of the peculiarities of the Clark standard cell.

Alloys of Cadmium, Bismuth and Lead.‖—W. E. Barlow has determined the equilibrium diagrams of two binary systems, lead-cadmium and lead-bismuth, and the ternary system, by thermal methods. Supercooling was avoided by frequent inoculation of the cooling melt with fragments of the solid alloy. The composition of the ternary eutectic is given as 40·2 p.c. lead, 51·65 p.c. bismuth, 8·15 p.c. cadmium; its freezing-point is 91·5° C.

Heat-treatment of Brass.¶—G. D. Bengough and O. F. Hudson have studied the effects of heat treatment on rolled and drawn brass containing 70 p.c. copper, 30 p.c. zinc. The best combination of strength and ductility was obtained by annealing at temperatures between 600° and 700° C. Length of time of annealing has a marked effect; a bar of pure brass may be heated for half-an-hour at a temperature a few degrees below the solidus without burning, while a sufficiently long annealing at a temperature 100° C. lower may produce burning. Burning is considered to occur if the elongation in the tensile test is lowered. The atmosphere of the annealing furnace, whether oxidizing or reducing, appears to have little effect on the brass. The growth of the crystals upon annealing was studied microscopically.

* Comptes Rendus, clii. (1911) pp. 859–62 (3 figs.).
† Zeitschr. Anorg. Chem., lxix. (1910) pp. 38–46 (2 figs.).
‡ Zeitschr. Phys. Chem., lxxiv. (1910) pp. 202–6 (2 figs.).
§ Tom. cit., pp. 437–93 (8 figs.).
‖ Journ. Amer. Chem. Soc., xxxii. (1910) pp. 1390–1412 (14 figs.).
¶ Journ. Inst. Metals, iv. (1910) pp. 92–127 (28 figs.).

Metallography as an Aid to the Brassfounder.*—H. S. Primrose, discussing the use of microscopical examination for controlling the quality of brass and bronze castings, points out the importance of casting temperature in the case of gun-metal castings.

Shrinkage of the Antimony-lead Alloys.†—D. Ewen and T. Turner have determined the changes in length taking place in cast bars in cooling from the solidification temperature, for antimony-lead and aluminium-zinc alloys. Time and temperature observations were made simultaneously with the length measurements. The microstructure and hardness of the cold bars were investigated. In the antimony-lead system, where no solid solutions exist, the extensometer curves gave results apparently having no relation to the equilibrium diagram, except as indicating an expansion due to the solidification of the eutectic. In the aluminium-zinc system, which contains solid solutions, the expansion curve closely follows the liquidus curve from 0 to 50 p.c. aluminium. A general theory relating expansion in alloys to range of temperature during solidification cannot yet be propounded.

Effect of Silver, Bismuth and Aluminium upon Copper.‡—F. Johnson has determined the effect upon the properties of copper, containing small quantities of oxygen and arsenic, of additions of silver, bismuth and aluminium. The ingots were hot-rolled to bars; tensile and bending tests were made, and the microstructure was studied. Hydrofluoric acid was used as an etching re-agent for some of the specimens containing bismuth.

Occluded Gases in Copper Alloys.§—G. Guillemin and B. Delachanal have heated twelve different specimens of brass, bronze and tin in a vacuum at 1100 or 1000° C. The extracted gases were analysed, and were found to consist chiefly of hydrogen in the sound specimens, while in spongy castings notable amounts of carbon monoxide and dioxide were found in addition to the hydrogen. Phosphor bronzes yielded little gas.

Influence of Sulphur on the Iron-carbon System.‖—T. Liesching has taken cooling curves of fifty melts containing 0·08 to 4·78 p.c. carbon, 0·01 to 1·11 p.c. sulphur, and has microscopically examined the solid alloys. The microsections were etched by successive immersion in an amyl-alcohol solution of picric acid, an amyl-alcohol solution of nitric acid, and a hot solution of sodium hydrate. The sulphide was coloured brown in preparations thus obtained. The temperatures of commencing solidification and of eutectic solidification are lowered by addition of sulphur; the temperature of pearlite formation (Ar_1) is unaffected. Melts containing more than 2 p.c. sulphur and a high carbon content separate into two layers, the upper layer being rich in sulphur and poor in carbon, the lower poor in sulphur and rich in carbon.

* Journ. Inst. Metals, iv. (1910) pp. 248-64 (16 figs.).
† Tom. cit., pp. 128-62 (29 figs.).
‡ Tom. cit., pp. 163-234 (24 figs.).
§ Rev. Métallurgie, viii. (1911) pp. 1-6 (6 figs.).
‖ Metallurgie, vii. (1910) pp. 565-71 (19 figs.).

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Old Microscope by J. Simons: presented by Members of the Council.—The name of J. Simons (Invent. et fecit), engraved on the

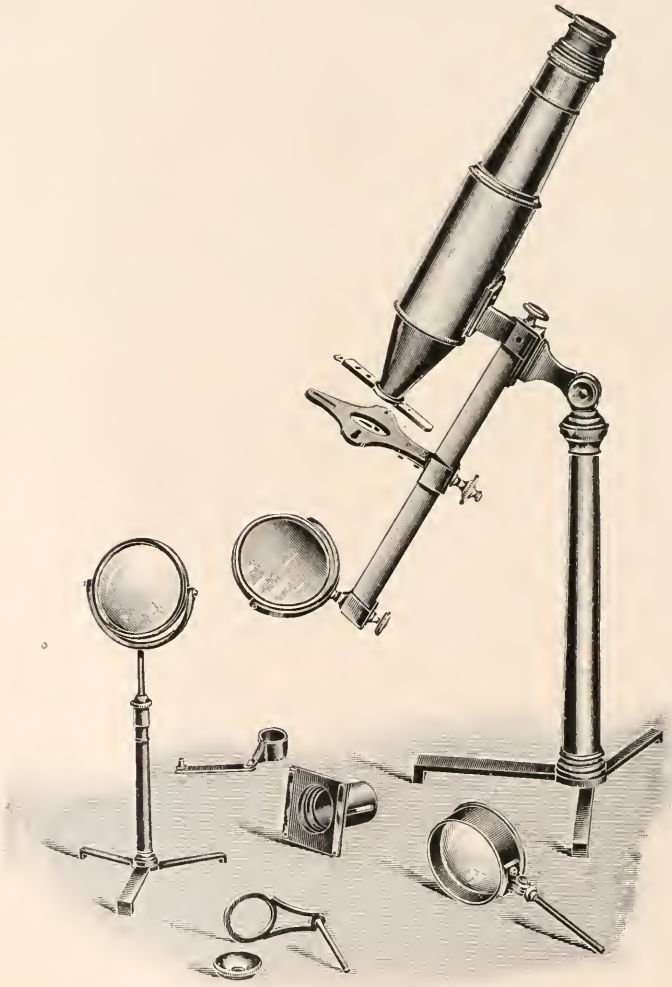

Fig. 49.

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

stage of this old Microscope, does not appear to have been known, so far, as an optician of the latter part of the eighteenth century. The Microscope which bears this name has a close resemblance to instruments made by George Adams about 1780, though it possesses some features and variations of interest.

The body is very large, tapering towards both ends, and fastened to

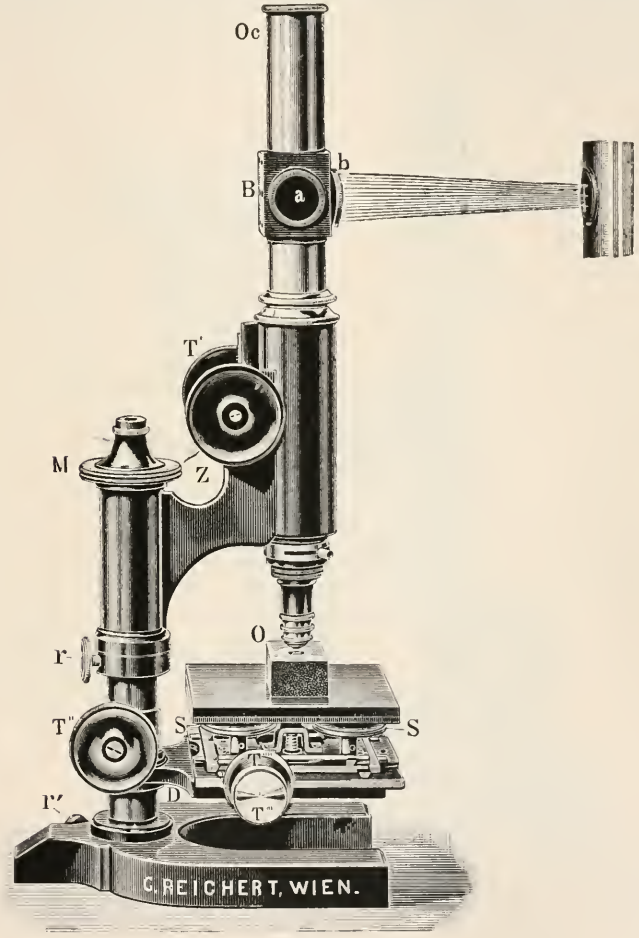

FIG. 50.

the limb by means of a dovetailed slot. The limb is a triangular bar with the rack cut inside, after Benjamin Martin's plan; it is joined by means of a compass joint to a tall pillar raised on a folding tripod base. The whole Microscope is made of brass, and very massive.

The object-glasses, six in number, and consisting of single lenses, are mounted on a sliding bar, which is a feature of earlier Microscopes. The stage is triangular, and carries below a lens mounted in a tube,

which acts as a substage condenser. A bullseye on separate folding tripod-stand is provided, and another much thicker bullseye is fitted to the stage. The date of this old Microscope may approximately be given as 1790 to 1800.

Fig. 49 shows the stand with the body set at an angle. To the extreme left is a bullseye condenser on a stand having a tripod base; a stage bullseye condenser is also shown in the foreground to the right; it is excessively heavy, so heavy that its hinged joint fails to hold

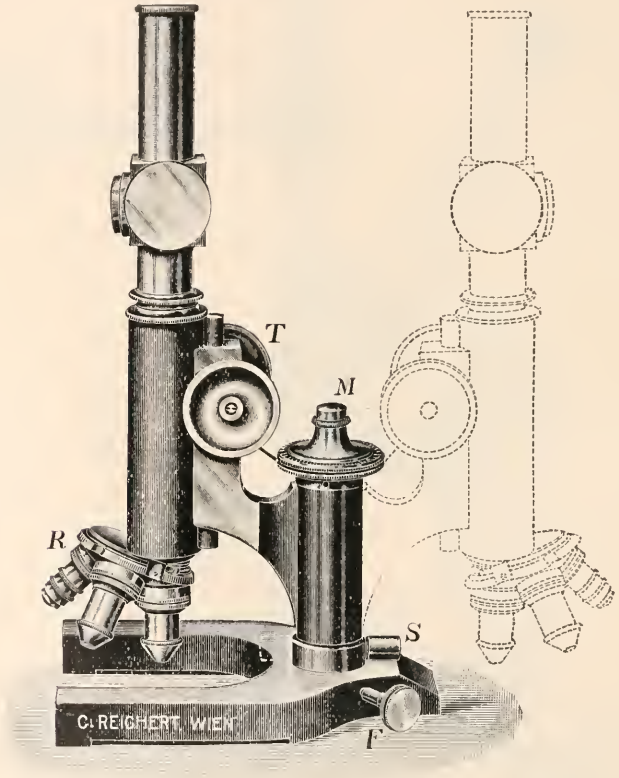

Fig. 51.

it in any required position. A lieberkühn with its holder are seen in the foreground, and in the centre lies a spring stage for carrying "sliders" containing objects mounted between discs of talc: attached to this is a tube containing a substage condenser which slides in it for focusing; the tube is dropped through the opening in the stage-plate, the spring-stage resting thereon. The use of the piece of apparatus lying in the background is unknown, but it may have been intended to hold a candle.

Rejtös Metal-Microscope.*—This instrument is made by Messrs. Reichert from Professor Rejtö's designs. It is represented in fig. 50 as a Laboratory Microscope. Fig. 51 shows it, however, in a simplified form, the middle parts, including the stage, having been removed to facilitate application of the instrument to the direct examination of large-sized objects. For the weaker magnifications, daylight or lamplight incident on the metal surface will suffice. But for stronger powers illumination of the object must be performed with the special apparatus inserted in the drawn-out tube. This apparatus can be inserted, or removed, as an ordinary ocular. It consists of a cylindrical

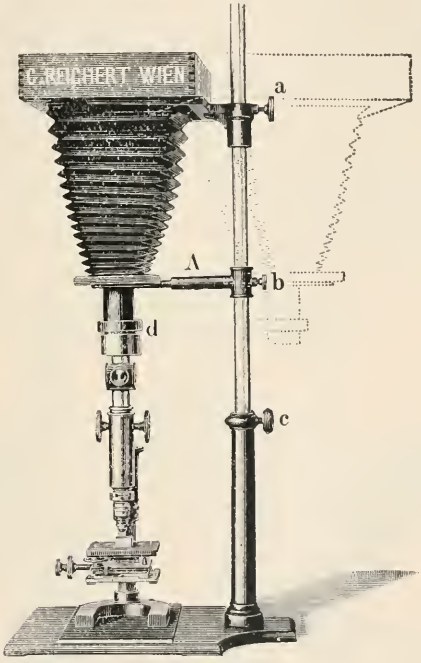

Fig. 52.

sleeve carrying a plane-parallel glass plate, inclined at 45° to the tube axis, and an illuminating lens. The focal distance of this lens equals the sum of the distances from the lens to the glass plate, and from the glass plate to the objective. The light is set, preferably, at a distance of 1 m. from the apparatus. An incandescent gas-mantle or a triple burner will be found the most suitable, and must be placed on a special stand adjustable as to height. It is desirable to enclose the light-source in an iron or asbestos cylinder, with a lateral aperture of suitable size. This aperture must be fitted with an illuminating lens of parallelized light as required. In making the adjustments the light-source must be first brought to the level of the illuminating apparatus B.

* Special Catalogue, Em 3, "Metall-Mikroskope," C. Reichert, Vienna, pp. 1–7.

The observer, having removed the ocular, then looks down the tube, and will probably find that the interior of the tube is not uniformly illuminated: small adjustments, in elevation, of the light-source will correct this defect. The function of the lens *b* is to make the light-rays convergent, so that after incidence on the inclined glass plate (not shown in figure) they may focus on the objective-focus and thence reach the object. Thence they are reflected upwards through the objective to the ocular. The object to be examined (fig. 50) should be provided with two plane-parallel surfaces so that it may lie horizontally on the stage, small differences of level being compensated by the screws S S. The object-stage is provided with two slides, so that the stage may be moved north-south, east-west, by means of the milled-heads T‴ T‴. The stage is raised and lowered by means of T″. If the object is too thick for the stage, the stage can be removed, and either the object be placed on the horse-shoe foot, or the instrument, by relaxation of the screws *r r'*, be swung round and brought (fig. 51, dotted lines) directly over the object. If photomicrographs be desired, the vertical arrangement shown in fig. 52 is adopted, a picric-acid filter having been placed in front of the light-source.

Reichert's New Metal-Microscope.*—This instrument (figs. 53–59) is distinguished from Rejtö's Metal-Microscope chiefly in the following

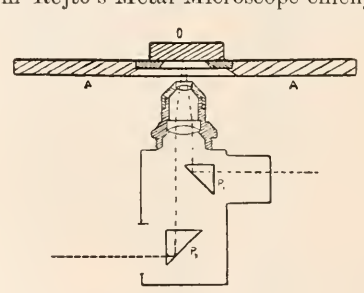

Fig. 53.

respects:—1. By a different mode of light application and by a more complete illumination of the object. 2. By the necessity of preparing only one plane-surface; this plane-surface being set in contact with the stage. 3. By a specially convenient arrangement for photomicrography. 4. By a new fine-adjustment and a lateral screw for oblique inclination. In fig. 53 a schematic representation of the ray-path is shown. The light issuing from the source is brought to the object by means of the prism P_1 and the objective—this objective thus acting as a condenser. The light reflected from the object reaches the prism P_2, and thence it is deviated through the horizontal tube to the observer's eye. To change over from subjective observation to the photographic fixation of the image, the last-named prism P_2 is rotated 90° about an axis perpendicular to the stage-plane. It will be seen from fig. 56 that the photographic camera is perpendicular to the optical bench carrying the axis of illumination. For convenient observation of the image, an

* Special Catalogue, Em 3, "Metall-Mikroskope," C. Reichert, Vienna, pp. 1–14.

ocular of approximately right-angled shape can be applied to the instrument; it is placed in the sleeve of the horizontal tube (fig. 54, *b*). A prism suitably placed deflects the rays to the ocular, and the operator

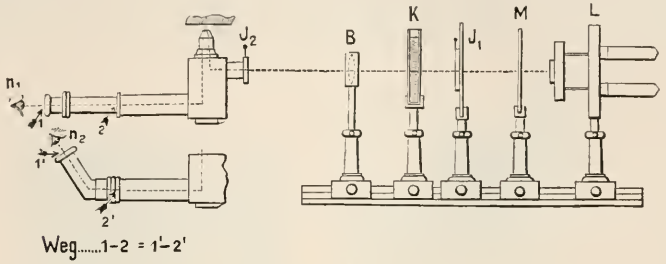

Fig. 54.

can therefore make his observations in the ordinary microscopical attitude. For the light-source either the incandescent gas-mantle, the Nernst lamp, the limelight, or the electric arc-light may be used; but for photomicrography only the three last can be recommended. The arrange-

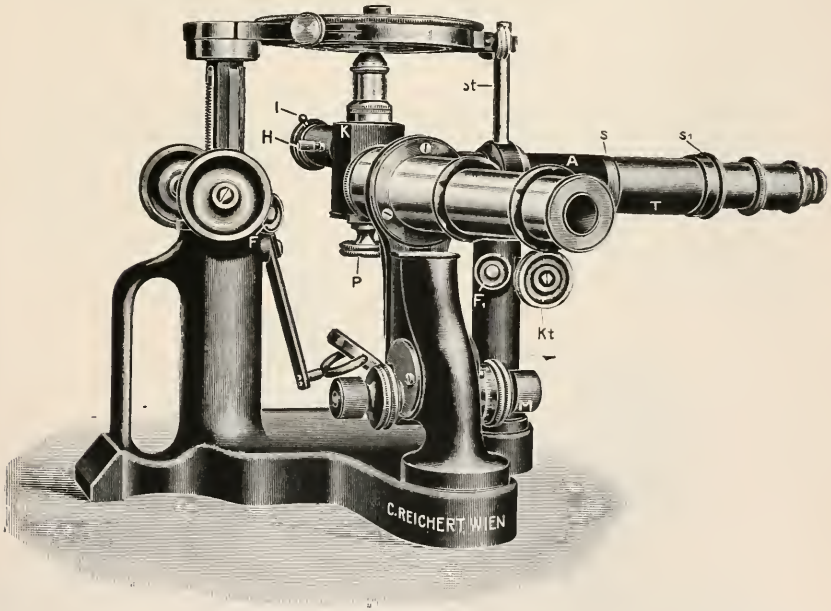

Fig. 55.

ment of the parts of the illuminating apparatus will be understood from figs. 54 and 56. At a slight distance from the light-source L a revolver diaphragm J_1 limits the illuminating area. If the filter-screen K is used it will be placed between J_1 and the illuminating lens B. The

external appearance of the Metal-Microscope is shown in fig. 55. A strong handle-shaped pillar for convenient transport of the instrument rises out of the stout cast-iron base-plate. This pillar carries the rack-and-pinion coarse-adjustment of the stage; it also carries the universal mirror. The fine-adjustment is similar to that adopted in Reichert's stands A i. and A ii. The Microscope-stage can be centred and is rotatory.

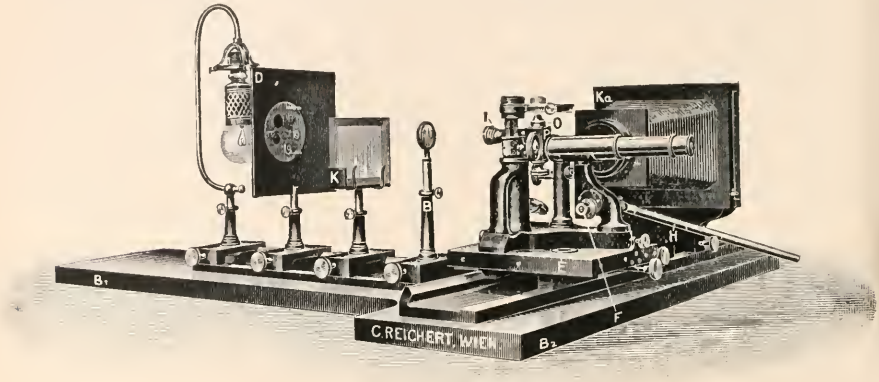

Fig. 56.

It has two lateral position-screws, which permit a movement of several millimetres; larger movements must be done free-hand, or with the sliding-stage (fig. 56). The camera (fig. 56) is on heavy metal feet, and moves on an optical bench. The tube of the Microscope is applied to the camera with light-tight connexion. Movement of the eye-lens of the projection ocular throws a sharp image on the matt-glass screen of the camera without requiring any alteration in the instrument as ar-

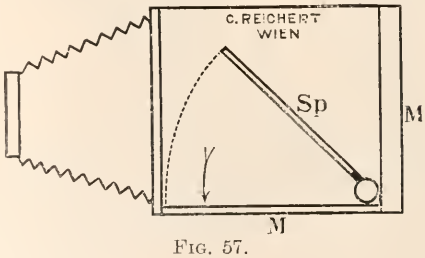

Fig. 57.

ranged for visual observation. It may, however, be necessary, especially in the use of filters, to perfect the image by the camera fine-adjustment —this is done by a Hook key.

New Mirror Reflex-camera.—In order to enable the operator to control the photographic image without rising from his seat, this camera (fig. 57) has been contrived. It has the matt-glass M parallel to the camera-axis, the shutter-box K in the usual place. Between them is a vertical mirror Sp, worked from outside by a knob, and rotatory

about a vertical axis. The mirror is rotated in the direction of the arrow, and at an angle less than 45° throws the image on to M. Another view of it is seen in fig. 58. Fig. 59 gives a general view of the whole instrument.

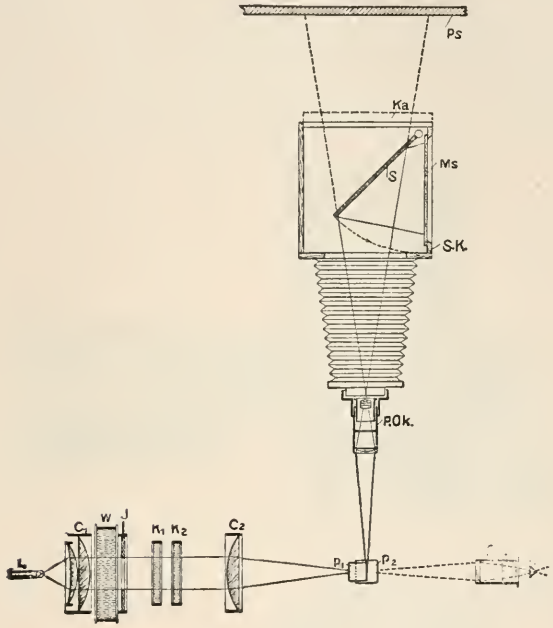

Fig. 58.

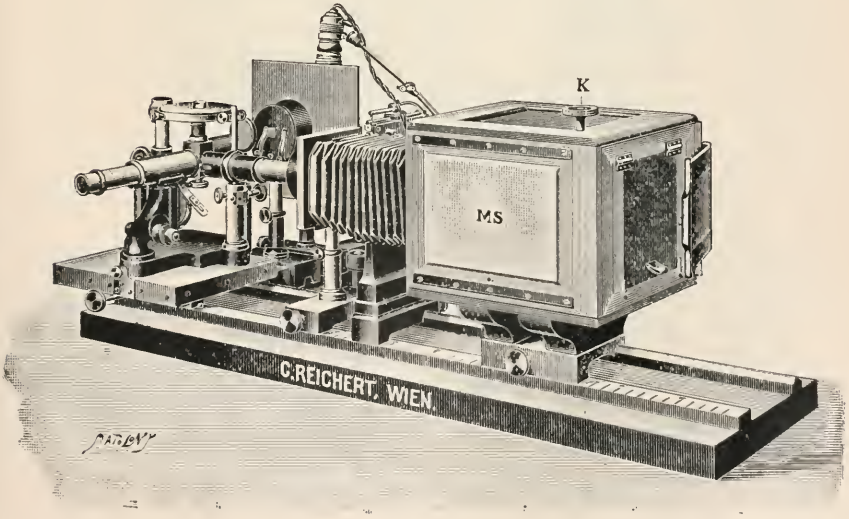

Fig. 59.

(2) Eye-pieces and Objectives.

Winkel's Eye-piece with Screw Micrometer and Graduated Glass Diaphragm.*—Fig. 60 gives a general view of this eye-piece, which can be used for approximate measurements as well as for readings of great precision. It is provided with a clamping screw to fix it firmly to the tube of the Microscope, and an adjustable eye-lens for focusing the scale. The scale itself is mounted on a plate (fig. 61), which is movable in a lateral direction by a screw, the spring serving to keep the plate always in contact with the screw, which has five threads to the millimetre and

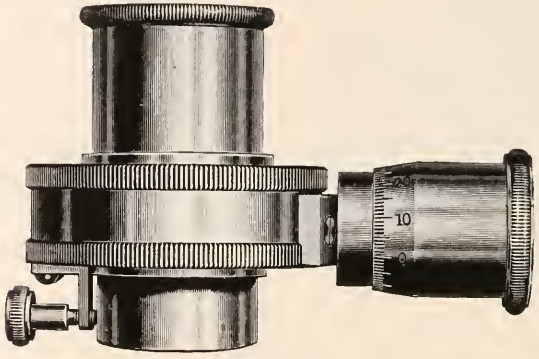

Fig. 60.

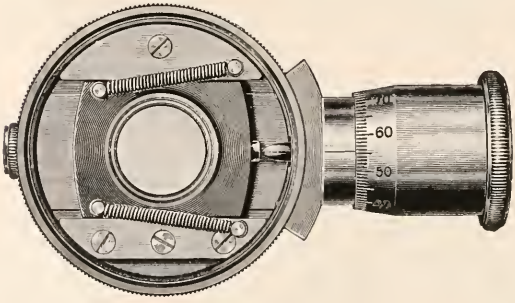

Fig. 61.

is fitted with a drum divided into 100 parts; each interval of the drum is equal, therefore, to a lateral displacement of the scale of $\frac{1}{500}$ mm.

This combination of scale and screw micrometer has been chosen (at the suggestion of the late A. Koch†) in preference to screw and web usually employed, as it gives a ready means of obtaining the exact measurement of objects subtending a number of divisions of the eye-pieces scale, the fractional part only of an interval having to be determined by means of the screw.

* R. Winkel, Gottingen Catalogue, 1911, p. 14 (2 figs.).
† Zeitschr. wiss. Mikrosk., vi. pp. 33–35.

The Society's Standard Thread.*—E. M. Nelson makes the following communication :—

"Mr. Watson Baker, in the Journal of the Royal Microscopical Society, 1911, p. 175, has called attention to 'the great diversity which exists in the objective screw-threads made by the various makers, and described as of the Royal Microscopical Society's standard size.' Possibly a few remarks from one of the members of the sub-committee appointed by the Council of the Royal Microscopical Society to report upon this very question may not be out of place, the more so as Mr. Watson Baker's paper deals only with the facts which, apart from the history of the subject, may cause very erroneous ideas to be formed.

The Society's Screw.—Fifty-four years ago this screw was adopted by the Microscopical Society of London, upon a report from a sub-committee composed of George Jackson, Charles Brooke, and H. Perigal, jun. The multiplicity of adapters had even then become such a nuisance that the Society standardized a screw with a view to stopping it, and the thanks of everyone using a Microscope is due to them for so doing. This standard screw was at once adopted by the three leading London Microscope makers—viz. Messrs. Powell, Ross, and Smith and Beck. (The size of the screw was that used by Messrs. Smith and Beck, Mr. Smith having brought it with him from Messrs. Tulley, of Islington ; he had previously used it in making the celebrated Lister-Tulley Microscope. The Tulleys had taken this screw from the "Pipe" of Benjamin Martin's Microscope† (1760–70). When it was standardized it was altered to a Whitworth thread ; but, notwithstanding, a Benjamin Martin's "pipe," or a Tulley-Lister objective, will screw readily into any R.M.S. standard nose-piece ; but an objective with a standard thread is the merest trifle too large to enter either a Benjamin Martin or Tulley nose-piece).

Six months after the adoption of the report Mr. Richard Beck published an account, with six figures, of the screw-gauges and tools. Two plug and ring-gauges for the tops of the threads of the inside and outside screws, and pairs of sizing-tools, were made by Whitworth, the sizing-tools being supplied to the trade at cost price. At first there was, it seems, a little grumbling and fault-finding, as was inevitable upon a reform of this kind ; but soon things shook down and settled themselves, with the result that, in my own experience, I have never seen an objective by Powell, Ross, or Beck, that was not interchangeable in either of their nose-pieces, and I very much doubt if anyone else has.

In the eighties, German object-glasses, by Messrs. Zeiss, Leitz, and others, were largely imported, and at the end of that decade there was a demand for sizing-gauges. One of the secretaries of the Royal Microscopical Society, not finding any in stock, took an old tap he happened to see in a drawer, and, without comparing it with the standard gauges, and at a considerable expense, had it precisely reproduced, and distributed the facsimile copies on the Continent. All this was done quietly, and no one knew anything about it.

Some objectives I had purchased from Messrs. Zeiss had been sized

* English Mechanic, xciii. (1911) p. 290.
† See this Journal, 1898, p. 474, fig. 81.

under the conditions specified: (1) Those showing absorption bands, by these new tools, and when I received them I found, to my astonishment, that they would enter none of the eight Microscopes I had. The experience of others was similar, and as representations were frequently made to the Royal Microscopical Society upon the subject, the Council, in 1896, appointed another sub-committee to report upon the whole question. This sub-committee, of which I had the honour of being a member, found that the tap which had been copied was a very badly-cut screw, which, when tested by the Society's standard gauges, was not of the Society's standard size. We ordered that it and its copies should be destroyed. We recommended that new sizing-tools should be made in accordance with our standard gauges, and we suggested that limiting gauges should be added to our standards. Our recommendations * were adopted by the Council, and the new gauges and sizing tools were ordered from Messrs. Whitworth. These were supplied, and, so far as these sizing-gauges are concerned, I personally tested every one, and I am quite sure that all objectives and nose-pieces sized by any one of those will be interchangeable. I purchased a set (now on the table as I write). The legend on it is "R.Mic.So., London, 1897. Whitworth, Manchester, .8015 36ths," and on the die is .7967.

Mr. T. Powell, also a member of the sub-committee, exhibited the original sizing-tool his father had bought. He said it was the one he had always used. After all these years it was in as good a condition as it was when new; it was made and hardened in one piece, and was without the three adjustable blocks which are fitted to the new dies.

The Continental manufacturers to whom the Society had supplied the wrong screw were very indignant, and rightly, too. At first they refused to accept the new tools, but after Mr. C. Beck had pointed out to them the confusion that must inevitably arise, they chivalrously waived the matter, and adopted the true standard screw. Mr. C. Beck deserves the warmest thanks of all microscopists for his good offices in this matter.

So far as my own experience goes, I have not seen a single objective that has been sized by these new tools that is not interchangeable. If a new standard, or any alteration in the Society's present standard, is proposed to the Continental manufacturers, I think, after what has already occurred, there will be some difficulty in persuading them to accept the change.

Personally, I prefer an objective that screws very loosely into a nose-piece, and fixes into position by facing up on its flanges; so, looking at the question from every point of view, my counsel would be to leave things as they are."

(3) Illuminating and other Apparatus.

Directions for using Glass Micrometers.—Messrs. Carl Zeiss have published, under the above title, a very clear and complete pamphlet of 8 pages, dealing with microscopic magnifications. Eye-piece micrometers, Plagge projection micrometer eye-pieces, stage-micrometers, and methods of determining magnifying powers, are all dealt with.

* See this Journal, 1896, p. 389.

Interferometer.—This instrument (fig. 62) was shown at the June Meeting and was described fully by C. Beck (see Proceedings, p. 565, of the present number).

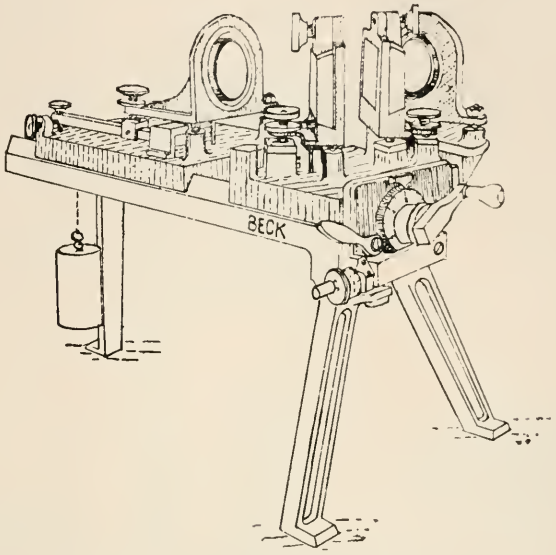

FIG. 62.

Micro-spectroscopic Observation.*—F. J. Keeley points out that while micro-spectroscopy has been largely used with transmitted light, very little application of it has been made with reflected light. Yet with reflected light it is not only suitable for use with small quantities, but has a number of additional advantages. Thus he finds that absorption bands are usually more distinct; a small crystal on a mineral specimen or a gem embedded in an opaque setting may be examined without disturbing or damaging it; and phenomena such as iridescence on opaque substances may be studied.

The Microscope used for this purpose should always be a binocular, which permits the object to be examined through one tube, while the spectroscopic ocular is applied to the other. The illumination should preferably be rather brighter and whiter than is generally necessary for the examination of opaque objects, and is best concentrated by means of a parabolic silvered reflector attached to the objective. For preliminary examination, the older form of micro-spectroscope, as made by Browning or Beck, is preferable, as very faint bands are more readily noted in its short, bright spectrum; but for further study and for recording the spectra, the Zeiss model with photographed scale is more desirable.

There are two classes of spectra which can be advantageously studied

* Proc. Acad. Nat. Sci. Philadelphia (Feb. 1911) pp. 106-16.

thus permitting the identification of certain minerals and gems; (2) interference spectra, thus assisting in determining the cause of lustre and iridescence. In the first class the method is very effective in dealing with minerals of the didymium and zircon groups, garnets, rubies, spinels, emeralds. The spectra are frequently so characteristic as to give infallible means of identification. For reference all spectra should be recorded diagrammatically on paper ruled with lines corresponding to the scale showing width of band: it should also be noted whether edges are sharp or misty, and whether the darkest part of band is central or eccentric.

In dealing with the second class it should be remembered that lustre and iridescence include such causes as simple reflection, refraction, and dispersion, scattering of light from microscopic particles, polarization, and diffraction. The most potent cause, and that to which practically all iridescence is due, is the interference produced by reflection from thin films, and this can be advantageously studied with the microspectroscope. Such interference colours generally show dark bands in the spectrum, one in the lower order colours produced by thin films, and two or more as the films become thicker so that additional wavelengths interfere. For comparison, records should be made of the spectra of all the brighter colours, which can be done by observing them in the "Newton's rings" produced between two surfaces of glass or by blowing a bubble of melted glass until it bursts, when the thin edges will answer the same purpose. The author has examined the natural iridescent surfaces of many minerals, butterfly scales, beetle scales, iridescent birds' feathers, opals, the chatoyance of cat's-eye germs, and the lustre of pearls. His experiments seem to show that the explanations usually given of certain phenomena, e.g. of butterfly scales, stand in need of revision. Thus the particularly brilliant blue spots on the wings of *Papilio paris* are apparently due to a film of air of about $0{\cdot}58\,\mu$ in thickness. Again, the lustre of pearls is not due to minute corrugations, but to repeated parallel laminæ separated by extremely thin films.

(4) Photomicrography.

Leitz' Small Photomicrographic Apparatus.* — This apparatus, numbered IV. in the maker's catalogue, is shown in fig. 63. It has a camera extension of 25 cm., and is designed for use in the vertical position only. It consists essentially of a rectangular base-plate of iron, covered with cloth, on one side of which a vertical steel rod is mounted in a massive socket. This rod carries the camera, which by means of the two clamping fittings (shown in the illustration) can be fixed at any required height. When so fixed the camera can be rotated for the final adjustment of the specimen on the stage by direct observation; the return of the camera to exact alignment with the optic axis of the Microscope is ensured by the provision of a spring-catch on the camera fitting, the catch engaging with a groove in the steel rod. The length of the camera is adjusted by sliding the rod, carrying the front up or down in the grooved fitting in which it is mounted. A light-tight

* Leitz' Catalogue, 43 G, Photomicrographic Apparatus, p. 18.

connexion is fitted to the front of the camera for use with the Microscope and for receiving the photographic objectives (microsummars) by means of sliding adapters when the Microscope is dispensed with.

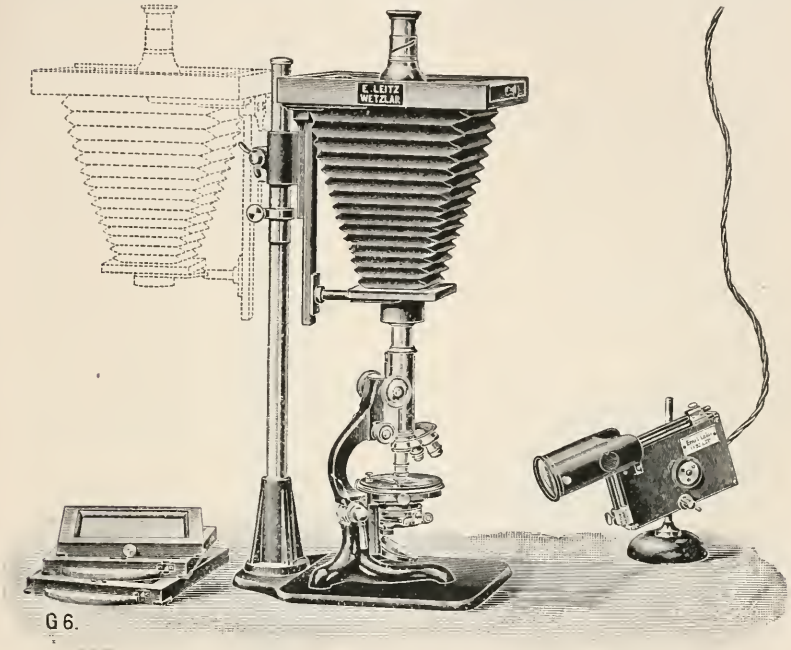

Fig. 63.

Leitz' New Large Photomicrographic Apparatus.* — This apparatus, Ia in the maker's catalogue, is shown in fig. 64 (vertical position). It is characterized by its long camera sliding upon an optical bench. The essential advantage of such a camera consists in obtaining a large variety of magnifications with a single objective; but, in addition to this, greater depth or focus is obtained by using an objective of relatively low magnifying power with an extended bellows. The optical bench, which is in two parts, consists of steel tubes mounted at either end and also midway upon cast-iron feet, the two halves being connected by a hinge arrangement. Upon these tubes can be fitted the various carriers, the curved feet of which fit the tubes exactly, any required position being maintained by means of clamping-screws. The camera occupies one half of the optical bench and rests upon two carriers, one of which holds the focusing screw, while the other carries the camera front with a portion of the light-tight connexion. By means of the hinge provided the camera can be brought into a vertical position: the apparatus may therefore be used either vertically or horizontally, as required.

* Leitz' Catalogue, 43 G, Photomicrographic Apparatus, p. 6.

The camera can be extended to any required distance up to its full length of 100 cm., as each carrier can be moved independently of the other. The bellows, besides being very substantially made, has additional wire supports, two in number, to prevent sagging when fully

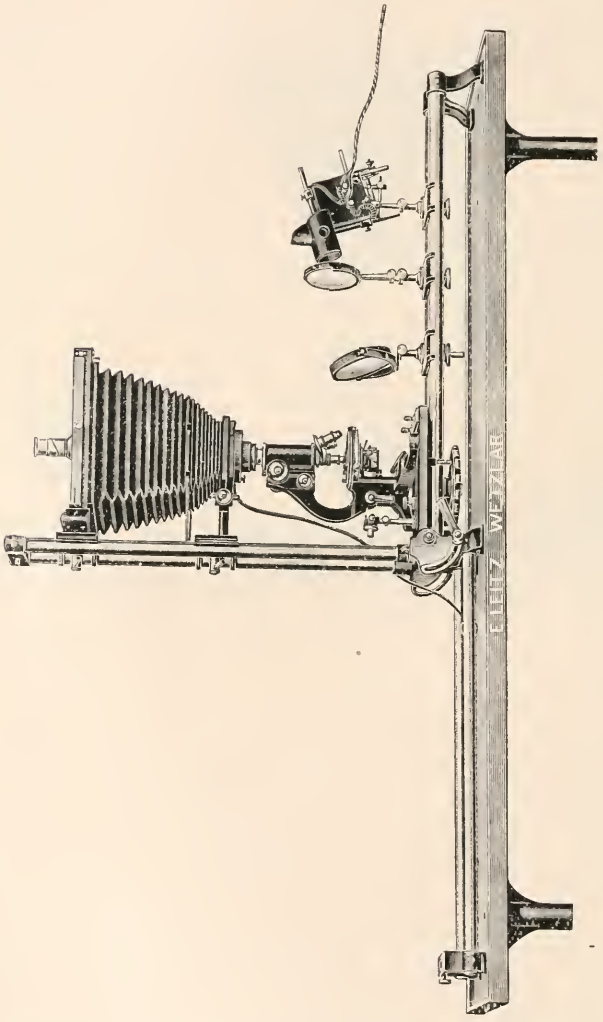

Fig. 64.

extended; the lower portion of the bellows is hinged to the focusing screen, so that upon the withdrawal of two bolts which keep the upper portion in position, it can be retracted in order to observe the image from the front whilst the necessary adjustments are being made. Two

focusing screens, one of ground glass and the other of clear plate glass, are supplied with the apparatus, together with two single dark-slides taking plates 24 cm. square, with carriers for smaller sizes, either English or Continental. The front of the camera is fitted with a pneumatic shutter for time and instantaneous exposures, and for the light-tight connexion referred to above, into which the objective-adapters can be pushed.

The other half of the optical bench is occupied by (1) the Microscope mounted upon a sliding base-plate ; (2) an illuminating lens or condenser ; (3) a large iris-diaphragm ; and (4) a Liliput arc-lamp. Each of these accessories is adjustable for height ; that for the sliding base-plate being controlled by a hand-wheel below the level of the steel rods, this adjustment being necessary to compensate for the variation in the heights of the optic axis of horizontal Microscopes. A special mechanism is fitted to the base-plate, and this, in conjunction with a lengthening rod, permits of the fine-adjustment being effected during observation of the image on the screen.

For taking photographs of large objects with the microsummars without the Microscope, a special vertical stage is provided, mounted on a sliding carrier, and fitted with a micrometer-screw fine-adjustment, to which the lengthening rod referred to above can also be connected should the length of the camera necessitate its use. A series of interchangeable diaphragms is supplied with the stage, and the diameter of each diaphragm corresponds approximately to the focal distance of the lens with which it is to be used, each diaphragm being provided with an illuminating lens which will illuminate uniformly and without colour the given aperture. Objectives and diaphragms are marked, so that the correct pair can be rapidly selected.

Leitz' Photomicrographic Apparatus for Photographing Insects.* This apparatus (fig. 65) has been suggested by Hermann, and is numbered III. in Messrs. Leitz' Catalogue. It is constructed for use in the horizontal position only, and is mounted on a stand consisting of two steel tubes resting upon two pairs of cast-iron feet. The camera, which can be extended to 70 cm., is mounted upon steel tubes : it has wire supports to prevent sagging, and the bellows-frame can be retracted in the same manner. The front carrying the objectives is fitted with a time and instantaneous shutter. Two lamps (Liliput arc, or incandescent gas) with condensing lenses serve to illuminate the object. These lamps are mounted on slotted arms attached to the pillars carrying the camera front in such a manner that not only the distance of the illuminant, but also the angle of incidence of the light can be varied within wide limits ; it thus becomes an easy matter to illuminate an object brightly and uniformly, or to control the density and position of the shadow required to give the necessary contrast.

The object-holder consists of a base-plate sliding upon the tubular base, to which it can be clamped in any desired position by means of a thumb-screw. It has two micrometer-screw adjustments for moving the object in a horizontal plane in two directions, at right angles to one

* Leitz' Catalogue, 43 G, Photomicrographic Apparatus, pp. 16–18.

another, one of which serves for lateral displacement and the other for focusing the image on the screen. The former movement is especially useful when taking stereoscopic pictures, and both are provided with lengthening rods, so that the adjustments are easily effected when the operator is sitting in front of the focusing plate. For the vertical adjustment of the object a rack-and-pinion adjustment is provided, upon which is mounted a universal arm carrying a glass rod, the possible movements of which are well shown in the illustration, the object being fixed to the point of the rod by an adhesive, or by first mounting upon cork.

In order to render the apparatus suitable for taking pictures by transmitted light, the universal arm figured and described must be removed

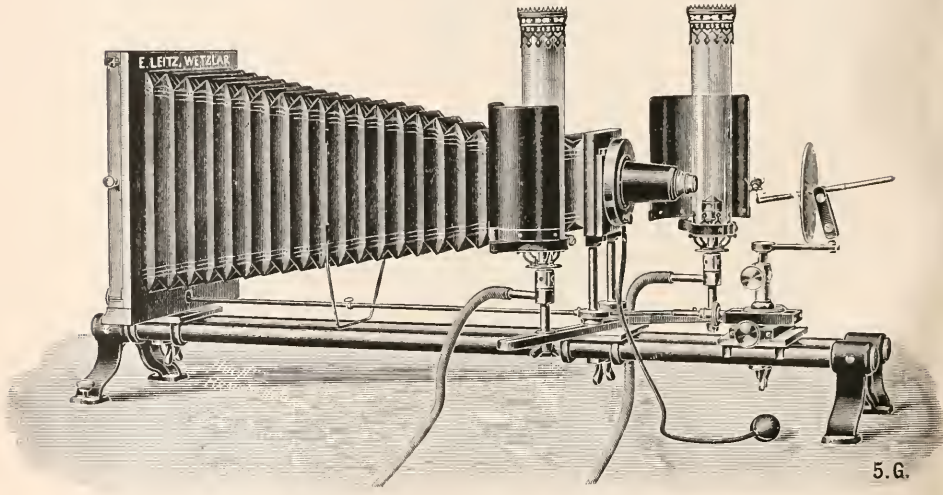

Fig. 65.

from the pillar actuated by the rack-and-pinion and replaced by a vertical stage. The illuminant (Liliput arc or incandescent gas) and condenser are then mounted on a special removable optical bench behind the stage. Leitz' microsummars will be found particularly useful with this apparatus; but, if higher magnifications, such as can only be obtained with a compound Microscope, be required, a tube carrying objective and eyepiece can be screwed into the front of the shutter, thus dispensing with the ordinary Microscope stand.

Barnard's Practical Photomicrography.*—In this work the subject is treated by the author, J. E. Barnard, in a simple and straightforward manner, and from first-hand knowledge. He remarks in the preface that it is one thing to be conversant with the practical side of the subject,

* London: Edwin Arnold (1911) xii. and 322 pp. (10 pls. and 79 figs.).

but quite another to write such a description of the procedure as will enable another person to carry it out. From a perusal of the work it is obvious that his descriptive power is quite equal to his practical knowledge. After a short description of such Microscope stands as are most suitable for the work, the author enters in fuller detail into the optical equipment—objectives, oculars, condensers, and collecting-lenses. The various types of illuminant and illumination are fully described—a subject as to the paramount importance of which no photomicrographer needs to be reminded. Upon the illumination success primarily depends, and the seventh and eighth chapters, by their insistence on the great advantage to the amateur or beginner of a good deal of preliminary experimenting, are intended to give him a firm grounding in the art of illuminating an object. For such preliminary work nothing can be more instructive than the observation of the image projected on an opaque screen. Colour-filters for securing contrast, or for more perfectly rendering colour differences in monochrome, are next considered, and are followed by plates and their development. Chapter XI. deals with photomicrography by ultra-violet light—a method with great possibilities, but at present only suitable for practised experts—with stereoscopic microphotographs, and with the production of coloured lantern-slides. Lastly, a series of progressive examples, ranging from botanical, bacteriological, and pathological subjects, to diatoms, foraminifera and metallic sections, and each chosen to show some special point in the structure or lighting, are illustrated by ten collotype plates.

(5) Microscopical Optics and Manipulation.

Ultramicroscopical Study of Solutions of Iodine.*—The fact that iodine gives, according to the nature of the solvent, solutions either violet or brownish, has attracted much attention from chemists. J. Amann has, in addition to chemical investigations, now attacked the subject by ultramicroscopical methods. He finds that there is a marked ultramicroscopic difference between the violet and the brown solutions. Although the former only rarely contain ultramicroscopic micellæ, yet the brown solutions furnish an ultramicroscopic micellar-phase, more or less abundant. The author fully discusses the significance of his observations, which seem to confirm the theories of polymerization of iodine.

Elliptic Interference with Reflecting Grating.†—C. Barus describes a method for obtaining elliptic interference. In a previous experiment (fig. 66) L was a source of light, M a glass-plate grating, $G_m G_n$ plane-mirrors, each reflecting a spectrum from M. It was found that elliptical interference was produced whenever the rays returned after passing M by transmission and reflection were made to overlap in the spectrum. The author's present method is the converse of this, since the gratings and the opaque mirrors now change places. Parallel rays from L strike the plate of glass M, and the component rays reach identical reflecting gratings G_m and G_n placed symmetrically with respect to M at an angle i to the E and L directions. The undivided rays pass off

* Bull. de la Soc. Vaudoise des Sci. Naturelles, xlvii. (1911) pp. 1–50.
† Proc. Amer. Phil. Soc. Philadelphia, i. (1911) pp. 125–39 (5 figs.).

eccentrically at R and are not seen in the telescope at E. They may, however, be seen in an auxiliary telescope pointed in the line R, and they then facilitate the adjustments. Rays diffracted at the angle Li, however, are respectively transmitted and reflected by M and interfere in

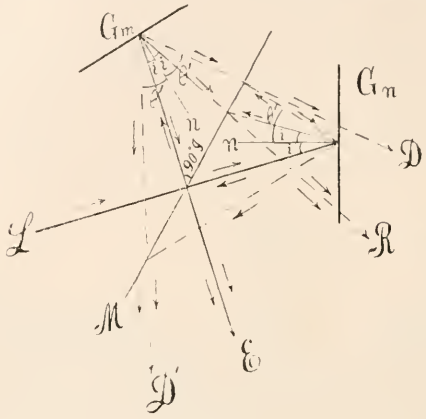

FIG. 66.

the telescope in the line E. Similarly, rays diffracted at an angle $\theta' > i$ interfere in the line D.

The author describes the adjustments necessary, and several modifications of the experiment.

HARTING, H.—**Uber eine Grenzbedingung bis der Konstruktion gewissen optischer Systeme.**

[The author has worked out the numerical values of the co-efficients for certain two-lens optical systems.]

Zeit. f. Instrumentenk., xxx. (1910) pp. 359–63.

HEINRICH, K.—**Verwendung der Savartschen Platte bei der Beobachtung der relativen Phasendifferenz zur Bestimmung der optischen Konstanten von Metallen.**

Berichte über die Verh. d. König. Sächsischen Gesell. d. Wissenschaften zu Leipzig, Math.-Phys. Klasse, v. (1910) pp. 253–5.

(6) Miscellaneous.

Quekett Microscopical Club.—The 474th Ordinary Meeting was held on May 23, Dr. E. J. Spitta, F.R.A.S., Vice-President, in the Chair. Mr. C. D. Soar, F.L.S. F.R.M.S., read a paper on "The Work of the late Saville Kent on British Hydrachnids." Together with Mr. Williamson, of Edinburgh, the author is preparing a monograph of British Hydrachnids, and having, by courtesy of the British Museum authorities, had access to Saville Kent's collection of slides, notes, and drawings, it was thought a brief account would be of interest to the Club. Saville Kent's work on these organisms was begun in 1867 and continued till 1883, and from the material available Mr. Soar had identified fifty

species, of which forty were adult forms. Saville Kent's method of preparing and mounting his specimens was described in Science Gossip, 1882. The specimens, adult, larvæ, or ova, were killed by momentary immersion in boiling water. They were mounted in a cell of suitable depth in either camphor-water, or a solution of 1 of spirit to 4 or 5 of water. Specimens fourteen years old so preserved retained their pristine form and brilliance of colour. The Hon. Sec. read a paper communicated by Mr. E. M. Nelson, F.R.M.S., on "Methods of Illumination." The paper dealt first with mirror illumination, and the right and wrong ways of getting centred illumination with concave mirrors only. The use of ground glass was referred to, and, generally, its use deprecated. The least harmful position for it is below the substage condenser. The very cheapest form of substage condenser will give a better image than is obtainable with ground glass. In dealing with the use of screens for visual work, it was stated that the normal eye is most sensitive to fine detail when the light is peacock-green in colour.

The 475th Ordinary Meeting of the Society was held on June 27, Mr. C. F. Rousselet, F.R.M.S., Vice-President, in the Chair. A paper by Dr. E. Penard, on "Some Rhizopods from Sierra Leone," was read by Mr. A. Earland, F.R.M.S. The material examined was supplied by Mr. G. H. Wailes, and yielded fourteen species of fresh-water Rhizopods, of which three were new, and four at least might be considered as special forms and varieties. The genera represented were *Centropyxis* (2 species), *Difflugia* (5 species, 2 new), *Euglypha* (2 species), *Lesquerentia* (3 species, 1 new), and *Pontigulatia* (2 species). The new species will be fully described and figured in the next issue of the Club's Journal. Mr. T. A. O'Donohoe read a note on "Dimorphism in the Spermatozoa of the Flea and the Blow-fly." In the common flea two forms were found, both of which are very large compared with those of man, whose spermatozoa have an average length of 0·06 mm. In the flea the larger form is 0·7 to 0·45 mm. long, and the smaller form about half these lengths. Carbol-fuchsin or gentian-violet are suitable stains. The spermatozoa of the blow-fly are much smaller than those of the flea. The two forms observed do not differ much in length, but one is very much thicker than the other. (For other cases of dimorphic spermatozoa see this Journal, 1905, p. 34.) A paper on "Normal and Abnormal Vision in Microscope Work," by E. M. Nelson, F.R.M.S., was read by the Assist. Hon. Sec. The experiments described showed that differences from normal sight produced the greatest effect with low powers, such as those obtained with a "loup."

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Examination of Water for Typhoid Bacilli by the Complement-fixation Method.†—G. Volpino and E. Cler employ the complement-

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

† Centrabl. Bakt., 1te Abt., lviii. (1911) pp. 392–9.

fixation reaction in determining the presence of typhoid bacilli in water. The water is filtered through a Chamberland filter; the deposit is scraped off and mixed with normal saline. To a measured quantity of this are added 2 drops of a strong anti-typhoid serum, 1 drop of complement, and 1 c.cm. of sensitized blood-corpuscles. The absence of haemolysis indicates the presence of typhoid bacilli. By actual trial the authors have determined that the method is much more delicate and reliable than the culture methods at present in use, and it is just as easy of application.

Collodion Filters.*— J. Duclaux and A. Hamelin make some observations on the use of collodion filters, based on an experience of several years. The usual difficulty in their use is that they cannot be dried or sterilized by heat. The authors have succeeded in preparing cellulose filters which obviate these difficulties, but the results are not constant enough to be satisfactory. These were prepared by mixing a solution of cellulose with Schweitzer's fluid, but much better results have been obtained by denitrifying nitrocellulose, the best agent for the purpose being ammonium sulphohydrate. These filters can be dried any number of times, or placed in boiling water without being affected. They also resist the action of alcohol, ether, and acetone. In filtering liquids containing very fine particles the process is very slow. It is impossible to use air-pressure lest the filter be ruptured, and the device is recommended of using osmotic pressure as an accelerating agent. To this end the authors employ a solution of Congo red, which does not penetrate the cellulose filter, but exerts a considerable osmotic pressure upon it. By this means they were able to increase the rapidity of filtration by as much as seven times without endangering the filter.

Resistance to Passage of Microbes through Collodion Filters.† Grenet and Salimbeni have succeeded in preparing a collodion filter for general use. Their method is to dip an ordinary Chamberland candle into a solution of collodion containing 10 p.c. of glycerin. The glycerin prevents the filter drying and so becoming useless. Before doing so it is necessary to remove all the air from the candle by plunging it in water, or, better, in alcohol. Such a filter prevents the passage of ultramicroscopic organisms, and it retains its efficiency for at least a year. It does not become clogged like an ordinary Chamberland. To prevent the growth of moulds upon it, it is advisable to add a trace of formalin to the collodion solution.

Rapid Method for Isolating Oospora lingualis.‡ — F. Guéguen states that carrot is the least unfavourable medium for isolating *Oospora lingualis*, a parasite found in cases of black tongue. The carrot is inoculated by stroking the surface with an affected papilla. In about five days the growth will be evident above the general surface. A trace of the growth is removed and sown in liquefied gelatin; a second tube is inoculated with a drop of the first, and from the second a third tube is similarly inoculated. Sometimes it is necessary to make a fourth and

* Ann. Inst. Pasteur, xxv. (1911) pp. 145–9.
† Comptes Rendus, cli. (1911) pp. 916–19.
‡ C.R. Soc. Biol. Paris, lxx. (1911) pp. 752–3.

even a fifth dilution. These different dilutions are then made into plates. In 48 hours at 22° colonies of yeast will appear, while *Oospora* only becomes evident about the sixth day as minute white points. These colonies grow extremely slowly.

Cultivation Medium for the Influenza Bacillus and Ducrey's Bacillus.*—Elizabeth T. Fraser recommends *Staphylococcus* agar for cultivating the influenza bacillus; this is made by melting a tube of ordinary agar and adding to it ½–1 c.cm. of a sterilized emulsion of *Staphylococcus* in saline solution. It is immaterial whether the emulsion be sterilized at 60° or 100° C. It is asserted that the organism grew better on this than on blood media; it is also suitable for Ducrey's bacillus.

Culture of Leishmania tropica on Solid Media.†—C. Nicolle and L. Manceaux have cultivated *Leishmania tropica* on blood-agar composed according to the formula of Novy and MacNeal. Two precautions are necessary: the surface must not be dry (therefore old tubes are not employed), and the condensation water must be pipetted off before the medium is inoculated. At 20–22° a film appears on the surface 4 or 5 days after inoculation. Much better preparations are obtained by this procedure than by the condensation-water method.

LUCET, A.—**De l'influence de l'agitation sur le développement du Bacillus anthracis cultivé en milieu liquide.** *Comptes Rendus*, cli. (1911) p. 1512.

(2) Preparing Objects.

New Methods of Histological Technique.‡—O. Schultze makes some general remarks on the use of osmic acid as a fixative, and maintains that it is one of the best. He indicates a method for staining with hæmatoxylin after osmic fixation. He makes further remarks on the clearing of large objects, such as frog embryos, in bulk, and recommends for the purpose a mixture containing 80 c.cm. of 1 p.c. chromic acid, 5 c.cm. eau de Javelle, and 10 drops of potash. This fixes, removes the pigment, and clears, so that the internal anatomy can be distinctly seen.

(3) Cutting, including Embedding and Microtomes.

Modification of the Freiburg Method of putting on a Directing-plane (Richtungs-Ebene) for Reconstruction.§—N. C. Rutherford's device consists in the use of lamp-black obtained by burning camphor. This is made into a thin film by means of a mixture of absolute alcohol and collodium, and applied by means of a camel-hair brush. After drying, melted soft paraffin is run over the surface in the usual way, and when this has solidified the squaring of the block is completed.

(4) Staining and Injecting.

Staining of Fats.‖—J. Lorrain Smith and W. Mair review their previous work on the methods of staining fats and lipoids. Fats can

* Lancet (1911) i. pp. 1573–4.
† C.R. Soc. Biol. Paris, lxx. (1911) pp. 712–13.
‡ Verh. d. Physikal.-Med. Gesell. z. Würzburg, xl. (1910) pp. 157–68 (pl. xvi.).
§ Anat. Anzeig., xxxix. (1911) pp. 22–4 (1 fig.)
‖ Skand. Archiv Physiolog., xxv. (1911) pp. 247–55.

be stained by anilin dyes, such as sudan iii, sharlach R ; by basic anilin dyes which depend for their action on hydrolysis of the fat, but not by acid dyes. Certain lipoid substances, however, can be stained with acid fuchsin. These substances must possess basic properties, and the staining is a result of the chemical reaction between the base and the acid Nile blue sulphate A was found to stain fat red, the peculiar result being due to an oxazine base in the dye, which in watery solutions slowly changes into an oxazone, red in colour and soluble in liquid fat. Weigert's and Altmann's methods of mordanting with potassium bichromate are discussed, and an investigation of the bichromate hæmatoxylin method has yielded an interpretation of Marchi's method.

Apparatus for Romanowsky Staining.*—C. Schilling describes a simple apparatus (fig. 67) for facilitating staining. It consists of two graduated tubes of equal bore, joined by a cross-piece. From the bottom of each tube leads a narrower tube to a stop-cock, by which both can be opened simultaneously. A small funnel receives the drop from each tube and conducts the mixed stain to the preparation. One tube contains methylen-blue (med. Höchst) 2 grm., borax 5 grm., water 93 grm., diluted 1 in 50 with water ; the other contains eosin B (A. extra Höchst) 0·2 grm. in 1000 grm. of water. The advantage of this method is that the mixing takes place uniformly and the staining is more rapid.

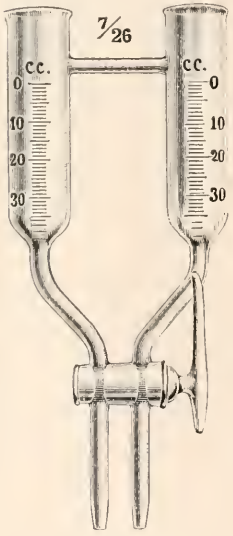

Fig. 67.

Methods of Staining Tubercle Bacilli.† S. Rosenblat, after a comparison of the staining methods of Gasis, Ziehl, and Much, has come to the conclusion that the first-named method is of little value. It throws no light upon the minute structure of the tubercle bacillus, nor is it of any practical value in routine diagnostic work. The method is very complicated. Much's modification of Gram's method may elucidate morphological points of importance, particularly in the case of young forms. It is of no use as an aid to the search for tubercle bacilli in sputum or in smears from animal tissues. There are also troublesome complications in this method. For the demonstration of the organisms, the best method is that of Ziehl, which gives a clear and distinct picture. The author considers that the granules shown in preparations according to the method of Much are not developmental forms, but degeneration products in bacilli which have lost their acid-fast membrane. A Ziehl-Gram combination throws some light upon the minute structure of the organism.

* Centralbl. Bakt., 1te Abt. Orig., lviii. (1911) pp, 264–5.
† Centralbl. Bakt., 1e Abt. Orig., lviii. (1911) pp. 173–92.

Improved Method of Iodine Staining.*—F. Tobler finds that by the use of lactic acid better results are obtained with histological botanical preparations stained with iodine. The original method had certain drawbacks, such as the rapidity with which preparations deteriorated, and the tendency of the iodine to crystallize irregularly. The application of lactic acid solutions obviates these troubles to a large extent. Iodine is only slightly soluble in lactic acid. If this latter reagent be allowed to diffuse in from the edge of a coverslip, displacing alcohol, and act upon a fresh iodine preparation, it will determine a crystallization of iodine in situ, and so fix the stain. Blue as well as brown staining preparations may be so tested, but greater care is required with the preparations.

Method for Studying Osseous Tissue.†—E. Retterer and A. Lelièvre first make paraffin sections of material previously fixed and decalcified. Two methods of staining are given. In the first the sections are immersed in alum-carmin for 12 to 24 hours, and then in potash-alum-hæmatoxylin ; they are then decolorized in dilute picro-hydrochloric acid, and, after washing in running water, are dehydrated and mounted in balsam. In the second method, the sections, with or without previous mordanting in picro-hydrochloric acid, are treated for 24 hours with potash-alum-hæmatoxylin, and then differentiated with the acid solution. After a thorough washing in running water, they are overstained with saturated aqueous solution of picric acid ; after a rapid wash in water they are passed through alcohol, then xylol, and mounted in balsam.

By these procedures it is found that the intercellular substance of osseous tissue is composed of morphotic elements and an amorphous mass. From a morphological and structural point of view, the authors compare the fundamental substance of bone to reinforced concrete : the iron framework corresponds to the capsules and to the trabecular system of the bone, the cement or mortar to the amorphous and calcified mass of the osseous tissue.

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

Fluid Mounting.‡—C. E. Heath remarks that for fluid mounting there is required a cement sufficiently hard to be adhesive, rigid enough to bear handling, yet elastic, to stand the trifling differences of volume due to temperature variation. Such a cement can be made as follows : a penny tube of cycle-rubber solution, which is rubber in naphtha, is emptied into a four-ounce bottle and double its volume of old gold-size added, shaking till thoroughly mixed. This must now be placed on a water-bath, or anywhere to be heated not beyond 150°, in order to drive off the naphtha and any volatile constituent of the gold-size. Whilst this is being done, prepare a thick solution of shellac in absolute alcohol (not methylated spirit) and add, when the other solution is naphtha-free, twice its volume of shellac solution as thick as treacle. Stir whilst hot and filter through fine muslin before cooling. It can be thinned as desired with absolute alcohol. The reason why methylated spirit cannot be used is that the denaturant which evaporates with the

* Zeitsch. wiss. Mikrosk., xxvii. (1910) pp. 366–8.
† C.R. Soc. Biol. Paris, lxx. (1911) pp. 630–3.
‡ Knowledge, xxxiv. (1911) p. 235.

spirit may evaporate inwards and be condensed in the fluid mountant, and many slides may be spoiled by a milky fog caused by the condensed denaturant, which is not transparent when mixed with water any more than methylated spirit is. The quantity required is not large, so absolute alcohol is not prohibitive.

Use the mountant as thickly as it can be worked to flow, and make a heavy ring on the slide. Of course, it is preferable to do a fair quantity at one time. This sets in about 15 minutes, and dries reasonably hard in a day. This ensures perfect contact of the cement to glass slip. To cement the rings, take a scraping of soap from the piece in use, and spread it on the turntable centre. A ring, flatted on coarse emery cloth if metal, or coarse sandpaper if vulcanite, can be pressed on to the soap and adjusted centrally with sufficient firmness to be cemented all round, leaving a more level ring than can be otherwise obtained. The next day, or later, a thin ring of cement can be put on the slip and the ring adjusted in place. When hardened, there will be perfect contact of cement and glass, with perfect contact of cement and ring, with an elastic layer of cement in between, which is capable of absorbing any small variation under the exercise of pressure. A ring fixed in this manner is likely to remain permanent if the further mounting operations are properly performed.

Direct Enumeration of Bacteria in Water.* — In the bacteriological examination of water samples, Y. Amann counts the number of micro-organisms by direct observation of a known volume of the water with dark-ground illumination. For this procedure are required the ordinary accessories for oblique illumination, and a ruled slide of the type used for the enumeration of blood-cells. The author finds that by this method much higher figures are obtained than with methods of plate cultivation. For example, a sample of water which, when plated, gave growth of 584 organisms, was found, by the method of direct enumeration, to contain 86,000 organisms per cubic centimetre. This method permits of the enumeration of organisms which are incapable of growth upon ordinary media, and of the differential counting of motile and non-motile bacteria.

Method of Preserving Brain Sections.†—R. E. Liesegang describes a simple and inexpensive method of preserving large sections of brain by means of embedding in gelatin. The section is placed carefully in a freshly prepared 5 p.c. solution of gelatin, which is gently warmed in order to prevent it from solidifying too rapidly. A further quantity of gelatin is then poured over the surface of the section, and the preparation is then removed to a cool place and allowed to solidify. Great care must be taken to remove all air-bubbles. The best quality of gelatin, that used for the preparation of photographic emulsions, should be used. Attention must be directed to obtaining an even surface on the embedded section. On no account should the preparation be placed in an incubator to hasten the solidifying process.

* Centralbl. Bakt., 2te Abt., xxix. (1911) pp. 381–4.
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 369–74.

(6) Miscellaneous.

Improved Form of Graduated Pipette.*—C. Permin has devised a form of pipette for bacteriological purposes, which possesses the advantage that its use does not involve those departures from hygienic

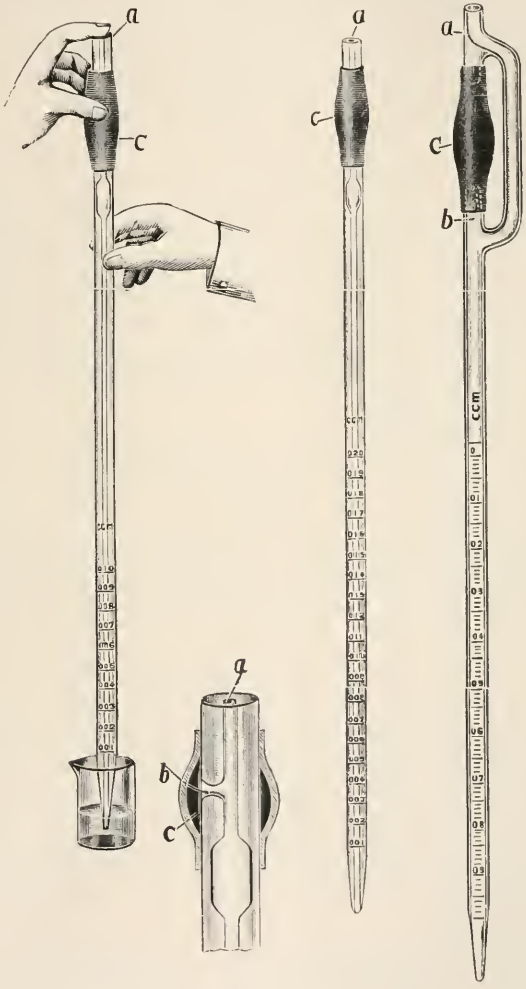

Fig. 68.

principles which are associated with the ordinary pattern. The peculiarities of construction and method of use are clearly illustrated in fig. 68. A side opening near the top end communicates with a chamber, walled with a rubber collar. When the top-end of the pipette is closed

* Centralbl. Bakt., 1te Abt. Orig., lvii. (1911) pp. 575–6.

by the finger, pressure upon this collar controls the column of liquid. If it be desired, on the other hand, to alter the size of the cavity within the collar, independently of the column of liquid, the top opening of the pipette is left free.

Method of Examining Fæces for Evidences of Parasitism.*—M. C. Hall, after describing methods of other observers, states that the best results in routine examination of fæces of all kinds are obtained as follows. Briefly, the method consists in breaking up the fæces very thoroughly by shaking in water, adding a quantity of small shot if necessary or desirable; sieving through a set of brass sieves and then through a silk bolting-cloth sieve, or a sieve made with a jeweller's fine-meshed brass screen; examining the material left on sieve for parasites; sedimenting (and washing); centrifuging (and washing)—one tube being filled with calcium chloride solution of 1250 sp. gr., centrifuged and, if desired, the top cubic centimetre removed with a pipette, shaken up in a tube with 14 c.cm. of water and centrifuged—and then making a microscopic examination of a drop of the sediment from the bottom of the tube centrifuged with water, and one from the top when the calcium chloride solution alone was used, or from the bottom in case water was added to the top cubic centimetre. The material is washed at either or both of the points indicated.

R. and J. Beck's Grinding and Polishing Machine for making Microscopical Specimens for Metallurgical Work.†—This machine, the details of which have been worked out in conjunction with some of the leading metallurgists, gives in a compact and convenient form all that is required for preparing metal specimens for examination.

Fig. 69 gives a general view of the machine, which consists of a vertical spindle carrying a grinding or polishing disc driven by a small electric motor. The spindle A is made of steel, and is bored out at the upper end to receive the disc upon which the polishing or grinding material is to be placed. The lower end is hardened to prevent undue wear. This spindle is furnished with a speed cone F with pulleys of varying diameters, and is driven by means of a belt from the driving cone G, which in its turn is driven from the motor. By shifting the belt on the speed cone a range of speeds varying from about 300 to 1,000 revolutions per minute can be obtained. The disc B is made of brass, and fits by means of a tapered fitting into the spindle A, which allows of its easy removal, and at the same time ensures accuracy in the running. A lip E projects downwards and prevents any grinding or polishing material reaching the bearing.

The cloth for polishing, or emery-paper for grinding, is secured to the disc by a simple but very effective device. A groove K is made in the edge of the disc, and the paper or cloth is stretched over the surface of the disc, and is held in position by means of a garter made of a stiff brass spiral spring, which presses the material into the groove. In this way the cloth or paper is held in close contact with the disc, no matter what its thickness may be.

* U.S. Depart. Agric., Bull. No 135 (1911) 36 pp. (figs.).
† R. and J. Beck's Special Catalogue (1911) (2 figs.).

In order to collect the spent polishing materials, the disc is surrounded by a catcher C, which can be easily removed for cleaning. Into the top of the catcher is fitted a guard ring D, which being wide forms a rest for the hand, and by being continued downwards below the surface of the disc and nearly touching the edge, prevents any specimens that are being polished from falling into the catcher should they be let slip from the fingers.

The standard machine is supplied with a switch H and flexible connecting wire, with a plug adapter attached, so that it can be connected

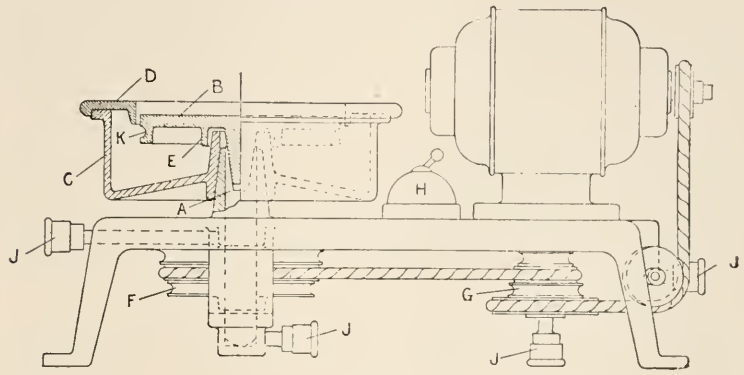

Fig. 69.

with any ordinary electric lamp fitting. The motor can be supplied suitable for any direct current circuit between 100–220 volts, or can be specially made to run on an alternating circuit if desired.

Metallography, etc.

Spontaneous Disintegration of Aluminium.*—H. le Chatelier describes the microstructure of aluminium utensils in different stages of disintegration. The metal in which the change had made progress showed, after etching, a continuous cellular network. At the surface, where the decay had proceeded the furthest, the network had developed into actual spaces, separating the grains, which could easily be detached. The disintegration appeared to be the result of the parting of the grains at their boundaries.

The same author† further discusses the subject. Investigations by Heyn and Bauer have shown that the decay takes place only in severely cold-worked metal. The instability of cold-worked metals appears to be a general phenomenon, and should not be overlooked when additional strength is sought by cold-working. While chemical influences may play a part in the decay of such material, they probably act merely as exciting agencies, setting in operation the latent tendency to disintegrate.

* Comptes Rendus, cliii. (1911) pp. 650–2 (4 figs.).
† Rev. Métallurgie, viii. (1911) pp. 373–6 (4 figs.).

Metallographic Notes.* — H. le Chatelier describes the microstructure of a variety of specimens. Titanium of different degrees of purity, carbide of titanium, carbide of aluminium, cast iron quenched in the experiments on the artificial production of diamond—all these being specimens prepared by Moissan in the electric furnace—were examined. The effect of cold-work in promoting the growth of crystalline grain in mild steel upon subsequent annealing between 600° and 700° C., was clearly shown by a specimen furnished by Charpy. This had been impressed by a Brinell ball, then annealed, and machined level with the bottom of the impression. The polished and etched specimen showed a ring of exceedingly large crystals, corresponding to the region which had undergone the greatest distortion in the test. The structure inside and outside this ring was much less coarse. The author's remarks on the disintegration of aluminium are dealt with in the preceding abstract.

Alloys of Sodium with Silver and Gold.†—C. H. Mathewson has worked out the equilibrium diagrams of the sodium-silver and sodium-gold systems by thermal, microscopical, and chemical methods. Sodium and silver form no compounds, and each is soluble in the other in the solid state only to a minute extent, if at all. Sodium and gold form one compound, Au_2Na. The concentration of any solid solutions is extremely small.

Ternary System, Silver-tin-lead.‡—N. Parravano has investigated this ternary system by determining, by thermal methods, the equilibrium diagrams of a number of sections, parallel to the silver-tin side, of the triangular ternary diagram. Cooling curves were taken of 102 alloys, falling into 13 series, each series containing a constant percentage of lead. Confirmation of the thermal results was obtained microscopically; a 10 p.c. solution of acetic acid in alcohol was used for etching. Four solid phases exist: mixed crystals of silver and tin, mixed crystals of lead and tin, the compound Ag_3Sn, and pure tin. A ternary eutectic melting at 175° C. was found.

Ternary Alloys of Lead, Tin and Antimony.§—R. Loebe has determined the equilibrium diagram of this ternary system by thermal methods, confirming his conclusions by microscopical examination of the alloys. Cooling curves were taken of some 200 alloys, falling into 12 series; each series formed a section across the triangular diagram. In the binary systems, lead-antimony and lead-tin, the components are insoluble in each other in the solid state, while in the tin-antimony system three series of solid solutions occur. The position and form of the four surfaces of primary crystallization of the ternary system were established, but owing to the slow rate of diffusion in the solid state, and also to the segregation caused by differences in specific gravity between some of the phases, the position of the solidus surfaces could not be fixed with certainty. No ternary eutectic point was found, the binary eutectic tin-lead having the lowest melting-point. The ternary

* Rev. Métallurgie, viii. (1911) pp. 367–76 (14 figs.).
† Internat. Zeitschr. Metallographie, i. (1911) pp. 51–63, 81–8 (14 figs.).
‡ Internat. Zeitschr. Metallographie, i. (1911) pp. 89–108 (32 figs.).
§ Metallurgie, viii. (1911) pp. 7–15, 33–49 (79 figs.).

alloys contain the same constituents that occur in the tin-antimony system, with the addition of lead; lead acts merely as a solvent. The microstructure of some of the alloys showed that complete equilibrium had not been obtained in the cooling.

Gold Tellurides.*—G. Pellini and E. Quercigh have determined the equilibrium diagram of the gold-tellurium system by thermal methods. A single maximum in the curve, at 464° C., corresponds with the compound $AuTe_2$. This compound occurs in nature as calaverite.

Amalgams containing Silver and Tin.†—R. A. Joyner has investigated the ternary system tin-silver-mercury, studying more especially the peculiarities of the alloys used as dental amalgams. Fresh filings of silver-tin alloys require more mercury for amalgamation than filings which have been kept for some months, or heated to 100° C. This property of "ageing" is shown to be a characteristic of the compound Ag_3Sn; possibly "ageing" is the result of the polymerization of this compound. The reaction, to which is due the hardening of amalgam prepared by mixing filings of silver-tin alloy with mercury, is the breaking up of Ag_3Sn with the formation of Ag_3Hg_4 and free tin. The ternary equilibrium was studied chiefly by the method of chemical analysis of the liquid phase, separated from the alloy by mechanical means.

Occlusion of Hydrogen by Palladium-gold Alloys.‡—A. J. Berry has determined the amount of hydrogen occluded by a number of palladium-gold alloys. Two similar voltameters containing dilute sulphuric acid were connected together in series. Both anodes and one cathode were of platinum; the other cathode was of the alloy under investigation. The difference between the volumes of hydrogen collected from the two cathodes is the amount occluded by the palladium-gold cathode. Alloys containing less than 25 p.c. palladium do not occlude hydrogen, while the occluding power of alloys containing more than 25 p.c. is a simple function of the concentration of palladium.

Properties of Cast and Rolled Gold Plate.§—H. J. Morris and A. McWilliam have investigated the relative strengths of cast and of swaged dental gold plate. Static bending tests indicated that cast plate had a much lower elastic limit than rolled or soldered plate, and in repeated alternating bending tests the endurance of the cast plate was very low. Some notes on the microstructure and the fractures of the different plates are given.

Flow-pressure of Tin.‖—The pressure at which a plastic metal will flow steadily through an aperture appears to be an important physical constant of the metal. E. Jänecke has measured the flow-pressure of tin at different temperatures up to 217° C. The curves showing the relation between temperature and flow-pressure do not indicate by any inflection the temperature at which the allotropic change in tin takes place.

* Atti R. Accad. Lincei, xix. (1910) pp. 445–9, through Journ. Chem. Soc., c. (1911) p. 45.

† Journ. Chem. Soc., xcix. (1911) pp. 195–208 (2 figs.).

‡ Journ. Chem. Soc., xcix. (1911) pp. 463–6 (1 fig.).

§ Proc Roy. Soc. Medicine (Odontological Section) iv. (1911) pp. 57–68 (9 figs.).

‖ Metallurgie, viii. (1911) pp. 68–72 (12 figs.).

Influence of Nitrogen on Cementation of Steel.*—J. Kirner has investigated the efficiency of two nitrogenous case-hardening materials, and a third containing alkali carbonates but very little nitrogen. From 600° to 850° C. cementation proceeded actively with the nitrogenous materials. At 900° C. their action was uncertain, while above 950° C. the rate of cementation again increased. With the nitrogen-free material the rate of cementation steadily rose with the temperature. When the nitrogenous materials were used at temperatures between 600° and 850° C. the nitrogen content of the outer layer of the steel rose to 0·6 p.c., diminishing, however, at higher temperatures. A new constituent, named "Flavite," was detected in the slowly cooled steel of high nitrogen content. Flavite goes into solution above the critical temperature, and is not observed in quenched specimens.

Influence of Manganese on Mild Steel.†—G. Lang has examined eleven mild steels containing 0·3 to 2·5 p.c. manganese, the carbon content being 0·09 to 0·12 p.c. Mechanical tests were made on rod, in three states, as rolled, quenched from 900° C. and slowly cooled from 900° C. Magnetic and electrical tests were also made. Tensile strength and hardness were raised by increase of manganese, and in general the addition of manganese up to 1·5 p.c. appeared to improve the properties of the alloys.

Iron-carbon System.‡—A. Baykoff considers as untenable the view that in the iron-carbon diagram there are two distinct branches, corresponding to the separation of cementite and of graphite from the melt. Cementite and graphite must therefore separate along the same line of the diagram, and from this it follows that cementite is a solid solution and not a compound. Determinations of heat of combustion of pure iron and of cementite, by burning in oxygen in a Berthelot bomb, have confirmed the author's view of the constitution of cementite, since that body is shown to have a negligible heat of formation. An interpretation of the iron-carbon diagram, involving the separation from the melt, at the carbon-rich end, of mixed crystals of iron and carbon, is advanced. The name "moissanite" is given to these mixed crystals, the carbon-content of which may vary through the range 100 to 6·66 p.c. (pure carbon to cementite).

In a footnote, H. le Chatelier points out that Baykoff's conclusion is in disagreement with the experimental results obtained by Moissan, who found graphite and cementite, but no intermediate solid solutions, in high-carbon alloys.

Iron-antimony Alloys.§—A. Portevin has determined the critical points of five alloys containing 1·19 to 9·20 p.c. antimony, with little carbon. The results indicate a tendency of antimony to raise the critical points of iron slightly. For microscopical examination, the alloys were etched with copper-potassium chloride solution acidified with hydrochloric acid. A white constituent first appeared in the alloy containing 6·5 p.c. antimony.

* Metallurgie, viii. (1911) pp. 72–7 (15 figs.).
† Metallurgie, viii. (1911) pp. 15–21, 49–53 (25 figs.).
‡ Rev. Métallurgie, viii. (1911) pp. 315–19 (2 figs.).
§ Rev. Métallurgie, viii. (1911) pp. 312–14 (3 figs).

"Graphitic" Cast-iron.*—O. Kröhnke has studied the peculiar decay of cast-iron pipes resulting in the so-called graphitic condition, in which the material is sufficiently soft to be cut with a knife or even to be crumbled in the fingers. Microscopical examination of numerous specimens has indicated that the change involves the dissolving of the ferrite out of the pearlite and the transformation of the graphite into a grey or white substance designated "graphitite." Cementite and the phosphide eutectic are unaffected, and only grey iron is subject to corrosion of this kind, white iron resisting the corrosive agencies.

Malleable Cast-iron.†—F. Giolitti, F. Carnevali and G. Tavanti have heated various samples of white cast-iron, grey cast-iron, and steel in different mixtures of carbon monoxide and carbon dioxide, at temperatures ranging from 800° to 1050° C., to ascertain the effect on carbon content and carbon condition. It was found that carbon was more readily oxidized when existing as cementite than when in the free state, as graphite or temper carbon. The conditions for effective decarburization were determined.

Precipitation of Free Carbon in the Iron-carbon System.‡—W. H. Hatfield has submitted a number of alloys of iron and carbon, containing also different percentages of common impurities, to various heat treatments. The main conclusion reached is that free carbon is only produced by the decomposition of structurally free carbide of iron. When silicon is the only other element present in the alloy, the carbide contains some silicon. Manganese is largely found in the carbide to the exclusion of silicon. Sulphur also appears to cause the exclusion of silicon from the carbide. The tendency of the carbide to decompose is influenced by the presence in it of other elements. The mechanism of the separation of annealing carbon in high-carbon steel is described.

Synthesis of Meteoric Iron.§—C. Benedicks has prepared an artificial plessite (the eutectoid aggregate, kamacite + taenite, of meteoric iron) by cooling an iron-nickel alloy containing 12 p.c. nickel very slowly from the molten state. The results are regarded as confirming the Osmond equilibrium diagram for the iron-nickel system.

Effect of Galvanizing on Strength of Steel Wire.‖—H. Winter has made a microscopical study of galvanized wire. The wire was coated electrolytically with copper and embedded in Rose's alloy; transverse sections were polish-etched with rouge and a solution of ammonium nitrate. The injurious effect of pickling, the formation of a brittle layer of zinc-iron alloy, the thermal action of too long immersion or too high temperature in the zinc bath, are causes of the reduction of strength which occurs to a very variable extent upon galvanizing.

Annealing of Steel.¶—W. Campbell has determined the temperature at which, in a rolled steel containing 0·30 p.c. carbon and having a

* Metallurgie, vii. (1910) pp. 674–9 (29 figs.).
† Rass. Min. Met. e Chim., xxxiii. (1910) pp. 1–51, through Journ. Soc. Chem. Ind., xxix. (1910) p. 1456.
‡ Proc. Roy. Soc., Series A, lxxxv. (1911) pp. 1–13 (36 figs.).
§ Rev. Métallurgie, vii. (1910) pp. 1084–6 (4 figs.) and viii. (1911) pp. 85–170 (15 figs.). ‖ Rev. Métallurgie, vii. (1910) pp. 1064–74 (15 figs.).
¶ Proc. Amer. Soc. Testing Materials, x. (1910) pp. 193–200 (12 figs.).

coarse structure, the coarse laminæ of ferrite disappeared. Small pieces were heated to temperatures ranging from 715° to 900° C., cooled in air, and microscopically examined. Complete refining, involving the disappearance of all ferrite lamination except that caused by re-precipitation on lines of slag or manganese sulphide, took place on the completion of the Ac 2–3 change, at 825°C.

Thermo-electric Forces of Solid Solutions.*—A. L. Bernoulli has made thermo-electric measurements for solutions of thallium and tin in silver, of mercury in cadmium, and of tin, zinc, and nickel in copper. Schenck's law was found to hold for sufficiently dilute solutions, but not so well with higher concentrations. For the copper-zinc alloys the potential differences are much greater than those calculated by Schenck's formula ; this is ascribed to the formation of the compound Cu_2Zn_3.

Defects in Alloys.†—C. H. Desch discusses the character and origin of defects commonly found in non-ferrous alloys. Sponginess is caused by gases, dissolved in the molten alloy, being released during solidification. The solubility of gases in molten metals appears to increase with rising temperature. Brittleness may be due to the presence of oxide or intercrystalline eutectic. It is suggested that the " burning " temperature, in brass, is that at which the zinc has a certain appreciable vapour pressure. Of the numerous other defects described, many may be detected microscopically.

Solid Colloid Systems in Metallography.‡—C. Benedicks develops the view that troostite is a solid colloidal solution of cementite in iron. Troostite, formed by reheating martensite, may by further reheating be coagulated into pearlite. Sorbite is regarded as an intermediate stage in which this coagulation is incomplete. Colloidal solutions probably exist in the iron-nickel, iron-manganese, and other alloys.

A. Lottermoser § compares iron-carbon alloys with gold glasses in their capacity for forming solid colloidal solutions.

Electrical Conductivity of Molten Alloys. —P. Muller describes in detail the apparatus and method he has used for the determination of electrical conductivity of alloys in the liquid state. Numerous results are given for the systems potassium-sodium, lead-tin, potassium-mercury, sodium-mercury, lead-cadmium, lead-antimony, lead-bismuth and lead-zinc. The relation of the electrical conductivity and the temperature coefficient to the constitution of the alloy is discussed.

Equilibrium Diagrams.¶—K. Bornemann enters upon a theoretical discussion of some general properties of binary equilibrium diagrams, these properties being illustrated by the complex transformations occurring in the nickel-sulphur system.

* Ann. Physik., xxxiii. (1910) pp. 690–706, through Journ. Chem. Soc. xcvii. (1910) p. 1030.

† Journ. Inst. Metals, iv. (1910) pp. 235–47, 257–64.

‡ Zeitschr. Chem. Ind. Kolloide, vii. (1910) pp. 290–9 (5 figs.).

§ Op. cit., viii. (1911) pp. 95–6.

Metallurgie, vii. (1910) pp. 730–40, 755–71 (35 figs.).

¶ Metallurgie, vii. (1910) pp. 740–7 (13 figs.).

Ternary Systems.*—E. Jänecke discusses the constitution of various types of ternary systems, classifying them according to the constitution of the binary systems of which they may be considered to be composed. As examples of the different types, systems are selected containing three of the following metals : copper, silver, gold, chromium, manganese, iron, cobalt, nickel, palladium, platinum.

Pseudo-binary Alloys.†—If in a metallic binary system the two components A B form a compound C, it is usually assumed that the complete equilibrium-diagram may be regarded as being composed of the diagrams of the systems AC and C B, merely juxtaposed. This involves the assumption that A and B cannot co-exist in equilibrium, one or the other of the two metals being completely combined in the compound C. A. Portevin draws attention to the possibility of a partial dissociation of the compound resulting in the co-existence of A, B, and C. In such a case the system must be regarded as ternary, the components being A, B, and C. The theory of equilibrium of such systems is worked out at some length, on the lines indicated by Roozeboom and Aten. Among the systems to which the theory is applied are aluminium-antimony, iron-molybdenum, and iron-chromium.

Apparatus for Microscopical Examination of Metals.‡—A. Sauveur describes the appliances he has found most satisfactory. Specimens of steel and other magnetic substances may be held on the microscope stage by a magnetic holder. This device is a thin V-shaped permanent magnet, 1 inch wide, 2½ inches long. It is placed on the Microscope stage like a glass slip, the specimen is held magnetically with its polished surface against the lower surface of the holder. Small sections are suspended near the small end of the V-opening, large ones being placed near the wider end. The plain glass illuminator is preferred to the prism type. A simple form of inverted Microscope with horizontal photomicrographic camera is described, though for photomicrography a vertical Microscope and camera are recommended. The stand, objectives, eye-pieces, illuminators, sources of light, condensers, and cameras, are all of well-known types.

Colour-etching of Steel.§—F. Robin and P. Gartner recommend the following method of etching for austenitic and martensitic steels. The polished surface is immersed in a saturated solution of picric acid in alcohol for 30 to 60 seconds, is then washed in water and allowed to dry slowly in air. From the colours observed on a surface etched in this manner much information as to the nature of the austenite or martensite may be obtained. Differences in speed of etching also serve to distinguish different natures of steel. The authors describe in detail the microscopical characteristics of a number of steels of different compositions treated to give austenite or martensite in large quantity.

* Metallurgie, vii. (1910) pp. 510–23 (46 figs.).
† Rev. Métallurgie, viii. (1911) pp. 7–37 (39 figs.).
‡ Proc. Amer. Soc. Testing Materials, x. (1910) pp. 518–50 (32 figs.).
§ Rev. Métallurgie, viii. (1911) pp. 224–40 (34 figs.).

Limits of Elasticity, and the Hardening of Metals.*—O. Faust and G. Tammann have submitted test pieces of various metals to tensile or compressive stress. One side of the specimen, previously polished, was observed microscopically during the loading; the stress at which dulling of this surface was noted, corresponding with the beginning of permanent deformation, is termed the lower elastic limit, and has the same value in both tension and compression. By successive compressions with increasing loads, between which the stress was removed and the face re-polished, the elastic limit was raised to a point beyond which no further increase took place; this is the upper elastic limit. The hardening of metals by strain is ascribed to a diminution in the size of the crystals, brought about by the formation of surfaces of slip. No evidence of the existence of an amorphous phase was obtained.

Reheating of Cold-worked Metals.†—L. Guillet has made tensile tests of cold-drawn wires of hard steel, mild steel, and nickel, which had been heated for 3 minutes to 100°, 250°, 300°, 400°, and other temperatures differing by steps of 50° up to 900° C. The results showed that complete annealing took place in each case between 750° and 800° C.

Stresses in Cold-worked Metals.‡—E. Heyn and O. Bauer have devised a method for the measurement of stresses existing in cold-worked metals. A cold-drawn bar of nickel steel (25 p.c. Ni) was found to be stressed in tension in the outer layers, and in compression in the inner portion, the value of the stresses exceeding one-half of the elastic limit. Such stresses disappear upon annealing. An explanation of the manner in which internal stresses come into existence upon cold working is given, and is illustrated with numerous examples. The specific gravity of most metals is diminished by cold work, and restored to its higher value by annealing. The causes of the cracking of cold-worked metals are discussed.

Simplification in Technique of Metallography.§—The preparation of hard or brittle substances for microscopical examination, by the usual methods, is a tedious and difficult process. Le Gris describes a method of embedding minute fragments in gum lac, for polishing, etching, and examination. A hole of suitable diameter (3, 6 or 10 mm.) and equal depth, is bored in a small piece of brass, which is then heated and the hole filled with gum lac. After cooling, the gum lac is filed level with the surface of the brass; the metal fragment is placed on the gum lac and pressed into it with a heated flat metal surface to a depth of rather more than half the thickness of the fragment. When cold, the preparation is polished by the usual methods, but as the surface of the fragment is so small, the operation takes little time. In 2 or 3 minutes an embedded fragment may be ground, polished, and etched. Filings, drillings or powder may be examined in this way. Typical photomicrographs of such preparations are given.

* Zeitschr. Phys. Chem., lxxv. (1910) pp. 108–26.
† Comptes Rendus, cli. (1910) pp. 1127–8.
‡ Internat. Zeitschr. Metallographie, i. (1911) pp. 16–50 (22 figs.).
§ Rev. Métallurgie, viii. (1911) pp. 335–9 (6 figs.).

Composition of Eutectics.*—K. Losew has studied microscopically the alloys of cobalt and antimony, and of nickel and antimony, as examples of systems stated to contain eutectics differing but slightly from one of the pure metals. The uniformity in the composition of such eutectics has been questioned. The results indicate the improbability of the existence of eutectics approximating to pure antimony in the two systems.

Electrical Conductivity of Alloys.†—W. Broniewski reviews the work which has been carried out upon the relation of constitution of alloys to their electrical conductivity and temperature coefficient of electrical resistance, and summarizes the general conclusions established. A comprehensive bibliography (1827–1910) is appended.

Electrical Conductivity of Molten Metals.‡—E. Wagner finds that in many cases the conductivity of a solid metal at the melting-point is a simple multiple of the conductivity of the liquid metal at the same temperature. An explanation based on the electron theory is advanced.

Influence of Pressure on the Melting-points of Metals.§—J. Johnston and L. H. Adams have constructed an apparatus suitable for studying chemical and physical reactions at temperatures up to 400° C. and under pressures up to 2000 atmospheres. Both temperature and pressure in the reaction zone could be accurately measured. The change with pressure of the melting-point of tin, bismuth, lead and cadmium was found to be a linear function of the pressure. The melting-point of tin, cadmium and lead rises with increase of pressure; that of bismuth falls. The difference between melting-point at 1 and 2000 atmospheres is 6·57° C. for tin, 12·61° for cadmium, 16·03° for lead, and 7·15° for bismuth.

Bornemann, K.—**Binary Metal Alloys.**
[Further instalments of the author's summarized account of the binary systems. See this Journal, 1909, p. 787; and 1910.]
Metallurgie, vii. (1910) pp. 572–9, 603–7 (39 figs.).

Burgess, C.F., & J.Aston—**Some Alloys for Permanent Magnets.**
Met. and Chem. Engineering, viii. (1910) pp. 673–6.

Campbell, W., & F. C. Elder—**Notes on Lead-tin-antimony Alloys.**
[The compositions of numerous bearing metals and other alloys are given, with some account of the equilibrium diagram of the ternary systems and the structure of the alloys.]
School of Mines Quart., xxxii. (1911) pp. 244–55.

Grard—**Hardness and Brittleness of Steels.**
Rev. Métallurgie, viii. (1911) pp. 241–74 (14 figs.).

Göpel, F.—**Blueing of Steel.** *Deutsche Mech. Zeit.*, 1911, pp. 121–3 (11 figs.).

Guillet, L., & L. Révillon—**New Shock Tests at Variable Temperatures.**
Rev. Métallurgie, vii. (1910) pp. 837–44 (1 fig.).

Hadfield, R. A.—**Experiments on Segregation in Steel Ingots.**
Tom. cit., pp. 1133–6 (6 figs.).

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* J. Russ. Phys. Chem. Soc, xliii. (1911) pp. 375–92, through Journ. Soc. Chem. Ind., xxx. (1911) p. 694.

† Rev. Métallurgie, viii. (1911) pp. 320–34.

‡ Ann. Physik., xxxiii. (1910) pp. 1484–92, through Journ. Chem. Soc., c. (1911) p. 177.

§ Amer. Journ. Sci., xxxi. (1911) pp. 501–17 (4 figs.).

Hall, E. H., & L. L. Campbell—**Electromagnetic and Thermomagnetic Transverse and Longitudinal Effects in Soft Iron.**
Proc. Amer. Acad. Arts and Sci., xlvi. (1911) pp. 625–68 (14 figs.).

Howe, H. M.—**Welding of Blow-holes in Steel.**
[Evidence is given tending to show that, in rolling, the welding of blow-holes may be complete, under favouring conditions.]
Proc. Amer. Soc. Testing Materials, x. (1910) pp. 169 92 (12 figs.).

Hughes, T. V.—**Failure in Practice of Non-ferrous Metals and Alloys.**
Journ. Inst. Metals, iii. (1910) pp. 187–203.

Lantsberry, F. C. A. H.—**Some Alloys of Aluminium.**
Foundry Trade Journal, xiii. (1911) pp. 202–6, 262–5 (6 figs.).

Parravano, N., & E. Viviani—**Ternary System Copper-antimony-bismuth.**
[Continuation and completion of the investigation of this system. (See this Journal, 1911, p. 124.) The complete equilibrium diagram is obtained by uniting the diagrams of Cu_3 Sb–Sb–Bi and Cu_3 Sb–Cu–Bi.]
Atti. R. Accad. Lincei, xix. (1910) pp. 197–201, 243–7, 343–449.

Portevin, A.—**Application of the Method of Thermal Analysis to Ternary Alloys.**
[A theoretical treatment.] *Rev. Métallurgie*, vii. (1910) pp. 1149–57 (9 figs.).

Portevin, A., & P. Gartner—**Use of Oblique Illumination in Photomicrography.** *Tom. cit.*, pp. 921–3 (6 figs.).

Ross, A. D.—**Magnetic Alloys formed from Non-magnetic Materials.**
Journ. Inst. Metals, iv. (1910) pp. 68–91 (3 figs.).

Ross, A. D., & R. C. Gray—**Magnetism of Copper-manganese-tin alloys under varying Thermal Treatment.** *Proc. Roy. Soc. Edin.*, xxxi. (1910) pp. 85–99.

Reinboth, F.—**Chemical Colouring of Metals.**
English Mechanic, xciii. (1911) pp. 446–8.

Tassin, W.—**Copper-clad Steel.**
[Photomicrographs are given to show the fine structure of steel coated with copper.]
Proc. Amer. Soc. Testing Materials, x. (1910) pp. 280–94 (16 figs.).

Waterhouse, G. B.—**Influence of Titanium on Segregation in Bessemer Rail-steel.** *Tom. cit.*, pp. 201–11 (8 figs.)

Wickhorst, M. H.—**Low-carbon Streaks in open-hearth Rails.**
[Some details of the method of macro-examination employed are given.]
Tom. cit., pp. 212–22 (14 figs.).

XIX.—*Apparatus for Photomicrography with the Microscope standing in any Position, especially in Inclined Position.*

By Domingo de Orueta, F.R.M.S.

(*Read April* 19, 1911.)

It will be agreed that the inclined position is the most comfortable one, and that the advantage of working in this position increases when large Microscopes are used. When, however, working with the inclined Microscope, it is desired to photograph the object under study, the position of the Microscope must be changed to the horizontal or vertical, and sometimes the instrument must be taken to the special table that holds the optic bench, with its illuminating apparatus: once there it must be centred again, and adapted to the photographic camera. All this is inconvenient and takes some time. There is also the greater inconvenience, that the good illumination obtained in direct observation is lost when the position of the Microscope is altered, and all the preliminary operations must be re-undertaken.

The apparatus described in this note has been constructed to avoid these inconveniences, and with the following aims. 1. To enable photomicrographs to be taken with the Microscope in any position, especially in the inclined one, without either moving the instrument or modifying or changing the illumination. 2. To secure that the apparatus shall always be ready for use, yet without incommoding the operator when not needed. 3. That the resulting photomicrographs may be of the most convenient size; that the camera may be lengthened or shortened in order to vary the magnification; and that the image may be focused on the ground glass or transparent screen as easily as it can be done with the ordinary horizontal camera.

The camera when fully extended has an optical length of 0·8 m. (31½ in.), taking plates of 13 by 18 cm., or smaller sizes.

A short explanation of the figures will be sufficient.

The camera (constructed by the firm of Carl Zeiss, of Jena), is mounted on a cylindrical bar B, along which either the front of the focusing screen can be moved at will, and when adjusted, fixed in any desired position by means of screws, the ends of which enter a V-shaped groove running the whole length of the bar (so that both front and back are always vertical).

The bar B slides forwards and backwards in a collar C, and can be fixed in the position desired. This enables the whole camera

to be moved nearer or farther from the Microscope without moving the camera base.

The collar C is supported on a vertical bar, by means of which the bar B and the photographic camera can be raised or lowered together.

The nut T is used to turn the other nut T′, and to prevent the height of the apparatus changing when it turns round the column C. Both screws are moved by a key A.

The amplitude of this vertical movement is 75 mm. (3 in.), and serves to adapt the camera to the Microscope, at the inclination given to the latter.

The camera, the bar B, and the nuts T and T′ are carried on a

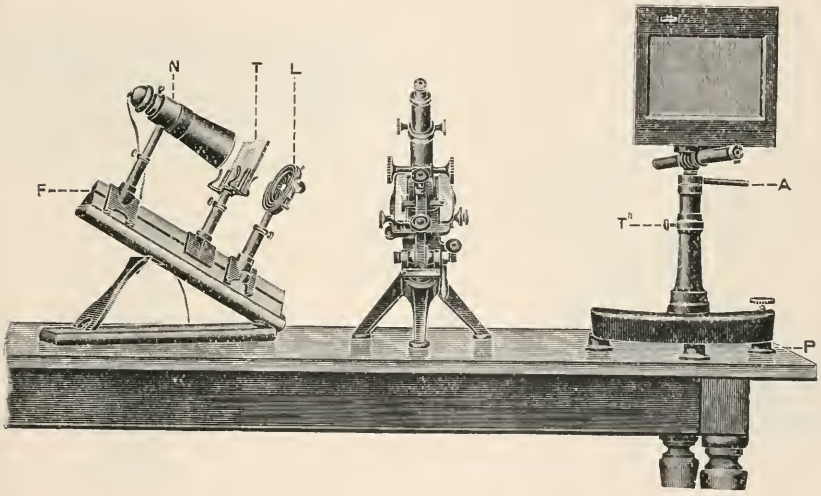


Fig. 70.

vertical column G rising from a cast-iron base M. The base M is provided with two levelling screws S and a pivot S′. The ends of these screws project into a groove made in the base-piece *p*, and they can run inside it moving the column and the camera parallel to the axis of the Microscope. The amplitude of this movement is 37 mm. (1½ in.), and by the combination of this movement and the vertical movement already mentioned, the camera can be rapidly adjusted to differences in the tube-length of the Microscope.

The important feature of the apparatus is a reflection prism P, which fits over or replaces the eye-piece and can be easily changed. This prism reflects the light rays at right angles to the axis of the Microscope, and is provided with a cylindrical cover which enters a tubular collar of similar diameter on the front of the camera, forming a light-tight connexion.

Fig. 70 shows the apparatus in the position corresponding to direct observation with the Microscope in an inclined position. The movements of the camera above detailed allow compensation for any change in inclination.

The camera stands some 15 in. to the right of the Microscope, leaving a space sufficient for the worker to move his hands and manage the Microscope.

When the object has been found and is well illuminated, all that is necessary is to take off the eye-piece and put on the prism eye-piece (or to put the prism over the eye-piece used for the direct observation) and turn the camera through 90° to the position of fig. 71, and adjust the cap of the prism to the collar on the

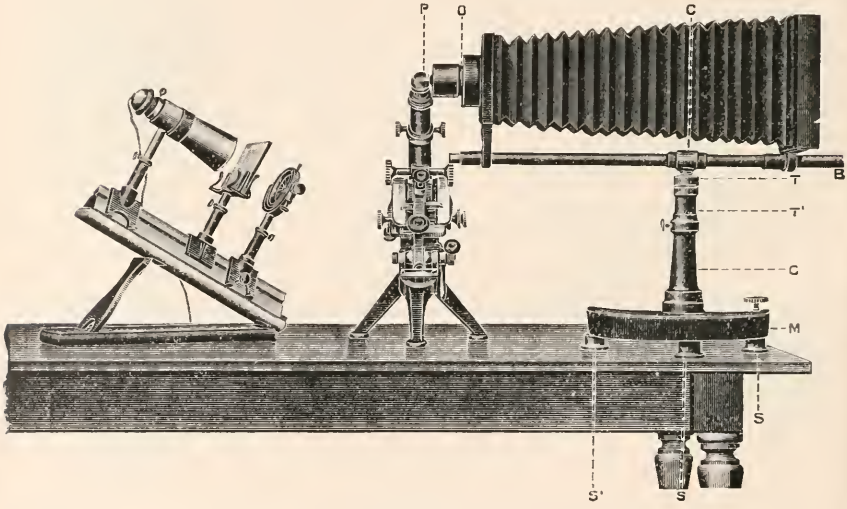


Fig. 71.

camera front. The image is then projected on the ground-glass screen and any necessary alterations in focusing, etc., carried out.

When focusing it will be found that the right hand easily reaches the screw of the Microscope, the maximum length of the camera being 0·8 m.

The shutter O controls the exposure. The same illuminating apparatus is employed for direct observation and for photomicrography. Perhaps the best illuminant for the purpose is the Nernst lamp, modified by Greil (three filaments crossed star-like, instead of one only), because the light is very intense, very steady, and gives a uniformly lighted field. It can be placed either to the left of the operator, as it is shown in these figures, or facing the Microscope.

The illuminating apparatus is mounted on a triangular optical bench F, of 0·5 m. (19½ in.) length, permitting exact centring and focus. This bench stands on a wooden desk, which can be inclined in all positions between the vertical and 50°.

The illuminating system used by the author is composed of a Nernst lamp, N, a support, T, for coloured glasses, or liquid filters of different classes, and a collector, L ("bullseye") with an iris diaphragm. In order to reduce the intensity of the light for direct observation, one or more white ground glasses are put on the support T. These must be removed when the photograph is about to be taken.

With this apparatus photographs can also be taken when the Microscope is in the horizontal or vertical position.

In the former case the camera axis must be placed in continuation of the axis of the Microscope. In the latter, the situation of the bar B must be changed, sliding it directly inside the column C.* The apparatus then becomes the vertical camera, figured in Zeiss's catalogues.

The author has made many photomicrographs with this apparatus, among them several of very difficult diatoms at 1200 diameters (with an apochromatic objective of 1·4 N.A.), and the results have always been very satisfactory. The price of the apparatus is very low compared with the price of the large photomicrography installations.

* It is better, however, to have an additional B bar.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Garjeanne's Simple Excursion Microscope.† — A. J. M. Garjeanne describes this instrument, which has been made to his designs by Messrs. W. Watson and Sons, London. The weight of this Microscope, when made of the ordinary brass and iron, does not exceed 1250 grm. : but

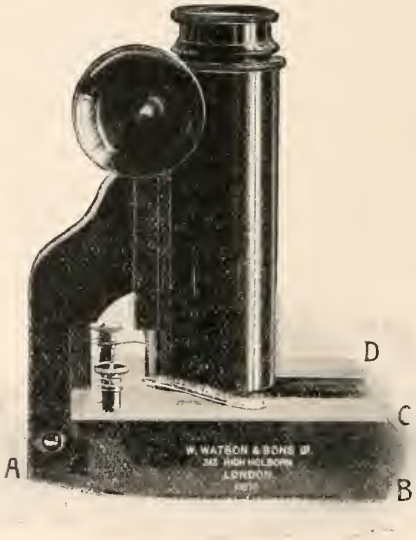


Fig. 74.

this might be considerably reduced by the use of lighter metal. The instrument can be packed in a mahogany box $15 \cdot 5 \times 11 \times 11$ cm., weighing 500 grm. ; the box provides room for two objectives, two oculars, and some small utensils. Fig. 74 shows the stand shut up, the height to the lower rim of the ocular being only $12 \cdot 8$ cm. The dimensions of the foot confer great stability, and are, A B = $9 \cdot 8$ cm., C D = $7 \cdot 8$ cm. The object-stage is rectangular, $8 \cdot 6 \times 7 \cdot 8$ cm., and is made with the Nelson cut-out. A simple diaphragm-disc is below the stage. The

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

† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 56–8 (2 figs.).

total length of the tube is 16 cm. open, 10·3 cm. closed. The peculiarity of the stand is the absence of a pillar between the foot and the hinge for oblique position (fig. 75). The mirror works in a clamping-ring between the toes of the horse-shoe foot ; it can be shifted forwards and backwards. When the stand is inclined at about 30° the distance

Fig. 75.

between the mirror centre and the diaphragm centre is about 4 cm., and the sliding adjustability of the mirror renders it possible to bring the mirror centre into the optical axis. As will be noticed from the illustrations, there is only one adjustment, a rack-and-pinion. But in all modern instruments the rack-and-pinion is so well made that it suffices for this Microscope.

Winkel's Demonstration Microscope with Detachable Foot.—A short description of this instrument (figs. 76, 77) will be found on p. 407.

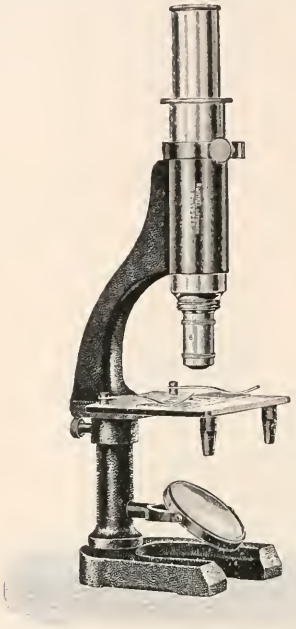


Fig. 76.

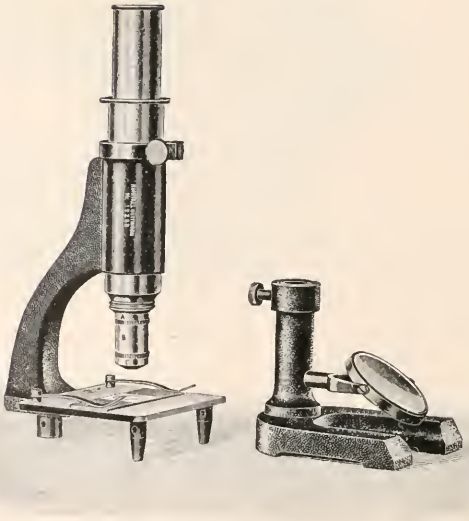


Fig. 77.

Recent Progress in the Construction of Mineralogical and Metallurgical Microscopes.*—E. Sommerfeldt treats of this subject with especial reference to the last decade. The following are the titles of his sections and sub-sections :—

1. *The Petrographic Microscope.*—Wide-angled types ; improvements in the condenser ; microscopes with simultaneous rotatory nicols.

2. *The Crystallographic Microscope.*—Stands for observations at high temperatures ; stands for universal (rotatory) methods.

3. *The Metallographic Microscope.*

4. *Microscopical Auxiliaries.*—Condenser and ocular ; heating apparatus ; hardness measurements ; accessories for metallographic microscopy.

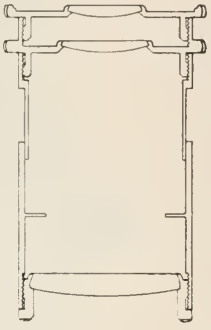


Fig. 78.

(2) Eye-pieces and Objectives.

Allan's Variable Eye-piece.—This eye-piece (fig. 78) was fully described by Mr. Conrad Beck at the June Meeting (see Proceedings, ante, p. 570).

(3) Illuminating and other Apparatus.

History of the Cardioid Condenser : Memorandum on the Leitz Mirror Condenser.†—In order to correct a somewhat ambiguous reference in A. Gleichen's Die Theorien der modernen optischen Instrumente,‡ W. v. Ignatowsky supplies the following information about the cardioid condenser. He states that Siedentopf's cardioid was first described in September, 1909, but that his (Ignatowsky's) had been actually placed on the market by Leitz in October, 1907, and its theory had been published in 1908. It has, in fact, been shown by Schwarzschild,§ as Siedentopf admits, that the cardioid condenser is a special case of a more general construction. The author gives an outline of Schwarzschild's investigation.

Apparatus for Microscopical Observation of Frozen Objects. ‖ E. Schaffnit's cold-chamber is constructed out of a rectangular metal box, 9 by 2 cm. and 2·5 cm. deep. The glass lid slides in a groove, and is perforated for reception of the Microscope objective ; the metal floor is similarly perforated for receiving the condenser (fig. 79). The object-carrier *d*, about 15 cm. long, slides through a slit in the side wall *c*, and is steadied by two clips. The side walls are perforated for the escape of the carbonic acid vapours. A suitably graduated thermometer *g* passes through the front wall. Two watch-glasses for ether are placed on the chamber-floor, and are filled with a pipette. There is a suitable tube-attachment to a carbonic acid steel cylinder ; it is desirable to

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 70–82.

† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 50–55 (2 figs.).

‡ Stuttgart : F. Enke, p. 248.

§ Abhandl. d. Kgl. Gesell. d. Wiss. z. Göttingen, Math. Physik. Klasse : IV. "Untersuchungen zur geometrischen Optik ii."

‖ Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 45–8 (2 figs.).

place the cylinder on the observer's left, so that he can with his left hand regulate the outflow of gas. The whole chamber is clamped to the Microscope. With a continuous stream of gas a temperature of −30 C. is quickly and easily attained. The author has not found any injurious results happen to his lenses.

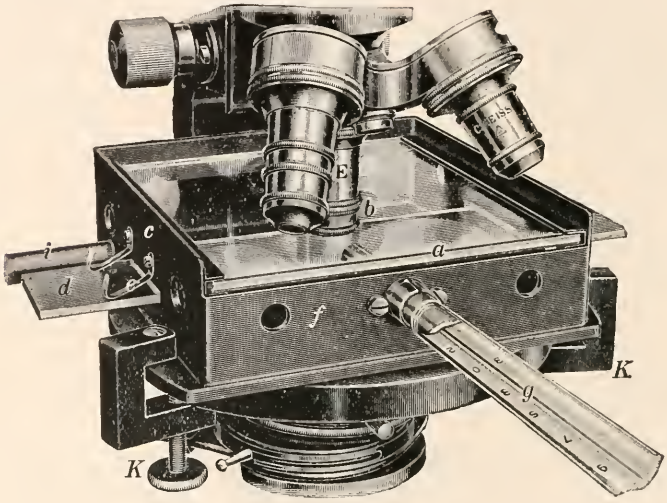


Fig. 79.

Leiss' Universal Spectral Apparatus.*—This apparatus has been constructed by the firm of Fuess, and many of its novelties have been suggested by J. Koenigsberger. The instrument is intended to be available for observations upon emission spectra, absorption spectra, Zeeman effects, wave motions, and measurements of layer thicknesses. Fig. 80 gives a general view of the apparatus, and fig. 81, which is a horizontal section through the collimator and the telescope, represents the optical arrangements. The bearer A of the observation-telescope is rotatory about a conical vertical axis carried on a strong tripod fitted with levelling screws. The bellows also, as far as possible, take part in this rotatory movement. The lever screws a clamp A, while the micrometer-screw a_1 operates the fine-adjustment. Connected with this is a drum graduated into 150 equal parts, each part corresponding to an angular distance of 10″. A large loup L facilitates the reading of the drum divisions, an electric glow-lamp e for 2 or 4 volts serving as an illuminator. The load of the bearer A is counterpoised by the weight g. In the above-mentioned conical axis a conical plug is inserted, rotatory by means of the milled head K for adjusting the prism-table, which is clamped on to the plug by the screw p. The screw k_1 clamps the axis of

* Zeit. f. Instrumentenk., xxx. (1910) pp. 353–7 (2½figs.).

the prism-table. The collimator is supported by a very strong pillar situated on one of the legs of the tripod. The slit opens symmetrically; its cheeks are of hard steel; it is first accurately adjusted for infinity

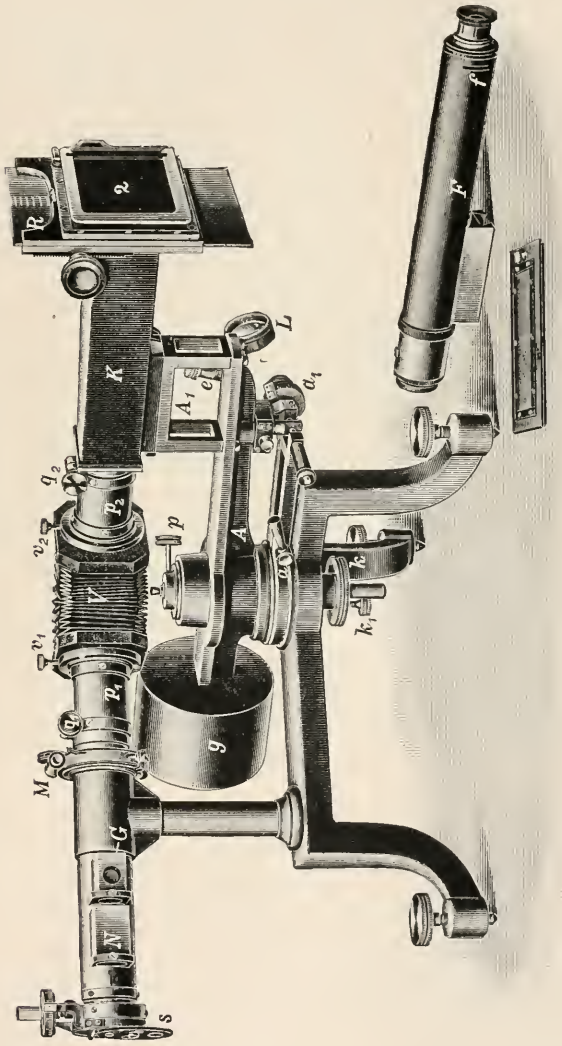


Fig. 80.

and then firmly secured to the collimator. A drum interval of the micrometer-screw corresponds to 0·01 mm. A rotatory disc s is in front of the slit, and is useful in connexion with the camera. It can be easily exchanged for two discs for photometric measurements in the case of very

high dispersion. One of these discs carries a totally reflecting prism, through which light passes from the comparison light-source; it also carries a holder, in which gauged smoke-glass wedges with scale and

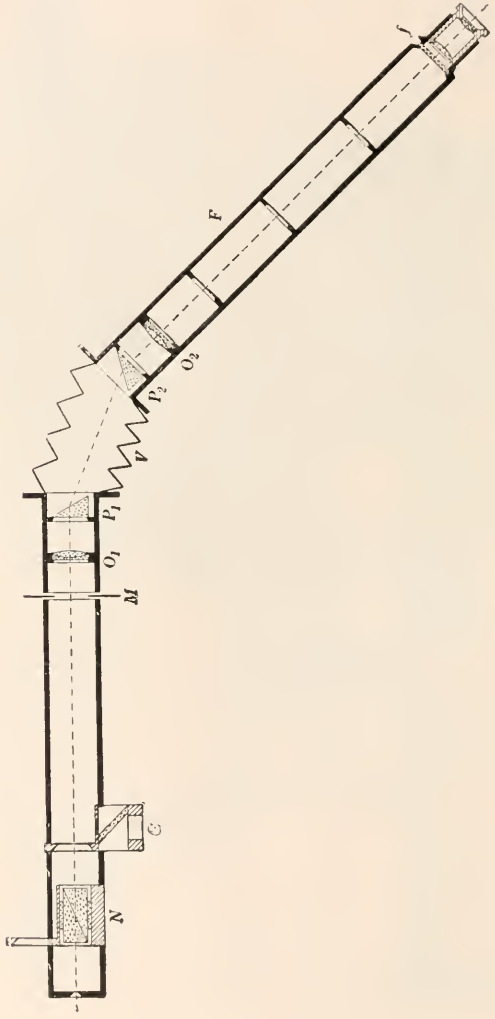


Fig. 81.

platinized glass plates can be inserted for weakening the light-source to a measurable quantity. A second disc is provided for photometric comparisons with the smoke-glass wedges in the direction of the collimator-tube: this arrangement is for measuring the selective absorption of

emitted flames. Behind the slit is a nicol N, movable in and out, and a plane parallel glass plate G, inclined at 45°, and also movable in and out. The nicol is used for observing Zeeman effect, electrical and magnetic double refraction, normal and abnormal magnetic rotations. For observing the Zeeman effect parallel to the lines of force, a mica $\frac{1}{4}$-λ double plate, right and left circularly polarized, is placed in front of the slit ; the nicol is then pushed in. For observing the same phenomenon perpendicular to the lines of force there are two methods : one is to place in front of half of the slit a plate of quartz cut perpendicularly to the axis ; the other is to place a $\frac{1}{2}$-λ double plate of mica. A Rowland's grating is then applied in order to avoid the overlapping of the spectra. The nicol is also so placed that its direction of displacement (electric or Fresnel's victor) is vertical. For measuring electric or magnetic double refraction, the mica plate is brought on to the slit of the collimator (after Koenigsberger) ; then comes the compensator, next the substance in the electric field, and then a second nicol.

If the nicol, as is the case here, is applied to the collimator, then the adjustment of the collimator-lens must be altered, and this adjustment is facilitated by the provision of a notch. The inner nicol affords, in contrast with other arrangements, the advantage of greater brightness with moderately small dimensions ; it is also very easily adjustable. Anyone who has once worked with it will scarcely ever abandon it.

The glass plate also serves for measuring layer-thicknesses and phase-origins by Wernicke and Wiener's methods. Near the collimator-objective O_1 is a shutter M, which can be regulated up to 0·02 seconds for time and instantaneous exposures.

The observation tube F and the camera K are easily interchangeable. A glass micrometer divided into hundredths is inserted at the image-plane *f* of the telescope ; it is illuminated from a lateral slit. Two diaphragms can also be inserted at *f* for shutting out desired parts of the spectrum. A Young's prism arrangement produces the dispersion, which can be increased, if desired, by a Cornu double prism.

The camera K is entirely of metal, and for coincidence photographs a rotatory disc *s*, with four apertures, is placed in front of the slit.

Glass Polarizing Prisms.*—Of late years calcite has become not only scarce but difficult to obtain sufficiently large and free from defects. The expense of calcite polarizing prisms is consequently considerable. Among other substitutes glass prisms of suitable angle have been suggested. H. Schulz quotes a form due to Stotze (fig. 82) in which the angle π of the prism A B C D E F is so chosen that the ray passing perpendicularly through A B and D E is totally polarized at incidence on B C, the plane E F being silvered to diminish the weakening of light-intensity due to reflection at its surface. The lateral displacement of the polarized beam is, however, a great disadvantage, and has been an obstacle to the adoption of the method. H. Schulz now proposes a prism of the form shown in fig. 83, by which the path of the emergent

* Zeit. f. Instrumentenk., xxxi. (1911) pp. 180–2 (2 figs.).

ray is a continuation of that of the incident ray. The author also discusses some other forms of prisms suitable for the same purpose.

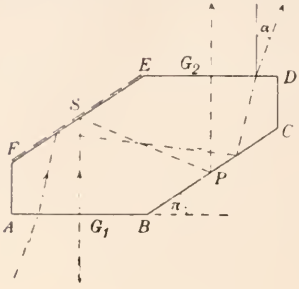


Fig. 82.

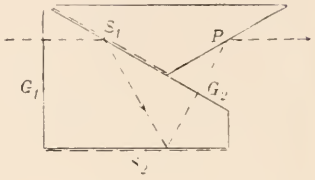


Fig. 83.

Aids to Crystalloptic Projection.*—In discussing the above subject J. Beckenkamp recommends the use of a lantern-screen prepared with aluminium bronze. Photometric tests of such a screen in comparison with screens of other kinds are very much in its favour. The most advantageous position is to arrange so that the incident beam of light falls horizontally on the vertical screen ; moreover, the light-beam should be central with regard to the auditorium, the screen being about 3–4 m. from the lantern. The spectators should be ranked on each side of the optic axis of the lantern, and, if possible, the rows should rise in tiers one behind another.

Emrys-Roberts Microscope Lamp.—This apparatus (fig. 84) was exhibited and described at the June Meeting (see Proceedings, ante, p. 571).

Fig. 84.

Model of the Vibration-planes of Light in the Polarizing Apparatus.†—In order to assist the realization of the path of a ray of light

* SB. Phys. Med. Gesell. zu Würzburg, 1911, pp. 13–16.
† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 42–5 (1 fig.).

through a polariscope, H. Triepel has designed the model shown in fig. 85. It consists of a rod about 40 cm. high, on a firm foot. Four pairs of cardboard sheets fitting into tubes are slipped over the rod, and are thus easily adjustable in any required vertical positions. In each of the two central pairs the cards are at right angles. The whole arrange-

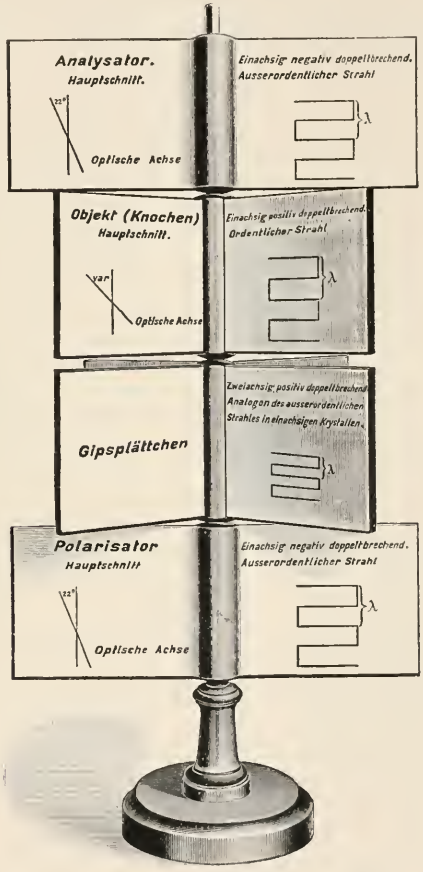


Fig. 85.

ment illustrates the ray as it passes successively through polarizator, selenite, object, and analyzer. The optical axis is supposed to be vertical, and the axis of the nicol prism inclined to it at 22°. Suitable information is recorded on the sheets.

Leitz Liliput Arc-lamp.*—This auxiliary is intended for photomicrographic use, and is illustrated above in fig. 63, p. 541. It pro-

* Leitz, Catalogue 43 G, Photomicrographic Apparatus, p. 9.

vides a current of 4 amperes, and has rack feed and centring adjustment. It has also extension gear for adjusting the carbons while the image on the screen is being observed.

§ (4) Photomicrography.

Wychgram, E.—**Aus Optischen und mechanischen Werkstatten iii.**

[The author gives a very interesting sketch of the progress and development of instruments connected with projection and photomicrography during the last two years.]

Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 59–69 (6 figs.).

(5) Microscopical Optics and Manipulation.

Observations on the Technical Execution and Biological Realization of Microscopical Measurements.*—R. von Lenderfeld reminds his readers of the great variability in the magnitudes both of crystals of the same chemical composition and of organisms of the same species. The difficulty of appropriately measuring them is therefore so great that the only sound method must be biometric. Thus, for example, the magnitudes of spicules and such like should be stated in relation to the magnitudes of the parent body. This would obviously require a great many measurements; but the measurements could, however, be plotted out on a curve and so afford a realization of their biological value. He has, therefore, contrived a measuring apparatus susceptible of great accuracy, and so arranged that a skilled worker can make a large number of successive observations and dictate them to an assistant. He projects the microscopic image on to a large plane mirror which reflects the image back on to a fixed matt glass screen of about 4 sq. m. in size. The mirror has universal adjustment, so that the image, which is of course a much enlarged one, is brought to a convenient spot on the screen in front of the observer's seat. The Microscope is so placed that the observer is able, without leaving his seat, to regulate the movements of the object on the Microscope stage. The dimensions of the image on the matt screen are ascertained by the use of scales specially drawn on tracing linen. An objective micrometer is used in the Microscope, and thus the proportion of image to object is known. A large number of measurements on one object, or on a group of similar objects, can be quickly and easily made, the results being dictated to an assistant who sits at a table behind the observer. The author has found his method give very satisfactory results.

Opacity of Certain Glasses for the Ultra-violet.†—L. Bell has examined the spectra yielded by ultra-violet rays after transmission through specimens of various kinds of glasses. Photographs are given of the results, which vary very much in opacity. The light-source used was a quartz mercury lamp.

(6) Miscellaneous.

Some New Diatomic Structures discovered with a New Zeiss Apochromat.‡—A. A. C. E. Merlin describes the results of his use of a

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 27–34 (3 figs.).

† Proc. Amer. Acad. Arts and Sci., xlvi. (1911) pp. 671–80 (2 pls.).

‡ Journ. Quekett Micr. Club, 1911, pp. 199–202.

new Zeiss $\frac{1}{3}$ apochromat made in 1910. He tested it upon diatomic structures, although the lens had not been specially constructed for such work. In several cases doubtful features were completely established; in others new features were revealed. Among the instances he gives are the following:—

Craspedodiscus coscinodiscus.—Secondaries previously doubtful, now clearly exhibited.

Epithemia turgida.—Primaries prove to be irregularly cruciform in shape, somewhat of the *arachnodiscus* type. High magnification (3000) required.

Cymbella gastroides Kütz.—Primaries rectangular in shape, divided and broken up into secondaries.

Gomphonema geminatum Ag.—Secondaries closely resembling the foregoing.

Stictodiscus areolatus Grun (Oamaru).—Exhibits a delicate but not particularly difficult network on the lower surface of the valve. A fine dotted structure can be seen on the under edge of the rim.

Aulacodiscus Janischii Gr. and St. (Oamaru).—Exhibits a very distinct and obvious veil. Should prove to be within the grasp of most good cheap oil-immersion lenses.

Eudictia oceanica Ehr. (fossil, from Peru guano).—Possesses easy secondary perforations plainly seen in balsam.

All the foregoing observations were made with working apertures varying between 1·3 and 0·95 N.A. In no instance was oblique light or a smaller illuminating cone employed.

The Micrologist.*—This quarterly journal, edited by A. Flatters, made its first appearance in July 1910. Its aims are to instruct the amateur microscopist in the methods of preparing and mounting natural history specimens for microscopical examination. It is illustrated by photomicrographs and also by ordinary line or half-tone blocks. The first volume contains manipulative methods necessary for microscopical work, and in the future special types will be taken, selections being made from those not generally dealt with in ordinary text-books. The first five numbers more than bear out the intention of the editor: they are full of practical information and are most excellently illustrated. The price is very moderate.

Principal Starches used as Food.†—This work by Waldron Griffiths has passed into a second edition. Its general characters are unaltered, but the number of illustrations has been considerably increased and the short descriptions have been as far as possible brought up to date. The object of the work is to facilitate the identification of starch, especially when used either for purposes of adulteration or substitution; it certainly fulfils the intention of the author.

Gleichen, A.—**Die Theorien der modernen optischen Instrumente.** Stuttgart: F. Enke (1911) 332 pp.

* Manchester: Flatters, Milborne, and M'Kechnie, Ltd., 1910–11, pts. i.–v.
† Cirencester: Baily and Woods (1911) 2nd ed. 70 pp. (38 figs.).

B. Technique.*

(2) Preparing Objects.

Effects of Pyridin Fixation upon Nervous Tissues.†—A. Montanari has made observations upon the effect of this fixative upon the cells of the medulla. Following Donaggio's method, he put portions of the tissue into the fixing reagent for varying periods of two to seven days, treated them with the mordant, ammonium chlor-molybdate, and stained with thionin. He found that there was a marked difference between the appearance of the cellular structure in those portions that had been in pyridin for two days, and in those that had been exposed to the action of the fixative for longer periods. He describes the appearances successively of cells which had been fixed for two, three, four, and so on up to seven or more days, and traces the changes from a first period of spongy vacuolation through an intermediate stage, showing a false network to a final form in which a true network with moniliform septa is seen. Concurrently with these reticular changes, an alteration in the behaviour of the nuclei towards the stain is observed. The author considers that this work may have a bearing upon the question whether the fibrillation of nervous cells is to be regarded as an artefact.

Fig. 86.

Simple Washing Apparatus.‡—E. Schaffnit has devised the simple piece of apparatus shown in fig. 86. To a water-tap is attached by means of rubber tubing a filter funnel or flask, from which the bottom has been removed. The open end of this vessel is covered with fine silk, fixed round the edge. Portions of tissue to be washed are introduced either through the neck or through the open end before fixing the silk membrane. Before turning on the water the flask is placed in a horizontal axis and half filled with water; then it is restored to its normal position, and as the water continues to flow, the air pressure maintains it at a constant level. To remove the smaller portions of tissue, when washing is complete, the rubber tube is removed, and the flask immersed in water, so that the material floats through the neck.

Simultaneous Fixing and Staining.§—F. Strecker comments upon the advantages, for histological purposes, of using solutions in which the fixing and staining agents are mixed. After a concise résumé of the methods and formulæ recommended by various workers, he points out

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

† Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 22–25.

‡ Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 49–50.

§ Zeitschr. wiss. Mikrosk., xxviii. pp. 17–21.

that fixing and staining reagents cannot be mixed indiscriminately. In the first place the optimum reaction of the various substances must not be disturbed, and, further, there are differences in activity, time of action and so on, which have to be considered. Some stains and fixing reagents are not miscible. For fixing and staining brain-tissues, the author recommends a mixture of 10 p.c. formalin and Ehrlich's tri-acid stain. This solution is also applicable to liver, kidney, spleen, and other tissues. Good results have also followed the use of a formalin-toluidin-blue mixture—10 p.c. formalin 100 parts, toluidin blue (solid) 3 parts.

Preparation of Kaiserling Material for Microscopical Purposes.*—B. Rawitz has devised the following method. Portions of tissue prepared by Kaiserling's method are put into 95 p.c. alcohol containing 10 p.c. tincture of iodine for fourteen days. The fluid is changed every day for the first three days, as it becomes turbid; after this time it will remain clear. From the iodine solution the material is transferred to a saturated potassium bichromate solution for fourteen days, the fluid being changed twice. The material is lightly blotted with filter-paper and put into 95 p.c. alcohol for two days, absolute alcohol for two days, and chloroform for a like period. From this it is transferred to chloroform-paraffin, and finally embedded in paraffin.

The author also describes the application of certain stains, formol-fuchsin and azofuchsin, to the staining of nervous tissues.

(3) Cutting, including Embedding and Microtomes.

Microtome Knives.—The firm of E. Leitz has recently completed arrangements for the manufacture of microtome knives in Sheffield, and are also prepared to undertake the re-sharpening of microtome knives. The sizes of the knives are from $4\frac{3}{4}$ to $9\frac{1}{2}$ in. in length.

Improvements in Rock-section Cutting Apparatus.†—H. J. Grayson thus describes the structural features of his new machine for cutting rock-sections.

"Dealing with the several portions of the machine in order, Plate XX., which may be regarded as equivalent to a sectional or front view, shows all the principal features of the apparatus, which is built into a corner of the workroom; the lathe in the foreground has no connexion with the rock slicer, beyond being driven by the same motor. The three guard-trays have been removed from the top of the rock machine table, in order to show the position and relation of the slicing and grinding-lap spindles, and of the several supports for rock-holders and clamps.

Plate XXI. may be regarded as a photograph in plan, i.e. looking down upon the machine. It shows to better advantage the relation of the working parts in running order, other than the driving mechanism, which is situated at some height above the machine, and is shown in detail in Plate XXII.

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 1–11.

† Proc. Roy. Soc. Victoria, xxiii. (1910) pp. 65–81 (4 pls.).

Plate XXIII. (Figs. 1 and 2) serves to show the special appliances for serial section cutting, parallel grinding, and work with the goniometer.

Reverting to Plate XX., it will be seen that the base of the machine is a strongly built wooden bench or table, with dimensions as follows: length 7 feet, width 2 ft. 4 in., height 3 ft. 2 in. The table-top, which is $1\frac{3}{4}$ in. thick, is supported on a strong, well-braced framework, which is screwed to the wall of the building so as to ensure complete freedom from vibration. The details of the construction of the table may be readily made out from an inspection of Plates XX. and XXII., except that a supporting beam for the three spindles, which runs from end to end of the table, 9 in. below its surface, cannot of course be seen.

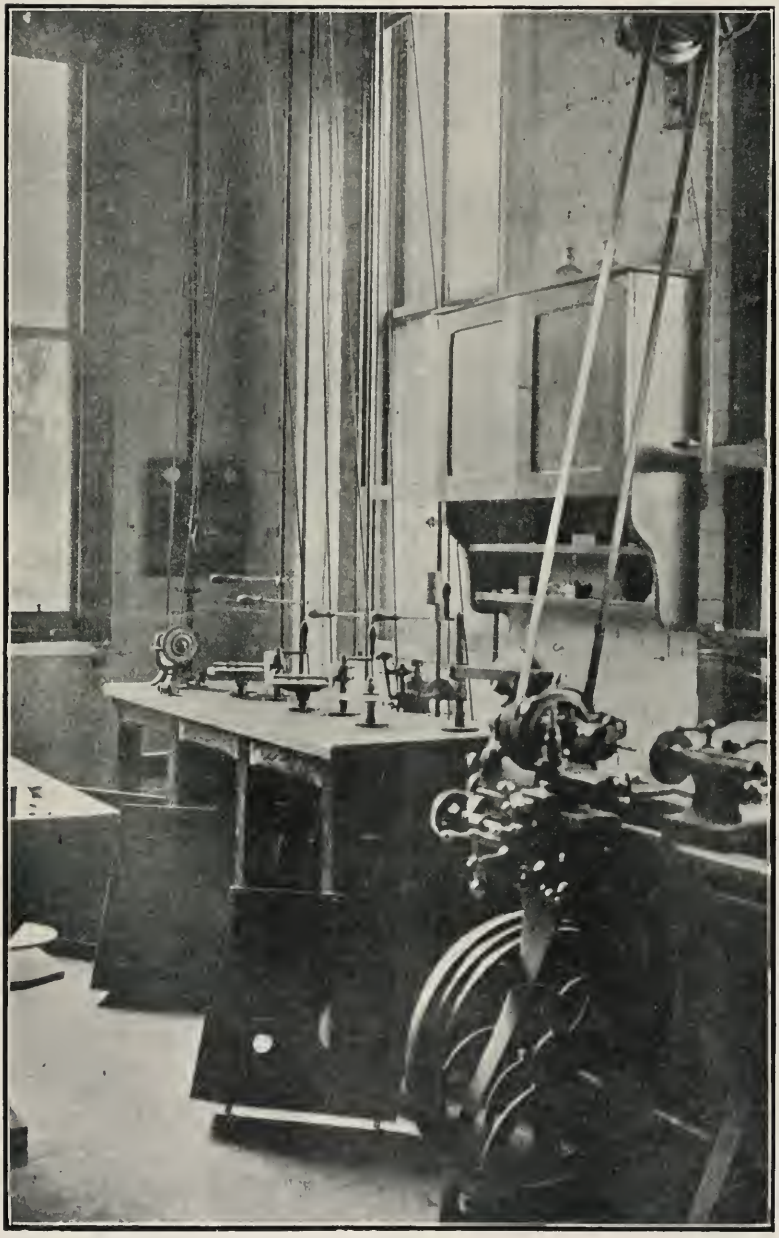
Details of the Principal Mechanical Parts.—These are described in order, from right to left, as they appear in Plate XXI. First comes the vertical revolving spindle of the slicer. This is made of mild steel—as indeed are all the spindles—15 in. long, by $1\frac{1}{8}$ in. in diameter. It passes through an accurately bored, flanged collar 3 in. long, screwed to the surface of the table. The lower end of this spindle, as also those of the grinding lap, is coned, and fits into a corresponding metal socket, provided with an oil recess and protecting collar, which is screwed to the longitudinal beam of the table-frame. The top of the spindle is threaded, and carries carefully fitted collars and flanges for clamping the slitting discs.

Somewhat to the right of and behind the spindle of the slicer, is a rod of steel, 1 in. in diameter and 18 in. long. The lower part of this rod, which is of somewhat greater diameter than the upper part, is coarsely threaded for 6 in. of its length, and screws into a long nut or socket fitted to the table, thus forming an adjustable support for the various specimen clamps. The rod has 3 in. or more of motion by means of a screw, and a further range is obtained with the aid of lock-nuts sliding on the spindle itself.

The larger specimen-holder is of the usual parallel screw-clamp type, and will hold specimens up to 5 in. in diameter. Several interchangeable clamps are used; one of these, to be seen in the photograph (Plate XXI.), is adapted to hold thick pieces of plate glass $3\frac{1}{2}$ by $1\frac{1}{2}$ inches (length and breadth), to which the ordinary microslips are attached. In addition to its radial motion, this carrier revolves axially, so that specimens to be sliced may be tilted at any convenient angle in relation to the slitting disc. This clamp also carries the goniometric crystal-holder (shown in the front right corner of the tray), which permits of slicing or grinding in any desired direction. The device for maintaining a steady pressure or pull against the slicer comprises the usual cord, weights, and pulleys, so placed as to be readily controlled.

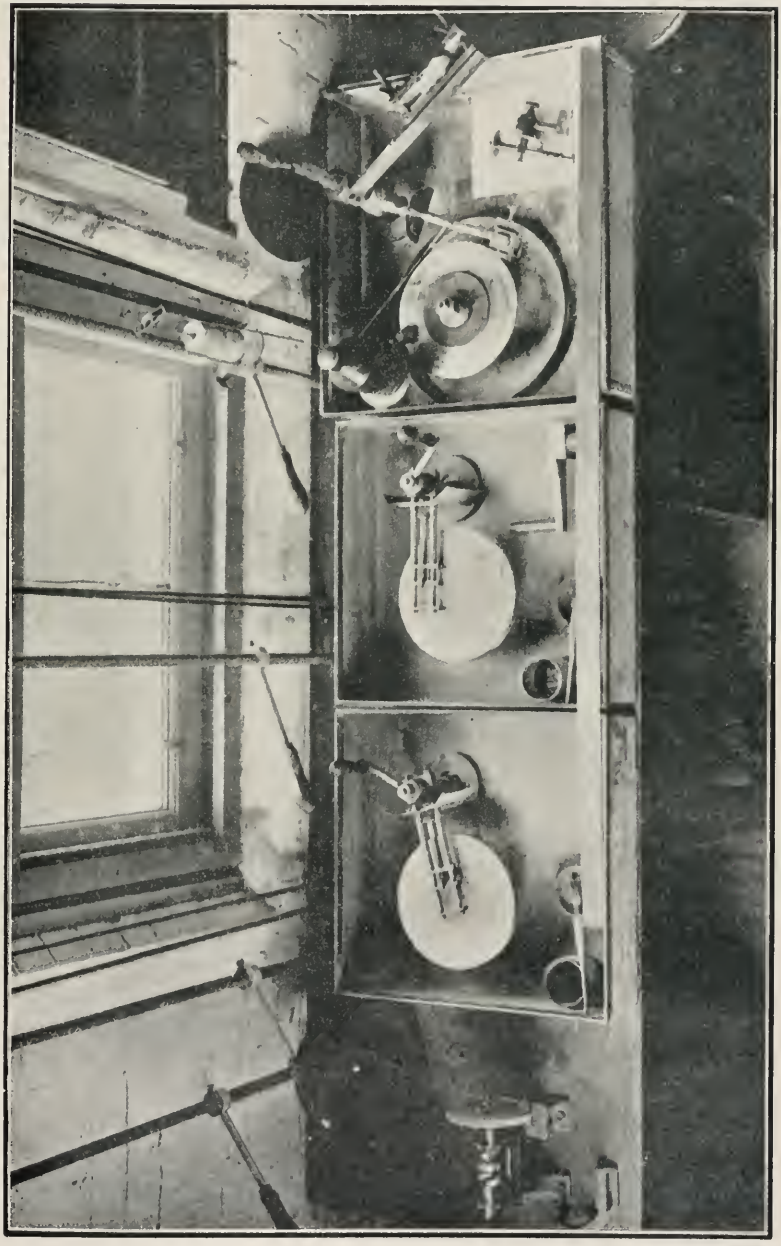
Lubrication of the slicer is provided for by means of a drip-can and two pieces of sponge, one above and one below the disc, held in position by a spring clamp.

Passing now to the grinding laps, of which there are two, seen in the centre of the table, it will be noted that they are screwed to the top of the spindles by means of a threaded boss below each plate. This mode of mounting allows the whole surface of the lap to be utilized, and

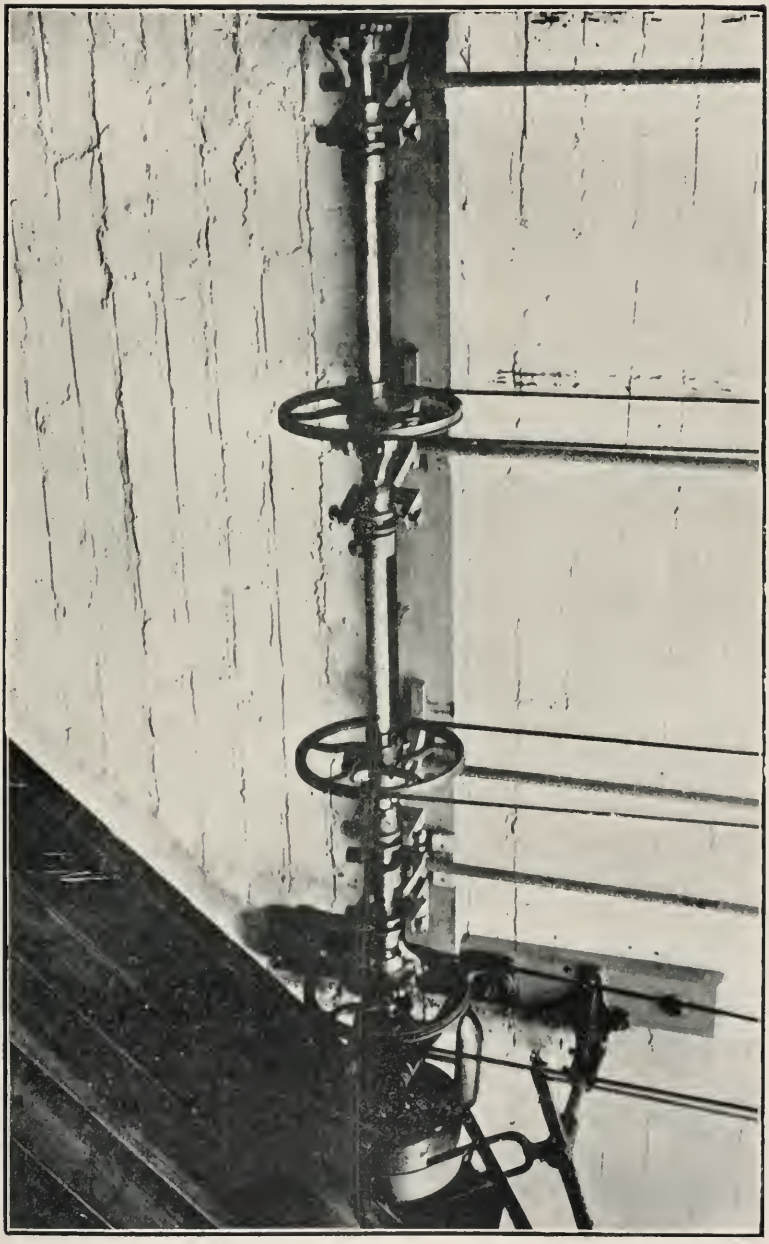


Grayson Rock-section Cutting Apparatus.

[*Follow p.* 704



Grayson Rock-section Cutting Apparatus.



GRAYSON ROCK-SECTION CUTTING APPARATUS.

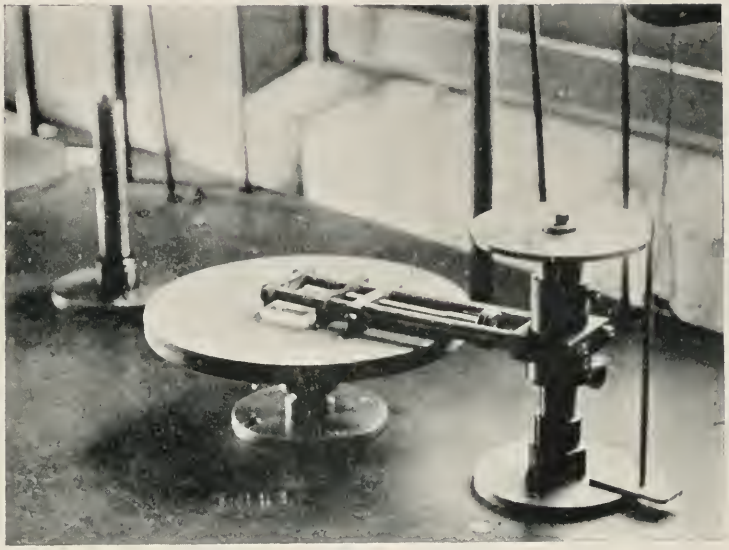


Fig 1

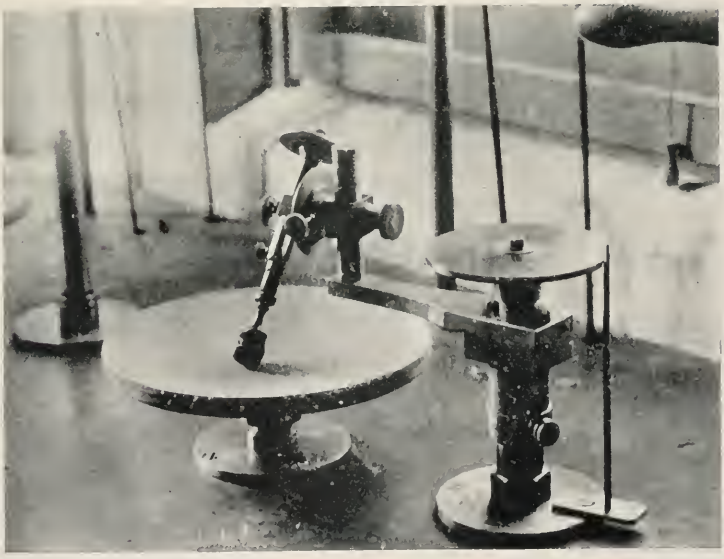


Fig 2

GRAYSON ROCK-SECTION CUTTING APPARATUS.

is a convenience which has only to be once used to be appreciated. It not only allows the utmost freedom of movement, but also aids in the maintenance of a true surface on the lap for a long time. The spindles of the laps are somewhat shorter than that of the slicer, their length being 12 in., so that the lap surface is about $3\frac{1}{2}$ in. above the table, which is a convenient height for most operators. The mounting of the spindles is the same throughout, and has already been described. Dust and grit are excluded from the bearings by means of a special close-fitting collar in each case.

It will be seen that each grinding spindle is accompanied by a pillar which supports a clamping device, in which specimens or blocks of glass are held so as to swing radially across the laps. This permits of parallel grinding to a precise thickness or definite form, and though not necessary for ordinary rock slicing, it has, as already explained, a variety of uses where precision is required.

The lower portion of each rod is threaded, and screws into a long socket let into the surface of the table. It can thus be accurately raised and lowered during use, so as to maintain a steady and even pressure upon the lap. It is also adapted to carry the goniometer, which fits the special holder shown in the centre tray, and, as already indicated, as every part of the machine is interchangeable if so required, a rapid transfer from one lap to another can be made. This correspondence between the several parts of the machine, and the facility of interchange which is thereby effected, results in the long run in a considerable saving of time.

The most effective laps, so far as my experience goes, are those of bronze containing a high percentage of copper, the aim being to secure a tough but not unduly hard lap. Pure copper laps would no doubt be better, but they are difficult to cast and turn. Discs of lead and tin, and also of wood with felted surfaces, are used in special cases and for polishing. A diameter of 10 in. is found to be convenient for most of these laps.

Tray-like shields, or mud-guards, are provided for each of the grinding laps, as well as for the slicer. As will be seen, they are of square outline and conveniently large, the distance between the several spindles, 22 in., permitting of this. The trays are made of stout galvanized iron, 5 in. deep, and the upper edges are rounded and brass-bound, forming clean and comfortable supports for the hands and arms of the operator. It should also be noticed that a space around each pillar or spindle is raised and carefully capped, so as to exclude dust and grit; this, in addition to the brass collars already noticed. The bearings of a machine running at a high speed, and upon which carborundum and other abrasives are to be freely used, cannot be too carefully protected from their intrusion: the life of the bearings is, in fact, directly proportional to the effective exclusion of the abrasives.

As already stated, the machine is motor driven, and as the method of connecting-up is in some respects novel, I refer to it in some detail. An electrically driven 1-horsepower motor serves to run the rock-slicer, lathe, emery wheel, and polisher, and has proved fully adequate for all requirements. As the motor runs at 1400 revolutions per minute, the

main shafting, shown in Plate XXII., is speeded down to about 300, a convenient speed for the driving-wheels of both lathe and rock-slicer. The usual method of gearing to a secondary shaft by means of belts and loose pulleys has been dispensed with, and a system of connecting directly to the main shaft adopted. This permits of any single portion of the section apparatus being run separately; the remaining cords and pulleys being stationary. This effects a saving of power, and reduces the wear and tear upon the machine and belts or cords. The slicer, and each grinder and the polisher, are hence directly connected to the principal shafting, which runs loosely through each driving-pulley, when the latter are not engaged. These pulleys are thrown into action, each by its own clutch, which is operated by a loose coned sliding collar on the main shaft. The sliding cone is moved directly from the work-table by means of a rod, to the lower end of which a lever handle-bar is rigidly screwed in a convenient position. At the top of the rod is a forked lever with adjusting screws fitting a groove in the sliding cone. By a twist of the handle-bar below, the cone is forced under the lever of the clutch, which tightly engages the hub of the driving-wheel, and the lap or slicer, as the case may be, is brought into immediate action; the reverse movement, of course, instantly disengages the clutch, and the lap or slicer becomes stationary. The photograph (Plate XXII.), which shows a portion of the main shaft, driving-wheels, and clutches, will serve to make this portion of the mechanism sufficiently clear.

Connexion between the driving-wheel and each spindle, by means of a leather cord, is easily effected, the latter passing directly from wheel to spindle with the aid of guide pulleys only, these being secured to the under-surface of the table.

Provision was originally made for two speeds, the change being effected by means of split pulleys on the spindle, which can easily be removed if required—but this is seldom necessary. A uniform speed of about 980 revolutions per minute has been found in every way satisfactory.

An extremely useful adjunct to the rock-slicer is to be found in the small emery grinder attached to the same bench (seen to the left of Plate XXI.), and driven in the same manner. It is speeded up to 2000 (or more) revolutions per minute, and has been found most convenient for a variety of work for which the larger machine is not so well adapted. It may be provided with various grinding and cutting wheels, as well as polishers and brushes, which fit it for use upon fossils, and the grinding and polishing of small mineral and other specimens. This is an addition to its varied usefulness in the workroom generally."

Method of Slicing, Grinding and Mounting Rock-sections.*—The following is a summary of the salient points adopted by H. J. Grayson when working at rock-sections:—

"A. *Charging the Slicers, etc.*—This is invariably done with diamond powder, which it pays to crush, and sift from time to time during the operation. The sifting is easily done with the aid of several bits of glass tube about 1 in. long and $\frac{3}{4}$ in. wide, to one end of which, after grinding level, a bit of very fine bolting silk has been cemented. A slicer charged with properly graded diamond powder cuts faster and cuts longer than

* Proc. Roy. Soc. Victoria, xxiii. (1910) pp. 65–81 (4 pls.).

would be the case if the diamond were only ground to an almost impalpable powder in oil, as is frequently done; the former method is more effective as well as more economical.

Every slicer should be made to run 'dead' true, and should be maintained in that condition. The greater the speed at which it is run, the more important it becomes that it should run truly. A slicer is always ineffective in proportion to its eccentricity. Too often the slicer is made to cut as long as it will cut; this is unsound, both in theory and practice.

With regard to charging a slicer, I find a chilled steel roller by far the most effective instrument for this purpose. It is better than any glass or agate implement, and, if properly made, is almost everlasting.

I have tried notching the slicers and charging the notches; it takes a long time to do this well—and it must be well done, or not at all. I was certainly rewarded with a slicer which cut well for a long time. Usually, however, I find a slicer charged in the ordinary way, that is by pressure of the diamond powder into the smoothly turned edge of the soft iron slicer, gives a very satisfactory return for the small amount of time and trouble it requires to prepare. A hundred sections, each of which involves two cuts, at a cost of little more than a shilling, leaves nothing to complain of in the matter of expense. In slicing I use kerosene for lubrication, that is, if the rocks are compact and hard; for such rocks it is more effective than a soap emulsion, which of course must be used for soft and porous rocks. Any good soap makes an effective lubricant if properly dissolved. It need not be Castile soap, which, like many other things, is not always what it is claimed to be.

B. *Grinding Powders.*—For this purpose only the finest graded carborundum is used. I also re-grade what is ordinarily sold as graded material by the manufacturer. For example, FFF grade of the Niagara Falls Company can well be further separated into two or three grades. The coarsest of these is used upon the finest of the two machine laps; the remaining finer grades are used for finishing purposes by hand.

For the coarse lap, I find a fine but well graded powder is more effective than one that is coarse; indeed, the latter is simply thrown off a rapidly revolving lap. Two hundred and twenty grade carborundum is the coarsest I use for rough work. Ordinarily the series of laps comprises one coarse, one fine, and one finishing lap of slate for hand use only.

C. *Canada Balsam and Mounting Methods.*—Many people fail in their first attempts to cut and prepare sections satisfactorily, not through lack of perseverance or skill, but because they do not carefully prepare their balsamed slips beforehand. Good clean natural Canada balsam alone, if carefully prepared, will hold almost any rock securely to the end of the process of its preparation. The tenacity and range of hardness of the balsam may, however, be extended if a small quantity, not more than 1 to 3 p.c., of some clear and colourless organic oil is added to it. Poppy oil, castor oil, clove oil—even linseed oil—are all suitable if used in the right proportions, and here experience alone is the best guide. Those who have not tried the addition of one of these oils, or something similar, will appreciate the improvement effected by them, if the addition is judiciously made.

One should not prepare too many balsamed slips at once, as they continue to dry slowly if not used, and eventually become too brittle. As to mounting, the specimen should be attached, in the first instance, to the slip upon which it is to remain. Transference to another slip is obsolete and unnecessary. It did well for thick sections, which were formerly much more common than they are, or should be, to-day. Again, the section and slip should not be flooded with balsam when about to attach the cover, for, besides making a sticky and unsightly mess, it is both wasteful and unnecessary. Prolonged heating of slip and section is not advisable, when one is mounting, with the object of driving out all the solvent from the balsam. The chances are, when this is attempted, that the section will be disturbed or float, and will tend to break up when putting down the cover, besides raising a crop of bubbles, which are very difficult to remove. It is a wiser and safer course to use no more balsam, and to apply no more heat than is necessary to bring the cover into close and uniform relationship with the whole of the section. An oven with a water-jacket, maintained at about 40° C., will, in from three to five days, complete the drying with perfect safety.

So much for what is general and more or less applicable to almost any successful process for the preparation and mounting of rock sections.

I will now briefly outline the process adopted with a collection of, say, twenty numbered rock specimens which are ready for slicing. It is to be noted that I seldom prepare sections from detached slices, as these involve two parallel cuts and much subsequent grinding. It is twice as economical, both as to time and material, to slice off the rock close to the mounting slip, as by this method the smallest possible amount of material remains to be ground away. Two dozen 3 by 1 in. slips are cleaned and placed, the whole upon white blotting paper, spread on a sheet of asbestos, or a metal plate; this is laid upon a well filled sand bath, supported on a tripod over a Bunsen flame. The heat from the latter is so regulated as not to discolour or char the paper below the slips. Each slip is now balsamed, using no more than experience has shown to be necessary for sections about 1 in. in diameter. While the balsam is "cooking" the specimens are successively clamped in the large specimen holder of the slicing machine, and a piece, large enough for a section, is sliced away; the whole twenty being thus treated. Meantime, the balsamed slips will have become sufficiently hardened. Each slip should be separately tested, when cool, with forceps or knife; the hardened balsam should indent with moderate pressure without splintering.

The sliced face of each specimen is now, for a few seconds, held upon the finest revolving lap, which is fed with F F carborundum, and moistened with water containing about one-fifth of its volume of glycerin, which maintains a rapidly revolving disc sufficiently moist, without excess, for a long time. Each specimen requires only a brief treatment, and if the lap is in first-class order no further preparation should be required. Usually, however, it is safer to give each specimen a few sweeps by hand, upon a slate or glass lap, the surface of which should be accurately true or flat. After washing and drying, the specimens are ready for attachment to the balsamed slips. This is done by heating them sufficiently to occasion discomfort when held against the hand for

a few seconds; the slip being correspondingly heated, the specimen is pressed home on the slip, taking care to exclude all air-bubbles. As each slide is dealt with it is placed on a second plate of glass ($3\frac{1}{2}$ by $1\frac{1}{2}$ in. by $\frac{5}{16}$ in. thick, the blocks being strictly uniform) and heated to melt the beeswax, which is used to hold the slip in position during its subsequent treatment. After the entire series has thus been treated and allowed to cool, each glass plate or block in turn is clamped in the special holder, and the slicer passed through the rock close to the glass of the mounting slip. With everything in good order this may be done to within 0·5 mm.; the thickness being regulated by means of two strips of thin sheet iron, held in position on the slip while the cut is being started.

The series having been sliced, each section is ground to within 0·1 mm. on the coarse grinding lap, using F carborundum, or certainly not a coarser grade than 220. After washing, the grinding is completed on the finest revolving lap, and if the latter is true and the operator experienced scarcely any further grinding will be required. With a sufficiently finely-graded powder, there should be no scoring or scratches; the latter, if present, being due to fragments of too coarse a powder, or to its use in too limited a quantity, thus allowing the specimen to come in contact with the metal of the lap. As a rule, and for safety, it is wiser to give the last touches by hand upon a suitable lap of slate or glass, using only the finest washed powder.

The whole process is not so long or so complicated as any description must necessarily seem to imply. With the aid of the machine described, and given balsamed slides in readiness, I find it possible to complete single slides in 10 to 15 minutes; the finished section, in area, uniformity, and thinness, leaving little to be desired. Furthermore, with a series of rocks—and it is usual to treat a number together—there is a corresponding gain in time, throughout the several operations. Naturally, too, and perhaps more particularly with the type of machine just described, individual experience, dexterity of manipulation, and judgment, are material factors affecting the final result, both as to time and quality of work. Compared with the older type of machine, both hand and treadle, there can be no question as to the net gain in time and labour, both of which are important. There is, too, I think, an equivalent improvement in the average quality of the finished product. On these grounds I hope the publication of this brief description will prove useful to all who are interested in the preparation of rock-sections."

(4) Staining and Injecting.

Staining Bordered Pits.* — G. Kowallik used three solutions: (1) 1 grm. acid-fuchsin dissolved in 100 grm. 95 p.c. alcohol and filtered; (2) 1 grm. anilin-green (brillant-grün ?), obtained from Wolff of Posen, dissolved in 100 grm. of distilled water and filtered; (3) 1 grm. chrysoidin dissolved in 100 grm. 95 p.c. alcohol and filtered. Sections of *Pinus* hardened in alcohol are covered with solution (2) and the slide is heated to vaporization. After a minute the slide is washed in water and then treated with solution (3) diluted one-half with water. After allowing

* Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 26–7.

this to act for one or two minutes the slide is rapidly washed in 95 p.c. alcohol and then transferred to solution (1) for not more than one minute. It is then treated for 2–5 seconds with 95 p.c. alcohol and afterwards with absolute alcohol for about one minute. The sections are treated with xylol for about five minues and afterwards embedded in balsam. The tracheids are yellow, the areola green, and the torus red.

(6) Miscellaneous.

Enumeration of Bacteria in Milk.*—R. S. Breed determines the number of bacteria in milk by direct microscopical examination. The sample of milk to be examined is shaken thoroughly and 0·01 c.cm. is withdrawn by means of a specially constructed pipette. The milk so obtained is spread evenly over an area of 1 sq. cm. on an ordinary glass slide. These areas may be easily determined by placing the glass slide over paper or glass on which areas of this size have been accurately ruled out. The milk is then dried with gentle heat, the fat dissolved out with xylol or other fat solvent, the smear again dried, then fixed with alcohol, again dried and stained with some anilin dye. Alkaline or other solutions which attack casein and loosen the smear must be avoided. The counting of the bacteria is done with a Microscope and an oil-immersion objective. If the diameter of the field be so adjusted by means of the draw-tube that it equals 0·16 mm., then each field of the Microscope covers approximately one five-thousandth (0·0002) of a square centimetre. On this basis each bacterium seen in a field taken at random represents 500,000 per c.cm. if they are evenly distributed. But as it is impossible to distribute them evenly, at least 100 fields should be counted. The total number of bacteria seen in 10 fields multiplied by 50,000, or the total number in 100 fields multiplied by 5,000, gives the total number of bacteria per c.cm. Though certain objections may be raised against this method, the author claims that it is more accurate than the plate method.

Metallography, etc.

New Critical Point in Copper-zinc Alloys.†—H. C. H. Carpenter and C. A. Edwards have confirmed the existence of a thermal change at about 470° C. in copper-zinc alloys containing 40 to 63 p.c. copper; this is the range in which the β constituent is present. It is suggested that this critical point corresponds to the decomposition, on cooling, of β into $\alpha + \gamma$. In alloys which above 470° C. consisted wholly of β, the presence of α and γ has been detected microscopically, at high magnifications only. The equilibrium diagram, modified in accordance with the authors' conclusions, is given. As γ is a brittle substance, the decomposition of β into $\alpha + \gamma$ causes embrittling of the alloy.

C. A. Edwards discusses the nature of solid solutions, in an appendix to the above paper, and concludes that (1) so-called metallic solid solu-

* Centralbl. Bakt., 2te Abt., xxx. (1911) pp. 337–40 (1 fig.).
† Journ. Inst. Metals, v. (1911) pp. 127–93 (26 figs.).

tions are intimate crystalline mixtures; whilst the primary crystals are too small to be detected microscopically, they are large enough to retain their identity; (2) the term "solid solution" is strictly not applicable to crystalline bodies such as metallic alloys, and should be restricted to supercooled liquids, such as glass.

Alloys of Aluminium and Zinc.*—W. Rosenhain and S. L. Archbutt have re-determined the equilibrium diagram of the aluminium-zinc system. Cooling curves and some heating curves were taken; 300 grm. of alloy were used for each experiment, and the rate of cooling was slow. Microscopic examination was applied to specimens which had been (1) slowly cooled from fusion, (2) annealed at certain definite temperatures, and either slowly cooled, or quenched. The diagram differs in important features from that given by Shepherd. The existence of the compound Al_2Zn_3 (corresponding to the β phase) has been demonstrated. In alloys containing this phase, dendritic crystals frequently assuming six-rayed forms were observed. A horizontal line in the diagram at about 440° C. is held to represent the formation of Al_2Zn_3, while a horizontal at about 255° C. represents the decomposition of that compound.

Aluminium Alloys containing Magnesium.†—A. Wilm finds that certain aluminium alloys containing a small amount of magnesium are capable of being hardened by heat-treatment. Immediately after quenching, the alloy is soft, but after a few days at atmospheric temperature its hardness rises considerably. An increase in ductility accompanies this increase in hardness. The hardness attained upon storage increases with rise of quenching temperature, up to 470° C. An alloy containing 3·5 p.c. copper, 0·5 p.c. magnesium, after being hardened by storage following quenching, was considerably further hardened by cold-rolling. The addition of a small quantity of manganese to such alloys renders them capable of resisting the destructive action of mercury, as the surface is not wetted by mercury.

Lead-tin Alloys.‡—D. Mazzotto has made a careful study of the heat-evolution in the solid state which occurs at about 150° C. in lead-tin alloys on cooling. In an alloy containing 33·3 p.c. tin and 66·7 p.c. lead, it was found that the intensity and the temperature of the recalescence phenomenon were considerably affected by previous annealing, the maximum values of both temperature and intensity being obtained by annealing at 183° C., the eutectic temperature. The temperature of maximum intensity, and the heat of transformation, rise with increase of tin content up to 18 p.c. tin, which is the concentration of the solid solution saturated at the eutectic temperature. The author shows that the thermal phenomenon in question may be fully explained by the rapid diminution of the solid solubility of tin in lead as the temperature falls below the eutectic temperature. The evolution of heat on cooling is caused by the falling of tin out of solution in lead. Annealing tends to increase the quantity of solid solution which is saturated at the annealing

* Proc. Roy. Soc., Series A, lxxxv. (1911) pp. 389–92 (1 fig.).
† Metallurgie, viii. (1911) pp. 225–7 (9 figs.).
‡ Int. Zeitschr. Metallographie, i. (1911) pp. 289–352 (8 figs.).

temperature, and therefore tends to concentrate the transformation. The ordinary temperature of transformation, 150° C., is that at which the solid solution saturated at the eutectic temperature, containing about 18 p.c. tin, begins to deposit tin.

Formation of Solid Metallic Solutions by Diffusion in the Solid State.*—G. Bruni and D. Meneghini have heated a nickel wire, electrolytically coated with copper, at 1000° C. in hydrogen, measuring the electrical resistance from time to time during the heating. The resistance, originally 0·026 ohm, ultimately rose to 0·21 ohm. The wire showed no signs of fusion, and the authors conclude that a solid solution of nickel and copper was formed by diffusion in the solid state.

Alloys of Silicon with Metals.†—R. Frilley has prepared, in an electric arc furnace, numerous binary alloys of silicon with manganese, chromium, nickel, iron, tungsten, copper, aluminium, calcium, barium, and strontium. The density of each alloy was accurately determined, and the curves, showing the relation for each system between density and composition, are held to indicate by inflexions or other peculiarities the presence and composition of the definite compounds occurring in the system. A list of the compounds found is too lengthy for reproduction. The author points out the simplicity and accuracy of the density method of investigating alloys. A comparison of the results obtained by applying the method to the copper-aluminium and cadmium-mercury systems, with the equilibrium diagrams obtained by the better-known thermal and microscopical methods, demonstrates the reliability of the density method for indicating the compounds. For each silicon-metal system the density results are given in the form of a specific gravity curve, a specific volume curve, and a molecular volume curve, abscissæ representing in each case the percentage composition. Some information about the properties of the alloys is given.

Extraction of Gases from Copper.‡—M. Guichard has made measurements and analyses of the gases extracted from copper by heating in a vacuum. The gas is quickly evolved from the superficial layer of the specimen, but the gas contained by the deeper layers diffuses very slowly to the outer layer, where it is evolved. By chemical methods, involving the conversion of the copper into iodide or oxide, much greater quantities of occluded gases were extracted. The extraction of the total gas content of copper by heating in a vacuum accordingly presents great difficulties.

Crystallization of White Cast Iron.§—C. Benedicks has examined microscopically a hyper-eutectic cast iron containing 4·36 p.c. carbon and 1 p.c. manganese. Three faces of the specimen, approximately at right angles to each other, were polished and etched. The eutectic was found to exist as "colonies," resembling homogeneous crystals. In some cases the eutectic exhibited spherical surfaces. The solidification of white iron appears to proceed in a discontinuous or oscillatory manner.

* Atti R. Accad. Lincei, xx. (1911) pp. 671–4, through Journ. Chem. Soc., c. (1911) p. 703.

† Rev. Métallurgie, viii. (1911) pp. 457–559 (39 figs.).

‡ Comptes Rendus, cliii. (1911) pp. 104–7, 272–5.

§ Int. Zeitschr. Metallographie, i. (1911) pp. 184–91 (14 figs.).

Changes occurring in Nickel Steel.*—C. E. Guillaume has investigated the length changes taking place in course of time in high-nickel steels. Steels containing 28–42 p.c. nickel expand slightly on keeping, while those with higher nickel content, up to 70 p.c., contract. Previous heating, by accelerating the transformations corresponding to these volume changes, reduces the amount of the subsequent alterations. The advantages offered by the 42 p.c. and 56 p.c. alloys for the construction of length standards are discussed.

Ovifak Iron.†—C. Benedicks has microscopically examined specimens of the mass of iron, weighing 25,000 kilograms, found at Ovifak, in order to determine if it is of meteoric origin. The iron was found to contain 1·6 p.c. carbon and some sulphur. The chief constituents are free cementite and pearlite, which by its fine structure would indicate that the iron cannot have been cooled slowly below 700° C. A structure formed of alternate lamellæ of cementite and iron oxide is termed "oxide-pearlite." This mass of natural steel has probably been formed by the reduction of iron compounds in molten basalt by carbonaceous matter.

Cementation of Alloy Steels.‡—F. Giolitti and F. Carnevali have carbonized nickel steels containing 2–30 p.c. nickel, and a chromium steel containing 2·3 p.c. chromium, with ethylene and with carbon monoxide, at 950° and at 1050° C. The phenomena of cementation were in general the same as those observed with carbon steels, but in the nickel steels the maximum content of carbon in the cementation zone diminished with increase of nickel content, while the presence of chromium raised the maximum carbon content. The eutectoid composition of steels containing 2–5 p.c. nickel appears to be 0·6–0·65 p.c. carbon.

F. Giolitti and G. Tavanti have studied the cementation of nickel steels containing 20–50 p.c. nickel.

Structure of Galvanized Iron.§—W. Guertler has investigated the microstructure of galvanized iron manufactured by the three usual methods: the dipping process, sherardization, and the electrolytic process. In all cases, a layer of crystals of the compound $FeZn_3$ is present between the iron and the zinc coating, but in material zinc-coated electrolytically, this layer of $FeZn_3$ is much thinner than in dipped or sherardized specimens. The $FeZn_3$ layer is electro-negative to both iron and zinc, and accordingly accelerates corrosion when exposed. The zinc coating obtained by dipping always contains crystals of about the composition $FeZn_7$, also electro-negative to zinc. Various other structural features of galvanized iron characterizing the different processes of manufacture are described.

Welding up of Blowholes and Cavities in Steel Ingots.‖—J. E. Stead defines welding as the crystallizing into union of two solid metallic

* Comptes Rendus, cliii. (1911) pp. 156–60 (1 fig.).

† Metallurgie, viii. (1911) pp. 65–8 (8 figs.).

‡ Atti R. Accad. Sci. Torino, xlvi. (1911) pp. 409–32, 558–68. Rass. Min. Met. e Chim., xxxiv. (1911) through Journ. Soc. Chem. Ind., xxx. (1911) p. 1017.

§ Int. Zeitschr. Metallographie, i. (1911) pp. 353–76 (18 figs.).

‖ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 54–102 (10 figs.).

surfaces when they are brought together under suitable conditions. In a microsection of a weld, the crystals along the junction are found to be common to each of the original pieces of metal. The higher the temperature at which clean metallic surfaces are in actual contact, the more rapidly do they crystallize together. Upon heating in contact, in hydrogen, duplicate pieces of steel, welding resulted at as low a temperature as 800° C. Axial holes were drilled in three steel bars, and closed with steel plugs; the bars were heated to 800° C. and flattened, then re-heated respectively to 750°, 950°, and 1150° C., and forged into bars of smaller section. The piece forged at 750° C. showed no signs of welding of the artificial cavity, while the bar forged at 950° was partially, and that forged at 1150° C. completely welded. The author discusses the formation of blowholes, of blowhole segregations, and of pipe in steel ingots. It seems certain that blowholes will weld up completely when an ingot is rolled or forged at a temperature of 1000° C. or higher. It is doubtful if pipe cavities can be so readily welded, as the surfaces of such cavities are frequently coated with oxide.

Some Studies of Welds.*—E. F. Law, W. H. Merrett, and W. P. Digby have investigated the strength and the microstructure of steel welded by various processes. A true weld is regarded as involving fusion together of similar or allied metals. Whatever the process used, a more or less sharply defined region of altered structure is produced. Each process develops its own characteristic structural features in this region, so that a microscopical examination of an unannealed weld indicates by what process it has been made. Resistance welds and acetylene welds appear to be least, and arc welds most, prone to oxidation.

Resistance of Steels to Abrasion and to Crushing.†—F. Robin has tested a large number of different steels and cast irons by submitting them to abrasion by emery paper. The test piece, having a surface of given area, was pressed with a given load upon a disc of emery paper rotating at a known speed on a turntable. Usually the loss of weight of the test piece was determined after 1, 2, and 3 minutes' abrasion. Carbon steels show a minimum of resistance to abrasion at about 0·4 p.c. carbon. Steels containing nickel and manganese in high percentages are exceedingly resistant. Another method of testing investigated consists in the determination of the relation between energy of blow and amount of compression in a metal cylinder deformed by the blow of a falling weight. The shock work is the energy of a single blow producing at a given temperature a crush equal to one-fifth of their depth in normal cylinders at a constant velocity, and is held to characterize the metal tested. The tests were carried out upon a large number of carbon and alloy steels, at temperatures from −180° to over 1100° C. In connexion with this test, "interstrain," or the hardening resulting from mechanical distortion, was studied. The original paper should be consulted for an account of the great quantity of experimental work performed and the conclusions yielded by it, and for the author's views on the numerous theoretical points raised.

* Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 103–24 (33 figs.).

† Iron and Steel Inst., Carnegie Scholarship Memoirs, ii. (1910) pp. 1-270 (94 figs.).

"Filiations" of Metallic Alloys.* — The heterogeneous mass obtained by the superposition of two molten metals, in such a manner that mixing is incomplete, is termed by Le Gris a "filiation" of a metallic alloy. A successful preparation contains one metal in a pure state at the bottom, the other pure metal at the top, while the intermediate layers represent, in order, every possible composition of binary alloy. Le Gris has so improved the method, originally introduced by Le Chatelier, that a complete "filiation" can be obtained not exceeding 1 mm. in height. These small preparations are made by bringing into contact fragments of the two metals, melted and in the globular state, and cooling rapidly the single globule formed. Larger "filiations" are made in crucibles. The preparations are useful for a rapid study of the metallography of the complete system, and by successive re-polishings and etchings with different reagents it is a simple matter to ascertain which reagent is the most suitable for the identification of any one constituent. Similar in principle is a method described for the study of the effect of speed of cooling upon grain-size and other structural features. A small ingot is cast in a non-conducting mould, which has a large cold block of metal as its base. The bottom of the ingot is thus rapidly chilled and solidified, while the rate of cooling becomes slower as the top of the ingot is approached.

The author determines the hardness of the various constituents found in a "filiation" by a modification of the Brinell method. The end of a drawn thread of glass is melted, so that a ball having a diameter of a fraction of a millimetre is formed. A series of impressions is made, proceeding from one end of the preparation to the other, with a load of a few hundred grams; the impressions are conveniently measured on a photomicrograph. The presence of impurities in one of the metals usually has a marked effect upon the microstructure of a "filiation"; this observation may be utilized for the detection of impurities and an approximate determination of the amount present. A "filiation" may be prepared and microscopically examined in a quarter of an hour.

Jointed Arm for Workshop Microscope.†—S. Prauss describes a useful modification of the Stead Workshop Microscope. The Microscope is carried by a jointed arm, the other end of which is attached to the specimen by a vice or an electro-magnet. Any surface of a large mass of metal may thus be examined.

Corrosion of Metals.‡—G. D. Bengough reviews generally the present knowledge of the corrosion of non-ferrous metals. The literature of the subject is summarized, and the electrolytic theory of corrosion, to which the author attaches much importance, is clearly explained. The problems awaiting solution are stated, and a scheme for the investigation of the corrosion of 70:30 brass, in the form of condenser tubes, is put forward.

J. T. Corner§ describes some cases of corrosion of metals and alloys.

* Rev. Métallurgie, viii. (1911) pp. 613–25 (21 figs.).

† Metallurgie, viii. (1911) pp. 124–6 (6 figs.).

‡ Journ. Inst. Metals, v. (1911) pp. 28–114 (4 figs.). Report to the Corrosion Committee of the Institute of Metals.

§ Journ. Inst. Metals, v. (1911) pp. 115–26.

Nucleus Action and Grain-growth. * — H. M. Howe discusses Cohen's inoculation experiments, in which bright tin surfaces (usually cold worked) were dulled when pressed against specimens of tin which had previously been rendered dull. Most cases of this infection may be explained on the assumption that the cold-worked metal is in a metastable state, and that contact with normally crystalline metal induces the change to the stable condition, a change which is accelerated by raising the temperature. It is difficult, however, to apply this explanation to the case of the dulling, by contact with dulled tin, of the bright surface of a quietly frozen ingot of tin. The author indicates the bearing on this question, of Charpy's discovery that overstrained iron shows a much more rapid grain-growth between 650° and 800° C. than iron which has not been overstrained.

National Physical Laboratory.†—The existence of the compound Al_2Zn_3 has been fully established, but it is stable only within the temperature range 254°–443° C. The microscopical effects of tensile strain upon strips of various binary alloys of eutectic composition have been investigated; the differences observed in modes of deformation appeared to indicate that the crystalline arrangement is fundamentally different in different eutectics. A remarkably coarse crystallization was observed in some electrolytic iron which had been prepared for experiments on effects of strain at high temperatures. The iron had been annealed after rolling into thin strips. It was possible to detach single crystals from these strips; the individual crystals were found to be perfectly tough and ductile.

* Met. and Chem. Eng., ix. (1911) pp. 79–80.
† Nat. Phys. Lab. Ann. Report for 1910.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

The Binocular Microscope.†—J. Amann points out that the important developments of late years in Microscope construction leave little hope that much further optical improvement is likely to be made. He thinks, however, that practical and especially hygienic considerations still require attention. He would much like to see the Continental Microscope adapted to normal binocular vision. He contrasts monocular with binocular vision, to the disadvantage of the former, but fully admits the difficulties of the undertaking to which he invites the attention of

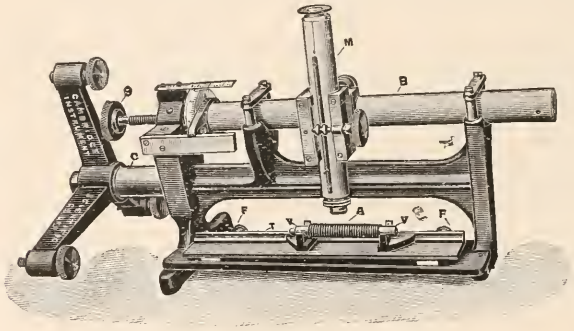


Fig. 87.

Microscope makers. The latest and most complete binocular is Greenhough's Stereoscopic Microscope, but it is only adapted for comparatively weak objectives, which are quite insufficient for modern biological investigations. He considers that the constructional requirements to be met in designing a binocular arrangement are:—1. That the arrangement should not sensibly alter the correction of the optical system; it should permit the use of compound objectives—weak, medium, high, including homogeneous immersions. 2. That it should likewise be available for oculars of various types—Huyghens, Ramsden, Compensator. 3. That there should be no sensible loss of light; the light-strength of both fields should be approximately the same. 4. That the arrangement should be easily inserted and removed, in order to use the Microscope monocularly or binocularly as desired. The binocular should be suitable

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

† Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 488–93.

for use with all kinds of illumination—polarized light, dark-ground, ultra-microscopy.

Among instruments which have to some extent anticipated his requirements, the author mentions the Wenham-Schroeden objective-prism, made some fifteen years ago by Ross of London, under the title of "Improved Binocular Prism for High Powers." The excellent qualities of this prism—which he fully enumerates—are counterbalanced by the ponderous stand, which makes a rather unwieldy and costly instrument. In conclusion, while admitting that for certain special purposes, e.g. resolution of more difficult structures, test-objects, and so forth, the monocular instrument is the more suitable, yet for most systematic purposes, and especially for prolonged observations, he thinks that the binocular is so much to be preferred that he hopes his suggestions will not be unattainable.

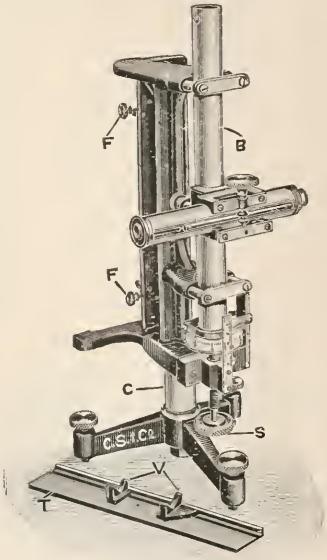


Fig. 88.

Comparator or Reading Microscope.*—This instrument (figs. 87, 88), made by the Cambridge Scientific Instrument Company, can be used with the axis of the Microscope vertical, horizontal, or inclined. The illustration (fig. 87) shows it with the axis vertical; in fig. 88 it is seen as a cathetometer, with the Microscope horizontal. The tube B, to which the Microscope is clamped, can be traversed slowly by the screw and milled-head S through 40 mm. reading, being taken on the divided micrometer-head to 0·01 mm. For supporting the object under examination a small sliding table I, resting on geometric fittings, is provided. This is supported with centring adjustments controlled by the screws F, F. Lucas's patent slow motion is used for this focusing mechanism of the Microscope. The Microscope M, which is fitted with cross lines and can be clamped at any point on the tube B, has a Zeiss achromatic objective a_2 and No. 2 ocular. The working distance between the nose of the objective and the object is 30 mm. The instrument, which weighs 17 lbs., is used as seen in fig. 87 for the examination of screws; it is also employed for measuring the hardness of steel. This is done by pressing a small steel ball into the steel to be examined, by the pressure of a known weight. The indentation thus produced is a measure of the hardness, the diameter of the indentation being measured by the Microscope.

* Cambridge Scientific Instrument Co., List No. 88, p. 9 (2 figs.).

(3) Illuminating and other Apparatus.

New Nernst Lamp for Microprojection.*—A. Köhler, in discussing some of the difficulties attendant upon the Nernst lamp, points out that the best results are attained when the collector-lens is so shaped that its image of a luminous bar completely covers the actual aperture of the iris-diaphragm : in other words, if the breadth of the image of a luminous bar is at least equal to the diameter of the diaphragm aperture. Thus, if (fig. 89) $2L^1$ be the breadth of the image of a bar, or, generally, the least diameter of the image of the light-source, $2r$ the diameter of the condenser-diaphragm, then this condition will be satisfied when $L^1 \geqq r$.

If, further, $2L$ be the breadth of a bar, or, generally, the least diameter of the light-source, f_1 the focal distance of the collector-lens,

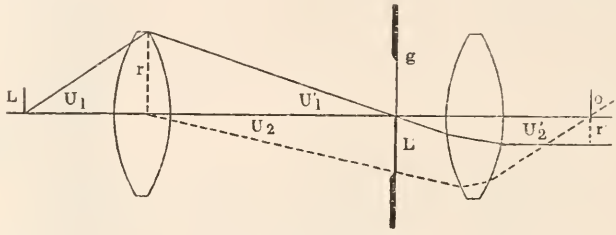


Fig. 89.

and x^1 the distance of the condenser stop from the rear focal point F^1 of the collector, then

$$\frac{L^1}{L} = \frac{x^1}{f_1}$$

From the foregoing results it follows that, by taking only the equality sign in the first equation,

$$\frac{r}{L} = \frac{r^1}{f_1}$$

and this derived equation gives approximately the distance at which a collector of focal distance f_1 belonging to a Microscope of assigned optical structure should be set up. If the image of the light-source is also to be sharp, when the collector has a greater angular aperture, there must be aplanatism ; this requires that,

$$L \sin u_1 = L^1 \sin u_1$$

The author proceeds similarly to investigate other conditions, with especial reference to Zeiss' apochromats and compensation oculars. His principles have been carried into practice by Messrs. Carl Zeiss, and a view of their apparatus is shown in fig. 90. It has the advantage, in the case of small light-sources, of combining the collector-lens with the Nernst. The collector, provided with an iris-diaphragm 1, is clamped

* Zeitschr. wiss. Mikrosk., xxvii. (1911) pp. 477–88.

firmly in a sleeve 2, which surrounds a slit adjustable by means of a micrometer-screw 3. In this manner the image of the bright bar can be made to fall sharp and clear upon the diaphragm of the Microscope-condenser. The screw 4 is for centring the light-source with regard to the axis of the collector. This screw raises and lowers the bright bar, and thereby effects a corresponding perpendicular movement of its image. A lateral movement is not necessary, for the image of the long thread always covers in this direction the condenser-diaphragm, provided that the height-adjustment is rightly attained. The bright bar lies in a pillbox-shaped receptacle, whose under portion is shown in fig. 90 separated from the upper part. In this lower part are seen the two electrodes,

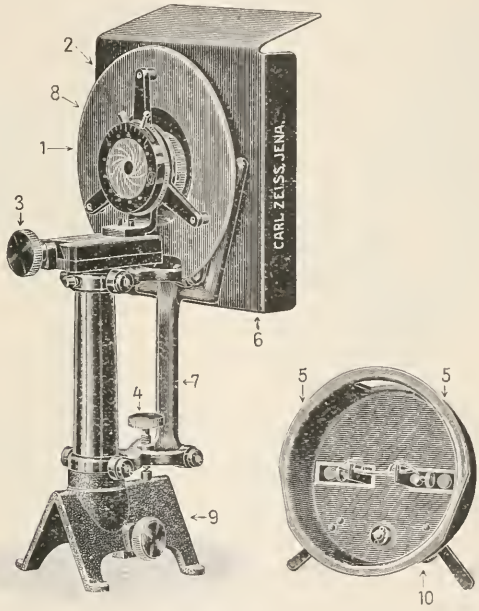


Fig. 90.

connected by a platinum wire and secured by the small screws 5. The front wall 6 of the receptacle is approximately square, and is provided with a small opening opposite to the collector. A so-called parallelogram-movement connects the opening with the pillar carrying the slit and collector, and controls the above-mentioned vertical adjustment of the light-source. The front and rear walls of the receptacle are provided with ventilation openings, and the front wall has also wing-shaped projections for assisting cooling-down. Between the receptacle and the collector is a covering 8 for guarding the collector against radiation from light-source and from receptacle. A rider 9 serves to carry the whole on Zeiss' optical bench. The author also describes many of the details connected with the current and with the management of the light.

Sliding-objective Changers and Revolvers.*—Among devices for saving time when an operator has to work with more than one objective, revolving nose-pieces are the best and most successful. F. K. Studnicka points out, however, that objectives used in this way are liable to errors of centring, and that in high-class work such errors may become important. Another, and perhaps more serious difficulty, is the limitation to the possible number of objectives on a revolver. More than four cannot be applied, and they are apt to interfere with the manipulation of the preparation-slide. The number on one revolver seldom, therefore, extends beyond three. With an objective-slide some of the above disadvantages disappear; there is no restriction as to number, and everyone can adjust the centring without tedium. On the other hand, exchange of objectives is a longer operation than with a revolver. The author expresses his surprise that no attempt has yet been made to combine the advantages of both systems; and that the revolvers themselves might be interchangeable, and be attached to the Microscope-tube by some sliding movement. In this way an operator might work with, say, two revolvers: one with his weak, and the other with his strong objectives.

Methods for the Identification of Sub-microscopic Structures.†—J. Koenigsberger has made use of Lippmann's layers in colour photo-

Fig. 91.

Fig. 92.

graphy for obtaining a natural grating. If the film obtained by blue-violet light be sectionized obliquely by a microtome (fig. 91) and mounted in damara in the usual way, then a grating is obtained in which the layers of silver granules are separated by intervals varying from one-third to four times the wave-length of yellow-red light ($\lambda = 0{\cdot}6\,\mu$), see fig. 92. Resolution through the end at which the layers are distant from each other less than a wave-length is of course impossible, but the polarization effects obtained give a clue to the structure. The author describes fully the nature of the auxiliary polarizing apparatus required.

New Zeiss Nernst Lamp.—This lamp (fig. 93) consists of a single filament in globular metal casing, nickel plated, and so arranged that the upper half readily removes, leaving free access to the filament which is to be started with a spirit flame or wax match after the current is switched on to render it incandescent. A small chimney to draw off the heat of

* Zeitsch. wiss. Mikrosk., xxvii. (1911) pp. 501–3.
† Zeitschr. wiss. Mikr., xxviii. (1911) pp. 34–41 (2 figs.).
‡ Pamphlet on Ultra Microscopy, pt. 4, figs. 1 and 4.

the lamp is provided for on top of the spherical casing, and the whole is mounted on a china pillar with base.

In the cylindrical mount attached to the spherical metal casing an aplanatic condenser of short focus is mounted with a slot arrangement in front to receive ground glass or colour screens. The lamp is fitted to the base in an inclined position, and the aplanatic condenser, which is a fixture, is so arranged that at a comparatively short distance from the lamp an enlarged image of the rod is projected, filling the entire aperture of an average Microscope mirror. The small glass tube

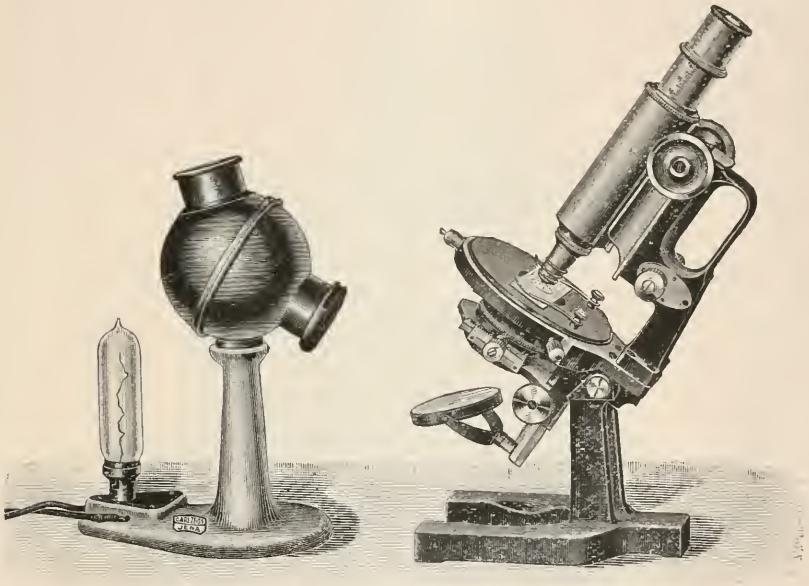


Fig. 93.

mounted to base is a wire resistance for the lamp. The lamp burns at 1 ampere, and can be supplied suitable for either continuous or alternating current. For high voltage an auxiliary resistance is supplied.

Winkel's Drawing Microscope.*—This excellent Microscope, says E. M. Nelson, although described nine years ago, is still so little known that a second and more particular account of it is necessary. Until it had been in use, the writer had no idea what a valuable instrument it was. Several naturalists and science masters who have seen it were very much struck with it, and expressed astonishment that it had not come into more general use.

Fig. 94 shows the instrument by itself—a non-inclinable Microscope upon a horseshoe foot. It is a stage focuser, and the stage, 2·9 in. square, carries on the same bracket a concave mirror 1·8 in. in diameter.

* English Mechanic, xciv. (1911) pp. 257–8 (3 figs.).

The aperture in the stage is 1·9 in. in diameter, and a reducing ring is supplied. Half an inch below the bottom of this stage is a "turn-out" ring with an aperture the same size as that in the stage, so that the disks which fit one will fit the other. The construction of the arm at the top of, and at right angles to, the limb is peculiar, and unlike that in any

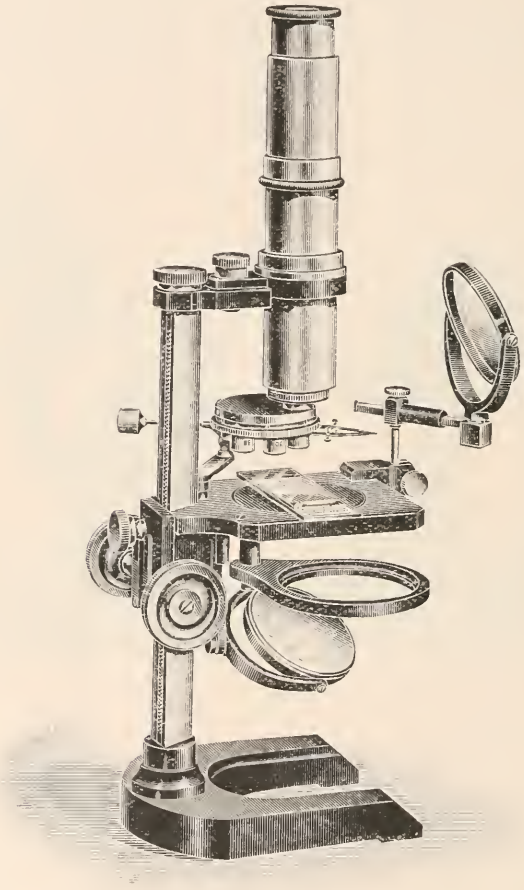


Fig. 94.

other Microscope. It is very short, and it is capable of being rotated and clamped in any position by a screw. This arm has a broad V-groove, to which a second arm, carrying the optical part, can be attached and clamped by another screw. This is a novel and excellent mode of attachment: half a turn of the screw firmly fixes it in position, and half a turn releases the body from the limb. It would be difficult to devise

a better mode of attachment for a body to a limb, for it is simple, rapid in use, and perfectly firm.

Having described the mechanical, we will now pass on to the optical part. (1) To the horizontal arm a short tube, holding a wheel of six "loups," can be attached by the method first described. These "loups"

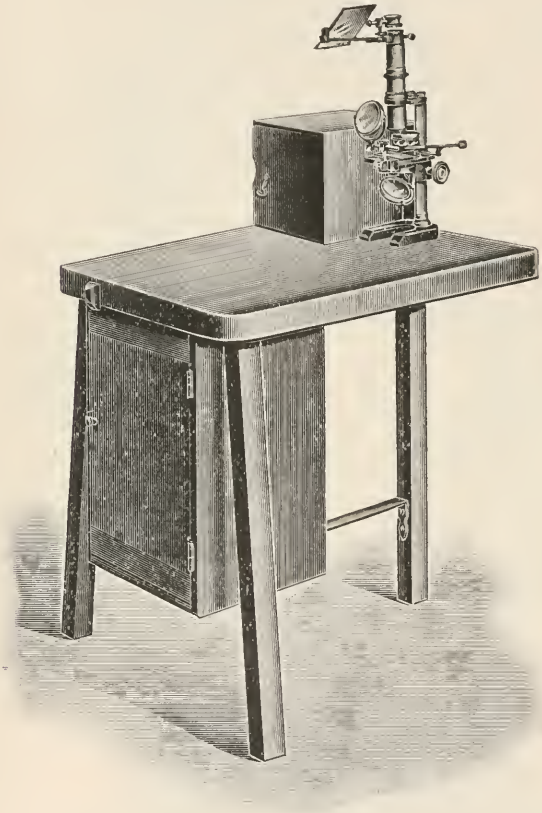


Fig. 95.

vary in power from 2 to 9 diameters. (2) A compound body with a fixed eyepiece, and another wheel of six lenses, giving powers from 12 to 38 diameters, can be attached in place of the "loups."

The drawing apparatus is an Abbe camera. The top of the special table measures 2ft. by 1½ ft., and is of pitch-pine 1½ in. thick. Its height above the floor is 2ft., and it has three legs of oak 1½in. square. The two back legs are braced by an iron bar, and a second bar joins this to the front leg. Beneath the table-top, and attached to it, is a cupboard, which holds the Microscope cabinet. When the Microscope is used for drawing, as in fig. 95, a box without a lid is laid upon its side, and its

lower side is clamped to the table-top by an ordinary brass bench-clamp. The bottom of this box measures 8½ in. by 7 in., by 7 in. deep. Therefore, its side, which forms the drawing-board, measures 8½ in. by 7 in. in area, and is 7 in. above the top of the table. When so placed, the path of the rays from the prism of the camera to the drawing-board is 10 in.

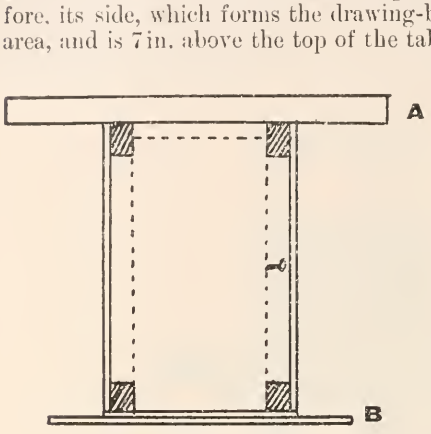


Fig. 96.

The instrument (fig. 95) is shown as arranged for drawing with the compound body; but when the "loups" are used, the Microscope is placed upon a box 8 in. by 6 in., and 3½ in. deep. The Microscope is thus raised 3½ in., and the camera prism kept the same height as with the compound body, and the drawing-board is 10 in. from it as before. The cupboard has four chocks of wood, 2½ in. by 1⅜ in. at each angle (fig. 96). These serve two purposes:—First, they greatly strengthen the cupboard, and enable it to be attached to the table-top by large screws; further, the whole table is made very rigid, because the iron brace is firmly screwed to the lower chocks in the cupboard. Secondly, the chocks form a packing for the Microscope cabinet, and allow it to be put into the cupboard with the key in the lock.

The main use of this Microscope is for the examination of unmounted objects, botanical, entomological, geological, etc. If the field-lens is removed from the body, and a similar brass adapter, without any lens, screwed into its place, the body is made similar to that of an ordinary Microscope, and ordinary eye-pieces of the Continental gauge can be

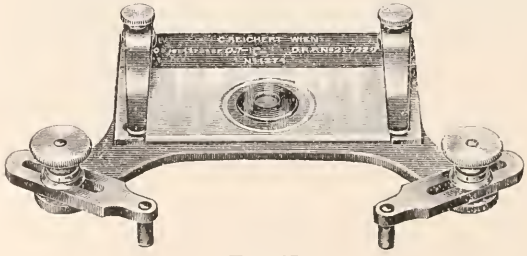


Fig. 97.

used. When the body is charged with a No. 4 complanat eye-piece, the powers given by the wheel of six object-glasses varies from 30 to 100 diameters. So by this addition of a screw adapter we have at our disposal a range of eighteen powers from 2 to 100 diameters, and the instrument has a considerable range of usefulness for general biological work.

Reichert's Dark-ground Illuminator with Arrangement for Centring on a Plain Stage.—This apparatus was fully described by

Mr. Niemeyer at the May Meeting (see p. 426). The blocks for the illustrations were not obtained in time for insertion in a previous number.

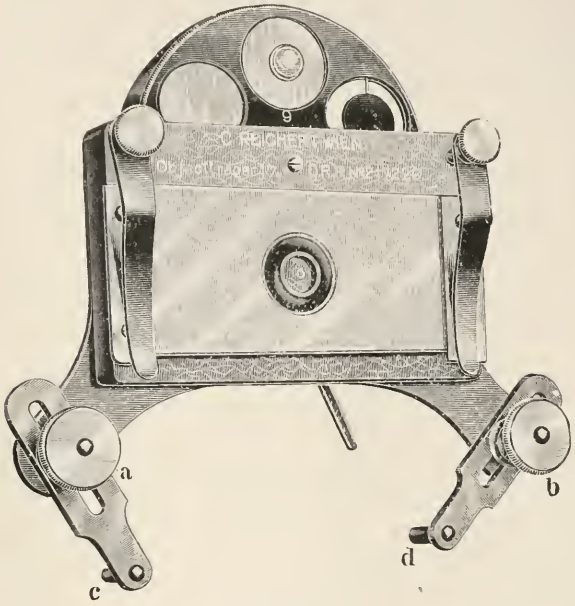


Fig. 98.

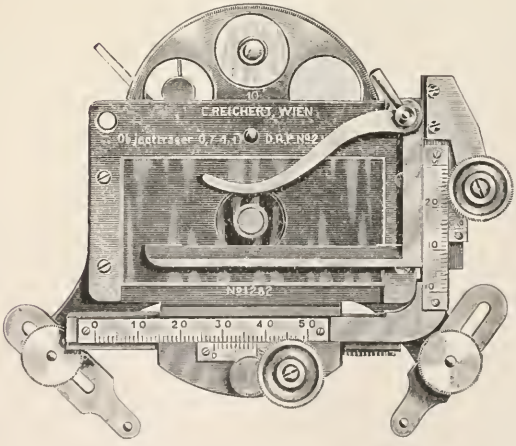


Fig. 99.

(4) Photomicrography.

Stereoscopic Photomicrography.*—A special Microscope has been devised for the purpose of taking stereoscopic photomicrographs, the body of which moves laterally in the arc of a circle, with the specimen as the axis. After the first exposure the body-tube is slightly moved to one side, the optical system keeping in a line with the object, and the second plate exposed. This ingenious and successful instrument is, however, says J. I. Pigg, rendered superfluous by a much simpler plan.

Some years ago a comparatively easy and effective method was introduced for taking stereoscopic photographs with the Microscope. Instead of altering the position of either the specimen or the Microscope-tube, the first exposure is made with one-half of the back-combination of the objective, covered with some opaque material. The back lens-covering is then moved to the other side of the objective, and the second plate exposed. The two negatives are thus taken through different halves of the back-lens, and the consequent separation of the two points of view produces the stereoscopic effect.

An improved variation of this mode of making a stationary lens take two pictures from different standpoints, has since been adopted by photomicrographers. Instead of using the two halves of the back-combination of the objective, a diaphragm with a circular aperture cut near the edge of the stop is fitted behind the lens. After the first exposure the diaphragm is turned round, so that the aperture is at the opposite side of the objective; the second negative is then taken. The use of a small aperture, in place of half the area of the lens, effects a considerable improvement in the stereoscopic effect, owing to the increased separation of the two points of view, but the exposure is proportionately increased. The worker must exercise his own discretion as to the exact size and position of the aperture. If the diameter of the lens will allow of the aperture being placed at a fair distance from the centre, the stereoscopic relief will be considerably improved.

This method of stereoscopic photomicrography is obviously most suitable for low-power work, and the beginner should confine his attention to low magnifications. The best results are obtained from objects illuminated by reflected light, and really beautiful effects can be secured from common microscopic objects. Unless an arc lamp is available, specimens to be photographed as opaque objects should be of a light colour, or the exposure will be abnormally prolonged, as a considerable amount of light is cut off by the diaphragm. Diaphragms for stereo-micro work may be purchased, but the amateur can easily make his own by punching out a hole of the required size near the edge of a circular piece of black paper. This diaphragm can then be fixed in position at the back of the objective, by being pressed into the mount. When the diaphragm is moved round for the second exposure, the aperture must be exactly opposite the position it occupied for the first negative.

Insects' eggs, foraminifera, small insects, and seeds of plants, make excellent subjects as opaque objects for reflected light; crystals, botanical sections, filamentous algæ, and foraminifera mounted in liquid cells, are

* Photographic Scraps, vi. (1911) pp. 279–80.

all sufficiently transparent to be taken by transmitted light without any previous preparation. One of the chief obstacles to success in stereo work with the Microscope, is the small depth of focus given by microscopic objectives. If the specimen has considerable depth of structure, the lowest power possible must be used, and the necessary magnification obtained by the eye-piece. When transparent objects are photographed, a narrow angle of illumination should be adopted. This will decrease resolution, but increase depth of focus. When a specimen has strong contrasts in light and shade, it is sometimes advisable to give a normal exposure for the first negative, and then over-expose the second plate, in order to get detail in the darker portions of the subject. A much better effect is given by this plan, when the two prints are viewed through the stereoscope. In the same manner, if a double-stained specimen is being photographed, the first negative should be exposed for the deeper colour, and the second for the lighter shade. Generally speaking, for stereoscopic work, soft negatives give the best effects, and no pure whites should appear in the finished print. The negatives should be printed on smooth paper, such as Ilford Glossy Gaslight.

(5) Microscopical Optics and Manipulation.

Pupil of an Optical System with regard to Perspective.* — C. Beck has found that the so-called "entrance and exit pupils" of an optical system may be used, in connexion with the Gauss planes, for explaining the action of optical instruments as regards the perspective of the images formed. It will be remembered that the Gauss planes enable us to refer the action of a complicated optical system to an equivalent single lens placed successively in two positions—the entrance equivalent-plane and the exit equivalent-plane. By this means, assuming that the optical system is corrected in such a manner that the oblique rays and those far from the axis act in the same manner as the direct axial rays, the position and size of images can be determined with accuracy ; but the perspective of the image cannot be correctly explained by aid of the Gauss planes alone. The "pupils," however, account for this apparent discrepancy, and, by assigning the correct position to these two apertures, or pupils, we can investigate the perspective of an image without taking further consideration of the system itself : just as, by assigning the correct position to the two Gauss planes, we can investigate the size and position of the images, irrespective of the system itself. The pupils, in fact, determine what rays form the image, and they further determine the perspective without invalidating the results given by the Gauss system as to the positions and sizes of the focused images. The author discusses in detail several typical cases, and, in particular, clears up a very interesting point in the practical use of telephotographic lenses. Such lenses have usually very small apertures, and possess a large degree of so-called depth of focus, and are consequently capable of depicting a great range of depth in the object. For distant views the perspective will, on the whole, give the effect produced by photographing with an ordinary lens, of about the same focal length as the equivalent focal length of the telephoto system. But if a telephoto lens be used for near objects, as, for

* Proc. Roy. Soc., Series A, lxxxv. (1911) pp. 462–70 (8 figs.).

instance, for full-sized portraits, the perspective of a 9-in. telephoto lens, with exit pupils arranged so as to come between the constituent lenses, will give the perspective effect produced by an ordinary lens of 17½-in. focus; or, if half-size, of a lens 14½ in. This accounts for the very

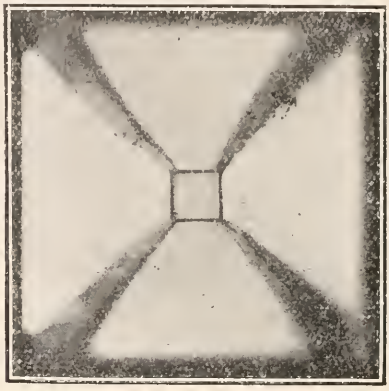


Fig. 100.

pleasing portraits obtained by the use of the telephoto lens. For all purposes, except extreme distance, the perspective foreshortening in a photograph taken with a telephoto lens is less pronounced than would be expected from a lens of that focal length.

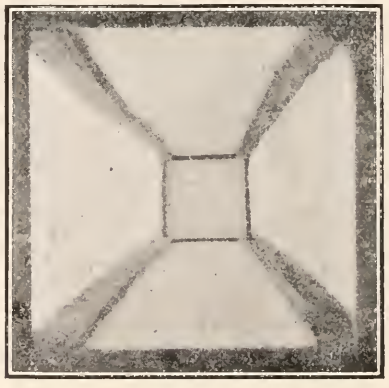


Fig. 101.

Figs. 100 and 101 show two photographs taken, the one (fig. 100) with with an ordinary photographic lens, the other (fig. 101) with the above telephoto lens. Both lenses had the same equivalent focal length. The object photographed was a parallel tube about 5 ft. long, built up of laths covered with tissue paper. The photograph was taken looking

down the tube, and the nearest end was in both cases placed at such a distance as to give the same sized image of the object. It will be noticed that the telephoto lens gives a totally different and less steep perspective effect than the ordinary lens.

(6) Miscellaneous.

Quekett Microscopical Club.—The 476th Ordinary Meeting of the Club was held on Tuesday, October 24, the President, Professor E. A. Minchin, M.A., F.Z.S., in the Chair. A paper by Mr. E. M. Nelson, F.R.M.S., on "An Improved Compound Microscope by James Mann, 1751," was read by the Hon. Sec. It is, in the main, a copy of J. Cuff's (1744), with various improvements. It is less heavily built, however, and is probably the second Portable Compound Microscope. The instrument originally belonged to the celebrated Dr. Johnson. "A General Account of the Spring-tails (Collembola)" was given by Mr. J. W. Shoebotham, N.D.A. Together with the orders Protura and Thysanura, they belong to the sub-class Apterygota, class Insecta. The various parts of the Collembola were fully described, especial attention being given to the very typical organs, the ventral tube and the spring. Previously considered to be scavengers only, it is now thought that they may do considerable damage to growing crops. In Ireland they have been found feeding on the leaves of tobacco plants. Nearly 500 species have up to the present been recorded, of which 107 are British.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Spirochætes.†—G. Arnheim gives an account of his microscopical and cultural investigations of spirochætes associated with gangrene of the lung and ulcerating carcinoma. He finds in these lesions a definite species of spirochæte, of which, however, the colonies cannot be distinguished from those of other species. These spirochætes are found in carcinomata both of men and of animals, and have been found in the blood of normal rats and mice. They cannot be demonstrated in growths that have not ulcerated.

For his cultivation experiments the author uses a modification of Schereschewsky's method. Material containing spirochætes is introduced into horse-serum, which has been heated for a short time to 75° C. For the isolation of spirochætes from a mixed culture, it is necessary to examine various portions of the mixed growth for the presence of these organisms, and replant it in successive attenuations.

Pure Cultures from a Single Cell.‡—S. L. Schouten has improved his method § for isolating single cells under the Microscope. In the

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

† Centralbl. Bakt., 1te Abt. Orig., lix. (1911) pp. 20–34.

‡ Konink. Akad. Wetenschap. te Amsterdam, xiii. (1911) pp. 840–50 (1 pl.).

§ See this Journal, 1901, p. 331.

simplified apparatus there is only one needle-holder, placed to the left of the Microscope. The plate on which the Microscope formerly stood is now omitted, and the instrument adjusted by hand.

A. W. Nieuwenhuis* describes an apparatus for the cultivation of micro-organisms from one cell. The description of the apparatus and the procedure is lengthy, and refers to a stand placed by the side of the Microscope. To the top of the stand is attached a needle specially constructed for the purpose of fishing out the desired cell from a culture placed on the stage of the Microscope.

Cultivation of Spirochæta pallida.†—H. Noguchi inoculated his media not directly from human lesions, but from the artificially infected testicular tissue of the rabbit. The only medium which proved suitable was serum-water, to which a piece of sterile rabbit-tissue was added, preferably kidney or testicle. The serum-water in test-tubes is rendered suitable for anaerobic cultivation by a layer of paraffin oil poured on its surface. After the first cultivation strict anaerobiosis is not essential, and the organism can be subcultured to solid media. The first cultures are usually contaminated by bacteria, but these are separated by means of two procedures. In the first the spirochætes are grown through filters which retard the passage of other organisms, while the second method depends on the fact that in stab-cultures the spirochætes grow away from the line of puncture into the surrounding medium, while other organisms fail to do so. The spirochætes cultivated by this method, when inoculated into the rabbit's testicle, produce characteristic histological changes, and are found growing freely in the infected tissue.

New Method for making Blood-agar for Cultivating Bacillus influenzæ.‡—W. Thalheimer recommends the following modification of Pfeiffer's method. Its chief advantage over that of Pfeiffer is that the laking agent is one which does not interfere with bacterial growth and does not have to be removed. Freshly-drawn beef-blood obtained from an abattoir was collected in a wide-mouthed jar, and defibrinated by shaking with a number of medium-sized marbles. This was laked by adding an equal part of distilled water, and rendered free from bacteria by passing through a sterile Reichel filter. This yielded a clear red fluid, and 20–30 c.cm. of this were added to a litre of melted agar at 45° C. and poured into sterile tubes. The medium thus obtained was perfectly clear, bright-red, and of the same density of colour as ordinary blood-agar. On this medium *Bacillus influenzæ*, *Streptococcus mucosus*, and *Gonococcus* grew luxuriantly.

(2) Preparing Objects.

Celloidin Decalcification Method.§ — C. F. Bödecker describes a simplified procedure for decalcification. It consists in mixing 10 c.cm. nitric acid (sp. gr. 1·15) with 30 c.cm. of a methyl-alcohol solution of celloidin. The fluid must be well stirred with a glass rod ; the thick

* Konink. Akad. Wetenschap. te Amsterdam, xiii. (1911) pp. 566–76 (2 pls.).
† Journ. Amer. Med. Assoc., July 8, 1911, through Lancet (1911) ii. p. 536.
‡ Johns Hopkins Hosp. Bull., xxii. (1911) pp. 293–6.
§ Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 158–60 (1 pl.).

jelly is then squeezed under a pressure of about 80 kilos, between thick layers of bibulous paper, in order to remove as much water as possible. The acid-celloidin is next mixed with twice its bulk of methyl-alcohol, whereby it is quickly dissolved. A piece of enamel, 0·5 mm. thick, takes about six days to decalcify. If gas bubbles be given off the process is going on too rapidly. The author alludes to previous communications, for which see this Journal, 1908, pp. 775, and 1905, p. 764.

Fixation and Staining of Glycogen.* — F. Zieglwallner describes fixation and staining methods for the simultaneous demonstration of glycogen and fat, and gives the following formulæ :—1. One p.c. chromic acid solution in 84 p.c. alcohol, 15 ; 2 p.c. osmic acid, 4 ; acetic acid, 1. The solution should be prepared immediately before use.

2. Saturated sublimate solution, 20 ; 2½p.c. osmic acid, 20 ; acetic acid, 10 ; absolute alcohol, 50. This fixes small pieces in from 8 to 12 hours. On removal the pieces are washed for 24 hours in 50 p.c. alcohol, to which a few drops of tincture of iodine have been added. In order to retain the blackening it is advisable to convert the osmium into sulphide by treating the sections or pieces with 70 p.c. alcohol, to which a small piece of Na_2S has been added.

3. By saturating a solution with formula very similar to No. 2 with dextrose, another fixative which gives fair results is obtained.

4. 10 p.c. trichlor-lactic acid for 3 to 4 hours, followed by 50 p.c. alcohol.

5. Trichlor-lactic acid, 9 ; 2 p.c. osmic acid, 24 ; acetic acid, 9 ; distilled water, 58. In this small pieces remain for 10 to 12 hours, after which they are thoroughly washed in 50 p.c. alcohol.

Various methods of staining glycogen are then alluded to, the best being Bleu-de-Lyon, as it gives considerable contrast.

Studying Amœba.†—B. Puschkarew pipettes off from a " zoological culture " the amœbæ, in company with algæ and bacteria, on to an agar-plate. After 6 or 7 hours, a piece, which should not exceed 1 c.cm., is cut out. The piece is placed on a Hansen's slide and a clean cover-glass imposed. After ½ hour, during which time the amœbæ will have crawled on to the cover-glass, the space between the ring of the slide and the agar slip is filled with fixative, the cover-glass not being removed. The fixative used was either sublimate-alcohol or 2 p.c. osmic acid ; the former being allowed to act for 20 to 30 minutes, the latter for 10 to 20. The fixative is then removed with a pipette and replaced with iodin-alcohol or 50 p.c. alcohol : the former after sublimate, the latter after osmic fixation. After allowing these reagents to act for 30 to 60 minutes, the cover-glass may be removed. The cover-glass is then washed in water. It should be mentioned that no procedure will get rid of all the bacteria, and these are sometimes very frequent. The preparations may then be stained by the Romanowsky-Giemsa method, or with Heidenhain's iron-hæmatoxylin.

The author's illustrations are extremely effective.

* Zeitschr. wiss. Mikrosk., xxviii. (1911).

† Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 145-50 (2 figs.).

Washing and Dehydrating Apparatus.*—By means of the apparatus devised by B. Romeis (fig. 102) such processes as the washing, dehydration, or decalcifying of fixed preparations may be carried out without trouble and without undue manipulation. The supply tube A, connected with a water-supply, leads to the cylinder C. This cylinder is drawn out at its lower end, and contains a perforated porcelain disc which rests upon the narrowing part. This cylinder has a twofold purpose : it may be used for washing tissues which can stand rough treatment, or, by the obstruction of perforations in the porcelain disc, it may serve to regulate the flow in the distal portions of the apparatus. By means of the tube E the cylinder communicates with the funnel-shaped vessel F, which contains a series of perforated trays. This vessel is closed at the top with a stopper, pierced by the outflow tube G. A perforated porcelain disc is

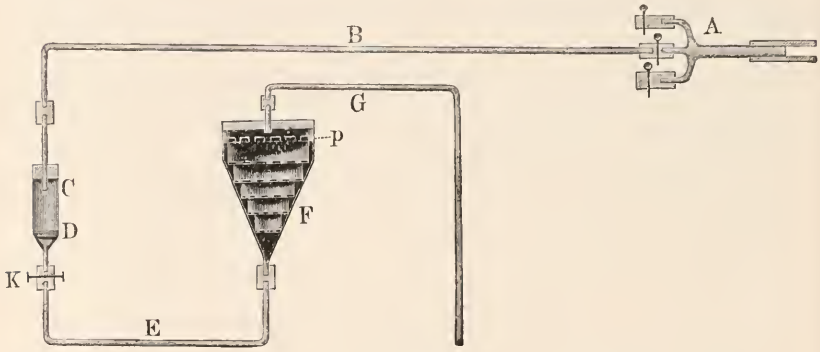


Fig. 102.

placed below this stopper. Objects to be treated are placed in these trays. When washing is complete, and dehydration is to begin, the tube B is disconnected from the water supply and linked up successively with flasks of mounting alcohols. Decalcifying is carried out in an analogous manner.

(4) Staining and Injecting.

Injection of Fusible Alloys in Microscopical Anatomy.†—L. Vialleton and A. Juillet find that Wood's alloy gives excellent results when injected into respiratory tubes or blood-vessels. It is fusible at 70°, and is composed of : bismuth 7, lead in sticks 2, tin in sticks 2, cadmium 2. The bismuth is pounded up and then melted in an iron crucible ; a stick of lead held with iron tongs is heated by means of a blow-pipe, and the molten metal allowed to drop into the bismuth. The tin is treated in a similar manner, and then the cadmium is thrown in. The alloy is vigorously stirred with an iron rod, and the mixture kept at a temperature of 120°, for if over-heated the cadmium becomes too much oxidized. To inject the alloy, say into a bronchial tree or pulmonary artery, a copper funnel with a capacity of about 60 c.cm., the tube being 2·5 mm. in diameter, is used. To the end of the tube metal cannulas

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 12–17.
† C.R. Soc. Biol. Paris, lxxi. (1911) pp. 249–51.

of varying size may be fitted as required. The funnel is placed some 20 cm. above the specimen to be injected; this height gives sufficient pressure. The funnel and cannula are kept warm by means of a ring-burner and gas flame during the injection; the alloy is then poured into the funnel. When the specimen is sufficiently injected it is allowed to cool, and after the lapse of ½ hour it may be cut off from the cannula. It is then placed in cold running water for 2 hours, and on removal all superfluous parts are removed. In order to obtain the casts of the lumina of the tubes or vessels, the organic material is digested away in artificial gastric juice at 50°. After 24 hours the preparation is washed in running water and then, if necessary, further cleaned with a brush.

New Method for the Detection of Tubercle bacilli in Sputum.* F. W. Enrich recommends the following procedure. A quantity of the sputum is shaken up with "antiformin" in a glass-stoppered vessel, such as a measure cylinder ("antiformin" = 15 p.c. liq. sod. hydrat. + liq. sodae. chlorinat. āā), the proportion of "antiformin" depending upon the consistence of the sputum; if the latter is very viscid or dense an equal proportion may be required; if thin, then half the amount may suffice. The mixture is occasionally shaken during five minutes; it is then diluted with a volume of distilled water approximately ten times as great as that of the "antiformin" used, and again shaken for a few minutes. Finally, there is added a mixture of equal parts of ether (methylated ether will do) and acetone equal in volume to that of the water. It is shaken once more for a few seconds and the whole allowed to stand. In a few minutes the contents of the bottle will be found to separate into three layers. The middle layer, appearing as a more or less dense white ring, will contain nearly all the tubercle bacilli that may be present in the sputum, and can be drawn off with ease by means of a pipette fitted with a teat. The density of this middle layer can be increased after it has been pipetted off, if desired, with the help of a centrifuge (an ordinary hand centrifuge will answer the purpose), but it is not necessary. A film is made, dried, and fixed in the usual way, by passing it through a flame. Before staining the film it is immersed for a few seconds in 5 p.c. sulphuric acid to neutralize any adhering alkali, and washed to remove the acid. If the examiner is interrupted, or otherwise pressed for time, the whole mixture may be allowed to stand till the next day or even longer; the acid-fast property of the bacilli is not affected by the delay. The sputum-antiformin mixture should be diluted with distilled not with tap-water, as the latter may contain acid-fast bacilli.

Negative Staining of Bacteria,† — H. Fischer, after alluding to Burri's indian-ink method, describes his experience with anilin dyes, such as Congo-red and nigrosin. A drop of the fluid containing bacteria is mixed with a drop of similar bulk of a saturated solution of Congo-red or nigrosin, and a film made in the usual way. When dry the film may be mounted in balsam. The solution may be heated previous to use.

* Brit. Med. Journ. (1911) ii. p. 596.
† Zeitschr. wiss. Mikrosk., xxvii. (1910) pp. 475–6.

(6) Miscellaneous.

Preserving Brains.*—A. Stärcke suspends brains in 15 p.c. formalin for 8 to 14 days. On removal the surface is carefully dried ; it is then immersed, vertex downwards, in a vessel filled with hard paraffin, heated to at least 15° above its melting-point ; a quick turn covers the surface with a mantle of paraffin. Should any gaps be found, the places implicated must be treated anew. Brains treated in this manner will, even after five years, give satisfactory preparations by Nissl's or Weigert's methods of staining.

Turbidometer for Counting Vaccines.†—C. F. Pawson and H. P. Bassett have devised an apparatus for estimating the number of bacteria contained in a certain volume of an autogenous vaccine. To the sliding bar of the mechanical stage of a Microscope is fixed a vertical rod—a hypodermic needle will serve—which dips into a rectangular glass box, fixed to the table. At one end of the box is a transparent circle which admits light; the other end is attached to a cylindrical metal tube, leading to a semicircular eye-shield, at the edge of the table. This shield screens the observer. If the box be filled with a turbid liquid, and the vertical rod be observed through the tube, as it is moved from the proximal towards the distal end of the box, a point is reached where, owing to the opacity of the intervening fluid, it disappears from view. The point at which this takes place depends upon the degree of turbidity. As this only gives a relative observation, it is necessary to have a standard. McFarland has devised a series of test-tubes containing different amounts of freshly precipitated barium sulphate. Tube No. 5 of his series contains sufficient precipitate to produce turbidity equal to that of a suspension of fifty million bacteria per cubic centimetre. This is taken as the standard. The vertical rod is moved to the proximal end of the box, and a reading taken from the scale on the mechanical stage. The box is filled with standard suspension, and the rod is made to move until it can no longer be seen. A second reading is taken. The difference between these readings gives the amount of translation of the rod. Similar observations are taken with the vaccine which is under investigation. The excursions of the vertical rod are inversely proportional to the turbidity of the samples ; and so from these data, an estimate may be formed of the strength of the bacterial emulsion.

Agglutination of Trypanosomes.‡—Lange describes a method by which a macroscopic agglutination test for trypanosomiasis may be carried out. For this purpose the author makes use of a suspension of trypanosomes obtained from the blood of a highly-infected animal. The blood is lightly centrifugalized, so that the organisms settle into a definite layer, which is then removed by means of a pipette. This emulsion is then washed in salt solution, centrifugalized and suspended in a fresh quantity of salt solution. A small quantity of formalin is added, and the suspen-

* Zeitschr. wiss. Mikrosk., xxviii. (1911) pp. 150–1.
† Centralbl. Bakt., 1te Abt. Orig., lviii. (1911) pp. 638–40.
‡ Centralbl. Bakt., 1te Abt. Ref., i. (1911) Beih. pp. 171–7.

sion will retain its efficiency for the purpose of these tests for a period of from four to eight weeks. When shaken up, the suspension should be homogeneous and of a greyish-white colour. It should not agglutinate in the presence of a normal serum in a dilution of 1 in 50. Spontaneous agglutination may take place if the washing process is too thorough.

The test is carried out in a similar manner to that used with bacterial emulsions. The serum under observation, in suitable dilutions, is put in tubes with equal quantities of the suspension. Controls are also put up. The tubes are incubated for 6 to 12 hours, and, if necessary, allowed to stand at room temperature for 20 hours after incubation. When examining the tubes, it is necessary to shake them up and examine the floating particles. It is not easy to distinguish degrees of agglutination.

Sommerfeldt, E.—**Ueber die Fortschritte der mikroskopischen untersuchungsmethoden für mineralogie und analytische chemie während der letzten Jahre.** *Zeitschr. wiss. Mikroskr.* xxviii. (1911) pp. 183–206 (2 figs.).

Metallography, etc.

Aluminium-magnesium Alloys.*—W. Broniewski has made determinations of the various electrical properties of alloys of aluminium and magnesium; the results indicate the existence of two compounds, AlMg and Al_2Mg_3. Alloys corresponding to the formulæ Al_4Mg and $AlMg_2$ were found to be heterogeneous in microstructure.

Bismuthides.†—A. G. Vournasos has prepared sodium bismuthide Na_3Bi, the existence of which is indicated by thermal analysis of the system, by adding bismuth to sodium melted under paraffin. Potassium bismuthide K_3Bi is obtained in a similar manner.

Arsenides of Tin.‡—P. Jolibois and E. L. Dupuy have prepared alloys by heating known weights of arsenic and tin together in sealed tubes, at 650° C. Sections for microscopical examination were etched with ferric chloride solution. The presence of the compounds Sn_4As_3 and SnAs was indicated.

A thermal investigation of the arsenic-tin system by N. Parravano and P. de Cesaris § indicates the existence of the compounds Sn_3As_2 and SnAs.

Alloys of Silver with Cadmium.‖—G. J. Petrenko and A. S. Fedorow have made a thermal and microscopical investigation of the silver-cadmium system. Six series of solid solutions, with intervening gaps, are formed. The compound AgCd results from a reaction occurring in the solid state. The compounds $AgCd_3$ and Ag_2Cd_3 are probable. The existence of $AgCd_4$ was disproved by quenching experiments.

* Comptes Rendus, clii. (1911) pp. 85–7 (6 figs.).
† Comptes Rendus, clii. (1911) pp. 714–15.
‡ Comptes Rendus, clii. (1911) pp. 1312–14.
§ Atti R. Accad. Lincei, xx. (1911) 1, pp. 593–6, through Journ. Chem. Soc., c. (1911) p. 613.
‖ Zeitschr. Anorg. Chem., lxx. (1911) pp. 157–69; lxxi. (1911) pp. 215–18 (15 figs.).

Selenium-antimony System.*—H. Pélabon has examined microscopically numerous selenium-antimony alloys, and concludes that the only compound obtainable by direct fusion of the elements is Sb_2Se_3. Within certain limits of composition, the alloys, in the molten state, consist of two phases, of nearly the same density. Measurements of electrical resistance of the alloys were consistent with the existence of Sb_2Se_3.

Alloys of Noble Metals.†—W. Geibel has determined the electrical resistance and its temperature co-efficient, the thermoelectric power against platinum, and the tensile strength, of palladium-silver, palladium-platinum, platinum-iridium, platinum-gold, and platinum-silver alloys. Palladium and platinum appear to form a continuous series of solid solutions, as also do palladium and silver.

Iron-carbon System.‡—R. Ruer and N. Iljin prepared a pure cast-iron containing 4 to 4·5 p.c. carbon, nearly all in the graphitic state. Small specimens were heated for 6 hours at different temperatures in the range 600°–1120° C. and quenched. The percentage of combined carbon then found in the specimen is held to indicate the lower limit of solubility of elementary carbon in iron at the temperature to which the specimen had been heated. The solubility curve is parallel to that of cementite, reaching a maximum of 1·25 p.c. at 1120°. By allowing specimens to cool from 1100° C. and quenching at different temperatures, it was shown that temper-carbon does not separate above 800° C., but that the length of time of heating above 800° C. influences the amount of temper-carbon separating below 800° C. It is suggested that "centres of crystallization" form at temperatures above 800° C.

Growth of Cast-irons after Repeated Heatings.§—H. C. H. Carpenter has continued his investigation of this phenomenon. Phosphorus, sulphur, and manganese tend to diminish growth. Dissolved gases have no influence when more than 3 p.c. silicon is present; their influence is most potent when silicon does not exceed 1 p.c.: they may then cause a growth of 10 p.c. A table is given showing how growth increases with increase of silicon content. An alloy containing 2·6 p.c. carbon, 0·6 p.c. silicon, and 1·6 p.c. manganese, showed no signs of growth after 150 heats; it appears to be a suitable material for annealing ovens and other objects in which growth on repeated heating is objectionable.

Iron-silicon-carbon Alloys.‖—W. Gontermann explains the equilibrium diagram for the range Fe–Fe_3C–FeSi of this ternary system. The diagram has been derived from the thermal analysis of numerous alloys. The two chief types of crystal separating from the melt are—(1) mixed crystals of iron, silicon, and carbon, termed silico-austenite; (2) mixed crystals of the compounds Fe_3C and FeSi, termed silico-cementite. Views of the three-dimensional model of the ternary system are given.

* Comptes Rendus, cli. (1911) pp. 1302–5; cliii. (1911) pp. 343–6.
† Zeitschr. Anorg. Chem., lxx. (1911) pp. 240–54 (9 figs.).
‡ Metallurgie, viii. (1911) pp. 97–101 (3 figs.).
§ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 196–248 (17 figs.).
‖ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 421–75 (20 figs.).

Malleable Castings.*—D. M. Levy explains the changes occurring during the annealing of white cast-iron in the production of malleable castings, by the ore-annealing process and by the black-heart process, in the light of the equilibrium diagram of the iron-carbon system. The influence of silicon, manganese, and sulphur is considered.

Magnetic Properties of Nickel Steels.†—E. Colver-Glauert and S. Hilpert have determined the magnetic properties of three steels containing respectively 5·9, 24·3, and 32·9 p.c. nickel, 0·37, 0·24, and 0·30 p.c. carbon. The measurements were made at room temperature, after the specimens had been quenched, or slowly cooled, from various temperatures, or had been cooled to temperatures ranging down to −180° C. The authors conclude that there is no connexion between magnetic properties and microstructure. The microstructures of commercial nickel steels are stated to be practically the same as those of meteoric iron. No evidence of the non-magnetic character of γ-iron—if γ-iron exists—was obtained.

Chromium Steels.‡—A. Portevin has cooled two steels containing 0·12 p.c. carbon, and 13 and 17 p.c. chromium respectively, extremely slowly from 1300° C. The steels were then found to consist of ferrite with interspersed carbide. The martensitic structure obtained by moderately slow cooling from 1100° C. is accordingly regarded as characterizing a metastable state.

Nickel Steels.§—A. McWilliam and E. J. Barnes have studied a series of eight steels containing 3 p.c. nickel, manganese less than 0·2 p.c., the carbon increasing from 0·06 to 0·91 p.c. Tensile and alternating stress tests were made after various heat-treatments, as in former investigations by the same authors. Heating and cooling curves were taken, and the heat-treated specimens were microscopically examined. The pearlite composition lies between 0·74 and 0·91 p.c. carbon.

Influence of Vanadium on Iron and Steel.‖—A. McWilliam and E. J. Barnes have made tensile and alternating stress tests of seven steels containing about 0·2 p.c. vanadium, carbon varying from 0·09 to 1·32 p.c., after different heat-treatments. The microstructure was studied and heating and cooling curves were taken.

W. H. Hatfield¶ has prepared five cast irons containing 0 to 0·65 p.c. vanadium. A chemical and microscopical investigation indicated that vanadium tended to maintain the carbon in the combined state.

Troostite.**—An investigation of the properties of tempered steel has led A. McCance to conclude that (1) troostite consists essentially of α-iron which is in the amorphous condition, or which has not yet attained its crystalline state of ferrite; (2) troostite contains carbon in suspension, and not in solution, as carbide of iron.

* Foundry Trade Journal, xiii. (1911) pp. 321–5 (1 fig.).
† Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 375–411 (35 figs.).
‡ Comptes Rendus, cliii. (1911) pp. 64–6 (2 figs.).
§ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 269–93 (18 figs.).
‖ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 294–317 (16 figs.).
¶ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 318–31 (20 figs.).
** Proc. Inst. Mech. Eng., 1910, pp. 1661–98 (21 figs.).

Internal Structure of Pearlitic Steel.* — M. Oknoff has applied the histological method of cutting serial sections to the investigation of the structure of steel in space. Pearlitic specimens containing 0·1, 0·7, and 1·7 p.c. carbon, were examined by successively grinding thin layers off the surface, a marked field being photographed at each stage. The continuity of the pearlite grains was thus established, and their solid form determined.

Crystallization of Steel.†—E. F. Lange describes some masses of perfectly developed "pine-tree" crystals found in the cavity of the sinking-head of a large steel casting. Some of the masses of the crystals pendent from the upper portion of the cavity were as much as 15 in. in length.

Influence of Impurities on the Corrosion of Iron.‡—J. W. Cobb finds that pure iron is electro-positive to most of its impurities, such as phosphide, sulphide, carbide, oxide, and silicate of iron, and carbon (graphite). Sulphide and silicate of manganese are electrically non-conducting. Microscopic examination of iron in contact with particles of impurities, in a corroding solution, showed that the iron went into solution around the particles, though certain rapidly appearing corrosion centres were not visibly related to impurities. Manganese silicate on iron was found to be inactive.

Changes in Properties of Metals upon Working §—G. Tammann further develops the view that the strengthening of metals by cold-working results from the splitting up of the crystals into smaller elementary crystals. Alloys of two metals of about the same strength are considerably stronger than either of the pure metals, since the crystallites of which the alloys are composed are smaller than those of which the pure metals are constituted.

Metallic Fog in Fused Salts.‖ — R. Lorenz, G. v. Hevesy, and E. Wolff, show that when lead is heated under fused lead chloride to 600° C., the darkening of the lead chloride is due to solution of lead in it. The lead settles out as a black "fog" on cooling. The authors describe a titration method for the estimation of the lead dissolved in the molten chloride, and have determined the solubility between 500° and 700° C.

Crystallization of Cast Metals.¶—C. H. Desch describes the process of solidification of a molten metal by the formation of crystallites.

Andström, V.—**Rusting of Iron.**
Zeitschr. Anorg. Chem., lxix. (1910) pp. 10–21 (3 figs.).

Baar, N.—**Alloys of Molybdenum with Nickel, of Manganese with Thallium, and of Calcium with Magnesium, Thallium, Lead, Copper, and Silver.**
[The equilibrium diagrams of the binary systems have been determined by thermal and microscopical methods.]
Zeitschr. Anorg. Chem., lxx. (1911) pp. 352–94 (13 figs.).

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* Metallurgie, viii. (1911) pp. 138–9 (35 figs.).
† Engineering, xci. (1911) p. 706.
‡ Journ. Iron and Steel Inst., lxxxiii. (1911) pp. 170–95 (14 figs.).
§ Nachrichten Kgl. Ges. Wiss. Göttingen, 1911, pp. 181–96 (2 figs.).
‖ Zeitschr. Phys. Chem., lxxvi. (1911) pp. 732–42 (5 figs.).
¶ Foundry Trade Journal, xiii. (1911) pp. 530–1.

Berg, C. P.—**Heat-treatment of High-speed Tools.**
Journ. West. Soc. Eng., xv. (1910) pp. 738–64.

Bernoulli, A. L. — **The Law of Babo and the Electron Theory of Metallic Mixed Crystals.** *Ber. Deutsch. Phys. Ges.*, xiii. (1911) pp. 213–18.

Bornemann, K.—**Binary Metallic Alloys.**
[Further instalments of this summary of published researches.]
Metallurgie, viii. (1911) pp. 270–80, 289–95, 358–65 (47 figs.).

Boudouard, O. — **Testing of Metals by Observation of the Damping of Vibrations.** *Comptes Rendus*, clii. (1911) pp. 45–7.

Brooks, K. P.—**Resistance of Metallic Mixtures and Alloys.**
[It is shown that the high resistance of alloys cannot be explained by the presence of opposing E.M.F.'s at the junctions of neighbouring particles of the two components.] *Phys. Zeitschr.*, xi. (1910) pp. 471–3.

Campion, A.—**Notes on the Treatment of Steel Castings.**
Foundry Trade Journal, xiii. (1911) pp. 531–2.

Calvo, A. R.—**Electrical Conductivity of Silver Amalgams and of Cadmium Amalgams.** *Ion*, ii. (1910) pp. 408–10.

Charpy, G., & S. Bonnerot—**Gases contained in Steel.**
[The gases were extracted by heating the steel at 950° C. in a vacuum; they were measured and analysed. The removal of the gases had no effect upon the thermal critical points.]
Comptes Rendus, clii. (1911) pp. 1247–50.

Desch, C. H.—**Composition of Eutectic Mixtures.**
Trans. Faraday Soc., vi. (1911) pp. 160–6.

Fay, H.—**Some Causes of Failure in Metals.**
[Metallographical investigations of some defects in steel are described.]
Mech. Eng., xxvii. (1911) pp. 690–1.

Greenwood, H. C.—**Vapour-pressure Curves and Heat of Evaporation of Metals of High Boiling-point.** *Zeitschr. Phys. Chem.*, lxxvi. (1911) pp. 484–90.

Guertler, W.—**Electric Conductivity and Temperature Coefficients of Alloys.**
Phys. Zeitschr., xi. (1910) pp. 476–9.

Guillaume, C.E.—**Anomalous Dilatation of Nickel Steels.**
Comptes Rendus, clii. (1911) pp. 189–91 (2 figs.).

Hartmann, L.—**Mechanism of Permanent Deformation in Metals Strained in Tension.**
[A study of the surface-changes observed during the loading of tensile test-pieces, and of the effect of previous cold-working, annealing, etc., upon these changes.]
Comptes Rendus, clii. (1911) pp. 1005–7, 1034–6, 1233–7.

Heyn, E.—**Formation of Graphite in Iron Alloys.**
Zeitschr. Elektrochem., xvii. (1911) p. 182.

Ishewsky, W. — **Production of Granular Pearlite by Annealing Steel in an Electrically-heated Vacuum Furnace.**
Journ. Russ. Met. Ges., 1910, pp. 196–202.

Jeriomin, K. A.—**Formation of Graphite in Iron Alloys.**
[The view that graphite results from the decomposition of cementite is discussed and supported.] *Zeitschr. Elektrochem.*, xvii. (1911) pp. 93–8.

Johnson, F.—**Annealing of Copper and Diseases of Copper.**
Met. and Chem. Eng., ix. (1911) pp. 87–90 (4 figs.).

„ „ **Notes on the Metallurgy of Wrought Copper.**
Met. and Chem. Eng., ix. (1911) pp. 396–401 (9 figs.).

Jolibois, P.—**Allotropic Varieties and Melting-point of Arsenic.**
Comptes Rendus, clii. (1911) pp. 1767–9.

Lebedew, P.—**Melting-point Studies of some Bisilicates.**
[The author has applied metallographical methods to the investigation of the equilibrium of some binary systems of silicates; some excellent photomicrographs are given.]
Zeitschr. Anorg. Chem., lxx. (1911) pp. 301–24 (15 figs.).

McWilliam, A., & W. R. Barclay—**The Adhesion of Electro-deposited Silver in relation to the nature of the German Silver Basis-metal.**
Journ. Inst. Metals v. (1911) pp. 212–27 (5 figs.).

Mason, W.—**Lüders Lines on Mild Steel.** *Engineering*, xcii. (1911) p. 81.

Matwejew, M.—**Reagents employed in the Metallography of Iron.**
Journ. Russ. Met. Ges., 1911, pp. 301–2.

Parravano, N.—**Ternary System Silver-tin-lead.**
[The equilibrium diagram, determined by thermal and microscopical methods, belongs to the same type as that of the copper-antimony-bismuth system.] *Atti R. Accad. Lincei*, xx. (1911) 1, pp. 170–2.

Primrose, J. S. G.—**Metallography as an Aid to the Ironfounder.**
[The metallographical investigation of defects and of causes of failure is discussed; numerous examples are given.]
Foundry Trade Journal, xiii. (1911) pp. 525–30 (16 figs.).

Putnam, W. P.—**Malleable Annealing Temperatures.**
Foundry, xxxviii. (1911) pp. 283–5 (8 figs.).

Sauveur, A.—**Metallography and its Industrial Importance.**
Met. and Chem. Eng., ix. (1911) pp. 239–41.

Sieverts, A.—**Solubility of Hydrogen in Copper, Iron, and Nickel.**
[The solubility has been determined at pressures up to 1·5 atmospheres and in the temperature range 400°–1600° C.]
Zeitschr. Phys. Chem. lxxvii. (1911) pp. 591–613 (2 figs.).

Smith, C. A. M., & H. J. Humphries—**Some Tests on White Anti-friction Bearing Metals.** *Journ. Inst. Metals*, v. (1911) pp. 194–211 (9 figs.).

Stoughton, B.—**Annealing and Manufacture of Converter Steel Castings.**
[The effect of annealing upon the coarse structure of steel castings is discussed.] *Foundry Trade Journal*, xiii. (1911) pp. 467–9 (7 figs.).

Wahl, W. A.—**Chemistry of Meteorites.**
[A description of the microscopic structure of some meteorites is included.]
Zeitschr. Anorg. Chem., lxix. (1910) pp. 52–96 (13 figs.).

Weiss, P.—**Magneton in Solid paramagnetic Substances.**
Comptes Rendus, clii. (1911) pp. 688–91.

Winogradow, A.—**Characteristics of Carbide of Iron.**
Journ. Russ. Met. Ges., 1911, pp. 296–8.